User Manual

Tektronix

AD951A/AD953A
MPEG Test System

Volume 1 of 2

071-1423-00

This document supports firmware versions:
AD95X MPEG Test Systems Version 6.7
AD960 Data Test Systems Version 3.0

www.tektronix.com

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08/937,950	5848391	5,291,557	5,451,954	5 400 433
5,222,189	5,357,594	5 752 225	5,394,473	5,583,962
5,274,740	5,633,981	5 297 236	4,914,701	5,235,671
07/640,550	5,579,430	08/678,666	98/03037	97/02875
97/02874	98/03036	5,227,788	5,285,498	5,481,614
5,592,584	5,781,888	08/039,478	08/211,547	5,703,999
08/557,046	08/894,844	5,299,238	5,299,239	5,299,240
5,197,087	5,490,170	5,264,846	5,268,685	5,375,189
5,581,654	05-183,988	5,548,574	08/506,729	08/576,495
5,717,821	08/392,756			

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Table of Contents

Preface . . . . . **iii**
Related Material iii
Manual Conventions iii
Contacting Tektronix iv

Volume 1

Introduction
Transport Stream Analyzer . . . . . Sect. 1
Packetized Elementary Stream Analyzer . . . . . Sect. 2
T-STD Buffer Analyzer . . . . . Sect. 3
Tracer . . . . . Sect. 4
Player . . . . . Sect. 5
Monitor/Recorder . . . . . Sect. 6
Transport Stream Editor . . . . . Sect. 7
Multiple . . . . . Sect. 8
Make Seamless Wizard . . . . . Sect. 9
Stream Monitor Plus . . . . . Sect. 10

Volume 2

Elementary Stream Analyzer . . . . . Sect. 11
BS Digital Multiplexer . . . . . Sect. 12
BC Digital Multiplexer . . . . . Sect. 13
Carousel Analyzer . . . . . Sect. 14
Carousel Generator . . . . . Sect. 15
Transport Stream Maker . . . . . Sect. 16
Transport Stream Cutter . . . . . Sect. 17
ScriptP . . . . . Sect. 18
Custom SI Scripting . . . . . Sect. 19

Preface

This manual describes the software applications available to the Tektronix AD951A/AD953A MPEG Test System. All applications are installed; access will be dictated by the security dongle and those options purchased.

The manual is divided into sections, each describing one application. An overview of the applications is provided in the *Introduction* section.

Related Material

Getting Started Manual (071-1422-xx)
Describes the installation of the MPEG Test System.

Additional documentation, such as ReadMe files, may be included on the installation disks.

The following URLs access the Web sites for the standards organizations listed (the URLs listed were valid at the time of writing):

- MPEG-2 standards (International Organization for Standards) - http://www.iso.ch/
- DVB standards (European Technical Standards Institute) - http://www.etsi.org/
- ATSC standards (Advanced Television Systems Committee) - http://www.atsc.org/

Manual Conventions

Naming conventions for the interface elements are based on standard Windows naming conventions. Naming conventions for MPEG-2, ATSC, and DVB structures follow the conventions derived from the standards documents listed above. In addition, the following formatting conventions apply to this manual:

- **Bold** text refers to specific interface elements that you are instructed to select, click, or clear.
  Example: Select **Settings** from the Configuration menu.
- Boxed text represents buttons on the user interface.
  Example: Select **Trigger** on the Setup dialog.
- Mono-spaced text can indicate the following:
  - Text you enter from a keyboard
    Example: Enter the network identity (`http://TSMonitor01`)
  - Characters you press on your keyboard
    Example: Press `CTRL+C` to copy the selected text.
  - Paths to components on your hard drive
    Example: The program files are installed at the following location: `C:\Program Files\Tektronix\`

Contacting Tektronix

Phone	1-800-833-9200*
Address	Tektronix, Inc. Department or name (if known) 14200 SW Karl Braun Drive P.O. Box 500 Beaverton, OR 97077 USA
Web site	www.tektronix.com

Support - N & S America

Sales support	1-800-833-9200, select option 1*
Service support	1-800-833-9200, select option 2*
Technical support	Email: techsupport@tektronix.com 1-800-833-9200, select option 3* * - toll free in North America. 6:00 a.m. -- 5:00 p.m. Pacific time After office hours, please leave a voice mail message.

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Sales Support	+44 (0)1344 392000

Service & Technical Support

Telephone	+44 (0)1223 200700
Fax	+44 (0)1223 200701

Introduction

Introduction 3
The Software Suite 3
Proprietary Analysis Software 6
MPEG Files 7
Format 7
Locations 7

Introduction

All applications in the MPEG Test System family operate under a Windows operating system (refer to the Specifications section in the AD951A/AD953A Technical Reference Manual, 071-1425-xx).

The Software Suite

Table 1 lists the applications available to the MPEG Test System. The table shows which applications are included in the standard installation (✓); also shown are those applications that can be enabled as an upgrade option (✘).

Table 1: AD951A/AD953A Software Applications

Section Number	Desktop Icon	Application \ Product	AD951A	AD953A
1		**Transport Stream (TS) Analyzer** Transport stream analysis with user-selectable MPEG-2, DVB and ATSC conformance tests. Shows transport structure, header contents, hexadecimal packet contents, PCR timing /transport rate graphs and an error message log.	✘	✓
		TS Analyzer Lite As for the TS Analyzer except that the file size of transport streams to be analyzed is limited to 192 MB.	✘	✘
2		**Packetized Elementary Stream (PES) Analyzer** PES analysis with selectable test options. Shows PES program structure, header contents, packet contents, PTS/DTS timing graphs and analysis reports.	✘	✓
3		**Transport Stream – System Target Decoder (T-STD) Buffer Analyzer** Analyzes program streams modeling their behaviour in, and their conformance to, the MPEG-2 T-STD Buffer Model.	✘	✓
4		**Tracer** Views the message log produced by T-STD Buffer Analyzer.	✘	✓
5		**Player** Records and Plays out MPEG-2 streams.	✓	✓

Table 1: AD951A/AD953A Software Applications

Section Number	Desktop Icon	Application \ Product	AD951A	AD953A
6		**TS Monitor/Recorder** Monitors and/or Records MPEG-2 transport streams – gives viewing of the transport stream multiplex, triggered and filtered recordings, logging of events and generation of an external alarm signal linked to transport stream events.	✓	✓
7		**TS Editor** Viewing and Editing of transport stream packets, via a hexadecimal view of the packet contents and semantic interpretation of the header. Provides facilities to: remap PIDs, recalculate PCR values and introduce PCR inaccuracies.	✓	✓
8		**Multiplexer** Multiplexes table information and packetised elementary streams together to synthesise new transport streams. A fine level of control is provided to allow non-conformances and test cases to be specified for new transport streams.	✓	✓
9		**Make Seamless Wizard** Guides the user through the process of creating an MPEG-2 file for use by Stream Player in continuously looped operation.	✓	✓
10		**Stream Monitor Plus** Monitors one or more transport streams. Updates graphs, status displays and event logs in real time. Can make sequences of recordings, unattended, whenever user specified events occur.	✘	✓
11		**Elementary Stream Analyzer** Elementary Stream analysis at video picture and audio level. This includes vector graphs and macroblock picture quality.	✘	✘
12		**Broadcast Satellite Digital Multiplexer** The BSDM allows multiple transport streams, together with TMCC information, to be multiplexed into a BS Digital stream. A single transport stream may also be exported from an existing BS Digital stream.	✘	✘

Table 1: AD951A/AD953A Software Applications

Section Number	Desktop Icon	Application \ Product	AD951A	AD953A
13		**Broadcast Cable Digital Multiplexer** The BCDM allows multiple transport streams, together with TSMF information, to be multiplexed to produce ISDB-C streams (TSMF streams). It can also demultiplex existing TSMF streams and allow the TSMF to be edited.	✘	✘
14		**Carousel Analyzer** Data analysis showing structure, bitrate, repetition rate, syntax and semantics of data items.	✘	✘
15		**Carousel Generator** Provides in-depth off-line generation of MPEG-2, DVB transport streams containing a range of data broadcast protocols.	✘	✘
16		**TS Maker** Creates and initialises files for recording.	✓	✓
17		**TS Cutter** Extracts sections of MPEG-2 files to new files.	✓	✓
18		**Script Pad** Enables users to create and modify System Information (SI) scripts.	✓	✓
19		**Custom SI Scripting** A background document which describes the scripting arrangements of the AD951A/AD953A.	Documentation only	

Standalone Operation

All applications (with the exception of Player, Monitor/Recorder and Stream Monitor Plus) are available as standalone options that can be installed and used on a PC (For more information about the PC specification required, refer to the AD951A/AD953A Technical Reference Manual, 071-1425-xx).

Upgrading

Upgrades are available for the following products:

- AD95x MPEG Test System
- AD951A/AD953A MPEG Test System
- Standalone MPEG Test System.

All applications are available for upgrading, with the exception of Player, Monitor/Recorder and Stream Monitor Plus in standalone systems.

Proprietary Analysis Software

Analysis of proprietary DTV standards is carried out in the MPEG Test System by the addition of plug-in modules. Where these are supplied, any documentation provided will be included in Adobe PDF format as part of the installation procedure.

For information on the range and availability of proprietary analysis software, please contact Tektronix directly or an approved representative.

MPEG Files

Format

All files created by MPEG Test System applications start on a packet boundary. That is the first byte of a file contains the first byte of the first packet in that file.

Files which are produced or modified by other equipment or software must conform to this convention if they are to be opened by MPEG Test System applications. No harm will occur to a MPEG Test System if a file with an invalid format is opened.

Locations

MPEG Test System hardware uses two types of disk drives. The operating system, MPEG Test System applications and general data are stored on a standard computer hard disk drive. This is usually configured as Drive C:

Recording and playout of ATSC, DVB and MPEG-2 streams requires much higher data transfer rates and consistency of performance. To achieve this, a high performance disk drive is incorporated.

Other than the greater performance there is no difference in the function of the two types of disk drives. Files may be copied to and from the high performance drives in the same way as for the standard drives.

Additional high performance drives may be connected to a MPEG Test System. These will be mapped to other drive letters if Drive E: is already taken. If the MPEG Test System was supplied with extra disks configured, these will be documented in the Delivery Note.

Section 1

Transport Stream Analyzer

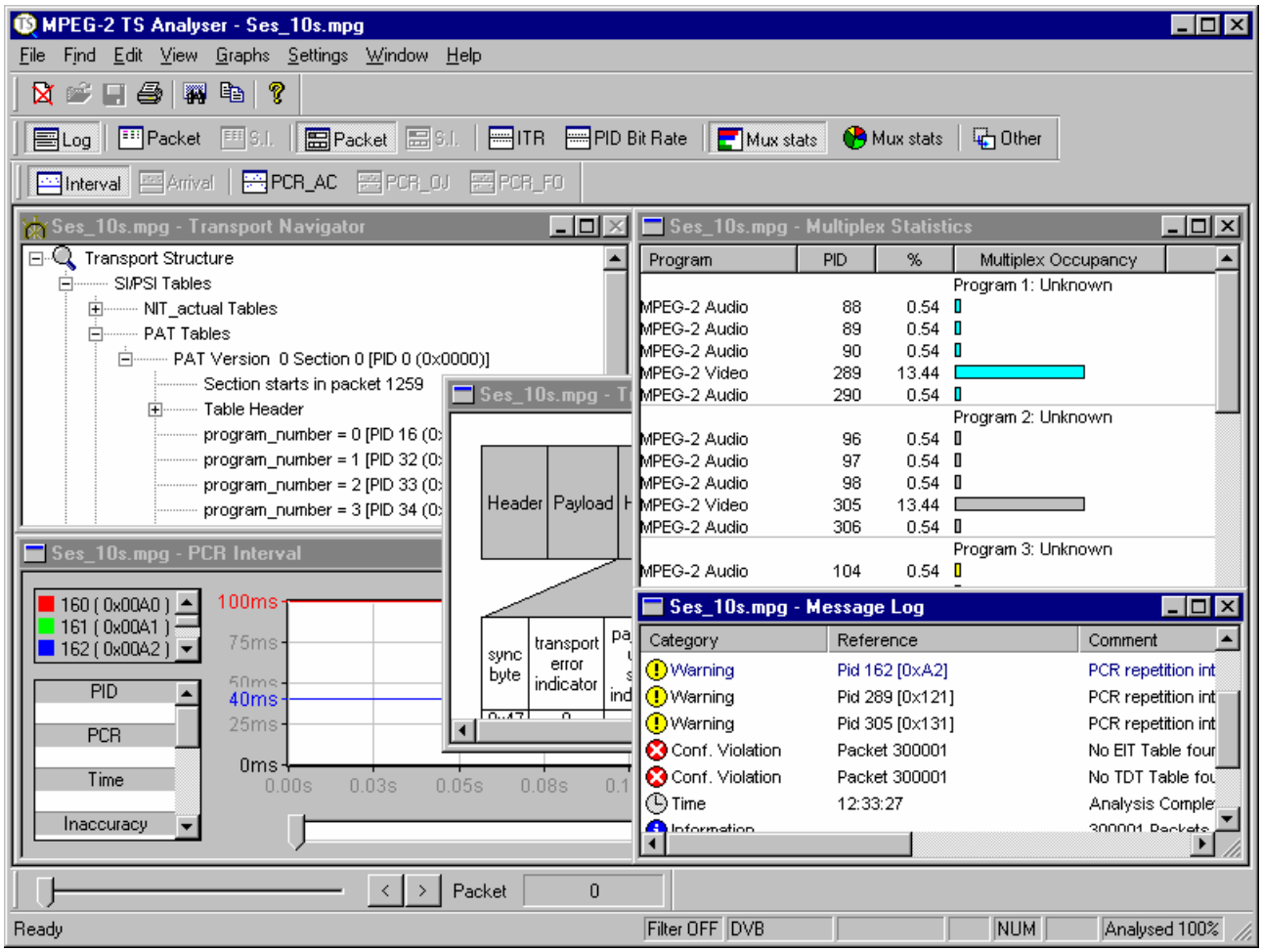
This section describes the Transport Stream Analyzer software.

If you have purchased the AD-TSAL software option, the functionality is exactly the same, except that the file size of transport streams to be analysed is limited to 192 MB.

Description of Features 3
Starting the Program 5
Initial Appearance 6
Initial Menu Options 6
Packet Size Selection 9
Stream Test Settings 10
MPEG2 Test Options 12
DVB Test Options 13
ATSC Test Options 16
Scripts and Modules 17
Handling Scripts and Modules 18
Script and Module Selection 19
Expert Mode 20
Opening a file 22
SI Filtering 25
Storing SI information 28
Menus and Controls 29
Menus and Options 29
Toolbars 34
Status Bar 36
Slider Bar 37
Find Transport Packet 39
Search by Criteria 40
Goto Packet 41
Transport Navigator 42
Transport Structure Diagram 43
Selecting a PID 44
Looking at the SI/PSI/PSIP Tables 46
Table Structure 47
Looking at the Packets 47
Looking at the Complete Table (Hex View) 53
Transport Packet Hex View 54
Packet Size 55
Packet Header 55
Adaptation Fields 56
Transport Private Data 56
Transport Packet Header 57
Adaptation Fields 58
Message Log 59
Packet Selection 60
Multiplex Statistics 62
Histogram View 62
Pie Chart View 67
Graphing Features 68
PCR Statistics Graphs 72
PCR Interval 72
Arrival Time Jitter (Arrival) 73
Inaccuracy (PCR-AC) 74
Overall Jitter (PCR-OJ) 75
Frequency Offset (PCR-FO) 76
PCR Drift Rate Measurement (PCR_DR) 76
Bit Rate Graphs 77
Instantaneous Transport Rate (ITR) 77
PID Bitrate 80
Electronic Program Guide 81
Schedule Window 83
References 85

Description of Features

The Transport Stream Analyzer allows the contents of a previously recorded or synthesised transport stream to be interpreted and viewed in a variety of formats. It also performs a series of user selectable MPEG-2, DVB and ATSC conformance tests. Errors found in specific packets are cross-referenced to enable each packet to be selected from the reference in the conformance report.



Information can be viewed in graphical and textual formats. To analyze and view the Packetised Elementary Stream (PES) packets use the companion program PES Analyzer, which can be run at the same time as this TS Analyzer. More than one instance of the program can be run simultaneously. This allows comparison of different files.

The functionality provided includes:

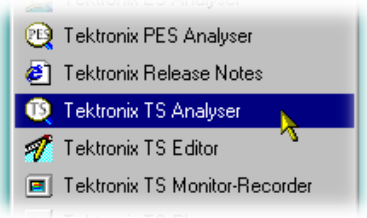
- Histogram or pie chart display of multiplex structure showing the Packet Identifier (PID) of all packets that are present in the stored file.
- Diagrammatic display and interpretation of Transport Stream packet header and adaptation field information for individual packets.
- Hexadecimal representation of Transport Stream packet, with color coding to differentiate the header, adaptation field and payload information.
- Location of a Transport Stream packet to match a particular condition in the packet header.

- Electronic Program Guide for DVB and ATSC streams.
- Display and interpretation of MPEG-2 Program Specific Information (PSI) tables:
    - Program Association Table (PAT)
    - Conditional Access Table (CAT)
    - Program Map Table (PMT)
    - Transport Stream Description Table (TSDT)
    - Network Information Table (NIT)
- Display and interpretation of DVB Service Information (SI) tables:
    - Network Information Table (NIT) as defined by DVB
    - Bouquet Association Table (BAT)
    - Service Description Table (SDT)
    - Event Information Table (EIT)
    - Running Status Table (RST)
    - Time and Date Table (TDT)
    - Stuffing Table (ST)
    - Time Offset Table (TOT)
    - Discontinuity Information Table (DIT)
    - Selection Information Table (SIT)
    - Single Frequency Network (SFN) information
- Display and interpretation of ATSC Program and System Information Protocol (PSIP) tables:
    - Master Guide Table (MGT)
    - System Time Table (STT)
    - Terrestrial Virtual Channel Table (TVCT)
    - Cable Virtual Channel Table (CVCT
    - Regional Ratings Table (RRT)
    - Event Information Table (EIT)
    - Extended Text table (ETT)
- Display and interpretation of ATSC A/57 table (Ref [2]:ATSC Standard A/57)
    - Program Information Table (PIT)
- Display and interpretation of ARIB tables
    - Network Information Table (NIT)
    - Service Description Table (SDT)
    - Event Information Table (EIT)
    - Stuffing Table (ST)
    - Time Offset Table (TOT)
    - Discontinuity Information Table (DIT)
    - Selection Information Table (SIT)
    - Broadcaster Information Table (BIT)
    - Linked Description Table (LDT)
    - Network Board Information Table (NBIT)

  - Software Download Trigger Table (SDTT)
  - Common Data Table (CDT)
  - ISDB-T Information Packet (IIP)
- Statistical display of the components of the Transport Stream and their data rates on a PID by PID basis.
- Calculation and graphical display of the instantaneous bit rate for each PID and for the entire Transport Stream from Program Clock Reference (PCR) time stamp values.
- Calculation and graphical display of PCR information:
  - The arrival interval between successive PCRs on a PID by PID basis.
  - The PCR accuracy for each PCR on a PID by PID basis.
  - The network, or arrival time, jitter on a PID by PID basis.
  - The overall jitter on a PID by PID basis.
  - The PCR frequency offset on a PID by PID basis.
  - The PCR drift rate on a PID by PID basis.

Starting the Program

The program may be started by selecting the **Tektronix TS Analyser** option from the Start -> Programs menu.

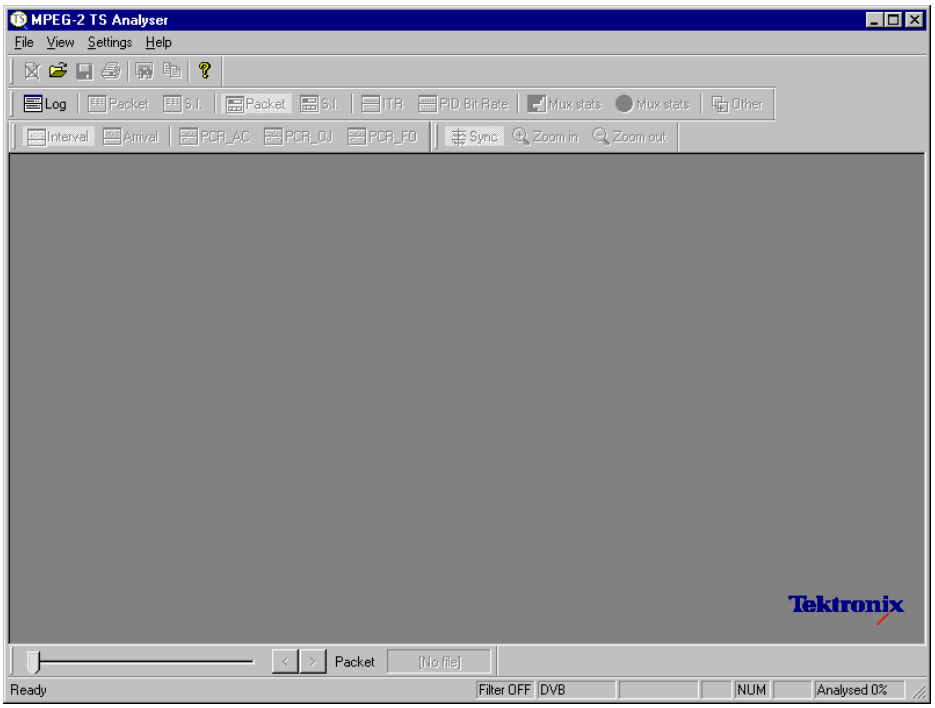


or

by double clicking on the **Tektronix TS Analyser** Shortcut on the desktop.

Initial Appearance

Once the program has started and is ready for use it will open a Main Window. When the program starts the main window looks like this:



The Toolbars (rows of buttons above the dark grey area of the empty window) provide quick access to the main menu functions. The toolbars can be docked on any edge of the window or floated (see page 29 et seq).

The Status line at the bottom of the window displays status information and tooltips and, because no file is open, that 0% of a stream file has been analysed.

Above the Status line is the Slider bar, for selecting packets within the file. This may be moved to the top of the window or floated.

Initial Menu Options

Users are presented with different menus and options, depending on whether or not a file is open for analysis. The menu options available when the program has just been started, or after a file is closed, are given below. Greyed out options are not available at this time.

(A check mark ✓ next to an option shows that the window or toolbar is currently visible; no ✓ means that it is hidden.)

File Menu Options

Open ... Opens a stream file for analysis. The program opens the file selection dialogue allowing the user to choose the required file.

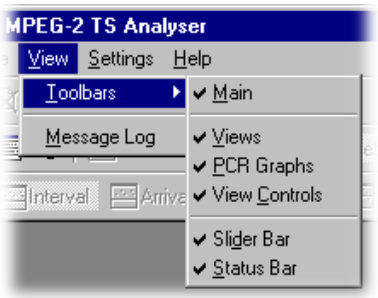
Print Setup ... Opens a dialogue for selecting which printer and associated options to use.

1 *<filename>*
2 *<filename>*
3 *<filename>*
4 *<filename>* A list of the four most recently analysed files. If the program has recently been installed the list may be empty or hold less than four files.

Selecting a filename opens that file for analysis.

Exit Finishes running the program.

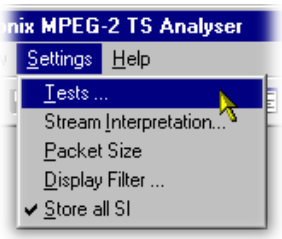
View Menu Options



Toolbar ► Shows or hides the sub-menu which allows the toolbars to be hidden or shown.

Message Log Toggles the Message Log window between being displayed or not.

Settings Menu options



Tests… Displays a dialog for selecting the tests to be used in stream analysis.

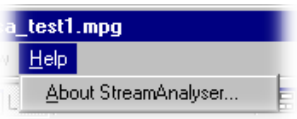
Stream Interpretation… Displays a dialog for selecting scripts and modules to be used in stream analysis.

Packet Size Allows the packet size of the incoming stream to be designated.

Display Filter… Allows designated table Ids to be filtered from the Transport Navigator display.

Store all SI When enabled, stores all SI information during analysis. When disabled, data for tables that are filtered out is not stored.

Help Menu Options

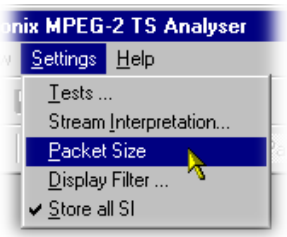


About StreamAnalyser… Displays Program Number, Version and copyright information.

Packet Size Selection

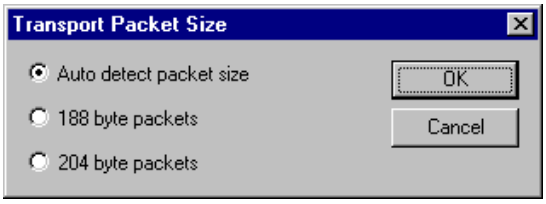
Specifies which packet size will be used to interpret the stream. (N.B. selecting the wrong packet size will cause analysis to report large numbers of errors, and the Transport Navigator and other views to show nonsense.) The options are:

Select **Packet Size** from the **Settings** menu to open the Transport Packet Size dialog.



Note that the Packet Size dialog is available when a file is open, but all activity is disabled.

The following dialog is displayed:



Auto detect packet size — Automatically detect the packet size used in a file when it is opened. If the program fails to determine the correct packet size it can be selected using the other Packet Size options.

188 byte packets — Analyze files as a stream of 188 byte packets.

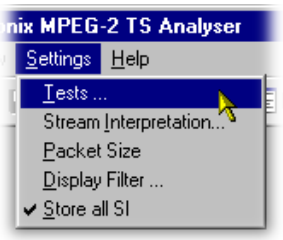
204 byte packets — Analyze files as a stream of 204 byte packets.

If large numbers of errors are reported during analysis, try selecting a different packet size.

Stream Test Settings

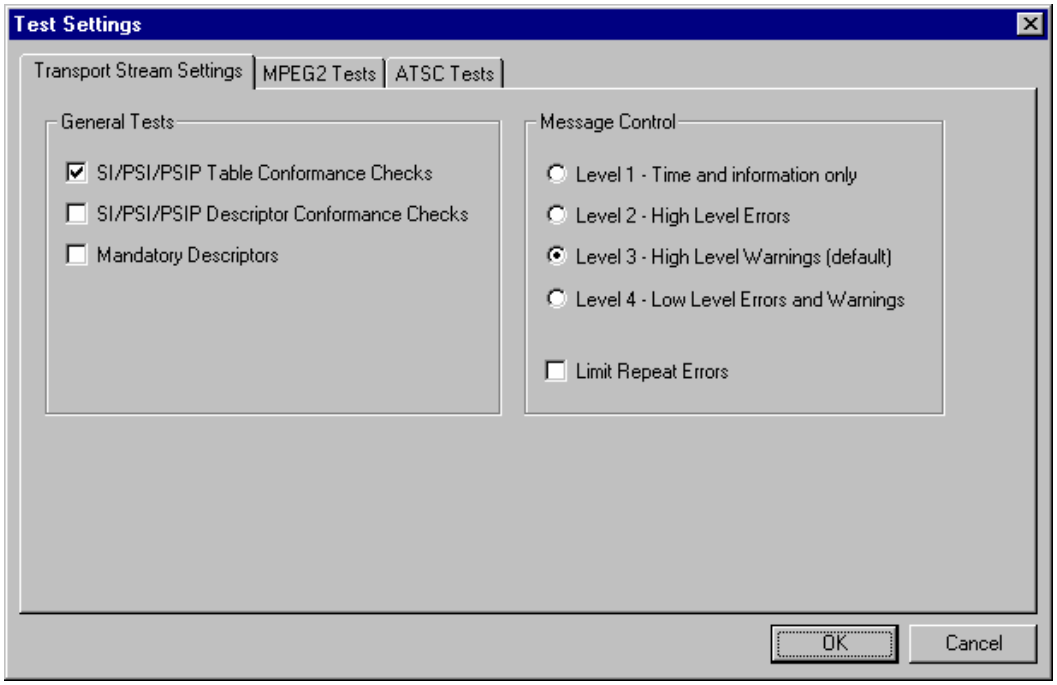
The stream Test Settings can only be modified before opening a file. To change these settings and options once a file has been opened: the file must be closed, the settings modified and the file re-opened.

Select **Tests...** from the **Settings** menu to open the Test Settings dialog.



Note that the **Tests…** option is not available when a file is open.

The Test Settings dialogue contains a number of tabbed pages as described below:



Tabs are shown only for the test sets available, as set in the Stream Interpretation screen.

General Tests

SI/PSI/PSIP Tables Conformance Checks	Enables conformance check of the SI/PSI tables.
IS/PSI/SI Descriptor Conformance Checks	Enables conformance checks of the SI/PSI descriptors.
Mandatory Descriptors	Checks for inclusion of mandatory descriptors within each SI/PSI table.

The ATSC standard, in particular, specifies differences in the allowed and mandatory descriptors based upon whether the context is cable, satellite or terrestrial. The analyzer does not know the intended context, so may log warnings that do not apply in all contexts. In these situations the log will indicate the contexts that are relevant.

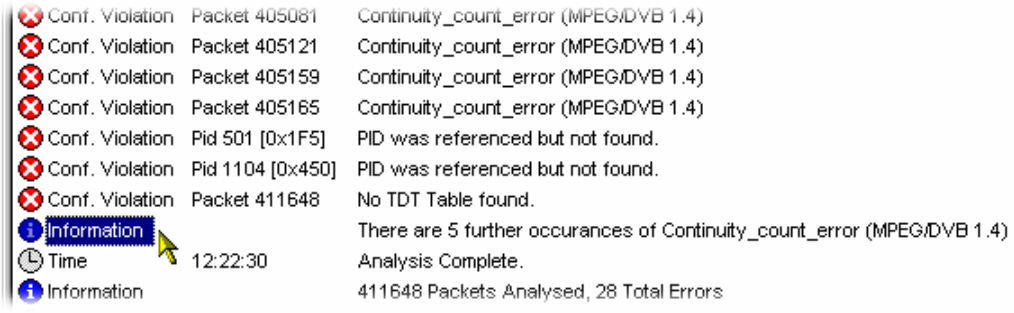
Message Control

Message Control is used to limit the level of error reporting during analysis. Select the error level required.

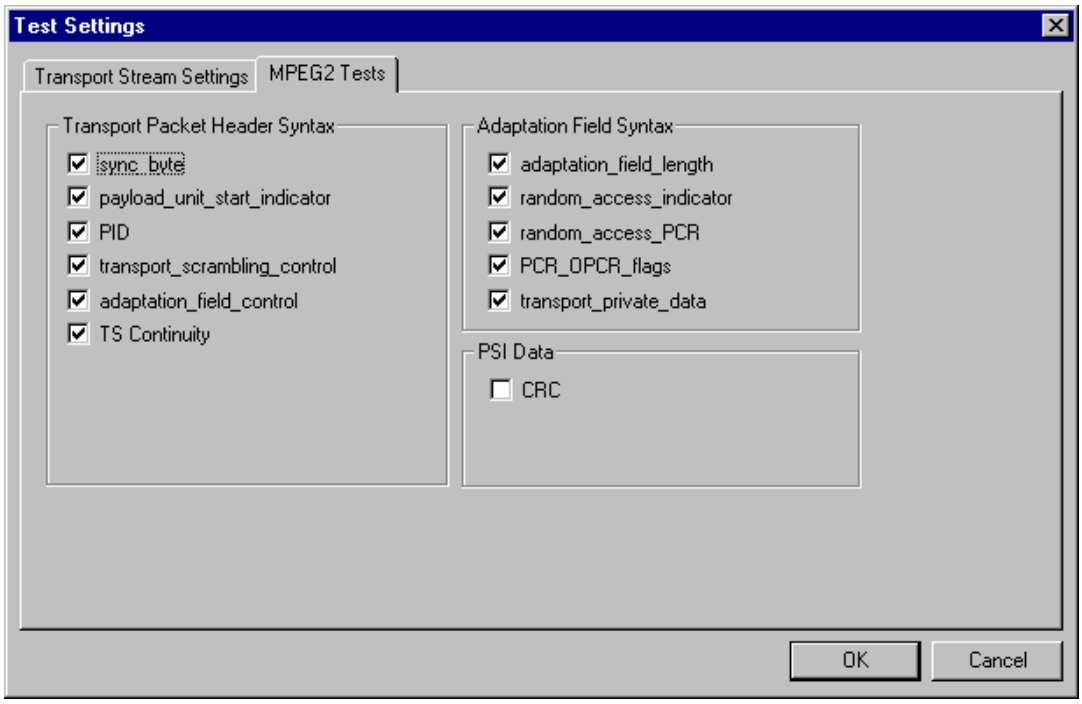
Limit Repeat Errors

Multiple reports (greater than 20) of errors can be limited, by enabling the **Limit Repeat Errors** checkbox.

When this option is enabled, up to 20 reports are made for a single error type, but thereafter a the total in excess of twenty is displayed at the end of the analysis.



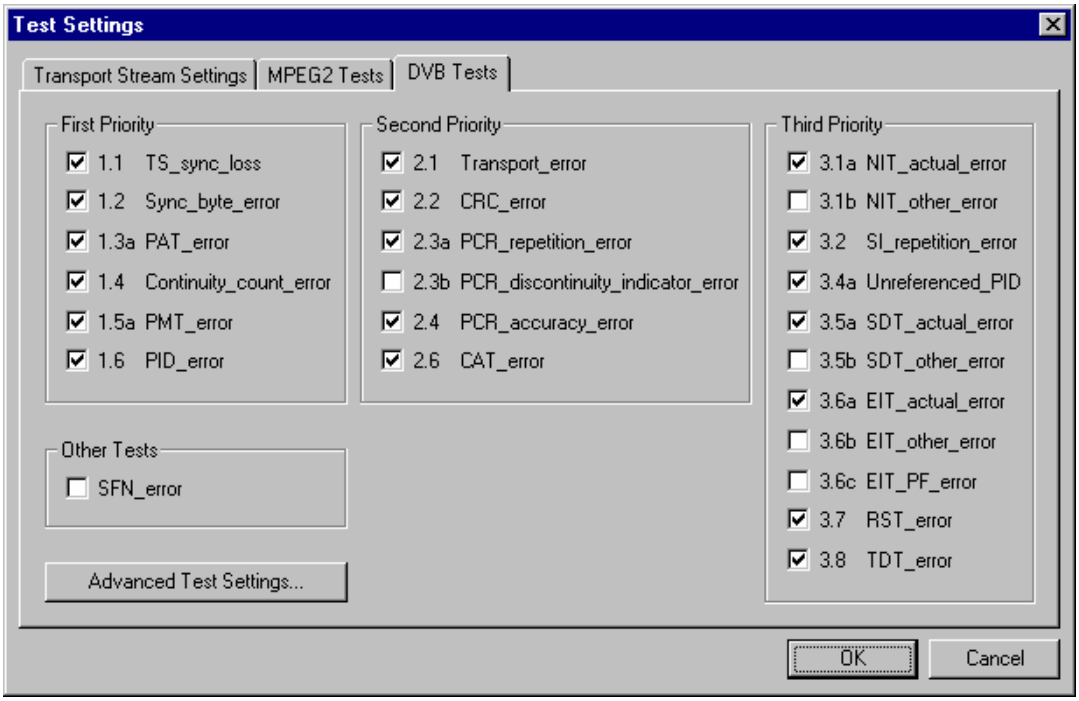
MPEG2 Test Options



These test options are laid out in a similar hierarchy to the conformance specifications in the MPEG-2 standard. For a full description of each test, see *section 2.3.2.1 of the MPEG-2 standard ISO/IEC 13818-4 (Ref* [9]*)*. The dialog uses the same names as those used in the standard.

Enable an option in the dialog to check for conformance to that part of the specification. A test is enabled when there is a check mark in the box. Conformance is not tested when the box is not checked.

DVB Test Options



These test options are laid out according to the Priority scheme used in the conformance specifications for the DVB standards. Refer to *section 5.2 of the DVB standard TR 101 290 (Ref* [1]*)* for a full description. The dialog uses the same names as those in the standard.

Enable an option to check for conformance to the related part of the specification. An option is enabled when there is a check mark in the box. Conformance is not tested when the box is not checked.

DVB 2.2 CRC-error and MPEG CRC tests refer to the same test and are linked in these dialogs. Enabling/Disabling either test in one of the dialogs will also enable/disable the test in the other dialog.

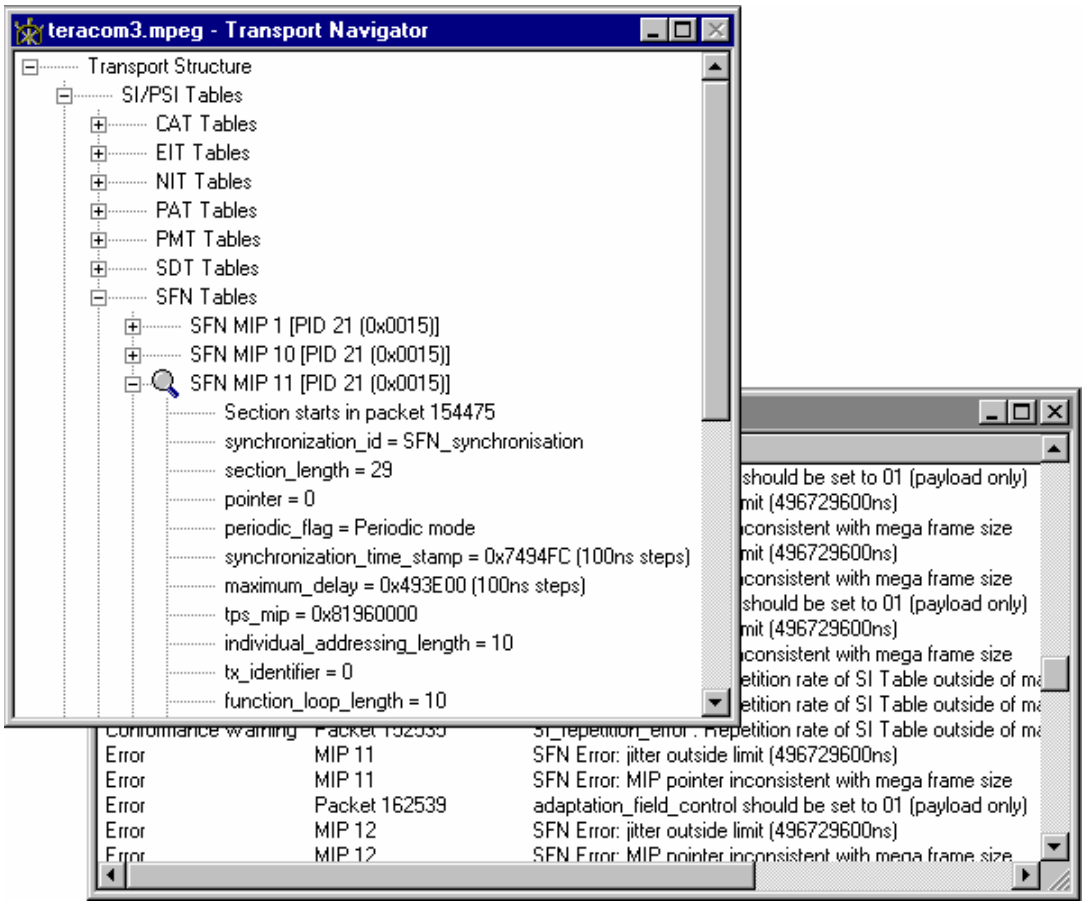
DVB tests also apply to both ISDB-S and ISDB-T standards.

Single Frequency Network (SFN) Errors

SFN error analysis is only applicable in DVB interpretation mode. The option is enabled when there is a check mark in the box. Conformance is not tested when the box is not checked.

All of the tests specified in *DVB standard TR 101 290 (Ref* [1]*)* are carried out.

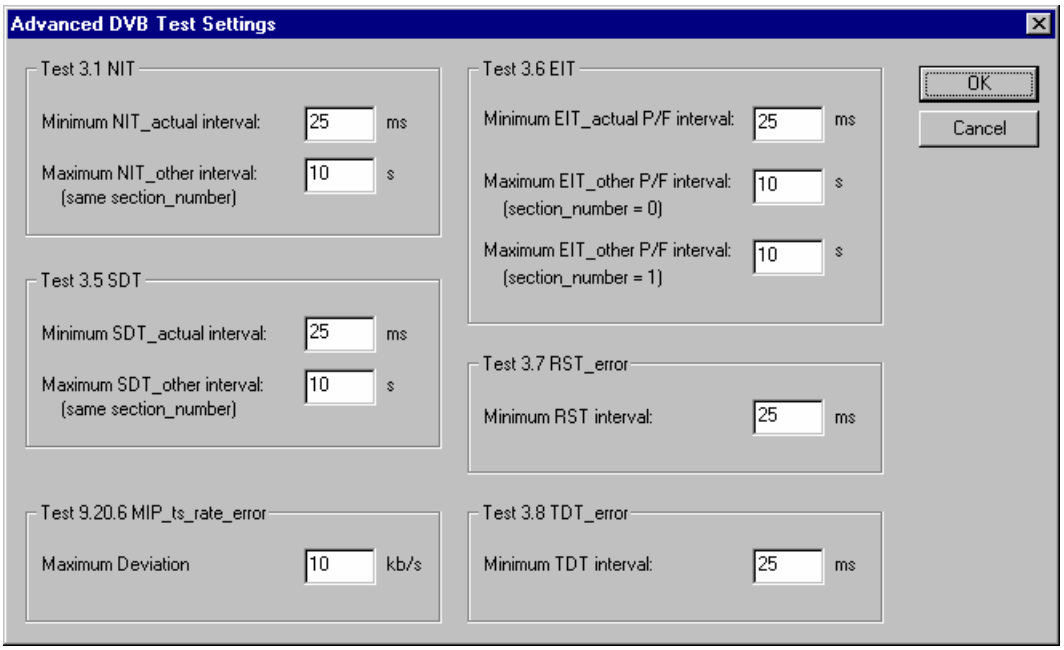
Although MIPs are not SI tables, they are listed in the Transport Navigator window as such for convenience. SFN errors are presented in the Message Log.



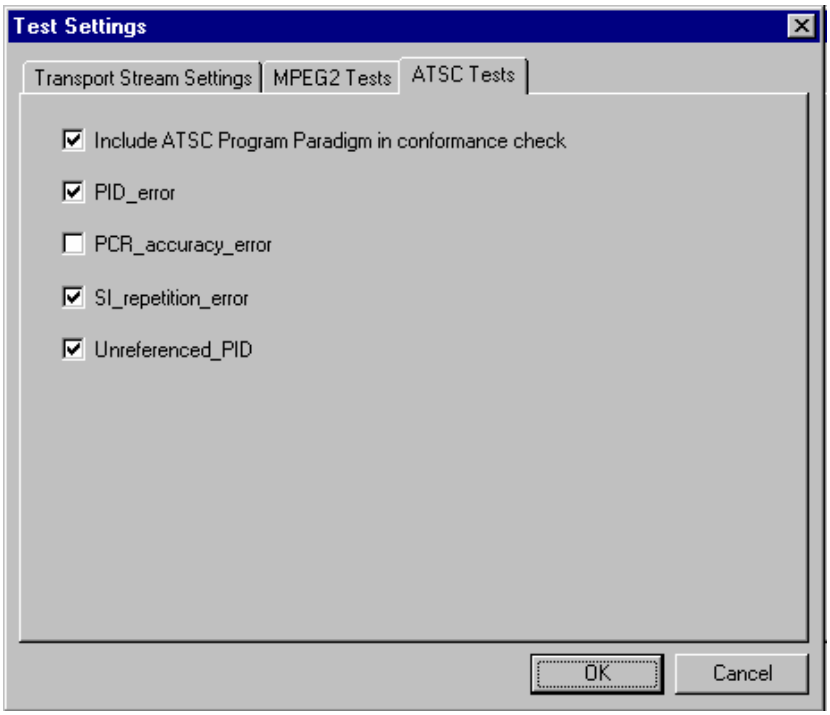
Advanced DVB Test Settings

The advanced DVB test settings dialog provides defaults for (and an opportunity to change) a selection of Priority 3 DVB test settings.

The dialog is accessed using the **Advanced Test Settings…** button on the **Test Setting** - **DVB Tests** tab.



ATSC Test Options



These test options are laid out according to the Priority scheme used in the conformance specifications for the ATSC standards. Refer to *A/65 Program and System Information Protocol for Terrestrial Broadcast and Cable (Ref* [3]*)* for a full description. The dialog uses the same names as those in the standard

Enable an option to check for conformance to the related part of the specification. An option is enabled when there is a check mark in the box. Conformance is not tested when the box is not checked.

PID_error, **PCR_accuracy_error**, **SI_repetition_rate** and **unreferenced_PID** conform to the equivalent DVB tests. **Include ATSC Program Paradigm in conformance check** is specific to ATSC streams.

Scripts and Modules

SI scripts and modules are available to the Transport Stream Analyzer to enable SI table and descriptor data to be analysed successfully. Whilst scripts are mainly used to enable analysis of SI data dictated by the various international standards, modules tend to be used to enable analysis of proprietary SI.

Essential scripts and modules are installed and enabled using the Stream Interpretation dialog. In the absence of any enabled scripts or modules, only the PAT table will be analysed, all other data will be presented as private data.

A listing of the currently available scripts is given in the *Custom SI Scripting* section of this manual. In addition, scripts may be customised to provided analysis of private data. Modules and their documentation are supplied when required. As a security measure, the use of some modules may require dongle permissions to be set.

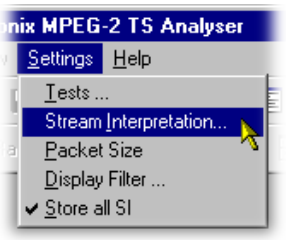
If a suitably configured script is selected and enabled before a stream is analysed, custom data will be analysed when the stream is opened. If the script is not selected or enabled the stream will not fail to be analysed, but any custom data will be reported as either an error in the stream configuration or as private or unknown data.

Scripts and modules can only be selected and enabled when no files are open. The Stream Interpretation dialog is available when a file is open, but all activity is disabled.

Note that a script file will not be used for analysis until:

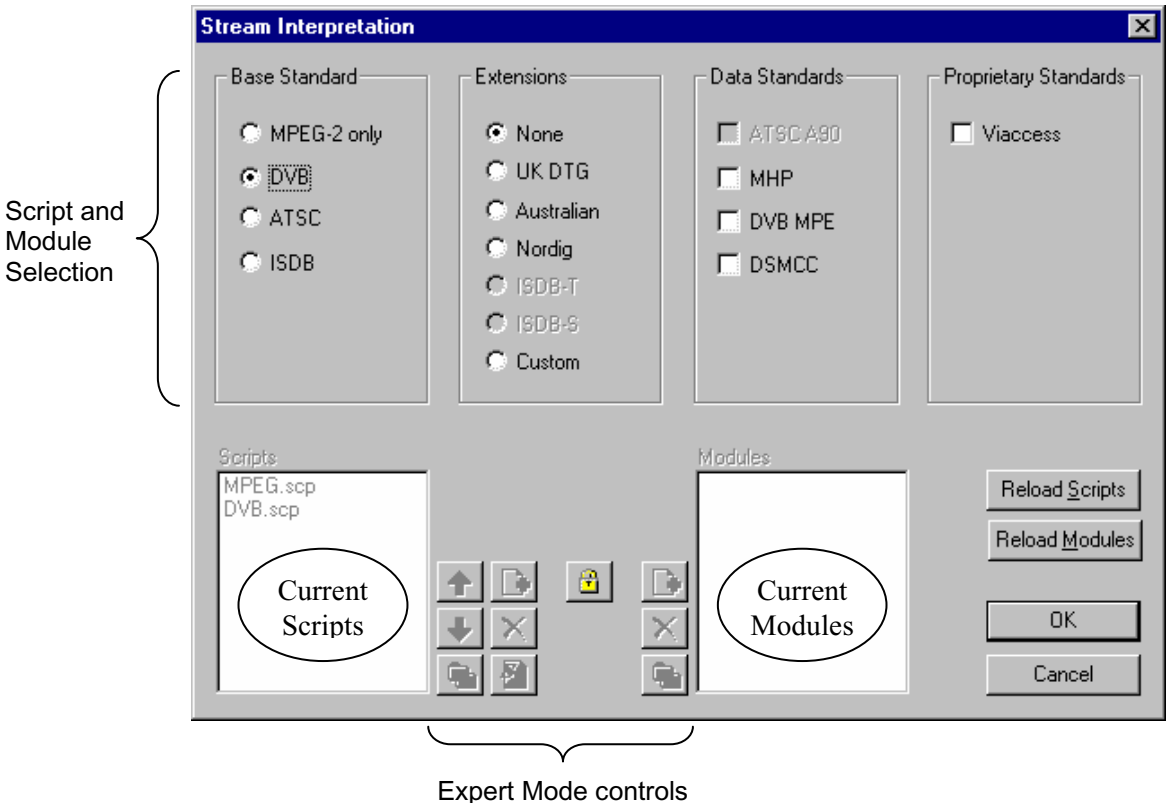
- It is present in the Scripts text-box in the current analysis mode.
- It is successfully enabled by closing the Stream Interpretation dialog using the OK button.

Handling Scripts and Modules



To open the Stream Interpretation dialog, with all files closed select the **Stream Interpretation…** option from the **Settings** menu.

The Stream Interpretation dialog is displayed as shown below:



The top half of the dialog is concerned with selecting scripts and modules. The two text boxes (Scripts and Modules) show the scripts and modules currently selected. The area between the two text boxes is dedicated to Expert mode controls.

Script and Module Selection

The selection area of the Stream Interpretation dialog is best viewed and used from left to right.

The **Base Standard** section allows the MPEG, DVB, ATSC or ISDB standard to be selected for analysis.

MPEG-2 only	Interprets and analyses the packets in conformance to the MPEG-2 standards.
DVB	Interprets and analyses the Transport Stream Packets according to the specifications of the DVB and MPEG-2 standards.
ATSC	Interprets and analyses the Transport Stream Packets according to the specifications of the ATSC and MPEG-2 standards.
ISDB	Interprets and analyses the Transport Stream Packets according to the ARIB and MPEG-2 standards

The standard selected will dictate the availability of the remaining options in the Extensions and Data Standard sections.

The **Extensions** section allows country-specific extensions to be added to the basic standard scripts. If **None** is selected, only the standard scripts are listed in the **Scripts** text-box. The remaining country-specific extensions add extra scripts to the current listing. As with the Base Standard, the choice of **Extensions** option will dictate the availability of the options in the **Data Standards** section. The **Custom** selection allows users to include their own selection of scripts using Expert Mode.

The **Data Standards** section offers a choice of data-specific scripts.

The last section, **Proprietary Standards**, lists the proprietary modules currently available.

Note that the scripts and modules listed by default are those resident in the default installation directory (i.e. tektronix\testsystem\modules). Other directory locations can be specified in Expert Mode. All selections will be retained between TS Analyzer sessions.

Syntax Checking

Scripts are syntactically analysed when the OK button is selected. They are also checked when the application is opened. A fault in the syntax of a script will not necessarily prevent a stream from being analysed, but it may result in incomplete analysis of the stream.

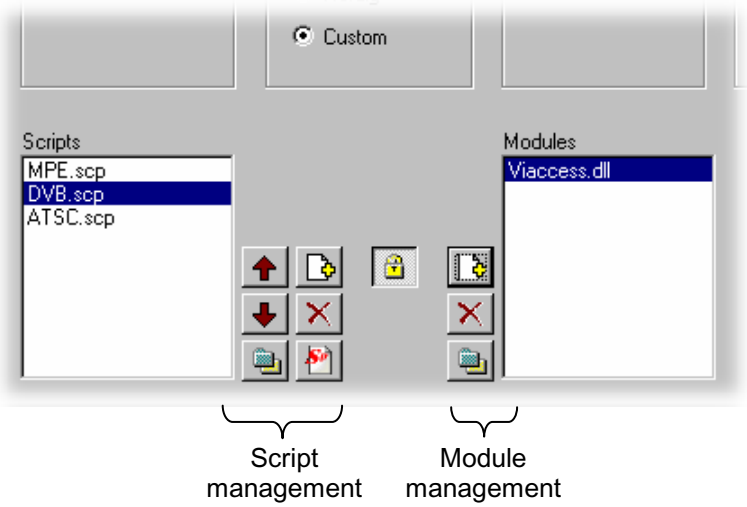
Scripts listed in the Scripts text-box will not be used for stream analysis until they have been successfully checked; that is, the application has been opened or the Stream Interpretation dialogue has been closed with no script-related error messages issued.

An intermediate check of scripts listed in the Scripts text-box can be made by selecting the **Reload Scripts** button. This performs the same action as the OK button but leaves the dialog open. Similarly, the **Reload Modules** button performs an intermediate check on the listed modules.

Syntactic errors will be indicated and reported in the Message Log.

Expert Mode

Expert Mode allows the user to select and customise the scripts and modules to be used in stream analysis. Note that when the expert mode is selected, the Custom extension option is automatically selected and that the management buttons are enabled. In Expert mode, all scripts become available to be added to the script list. The scripts will be checked and loaded, ready to be used for analysis, when the OK button is selected.



Script Management Buttons

The script management buttons act on the scripts currently listed in the **Scripts** text-box.


Script files are parsed in the order that they are listed; in some circumstances this may be important. To move a file in a list, highlight the file name and select the Up or Down arrow button as required. Each press of the button will move the file up or down one place in the list until it reaches the top or the bottom.

Add a script to the list: A standard Windows file selection dialog is opened. The default file extension is `.scp`. Select the required file. The selected script will be added to the bottom of the list. If necessary, it can be moved using the Up and Down buttons.

Scripts can be loaded from any directory.

Delete the highlighted script.

Change scripts' default directory: By default, all scripts are found in a default directory created during installation (i.e. tektronix\scripts). This button may be used to set a different default directory.

Note that all scripts supplied by Tektronix in the default installation are installed in a single directory; as long as this directory is designated as the default directory, they will work satisfactorily.

View highlighted script with the associated application; by default, script files are associated with the ScriptPad utility.

For a script file to be viewed successfully, the file extension (.scp) must be associated with a text editor in the MS Windows environment. The MPEG Test System installation program associates by default a script editing utility called ScriptPad; the user may use another text editor, e.g. MS Notepad, if preferred. ScriptPad is a simple script editor that can be installed with the MPEG Test System. Scripts can be viewed and edited as required (depending upon the file permissions).

Module Management Buttons

The module management buttons act on the modules currently listed in the **Modules** text-box.

Add a module to the list: A standard Windows file selection dialog is opened. The default file extension is `.dll`. Select the required file. The selected module will be added to the list; list order is not important as it is with scripts.

Note that some specialised modules need to be security enabled via the dongle. In these cases, a warning will be issued when the module is reloaded.

Delete the highlighted module.

Change modules' default directory: By default, all modules are found in a default directory created during installation (i.e. tektronix\testsystem\modules). This button may be used to set a different default directory.

Note that all modules supplied by Tektronix in the default installation are installed in a single directory; as long as this directory is designated as the default directory, they will work satisfactorily.

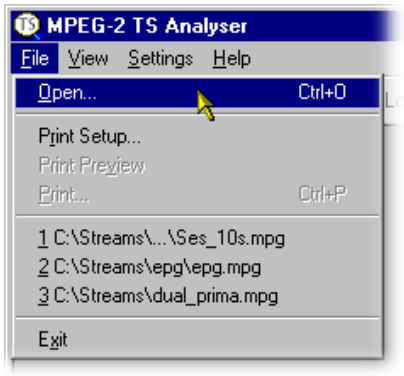
Opening a file

Any file holding a recorded or synthesised sample of a stream can be opened for analysis by this program. To analyze the PES packets open the file in the PES Analyzer. A file can be opened by both the TS and PES Analyzers at the same time.

Opening a file from the Menus and Toolbar

To open a file select the **Open ...** option from the **File** menu. If the required file is in the list of recently analysed files then it can be opened from the list to save using the open file dialogue.

Alternatively use the **Ctrl+O** keyboard shortcut.



There is a shortcut button available on the Toolbar for opening a file, which uses the standard file open symbol:

Opening a file from Windows Explorer or a File Browser Window

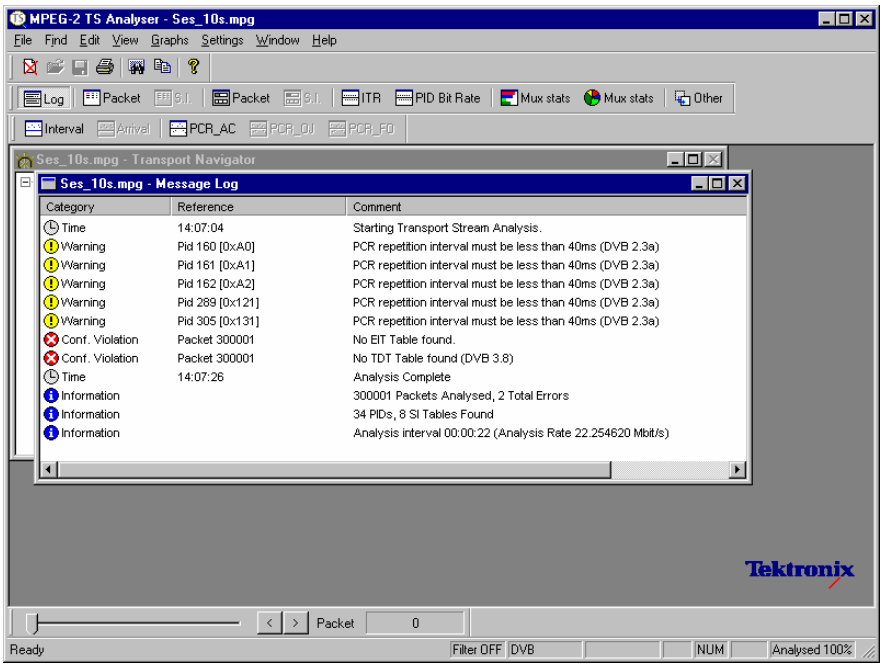
A new copy of the program can be run and a selected file opened in a single operation by selecting a Stream File in Windows Explorer or a File Browser window

Place the pointer over the file name or icon, press the right mouse button to pop-up a menu and then select the **Analyse** option

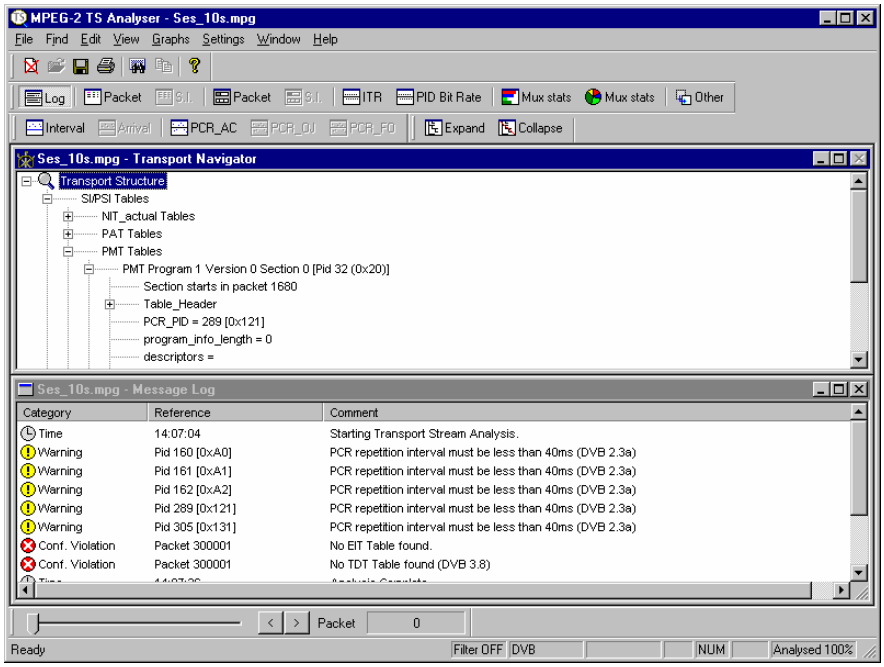
When the program is started with a selected file the last set of program options will be used.

Window Layout

Transport Navigator and Message Log windows are opened as soon as the file is opened. The layout of the windows will have been saved from the last time the program was used. If the program has just been installed the windows will be in the application default Cascade arrangement which looks like this:



Many users re-arrange the windows so that the Transport Navigator and Message Log do not overlap. The examples in this manual often use this arrangement:

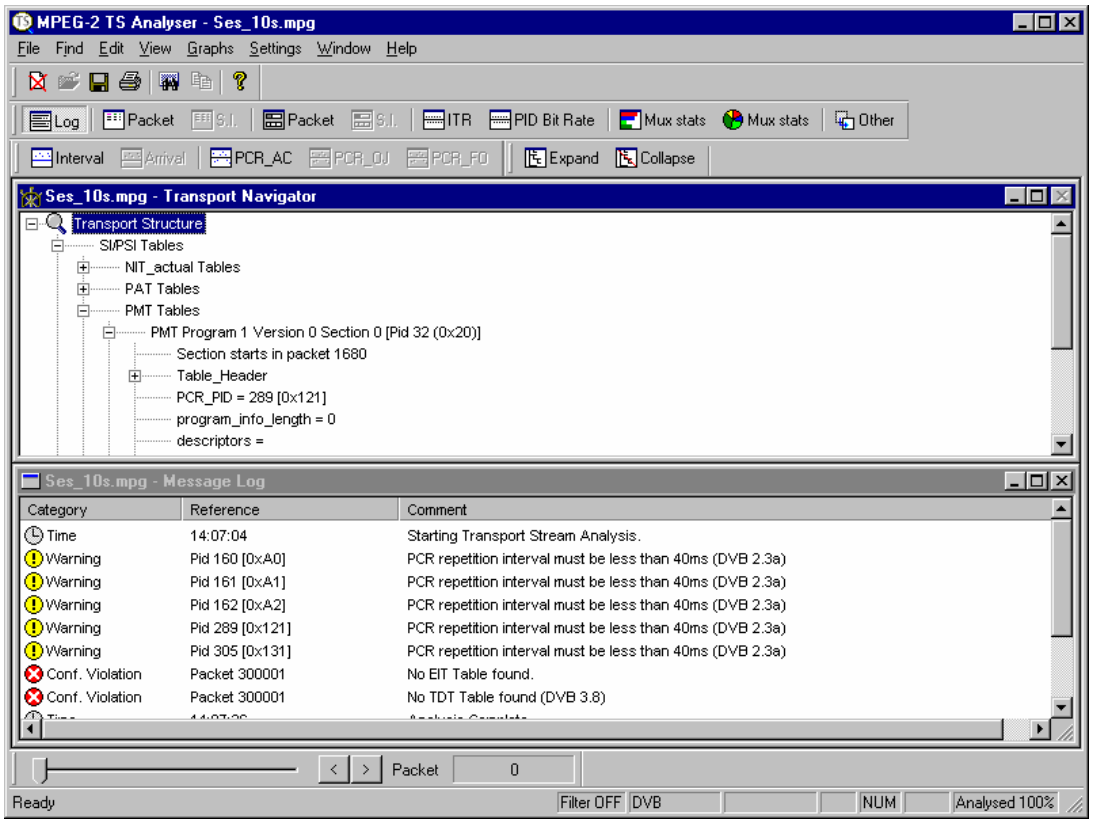


Transport Stream Analysis

The Transport Stream Analyzer program now starts to analyze the file for conformance to the selected tests. Thanks to the efficient algorithms used by the program a large file will be analysed in only minutes. A great deal of computation is being performed during the analysis phase, less efficient algorithms have been seen to take hours.

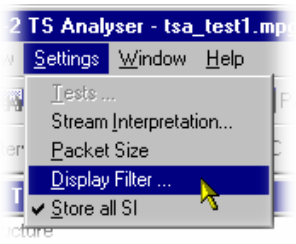
As the file is analysed messages are written in the Message Log and the Top Levels of the Transport Structure diagram are drawn in the Transport Navigator. The rightmost pane in the Status Bar at the bottom of the program window shows the progress of analysis as the percentage of the file processed.

When the processing is done an '**Analysis Complete**' message is written in the Message Log with a summary of the information analysed and errors found. The summary includes the rate at which the file was analysed

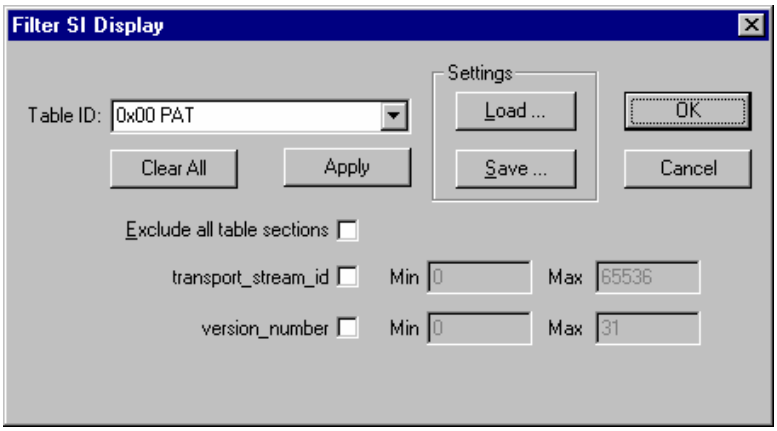


SI Filtering

Table elements can be excluded from the Transport Navigator display using the Display Filter available via the **Settings ➔ Display filter…** Menu bar option.

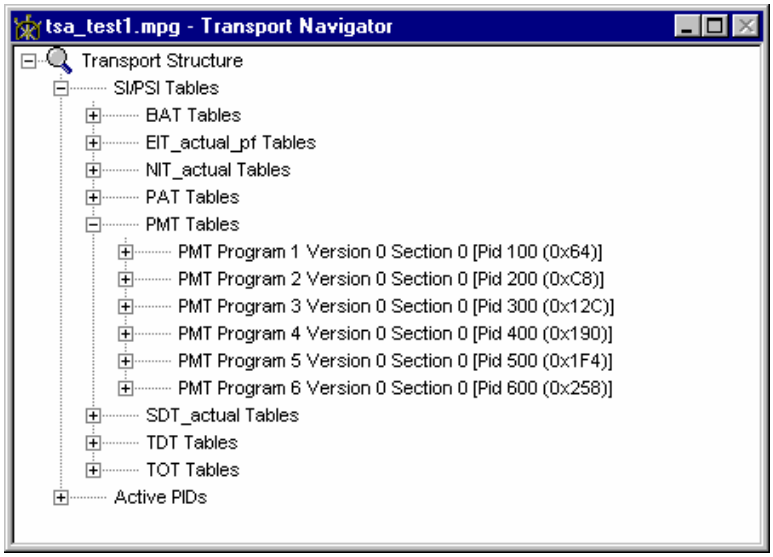


The following dialog is displayed:

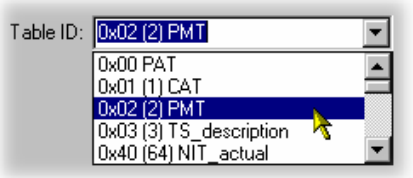


Selecting a Table for Filtering

Example: Prior to filtering, the stream tree may be as shown here:

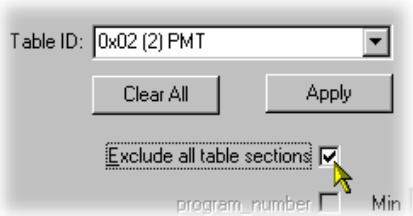


In the Filter SI Display dialog table identities are listed in the **Table Id:** drop-down menu.

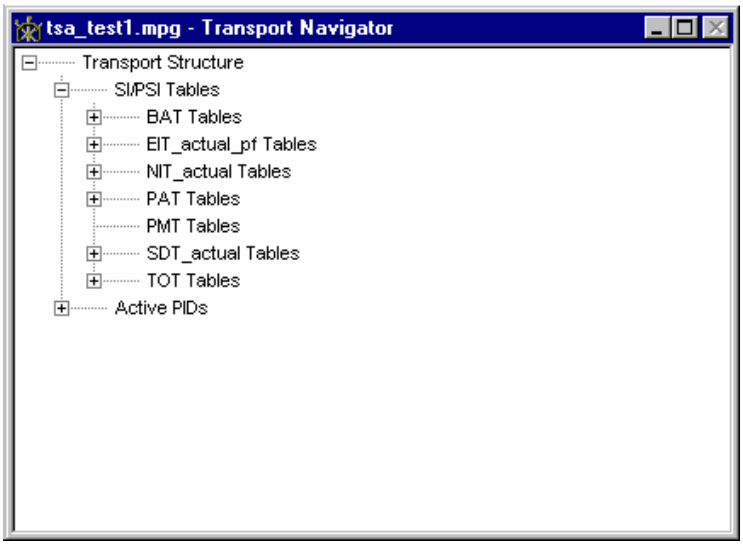


All sections of a table can be *excluded* by enabling the **Exclude all table sections** checkbox.

To view the result of filtering, the **Refresh Table Tree** option must be selected from the **View** menu.



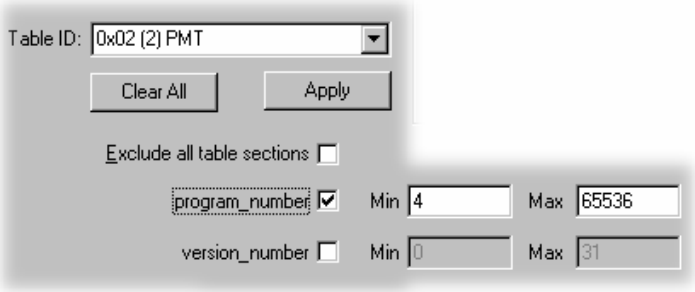
In this case the PMT Table Id will still be displayed but all sections will be excluded – as shown below:



or sections of tables can be *included*:

To exclude a range of sections, enable the section by selecting the checkbox and enter the range required.

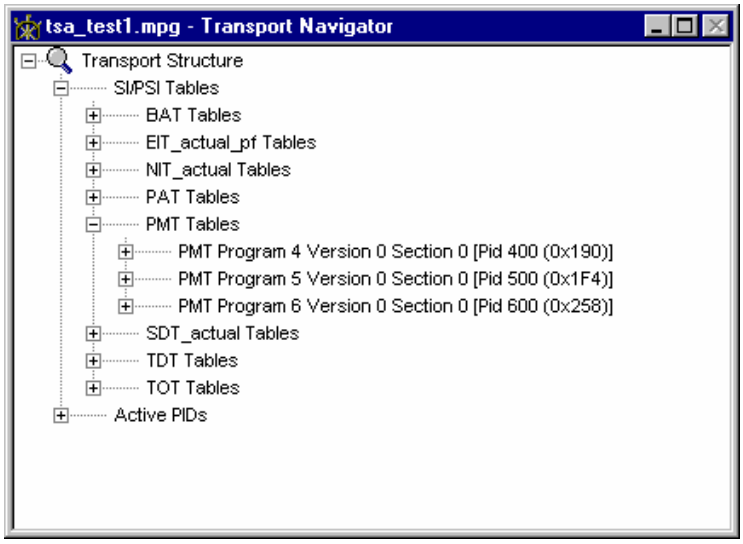
Note that section names shown in the dialog change according to the Table selected.



To view the result of filtering, the **Refresh Table Tree** option (or F5) must be selected from the **View** menu.

For example, the settings shown here will result in the display shown below:

Minimum and maximum values may be entered in either decimal (12345) or hexadecimal (0xA12B) format.



The parameters for each table must be set individually. Overall settings can be applied individually by selecting the **Apply** button when a setting is made or as a whole by making all of the settings and selecting the **OK** button.

To view the result of new filter settings, the **Refresh Table Tree** option must be selected from the **View** menu.

All settings can be cleared by selecting the **Clear All** button.

Note that filter settings remain in force for as long as TS Analyzer is active; filter settings made for one stream will be applied to all streams subsequently opened. The settings are lost when TS Analyzer is closed unless they have been previously saved.

Saving/Loading SI Filter Settings

The filter settings made in the Display Filter dialog can be saved and subsequently re-applied to the same stream or other streams.

To save the current filter settings, select the **Save** button and enter a name (and location) in the **Save As** dialog. To retrieve or load filter settings, select the **Load** button and identify the filter file in the **Open** dialog. The file extension `*.fil` is used.

Storing SI information

This features speeds up the analysis time where high densities of SI are present. Table data collected during analysis is stored in volatile memory if the **Settings ➔ Store all SI** option is enabled. This means that even if filtering is applied, the underlying data is still available. If the filtering is removed, the data can be successfully displayed. The data is lost when the stream is closed.

If the **Settings ➔ Store all SI** option is not enabled, full analysis will still take place, but any Table information which is not displayed because of filter setting will be discarded. If all sections in a table are filtered, even the Table Id will not be displayed in the Navigator tree.

Menus and Controls

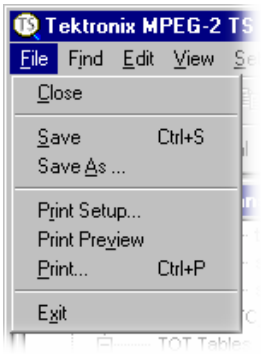
When a file is open the program presents a different set of controls. All TS Analyzer functions can be accessed from the Menu Bar. The Toolbars provide convenient shortcuts for the more frequently used menu options. All controls are context-sensitive; that is, they will be enabled or disabled depending on the view currently selected.

Menus and Options

The Menu Bar provides access to all system options via drop-down menus.

A check mark (✓) next to an option indicates that the window or toolbar is currently visible, no ✓ means that it is hidden. Similarly a greyed-out option indicates that the option is not currently available.

File Menu Options



Close Closes the current file. This option is available as soon as analysis starts. If the wrong file is being opened, or the wrong options are selected, selecting this option will abandon the analysis and close the file.

Save Allows the currently highlighted Transport Navigator view to be saved in ASCII format. (If the view has not previously been saved, the Save As… dialog is displayed so that a file name can be created.)

Save As… Allows the currently highlighted Transport Navigator view to be named and saved in ASCII format.

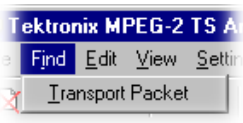
Print Setup… Selects printer and configuration.

Print Preview Provides an on-screen print preview of the currently selected view.

Print… Prints contents of the currently selected view.

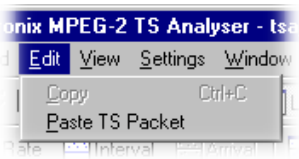
Exit Closes any file that is open and terminates execution the program.

Find Menu Options



Transport Packet Opens the Find Transport Packet dialogue, to search using one or more criteria..

Edit Menu Options



Copy Copies the contents of the current window to the Windows Clipboard, from which it can be pasted into a document in another application.

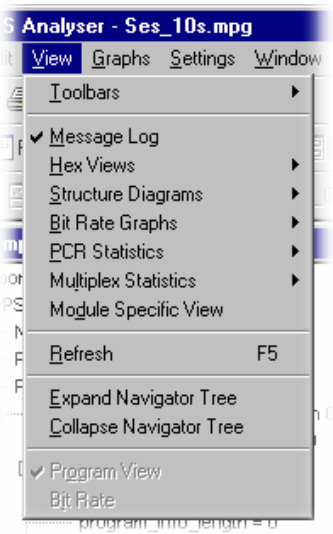
Paste TS Packet Selecting this option will go to and display details of the packet number held by the Windows clipboard.

(The packet should have already been identified in the PES Analyzer and copied to the Windows clipboard using the **Edit ➔ Copy TS packet** option.)

View Menu Options

Options available in this menu are dependent upon the currently selected view.

View Menu Options - All views, basic menu



Toolbars ►

A sub-menu that provides the Control viewing options. All options are toggle action. The following options are available:

Main	**Views**
PCR Graphs	**View Controls**
Slider bar	**Status bar**

(See Toolbars, page 34.)

All options in this section of the View menu are toggle action; either showing or hiding the named view.

Message Log

Shows or hides the Message Log view.

Hex Views ►

Transport Packet Hex View

Displays the transport packet in hexadecimal form.

PSI/SI/PSIP Section Hex View

Displays the PSI/SI/PSIP table section in hexadecimal form.

Structure Diagrams ►

Transport Packet Header and **PSI/SI/PSIP Section**

Bit Rate Graphs

Transport Bit Rate and **PID Bit Rate**.

PCR Statistics ►

Interval; **Arrival Time Jitter**; **Inaccuracy**; **Overall Jitter** and **Frequency Offset**

Multiplex Statistics ►

Histogram and Pie chart view selection.

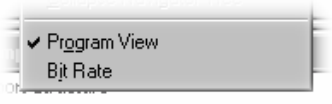
Module Specific View

Displays a module specific view, e.g. EPG (Electronic Program Guide). If more than one module specific view is available, a dialog is displayed from which a selection can be made.

Refresh

Refreshes the currently active view (where appropriate).

View Menu Options - Multiplex Statistics view (Histogram only)



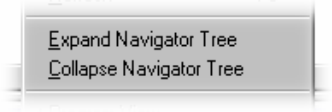
Program View

Changes the sort order of the PIDs in the Multiplex Statistics window. When enabled, the PIDs are sorted by Program and Table order. When disabled they are sorted by ascending PID number.

Bitrate

PID usage can be expressed either as a percentage of the whole stream or in Mbit/s.

View Menu Options - Navigator view



Expand Table Tree

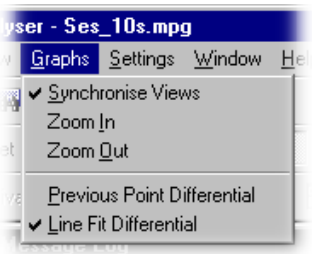
Expands all the nodes in the Transport Navigator window's Transport Structure tree.

Collapse Table Tree

Collapses all the nodes in the Transport Structure tree.

Graphs Menu Options

Graphs menu options are enabled when a graph view is open.



Synchronise Views
When enabled, automatically synchronises all displayed PCR graphs.

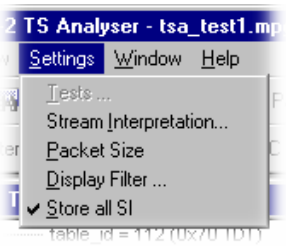
Zoom In / Out
Zoom in/out the displayed PCR graph.

Previous Point Differential
Selects PPD plotting in the PCR Statistics graphs.

Line Fit Differential
Selects LFD plotting in the PCR Statistics graphs.

Settings Menu Options

All **Settings** dialogs are enabled when no stream is open. With a stream open, all Settings menu options are enabled except the Tests option; the **Stream Interpretation…** and **Packet Size** dialog boxes are opened in read-only mode.



Tests…
Displays the Test Settings dialog.

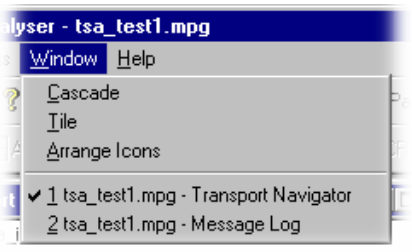
Stream Interpretation…
Displays the Stream Interpretation dialog.

Packet Size
Specifies the packet size that will be used to interpret the stream.

Display Filter…
Displays the Display Filter dialog.

Store all SI
When enabled, all SI information is stored during analysis. When disabled, SI Information for tables that are filtered out is not stored.

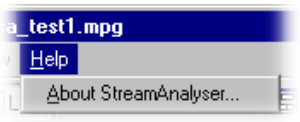
Window Menu Options



Cascade	Cascades all open windows in TS Analyzer. Minimized windows are ignored.
Tile	Tiles all open windows horizontally.
Arrange Icons	Aligns icons of any minimised windows at the bottom of the program's main window.

1 <*window title*> **2 <*window title*>** 3 ... etc.	Makes the named window active, putting it on top of any windows which had been hiding all or part of it.

Help Menu Options

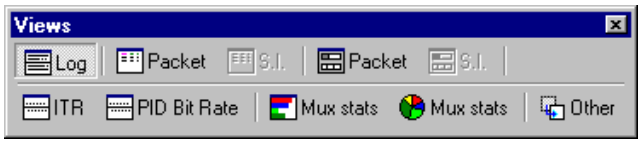


About StreamAnalyser… Opens a dialog which displays the program version number and license number.

Toolbars

Toolbars provide convenient shortcuts for the more frequently used menu options. The four toolbars are described in the following paragraphs.

Toolbars can be individually dragged off the edge of the main window into a floating pallet. To do this place the mouse pointer on the vertical bar at the left-hand end of the toolbar, hold the left button down and drag into the main window area. The result is a self-contained window as shown below:



Toolbars can also be docked with any edge of the main TS Analyzer window. To place the Toolbar on a window border drag it over the border until the outline changes shape.

Main Toolbar


Closes the current file. This button becomes enabled the moment a file is opened and analysis starts. If the wrong file is being opened, or the wrong options are selected, clicking on the button will abandon the analysis and close the file.


Open a file. This button is disabled when a file is open.


Saves the contents of the Transport Navigator to a simple text file.


Print the contents of the current window.


Opens the Find Transport Packet dialog to search for a packet by one or more criteria.


Copies the Message Log to the clipboard.


Opens a dialog that displays the program version number and license number.

Views Toolbar

Log	Toggles the Message Log view.
Packet	Toggles the Transport Packet Hex view.
S.I.	Toggles the SI Table Section Hex view.
Packet	Toggles the Transport Packet Header view.
S.I.	Toggles the SI/PSI Table view
ITR	Toggles the PCR Instantaneous Transport Rate scatter graph.
PID Bit Rate	Toggles the PID Bit Rate graph.
Mux stats	Toggles the Multiplex Statistics (Histogram) view.
Mux stats	Toggles the Multiplex Statistics (Pie Chart) view.
Other	Toggles a module-specific view, e.g. EPG view. If more than one module-specific view is available a dialog containing a list of available views is displayed.

PCR Views Toolbar

Interval	Toggles the PCR Interval scatter graph.
Arrival	Toggles the PCR Arrival Time Jitter scatter graph
PCR_AC	Toggles the PCR Inaccuracy scatter graph
PCR_OJ	Toggles the PCR Overall Jitter scatter graph
PCR_FO	Toggles the PCR Frequency Offset scatter graph

View Control Toolbars

Navigator View Control

Expand — Expands all branches of the **Transport Structure** tree in the Transport Navigator.

Collapse — Collapses all branches of the **Transport Structure** tree in the Transport Navigator.

Multiplexer Statistics Histogram View Control

Programs — Toggles the Multiplex Statistics histogram view between Program view and PID view.

Bitrate — Toggles the display of the value of the current occupancy of each PID relative to the other PIDs in either **%** or **Mb/s**.

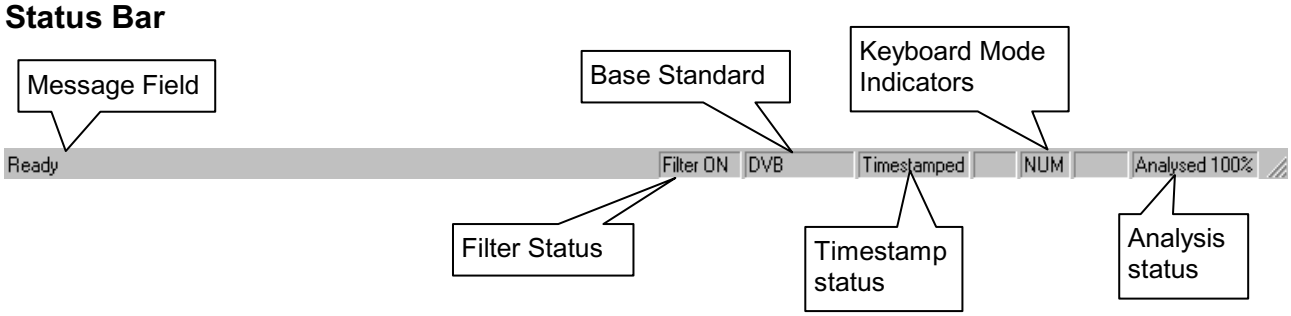
PCR Graph View Control

Sync — Synchronises all PCR graph displays.

Zoom in — Zoom in to PCR graph display.

Zoom out — Zoom out from PCR graph display.

Status Bar

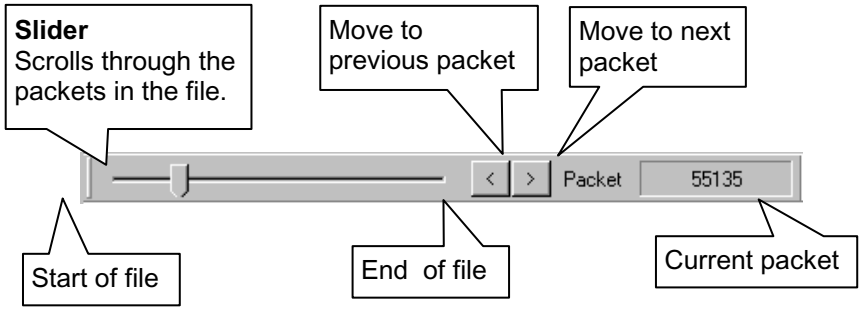


The Status Bar may be hidden from view, but if visible is always at the bottom of the main window. It displays the following information about the program and keyboard states:

Message Field	Gives a description of any button or menu option over which the mouse pointer is placed. It can also show non-critical messages.
Base Standard	Indicates the base standard selected in the Stream Interpretation dialog.
Keyboard Mode Indicators	Indicates the keyboard mode, i.e. CapsLock, NumLock and ScrollLock.
Filter Status	Indicates that the Navigator display Filter is in use, i.e. **Filter On**.
Timestamp Status	Indicates that timestamps have been found in the stream.
Analysis Status	Indicates progress when a file is being loaded.

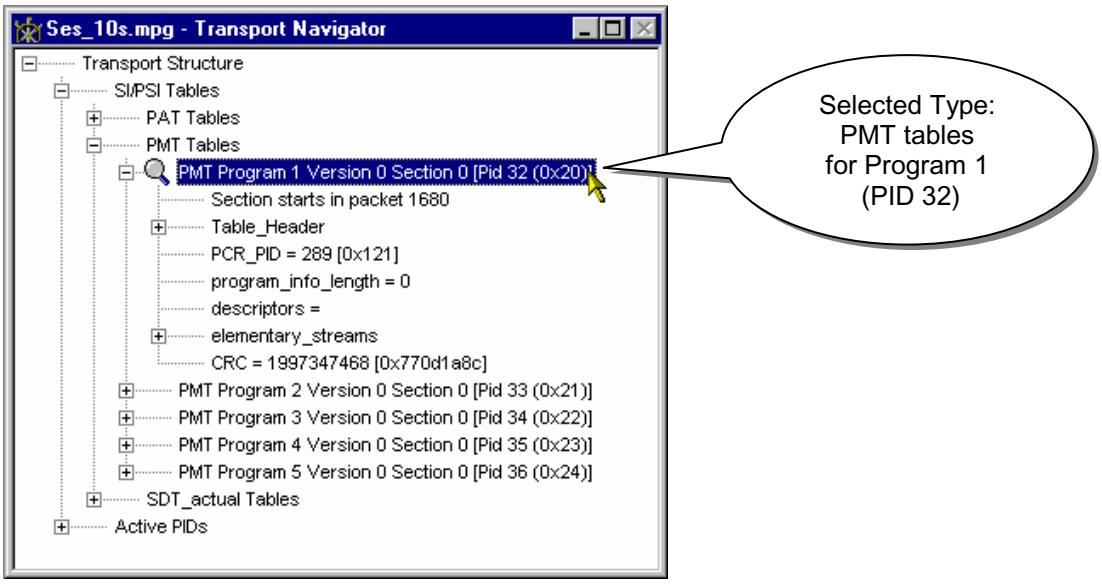
Slider Bar

The program can display the contents of any packet in the currently loaded file. Packets are numbered according to their position in the file, the first being packet 0 (zero). The Slider Bar displays the packet number for the current packet. It has a slider control and buttons for selecting which packet to view.



The left and right cursor movement buttons are shortcuts for the previous and next packet buttons.

A filter can be specified to restrict which packets the Slider Bar may select. The filter can be used to select a particular PID and table_id in the table sections of the Navigator tree or a single PID in the Active PIDs section of the Navigator tree. The current filter selection is indicated by the magnifying glass symbol,  , in the Transport navigator. A new filter can be selected by clicking on the required Table or Active PID in the Transport Navigator window.



Clicking on any reference to a PID or table_id will set the filter. For example clicking on the line '**PCR PID = 289 (PID 289 (0x121)**' will restrict selection to packets carrying PID 289.

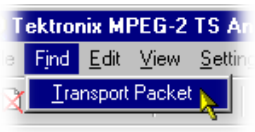
When there is no magnifying glass symbol or **Transport Structure** is selected the Slider Bar may select any packet. To disable filtering, click on the **Transport Structure** node.

Like the Toolbar, the Slider Bar can be dragged from the edge of the main window into a floating pallet. To do this click on the background inside the Slider Bar (the label '**Packet**' is a convenient place) and drag into the main window area. The result is a self-contained window which looks like this:

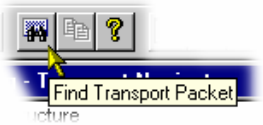
To replace the Slider Bar on the window border drag it over the border until the outline changes shape. Unlike the Toolbar it can only be placed on either the top or bottom edges.

Find Transport Packet

To go to or search for transport packets select the **Transport Packet** option from the **Find** menu.

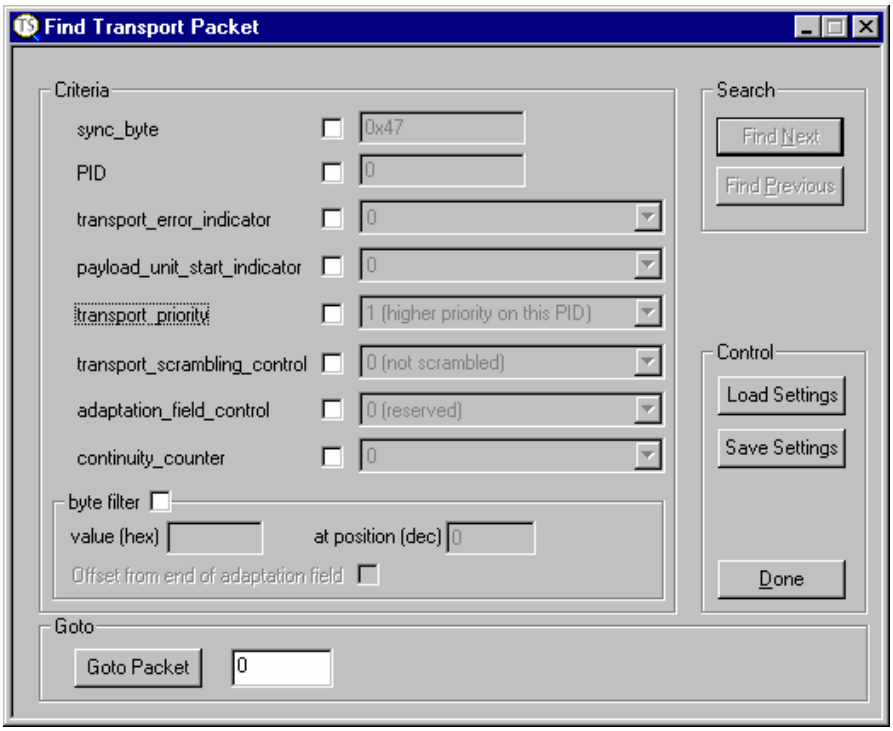


Alternatively click on the Find Transport Packet button on the Toolbar:



This opens the Find Transport Packet dialog. Packets can be searched for by any combination of the Criteria contained in the dialogue. The **Goto** facility selects a packet by its position within the file, taking the first packet as 0 (zero).

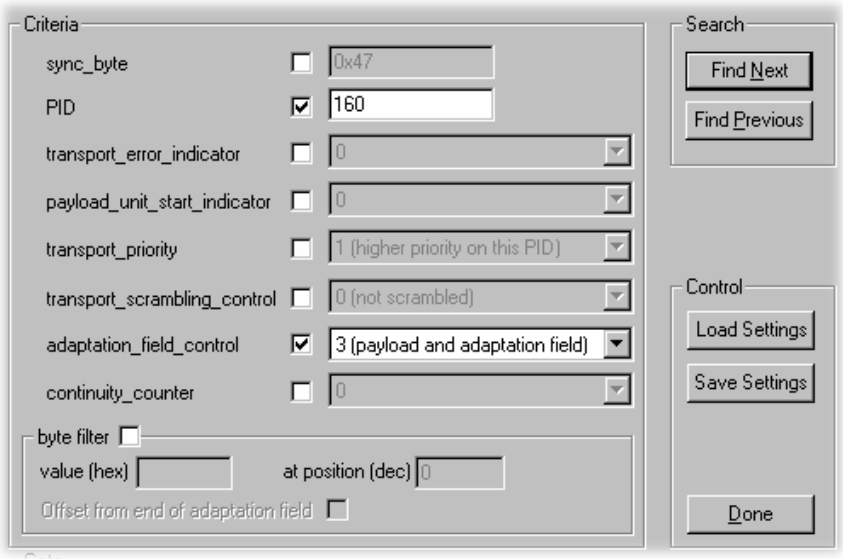
By default, when the **Find->Transport Packet** option is first selected, none of the criteria options are selected, the packet number in the **Goto** panel is 0 (zero), the **Find Next** and **Find Previous** buttons are disabled.



The Find Transport Packet dialog remains open after a packet has been selected to make it quicker to select further packets. It may be closed by selecting the **Done** button. The dialog is not confined within the boundaries of the main window. It may be moved on to the desktop and also minimised on the desktop.

Search by Criteria

To search for packets which match a set of criteria select the required options in the **Criteria** panel. For example, if packets of PID 160 carry MPEG-2 video, to search for packets with an adaptation field the criteria could be selected as follows:

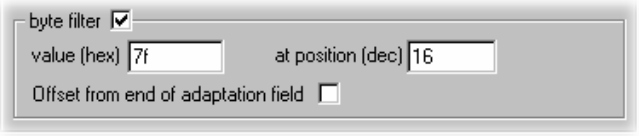


Click in a checkbox to select a search criteria. Once selected the associated value is no longer 'greyed out' and can be modified. The **sync_byte** and **PID** values may be entered in decimal or hexadecimal by prefixing the value with **0x**. E.g. PID **160** would be **0xA0** in hexadecimal. Select all of the required search criteria and specify the associated values.

Both of the **Find** buttons become enabled as soon as one of the criteria is selected. Click on **Find Next** to search forward from the current packet or **Find Previous** to search backwards.

The Byte Filter

The byte filter criteria provides facilities to search for packets by the value at a specific position in the packet.

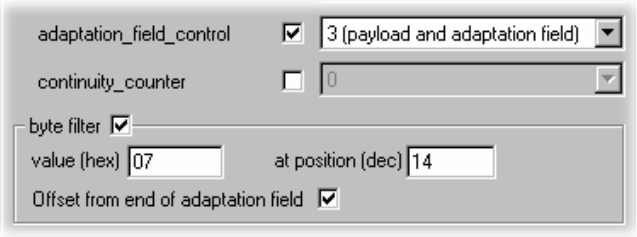


Select the **byte filter** option then enter the search value and position of the byte within the packet. Enter the search value as a pair of hexadecimal digits. In the above example the value is 0x7f (that is 127 in decimal). The position is specified as an offset from the first byte in the packet, the same as the addresses shown in the Transport Packet Hex View. The first byte of a packet is at position 0 (zero).

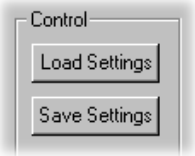
When searching for a packet with the **adaptation_field_control** criteria selected and a value of **3 (payload and adaptation field)** the **Offset from end of adaptation field** option becomes available for selection.

This option changes the address mode to treat the first byte after the adaptation field as position 0 (zero). For example:

To search for packets which have the value 7 in the 15 byte after an adaptation field, enter a value of 07 hex and a position address of 14 decimal.



Loading and Saving Settings



The current set of search criteria may be saved to disk for reference and re-use by clicking on the **Save Settings** button. A standard file browser window is opened to specify the name and location of the settings file.

By default the file has an extension of **.fnd**

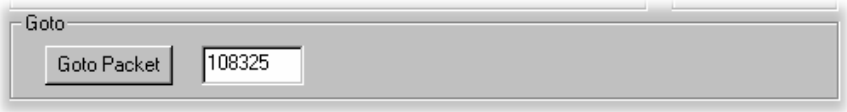
Select the **Load Settings** button to restore a set of previously saved search criteria.

This also opens a standard file browser with the default extension of **.fnd**

It is a good idea to choose names that explain what the settings are or give a reminder of what the search is for.

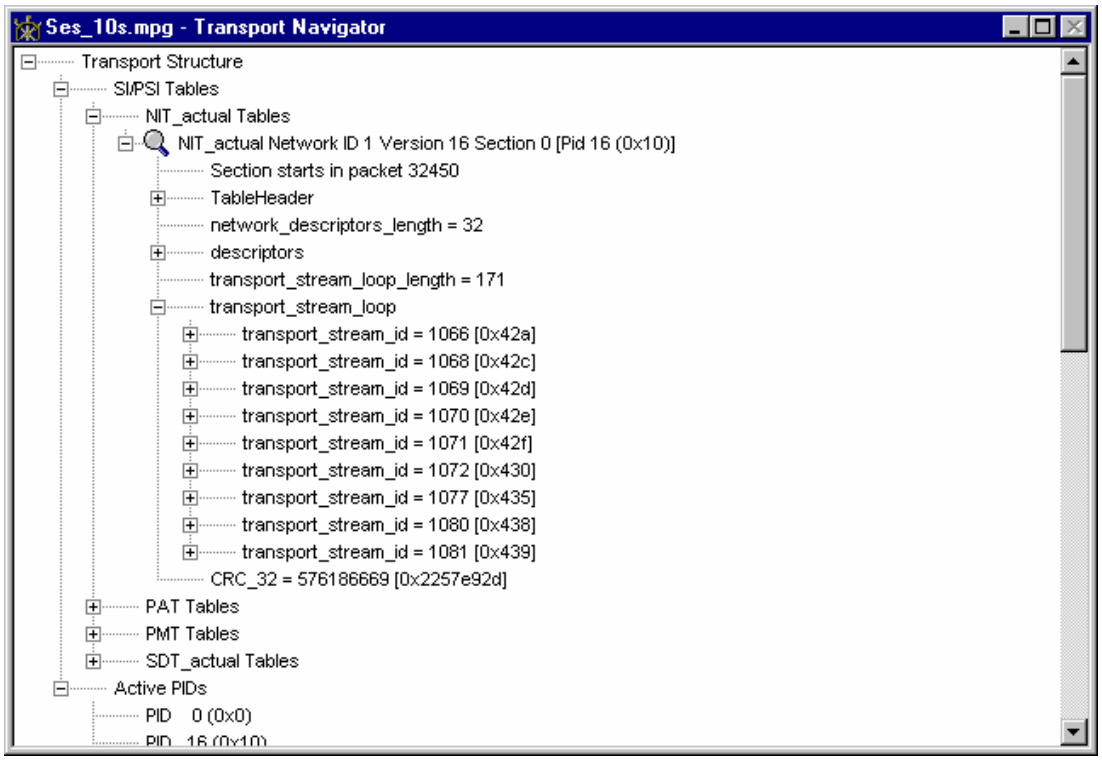
Goto Packet

Transport Stream Analyzer displays the location of a packet within the file on the Slider Bar. This is the position from the start of the file, numbering the first packet as Packet 0 (zero). To move to a specific packet by this address, enter the packet number and select the **Goto Packet** button in the **Goto** panel. For example:



This will move to packet **108325**. If the file is shorter than 108325 packets the program will stay on the current packet.

Transport Navigator



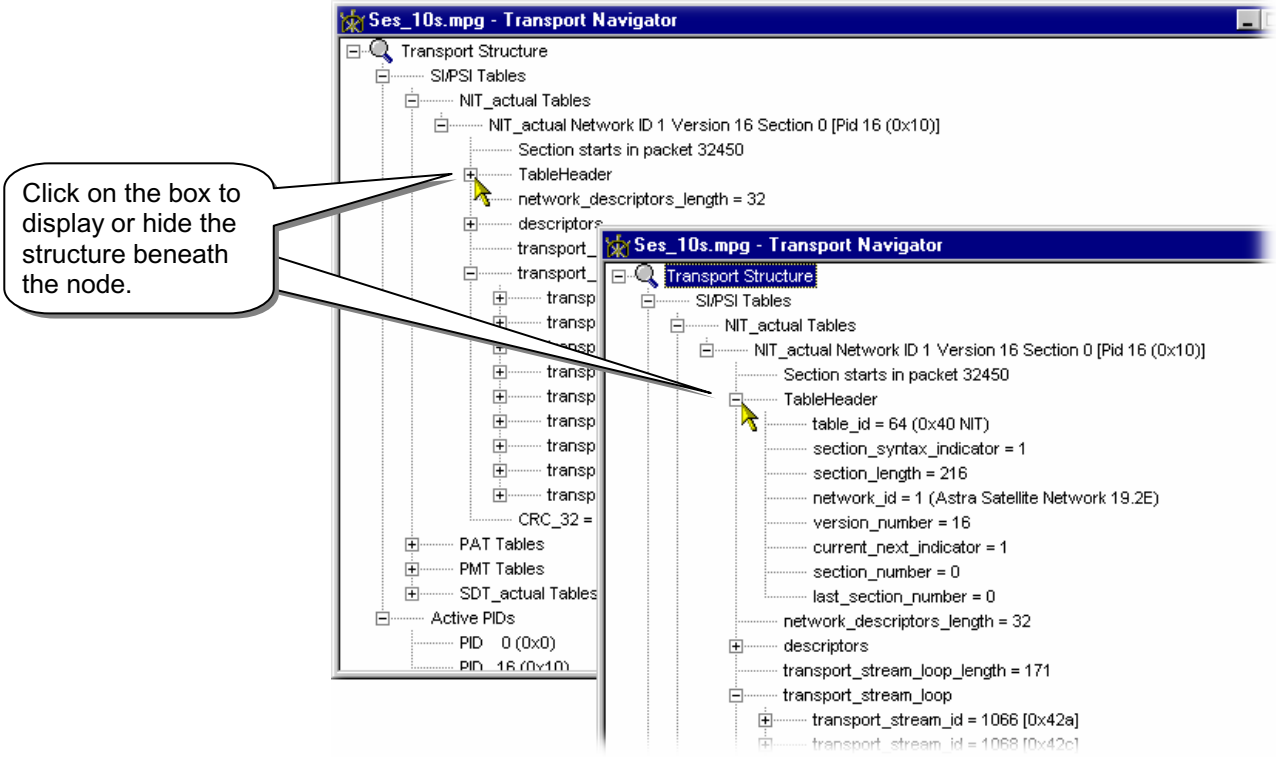
Where required, the Transport Navigator performs the following functions:

- Displays structure of the Service Information (SI/DVB) and Program Specific Information (PSI/MPEG) and Program and System Information Protocol (PSIP/ATSC) Tables, including their payload information.
- Lists all the Active Packet Identifiers (PID).
- Enables packet selection, via the Slider Bar, to be set to all packets or only those belonging to a particular PID or PID and table_id.

Transport Structure Diagram

The Transport Navigator is displayed by the program as soon as a file is opened. As the file is analysed the top levels of a structure diagram are drawn in the window:

The structure is represented by a tree diagram, with the 'root node' or highest level component at the top. Components which contain more information beneath them in the structure are indicated as a branch node by a square box.



If the branch node has a minus sign in the box the level of detail below it is displayed. The lower level(s) may be hidden by clicking the mouse pointer on the box.

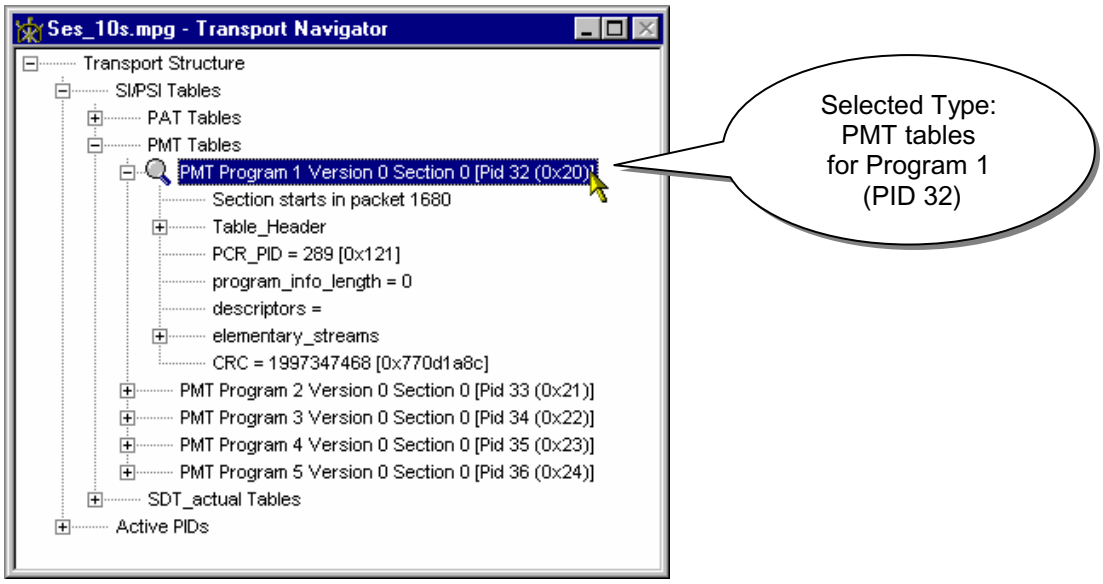
If the box contains a plus sign, there is another level contained by the node which is currently hidden. Click the mouse pointer on the box to display the next level of information under the node.

Components which are connected to a branch of the tree without a square box are leaf nodes. They display the lowest and finest level of detail.

Selecting a PID

The Transport Navigator displays Packet Identifiers (PID) as a positive decimal integer followed by the equivalent hexadecimal value in brackets (parenthesis). The PID is carried in a 13 bit field hence PID values range from **0 (0x0)** to **8191 (0x1FFF)**.

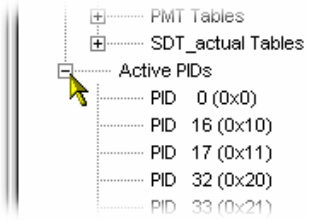
When a file is first opened and analysed any packet may be selected. The Slider Bar and Transport Navigator can be used together for restricting selection to packets with a particular PID and table_id. This is called PID and table_id filtering. A filter can be specified by clicking on any reference to a PID or table.

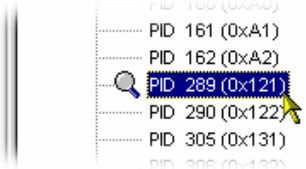


The magnifying glass symbol, , on the line indicates the selected PID and table_id.

To select a PID which does not hold table information or is not referred to in a table do the following:

Expand the **Active PIDs** branch of the Transport Structure. This gives a list of all the Packet Identifiers found in the file.

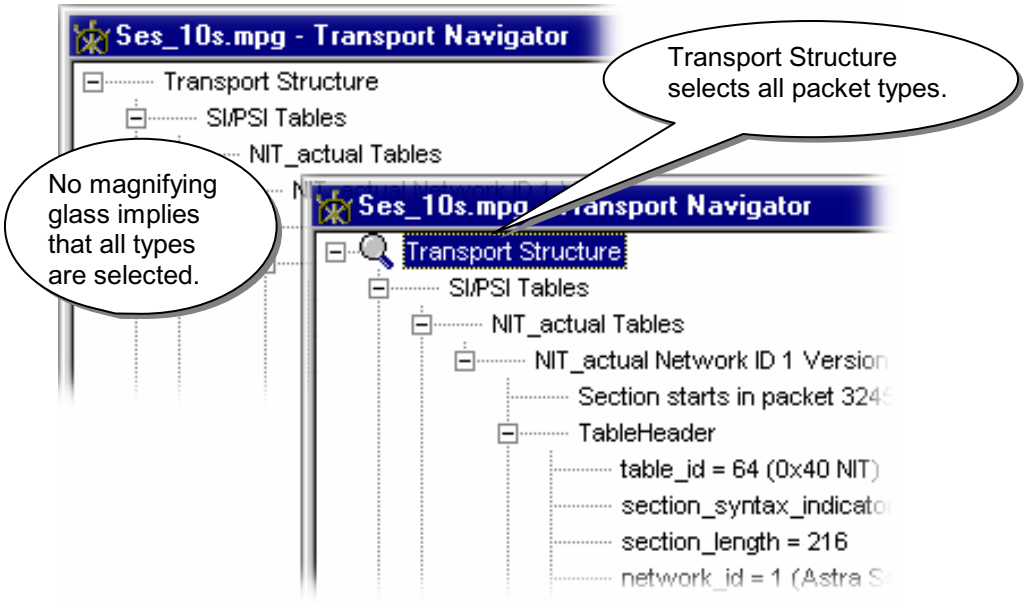




If the list is longer than can be contained in the visible area of the window a scroll bar will appear. Scroll down to find the required PID.

Select the line showing the PID number.

To disable the filter and allow any packet to be selected, click on **Transport Structure**, the root node. When the **Transport Structure** node is selected (or the magnifying glass symbol is hidden) the Slider Bar may select any packet.



Refer to the section on the Slider Bar for details of how to select packets once the PID selection is made.

Looking at the SI/PSI/PSIP Tables

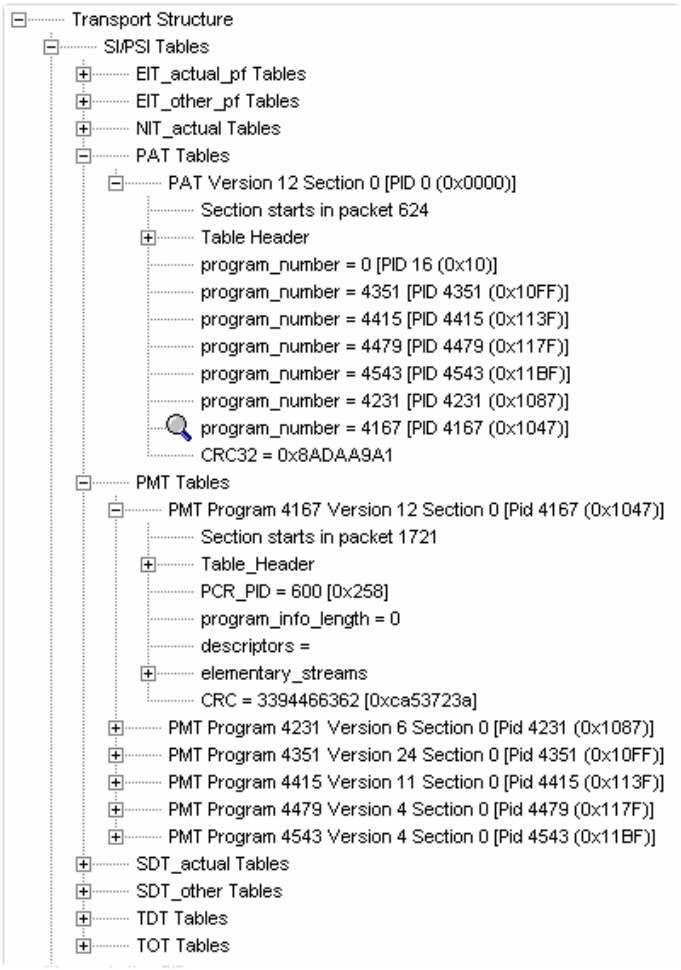
Table information is carried in the packet payloads. Each table section is carried in packets identified by a PID unique to that table.

For example:

The Program Association Table (PAT) is always held in packets of PID 0 (zero). The PAT contains information about which PIDs in the Transport Stream are carrying the Program Map Tables (PMT).

Under the Version and Section number the Transport Navigator identifies the first packet in the file holding the PAT section (**Section starts at…**).

For sections that do not have reserved PIDs (e.g. the PMT which is referenced by the PAT), **Section starts at…** does not identify the first packet of the first section in the file. Instead, it describes the first packet of the first section after the PID has been referenced.



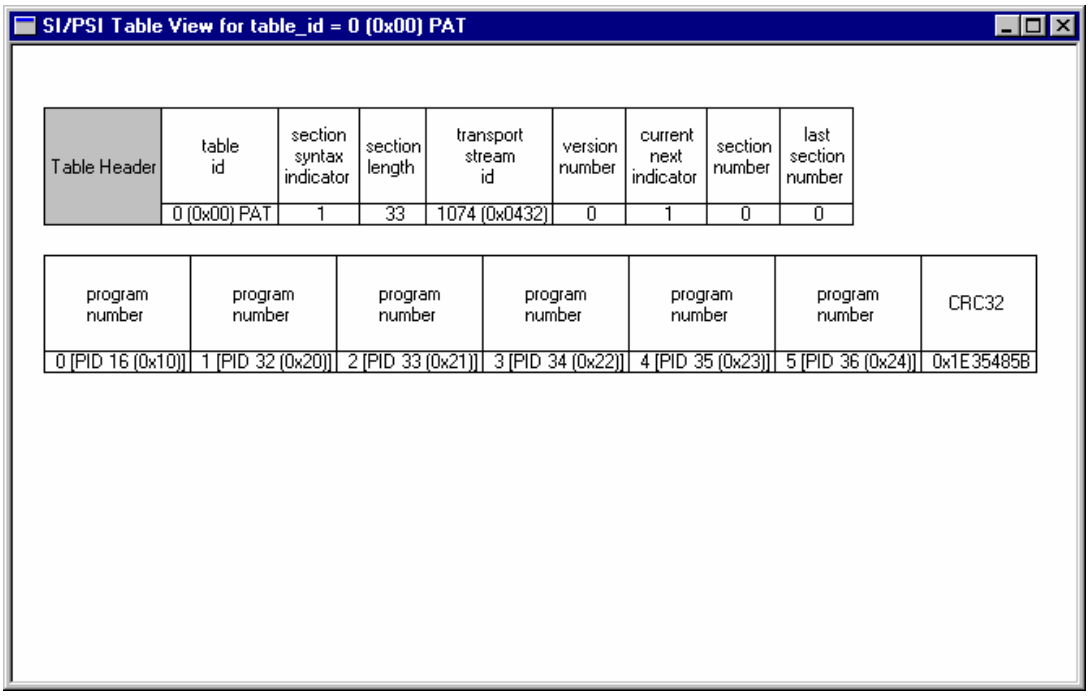
E.g. In the screenshot, the PMT for Program 4167 states **Section starts in packet 1721**. This (1721) is actually the first packet number of the section after PMT PID 4167 has been referenced by the PAT.

Some table sections are so large that their information is split across several packets. In these cases the transport navigator gives the number of the first packet of that section in the file with the **payload_unit_start_indicator** in the Transport Packet Header set.

Below this the program interprets and displays the contents of the section.

Table Structure

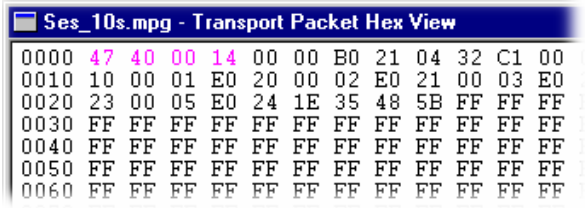
When a table section has been selected in the Transport Navigator, the SI/PSI Table Structure window may be opened. This displays the Table contents in an alternative format, as specified in the MPEG-2 standard *ISO/IEC 13818-1, Annex F*.



The above example shows a similar PAT to that displayed by the Transport Navigator in the previous section. The **section length** field in the Table Structure shows that, unless there is a large adaptation field, this table will fit in a single packet.

Looking at the Packets

Individual packets containing Table information can be examined using the Transport Packet Header and Hex View. This is the same PAT section as shown above. Looking at the first packet in the Hex View confirms that this section fits in a single packet:



Section length is held in this packet in the byte at address 0x0007, with a value of 0x21 (33 in decimal).

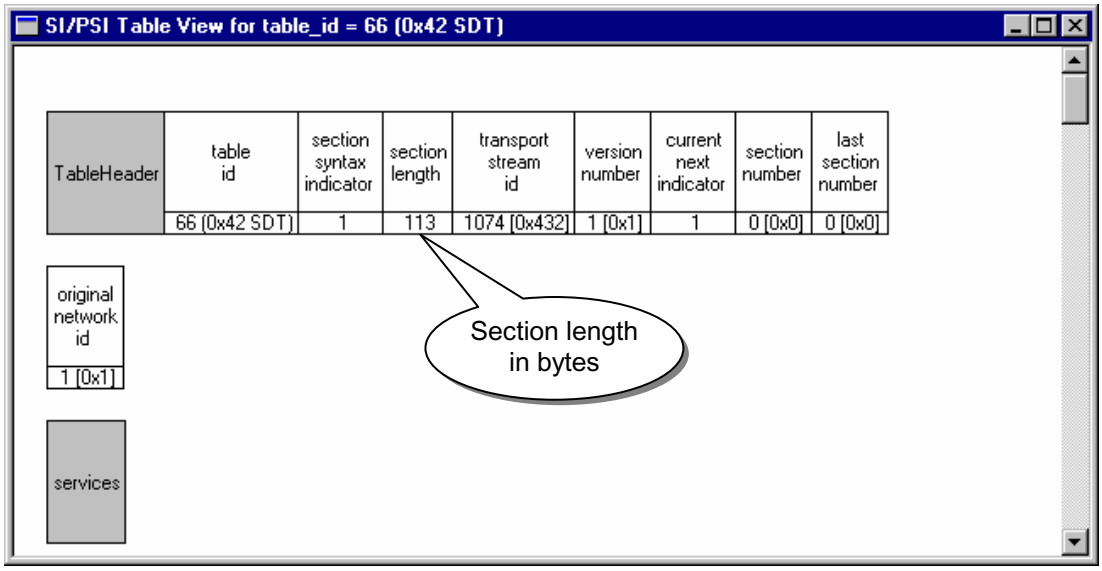
The last byte of table section information is at address 0x0028. From byte 0x002A to 0x00BC the packet has been filled with packet stuffing bytes of 0xFF.

The last 16 bytes contain the Reed Solomon data.

If in any doubt open the Transport Packet Header window to check for adaptation fields, as in the next example.

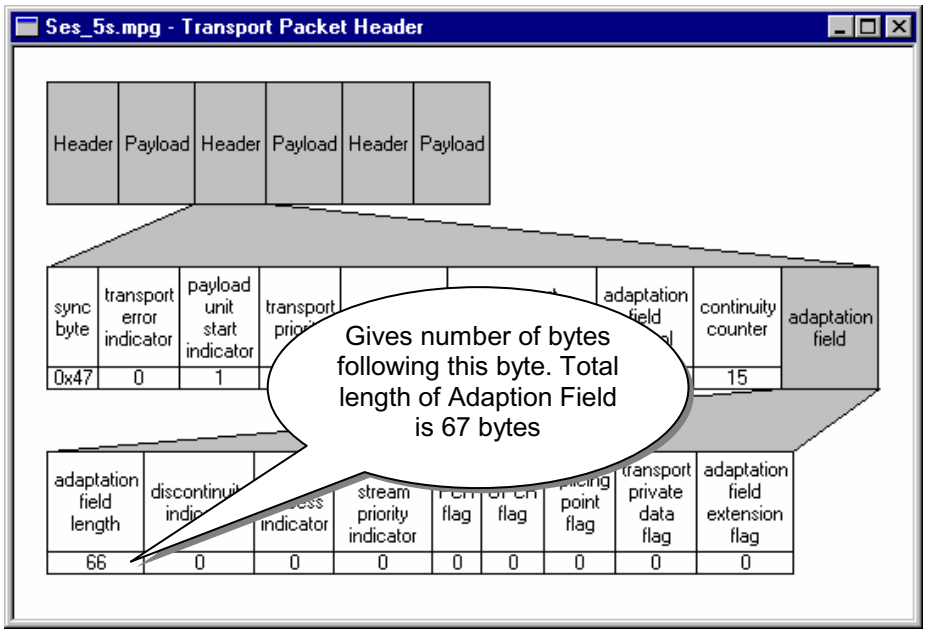
Packets with Adaptation Fields

Packets carrying table sections may also contain an adaptation field. Here is an example of a Service Description Table (SDT) section where an adaptation field and payload exactly fill one packet:



The Table Structure shows a section length of 113 bytes. This is the number of bytes after the **section length** field. So the total number of bytes in this payload is 117.

Opening the Transport Packet Header window shows an Adaptation Field of 67 bytes:



Adding these together with the 4 bytes of the Header gives a total of 188 bytes:

Header	4
Adaptation Field	67
Payload (Section length + 4 bytes)	+ 117
	188

If the transport stream consists of 204 byte packets the remaining 16 bytes contain the Reed Solomon data. This is how the packet looks in the Hex View:

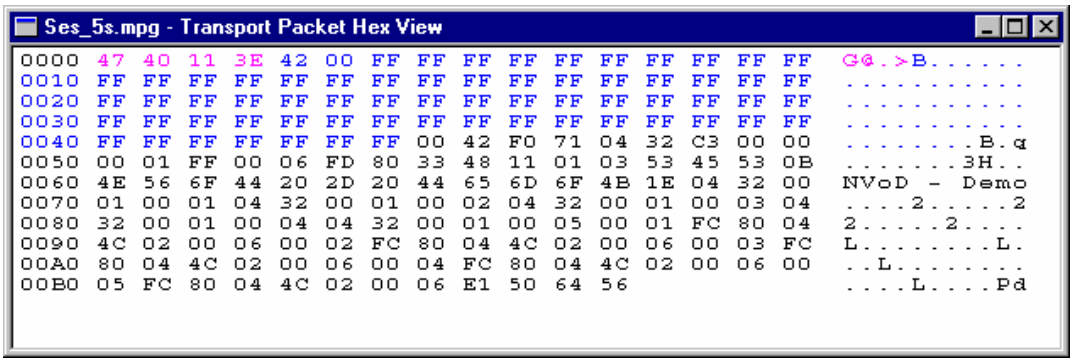
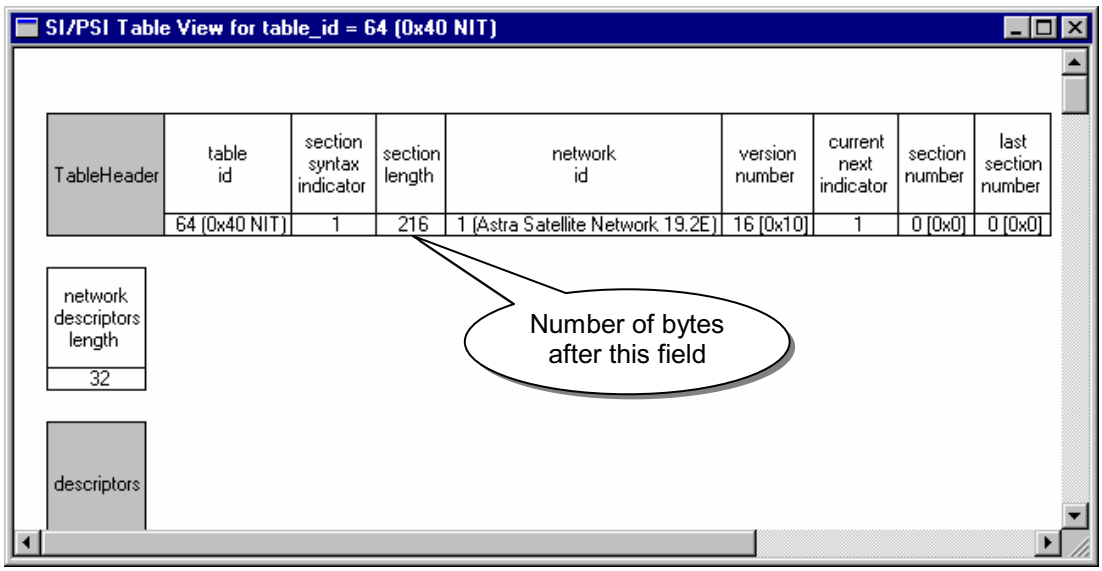
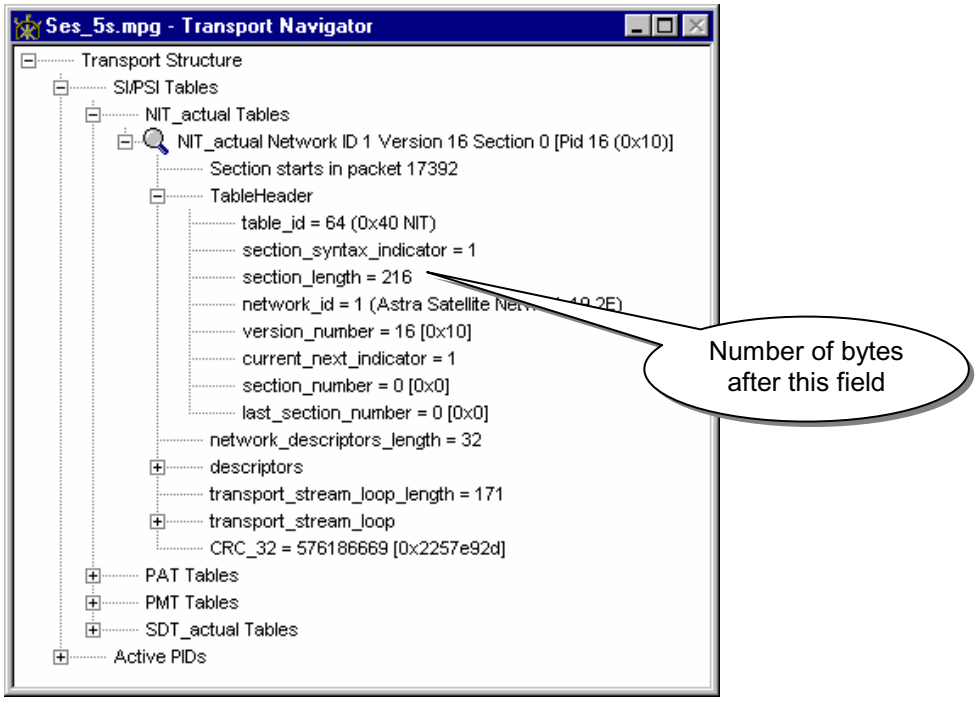


Table Sections spanning two or more packets

A table section may contain more information than can fit in a single packet. Without any space taken up by an adaptation field a packet has 184 bytes available to hold payload data. The section of the Network Information Table (NIT) in this example has a section length of 216 bytes:



The **section length** can be seen in the Transport Navigator as well as the Table View:

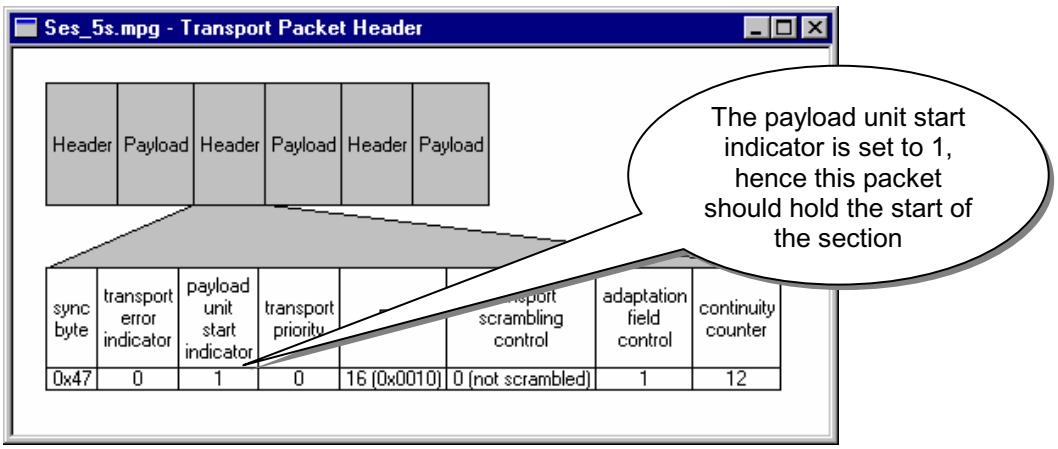


The payload for this NIT section consists of: 4 bytes of data up to and including the section length field, plus the 216 bytes following the section length field. A total of 220 bytes. This spans two packets as follows:

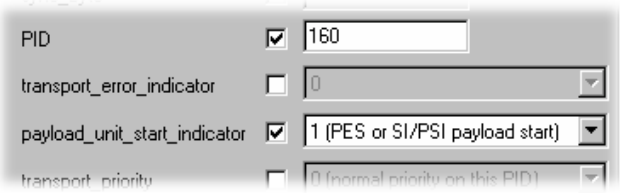
Packet carrying first byte of table section

Both Table Structure and Transport Navigator identify the first packet in the file which carries the start of the section. Selecting the Table in the Transport navigator automatically selects the first packet with a start of section. There may be one or more packets, preceding that, whose section start was prior to the start of file.

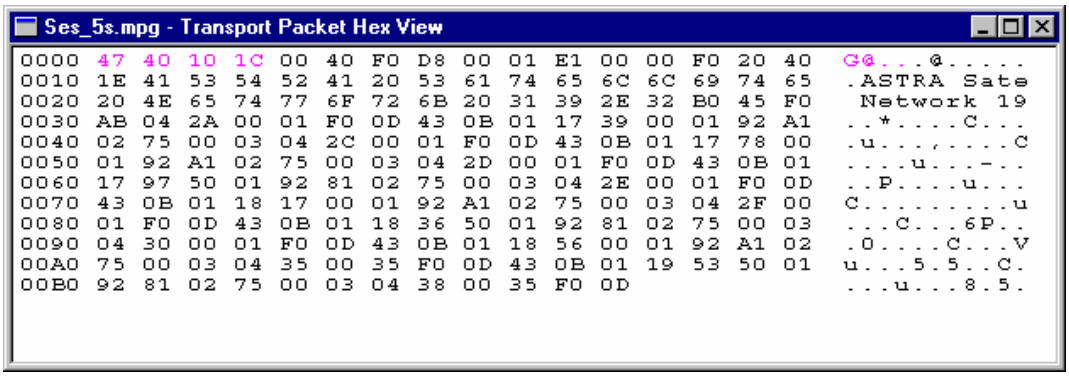
The Slider Bar will allow any packet of the chosen PID to be selected. The Transport Packet header will show if it carries the start of a packet. For example:



Alternatively, the **Find ➔ Transport Packet** menu option has facilities to search for packets by PID with a particular **payload_unit_start_indicator** value.



The Hex View shows that the packet is completely filled by the section contents. There are no packet stuffing bytes.

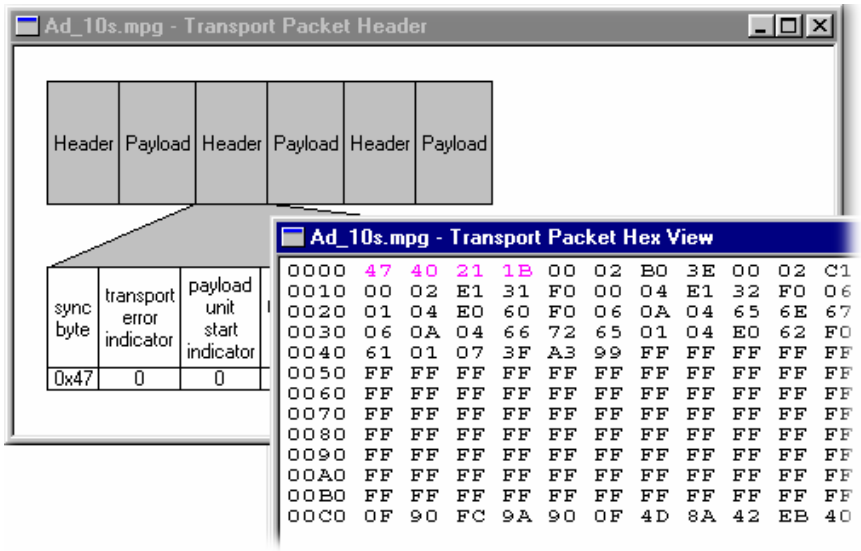


Subsequent Packet carrying PSI Table section

The next packet, which should contain the remaining 36 bytes of the table section, can be selected by either:

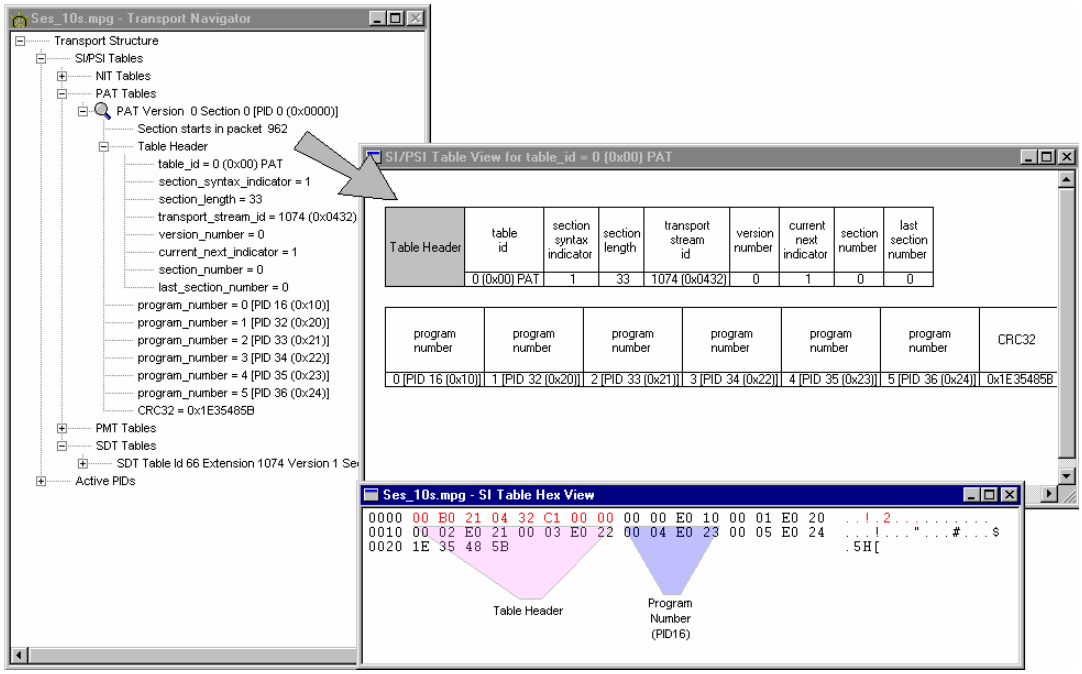
- Clicking on the Next packet button in the slider bar (providing that table section is still selected as the current PID in the Transport navigator)
- Using the **Find** -> **Transport Packet** menu option with the **payload_unit_start_indicator** parameter set to 0 (zero).

The second packet of the example NIT section looks like this in the Transport Packet Header and the Hex Views:



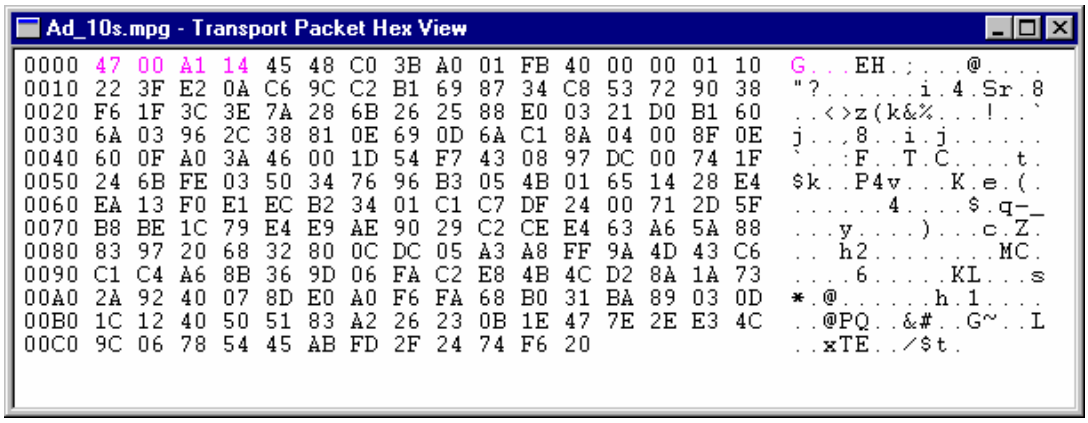
Looking at the Complete Table (Hex View)

The SI Table Hex view displays the complete table in hex format.

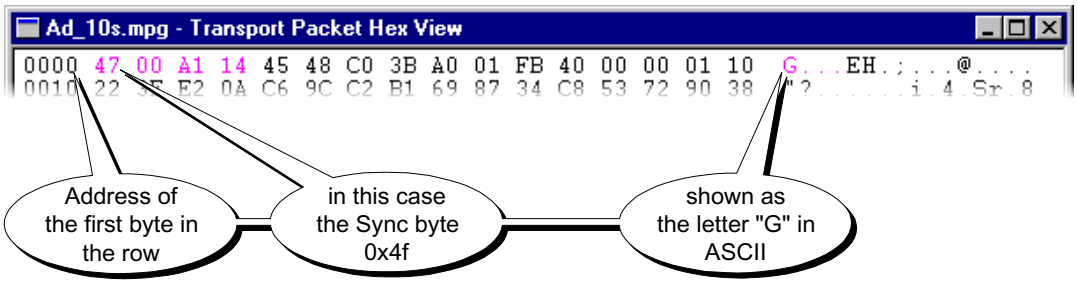


Transport Packet Hex View

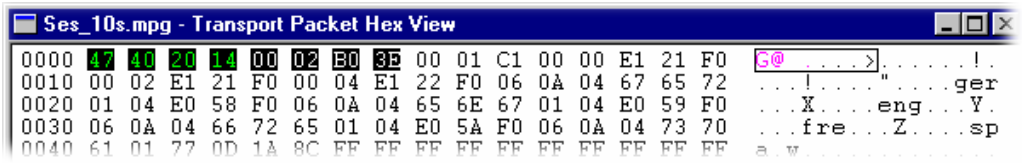
This is the lowest level view of the Transport Packet data. It shows the contents of each byte in hexadecimal on the left and ASCII characters on the right. The ASCII representation only shows characters for values in the range 0x20 (space) to 0x7e (tilde). All others are represented by a dot.



Each byte is represented as a pair of hexadecimal digits, in the hexadecimal representation and a single character in ASCII. The four digit numbers in the left most column are the addresses, also in hexadecimal, of the first byte of each row. Four example: the sync byte (value **47**) is first in the packet. It is at address 0x0000.



Note that by using the cursor to highlight a section of data, the corresponding data is highlighted in the hex or ASCII area.

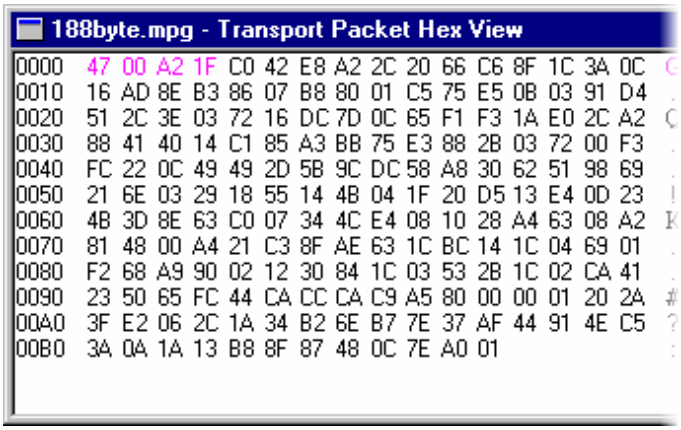


Packet Size

The packet size can be determined from the address of the last byte. 204 byte packets go up to address 0x00CC, but the last address of 188 byte packets is 0x00BC.

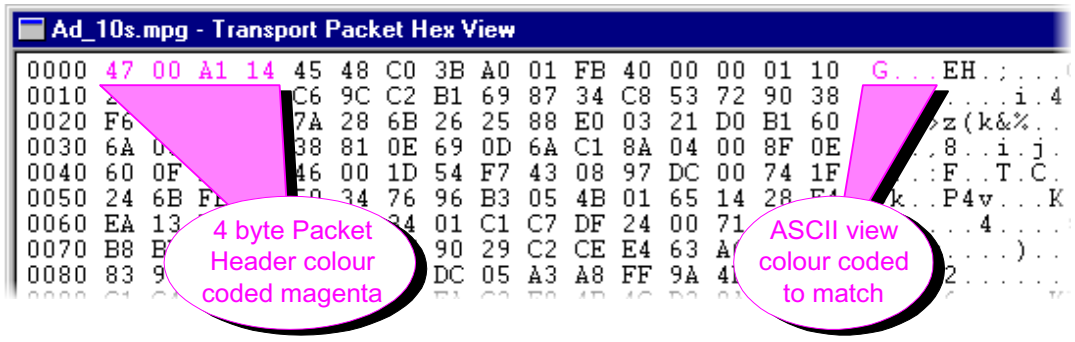
The previous examples are from a 204 byte packet stream.

This is an example from a 188 byte packet stream:



Packet Header

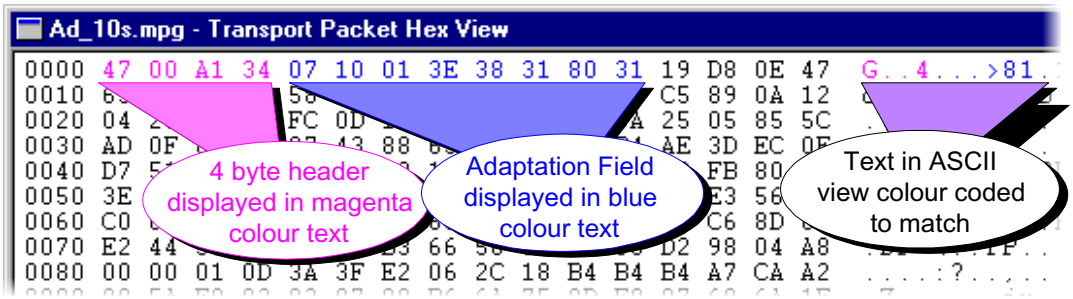
The first four bytes of the packet contain the Packet Header. The numbers in the Hex View and characters in the ASCII view are colored magenta to make the header stand out. The rest of the data, the payload, is displayed in black.



The Transport Stream Analyzer provides the Transport Packet Header view to interpret information held in headers and adaptation fields.

Adaptation Fields

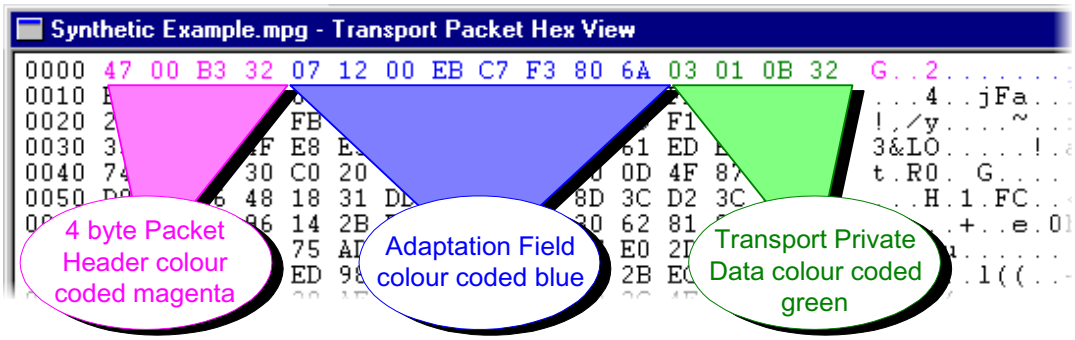
If the packet header has an adaptation field, the bytes are shown in blue. This is to make them stand out from the rest of the header and the payload data.



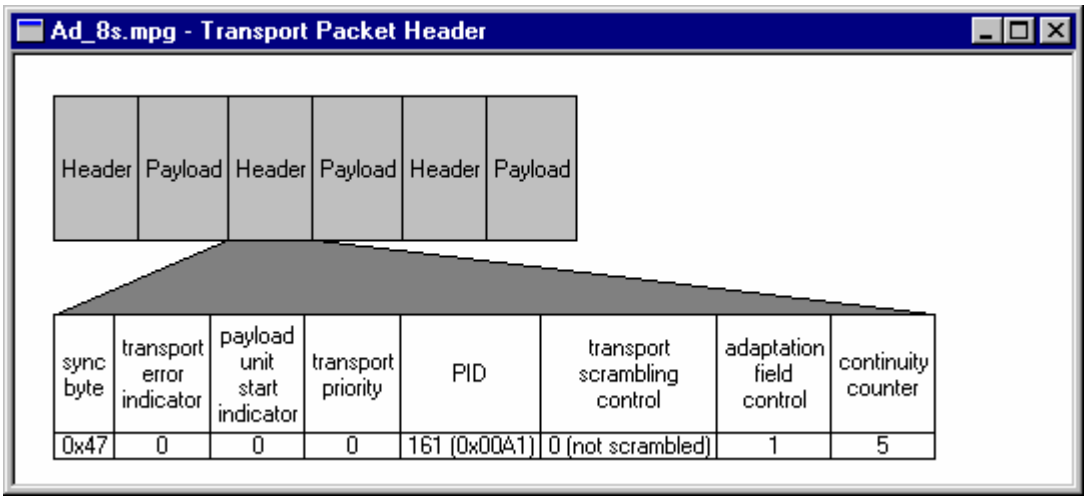
This particular packet belongs to an MPEG-2 video PID and contains a PCR adaptation field of 8 bytes. Adaptation fields can be much larger than this.

Transport Private Data

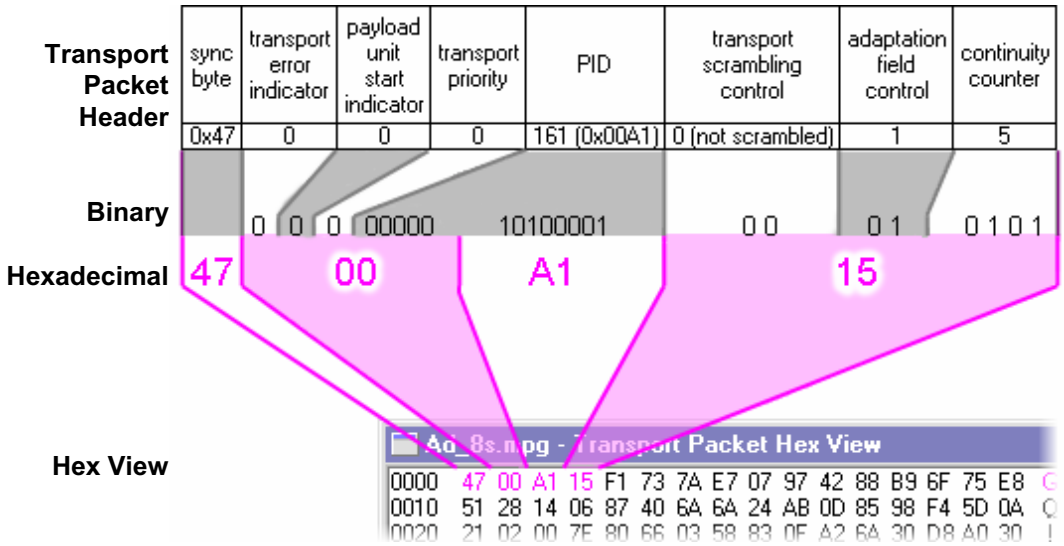
If transport private data is present it is color coded green in both the hexadecimal representation and ASCII view:



Transport Packet Header



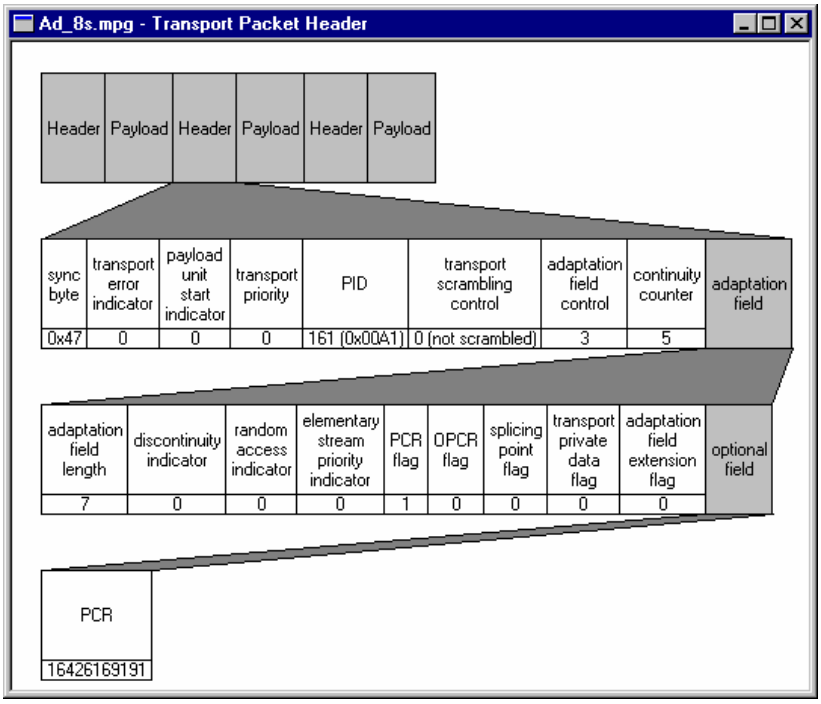
The Transport Packet Header view interprets and displays the header of the currently selected packet. The relationship of the information displayed to the Hex View and underlying binary data is shown in this diagram:



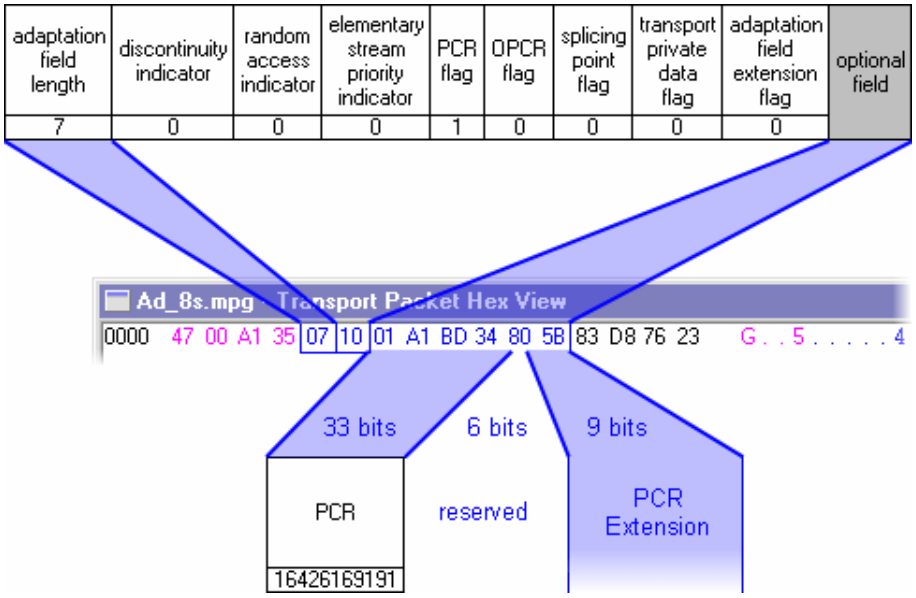
Adaptation Fields

If the packet contains an adaptation field the Transport Packet Header view will interpret and show information which is defined in the MPEG-2, DVB and ATSC standards. It will not interpret private data, whose format is not in the public domain.

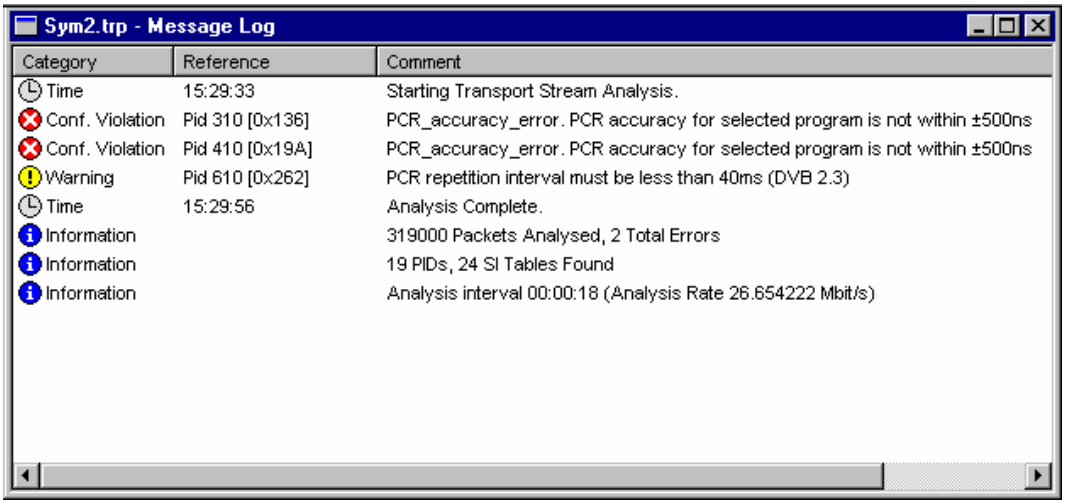
This is a Transport Packet Header view of an adaptation field containing a Program Clock Reference (PCR):



and this is the mapping between Transport Packet Header and Hex Views:



Message Log



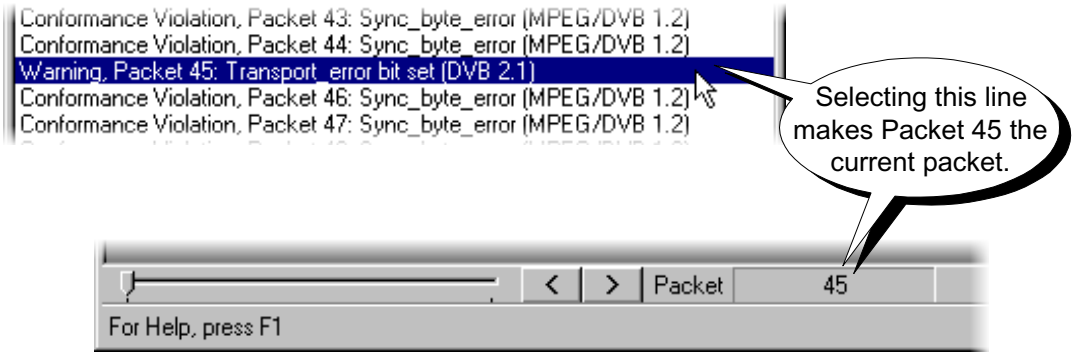
The program always displays the Message Log window when it opens a file. As the file is analysed the program reports the results, listing errors and warnings, in this window. Once analysis is complete, a summary is appended to the report.

The following icons are used to indicate the activity logged:

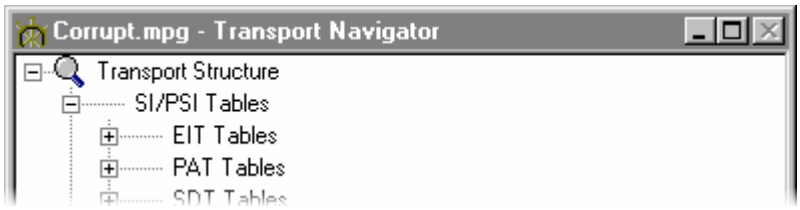
	Information	Indicates processing activity.
	Time	Indicates the time of an activity.
	Warning	Provides information about low severity events.
	Error	Provides information about high severity events and conformance violations.

Packet Selection

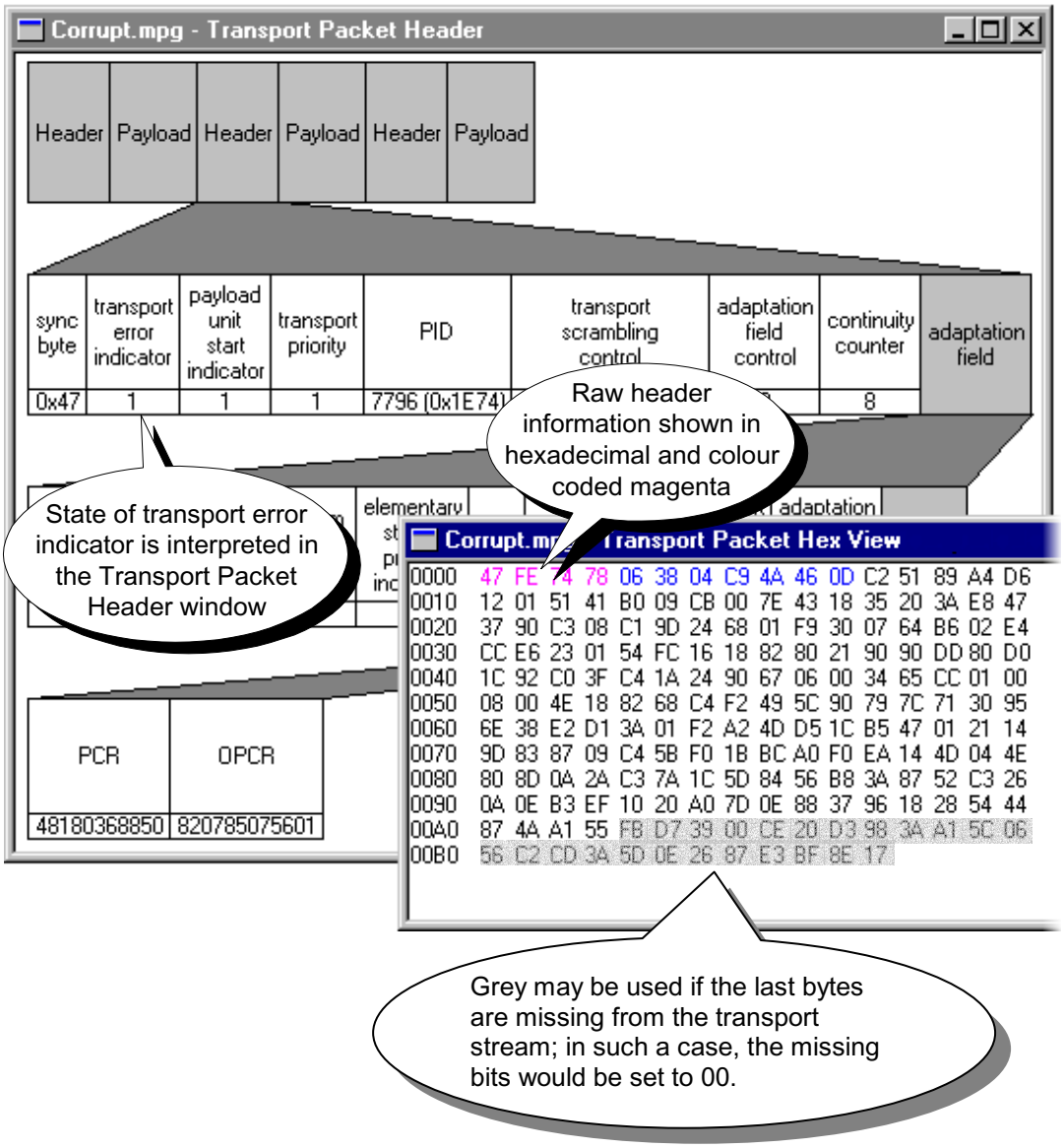
If a warning or error message gives a packet number, that packet may be inspected by selecting the message. For example, here is an extract from a Message Log which contains reports of errors and warnings, i.e. a series of conformance violations for packets 43, 44, 46,47 and a warning for Packet 45:



Any PID selection in the Transport navigator will be reset to allow all PIDs to be accessed. The magnifying glass icon will appear on the **Transport Structure** at the top level of the structure diagram:



Having selected the packet it can now be inspected with other tools, such as, the Transport Packet Header and Hex View.



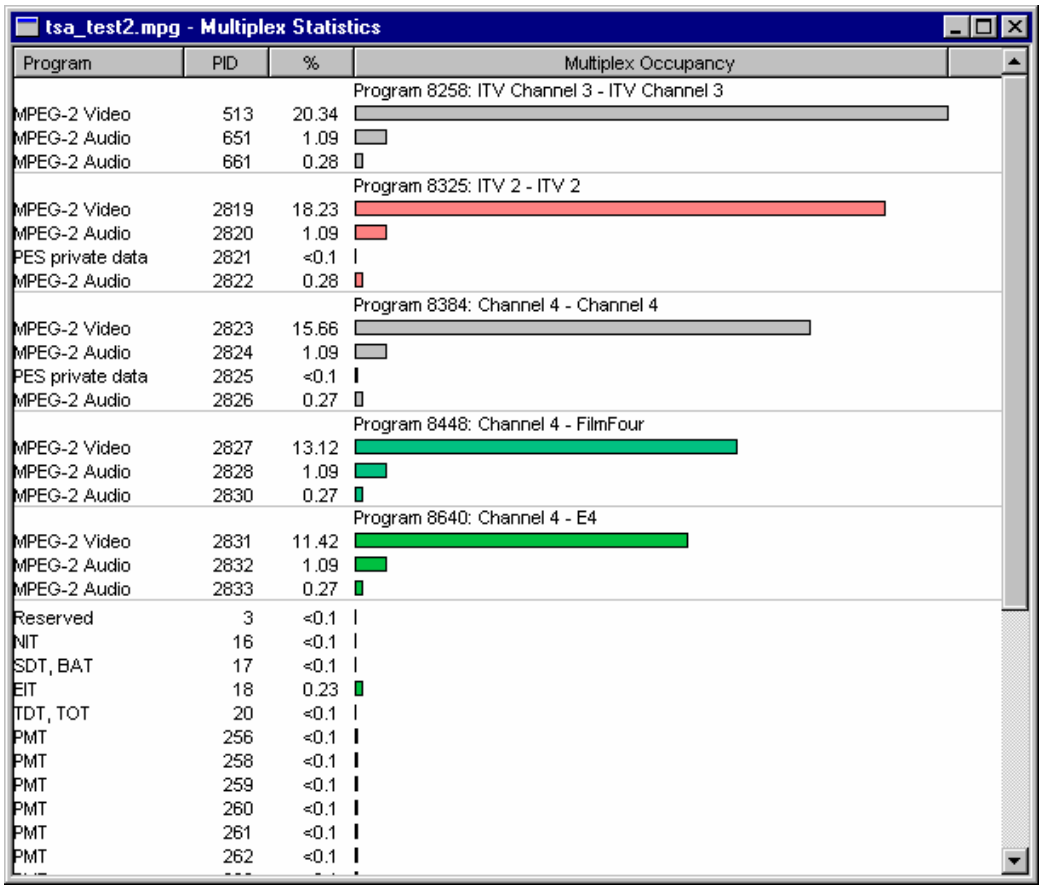
Multiplex Statistics

Two views of the multiplex statistics are available. Each view shows essentially the same information, one as a histogram, the other as a pie chart. They show what proportion of the Transport Stream is taken up by each PID, across the entire file. There are various display options available in the histogram view.

Histogram View

Program View

When Transport Stream Analyzer is first started Program View is selected by default. This displays the PIDs listed in program number order, then by PID number within each program. The tables and non-program PIDs follow the programs in the list.



If there are more PIDs than can be displayed a scroll bar will appear on the right hand side of the window.

From left to right the columns displayed in Program View are:

Program For program streams this displays the program number and type of data carried by each PID. The data types are:

Video PID carries packets of video

Audio PID carries packets of audio

AC3 Audio PID carries packet of ATSC compressed audio

Priv PID carries Private data

UPriv PID carries User Private data

For non-program PIDs a name or mnemonic is given if it can be determined from the relevant tables. Any PID carrying unrecognised data type is left blank.

PID Shows the PID number which each row of the table applies to.

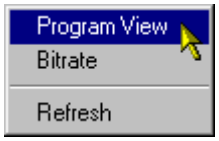
% or **Mbits/s** Displays the current occupancy of each PID relative to the other PIDs as a value. The selected units of measurement, **%** or **Mbits/s**, is displayed in the column title.

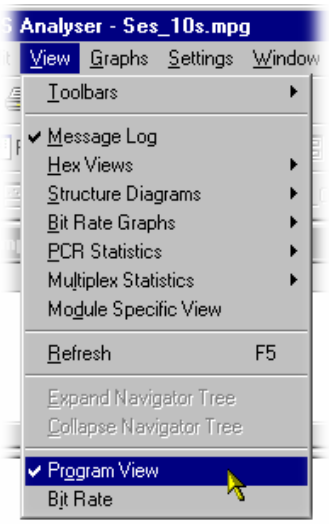
Use the **Bitrate** option from the pop-up Menu to toggle between the **%** and **Mbits/s** display.

Multiplex Occupancy Shows the current occupancy of each PID relative to the other PIDs as a bar chart.

Selecting Program View

To switch to Program View, if it is not currently selected, click on the **Program View** option from either the right-click menu (right) or from the **View** menu (below):



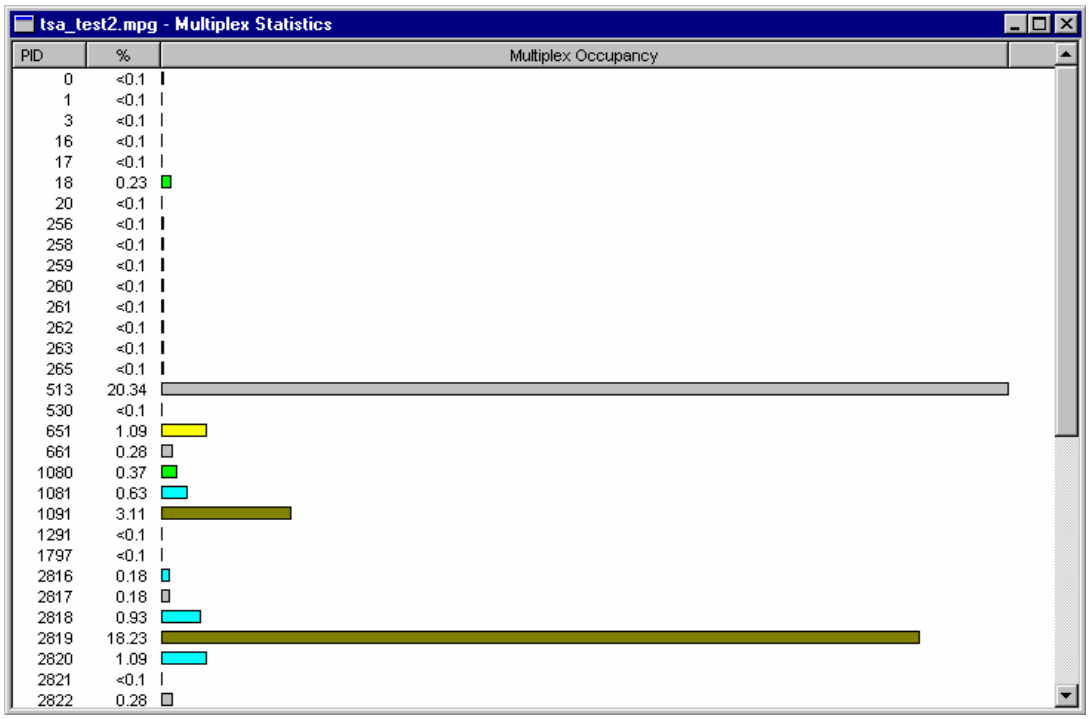


(A check mark ✓ appears next to the option when **Program View** is selected. No check mark indicates that PID View is selected.)

PID View

The PID View displays the PIDs, in PID number order, without program numbers or types. To select PID view, uncheck the **Program View** option in either the **View** or right-click menus.

Using the same file as for the previous Program View example, the PID View is:



From left to right the columns displayed in Program View are:

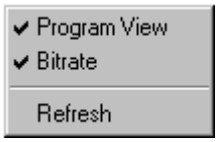
PID Shows the PID number to which each row of the table applies.

% or **Mbits/s** Displays the current occupancy of each PID relative to the other PIDs as a value. The selected units of measurement, **%** or **Mbits/s**, is displayed in the column title.

Multiplex Occupancy Shows occupancy of each PID relative to the others as a bar chart.

Right-Click Menu

This menu provides display options and a refresh command. Position the cursor anywhere inside the window and click the right mouse button to display the menu.



(A check mark, ✓, indicates that the display option is currently enabled.)

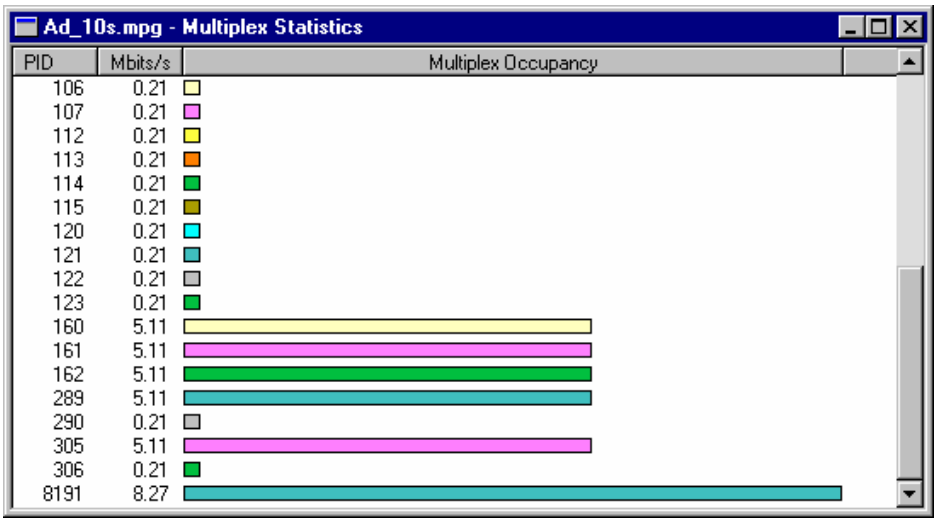
Program View Selects Program or PID view. (A check mark, ✓, indicates that Program View is selected. No check mark, ✓, means that PID view is displayed.)

Bitrate Toggle the **%** or **Mbits/s** column between displaying values as a percentage or bit rate. (A check mark, ✓, indicates that the values are given as a bit rate. No check mark, ✓, means that they are shown as a percentage.)

Refresh If a stream is still being analysed this option refreshes the display to show the latest results. Once analysis is complete, and the final results are displayed, this option has no further effect.

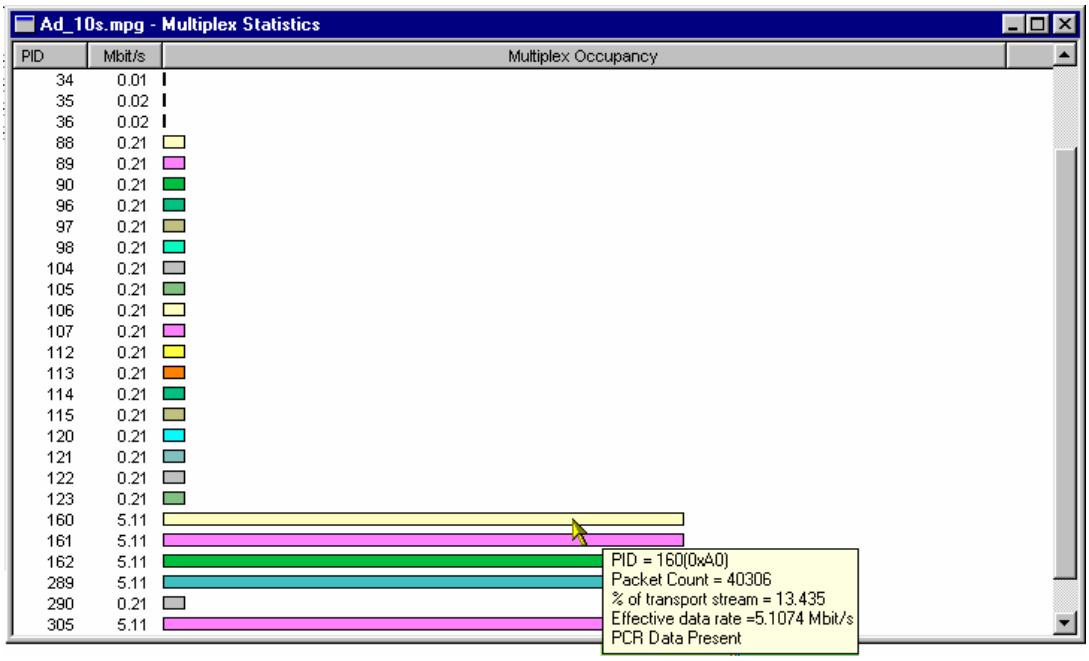
Bitrate Display

When the Bitrate option is selected from the right-click menu the **%** or **Mbits/s** column displays the occupancy figures in Mbit/s. For example:



Double Clicking for Additional Information

Once the analysis of the file is complete some more information can be displayed by double clicking on the bar or text for a PID. This causes the program to display a pop-up window showing additional information. Single or double clicking the mouse elsewhere removes the pop-up window.

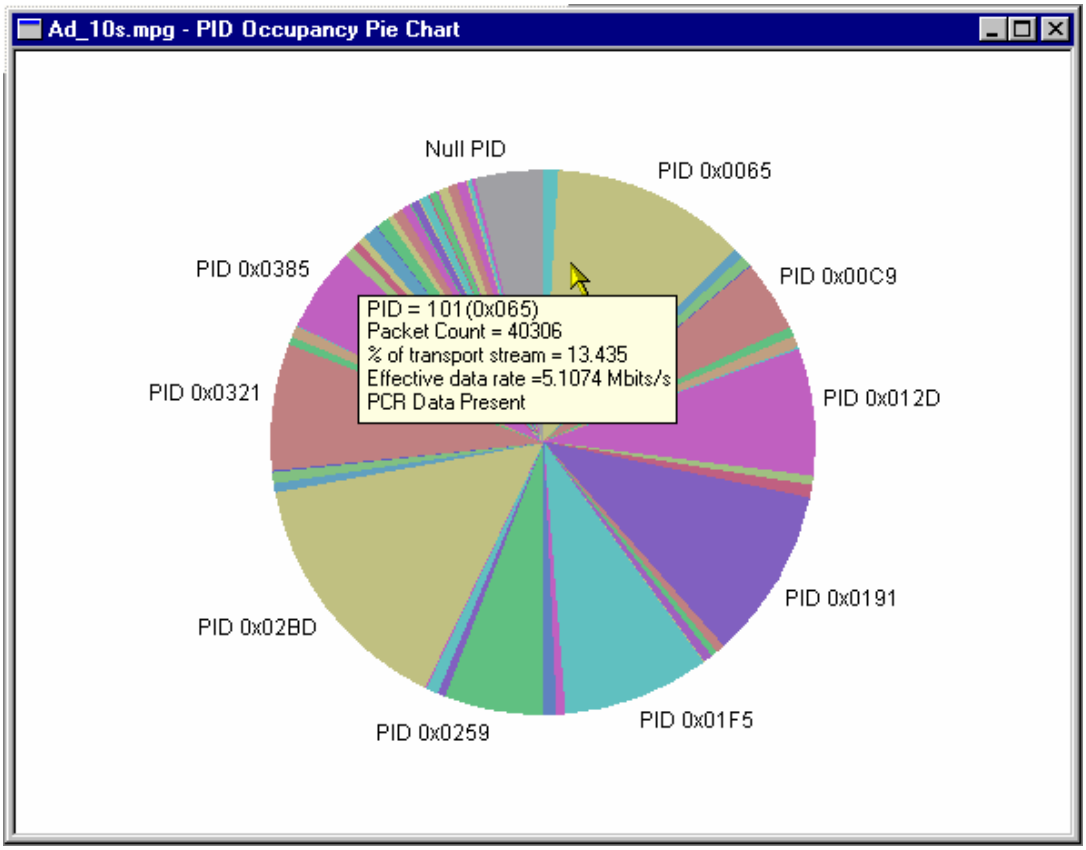


Double clicking provides the same information in both the Program View and PID View.

Pie Chart View

This Multiplex Statistics window displays a pie chart that shows what proportion of the Transport Stream is taken up by each PID, across the entire file.

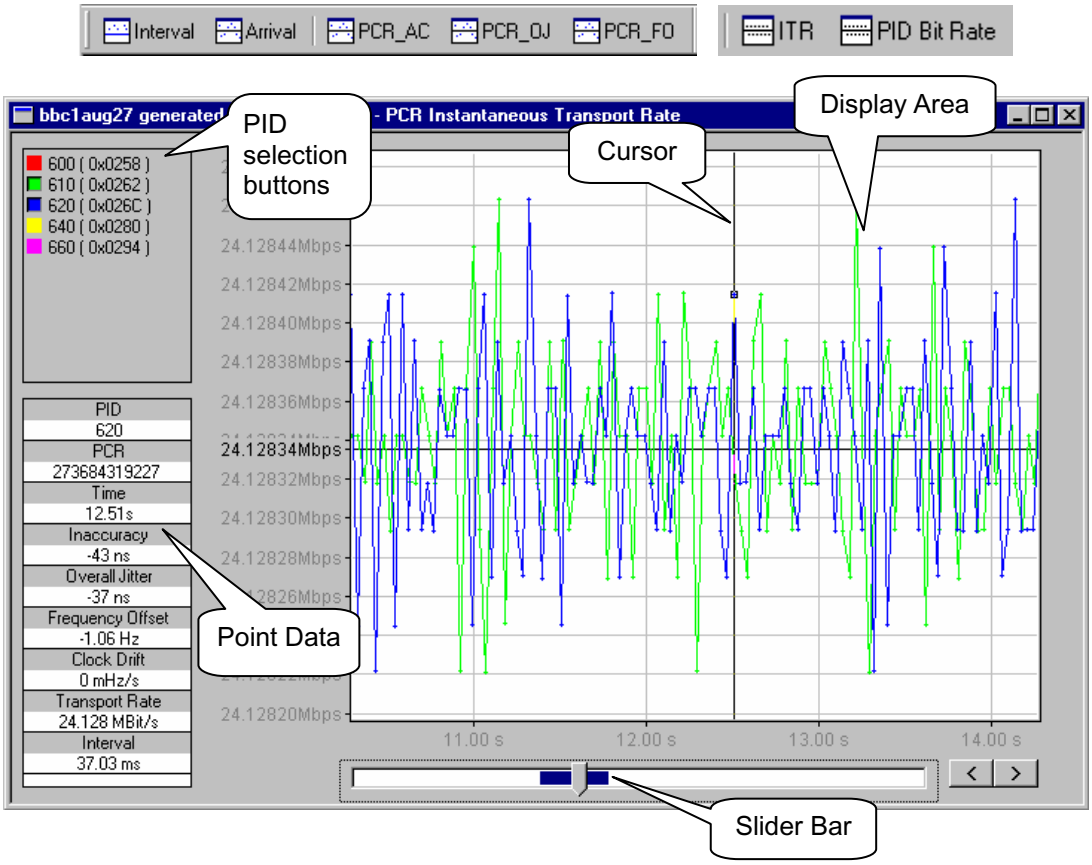
More information can be displayed by double-clicking a section of the pie chart. This causes the program to display a pop-up window showing additional information for that PID. The information displayed is the same as that shown in the histogram view.



Graphing Features

The Transport Stream Analyzer program checks the Program Clock References (PCR) for conformance to the DVB, ATSC and MPEG-2 standards. It analyses the timing of the PCRs and displays interpretations of these results using the PCR Statistics Graphs.

There are two sets of graphs: PCR Statistics and Bit Rate. All graphs have a similar format and controls. The common features are as follows:



PID Selection Buttons

Down the left hand side of the window are one or more buttons for selecting which PIDs to plot on the graph. In the above example there are 5, of which PID 610 and PID 620 are displayed in the graph.

Display Area

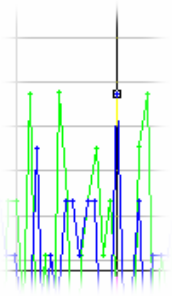
All points are color coded to match the color of their selection button, i.e. the points for PID 610 are colored the same blue as the top of the PID 610 button.

Cursor

The cursor indicates the point to which the current data applies.

Note the crosshair box at the actual data point.

(See also Slider Bar below.)



Horizontal (Time) Axis

The horizontal axis of the graph represents time, as related to the position of the packet within the file. The file starts at the left-hand side and finishes at the right.

Vertical Axis

The vertical axis is specific to each type of graph. The scale may be recalibrated when a PID is added to the graph (button selected) or removed (button deselected).

Point Data

The data associated with a selected point is displayed in the Point Data table. The point can be selected by clicking the cursor over the required point or by using the Slider Bar.

PID
610
PCR
1237372096100
Time
12.18s
Inaccuracy
81 ns
Overall Jitter
97 ns
Frequency Offset
-1.06 Hz
Clock Drift
0 mHz/s
Transport Rate
24.128 MBit/s
Interval
37.15 ms

PCR Statistics Point Data Table

PID
18 (0x0012)
Packet
210161
Time
13.10 s
Bit Rate
70.688kbps

Bitrate Point Data Table

Note that not all values are relevant to all of the graphs described in the following pages. Where not relevant, the value will be marked as 'not applicable' or the field will not be displayed.

Zoom Controls

Zoom in
Zoom out

For each press of a plus or minus Zoom button, the x axis is scaled by approximately ±50%.

PCR Synchronise

Sync

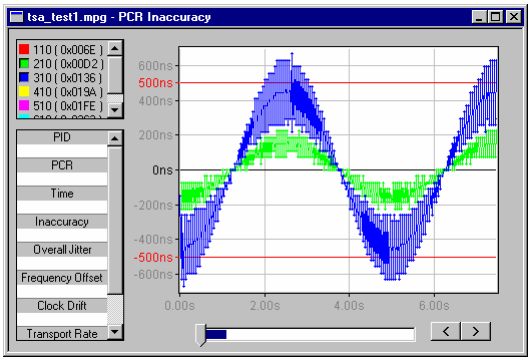
When enabled, this function automatically synchronises all displayed PCR and bitrate graphs in terms of displayed PIDs, cursor position and zoom level. The values are taken from the active PCR and applied to all open PCR and bitrate graphs.

Plot Format

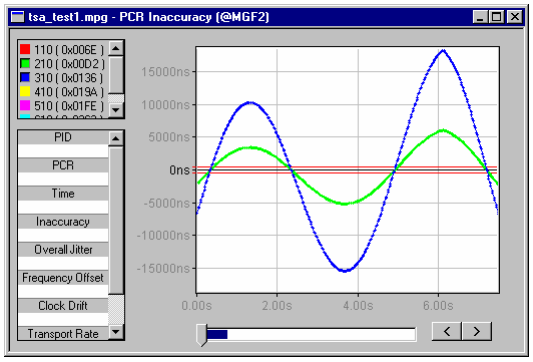
The points on the PCR_AC, PCR_OJ and Arrival Time Jitter PCR graphs can be plotted using one of two measurement methods: Previous Point Differential and Line Fit Differential. The technical aspects of these methods are described in an on-line Technical note accompanying this User Guide.

The plot method is selected via the **Graphs** menu.

As a guide, the two illustrations below show the same section of a file in the PCR Inaccuracy graph using the **Previous Point Differential** and **Line Fit Differential** (default) methods respectively.



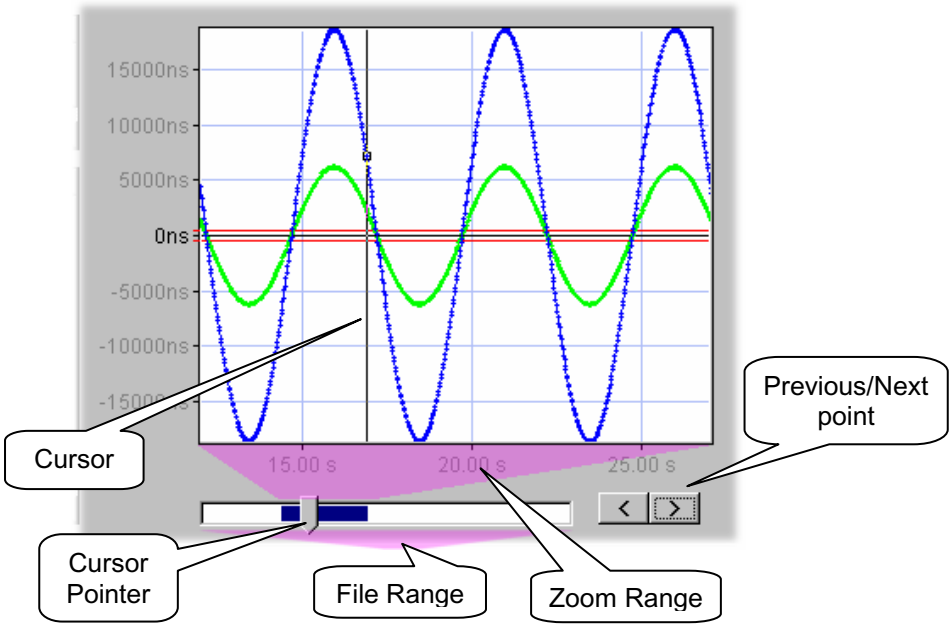
Previous Point Differential



Line Fit Differential

Slider Bar

The Slider Bar represents the position of the currently selected point in the file, the section of the file currently displayed and allows the selection to be changed.



The whole bar represents the whole file or File Range. The black section of the bar, the Zoom Range, represents the displayed section; this will change according to the zoom selection.

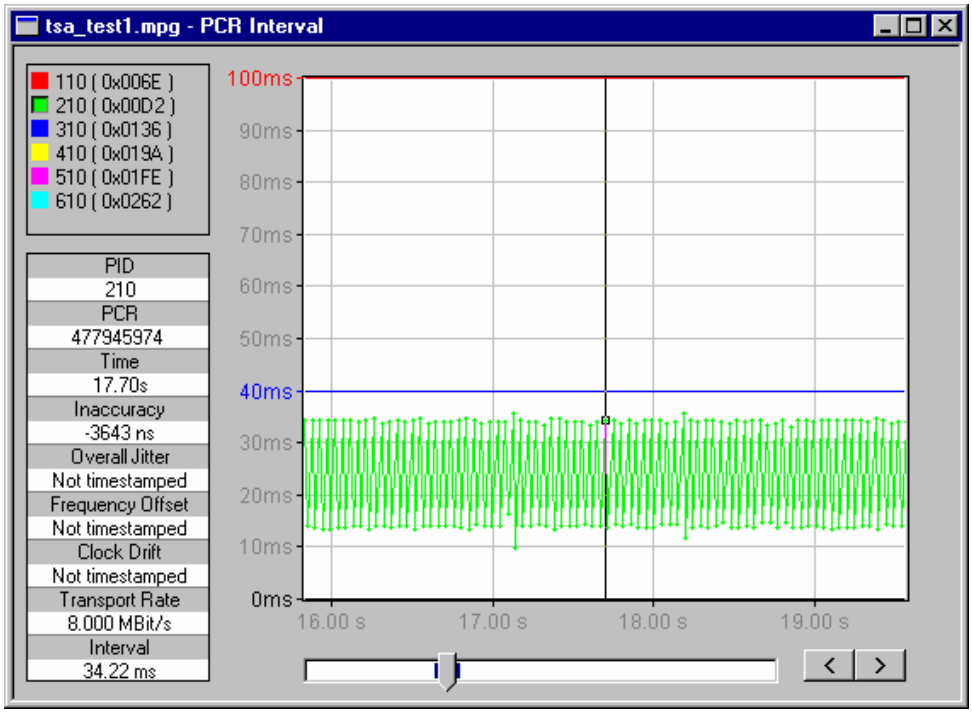
The Cursor Pointer indicates the position of the cursor in the file/zoom range. The cursor can be moved in the following ways:

- Click the mouse pointer in the display area. The Cursor will move to the nearest point and details will be shown in the Data table. The Slider Bar will also reflect the change of position.
- Use the mouse pointer to drag and drop the Cursor Pointer in the Slider Bar. If the pointer is dragged outside the current Zoom Range, the Zoom Range (and hence the display) will be moved to centre the cursor in the display area.
- Click the mouse pointer to the left or right of the Cursor Pointer.
- Use the Previous/Next point buttons. Each press of a button will move the Cursor to the previous/next point of the currently selected PID.

PCR Statistics Graphs

PCR Interval

Interval This graph provides a display of the time interval between successive PCRs. The interval is displayed on the y-axis. By default the y-axis scale shows the conformance thresholds for the DVB, ATSC or MPEG-2 standards.



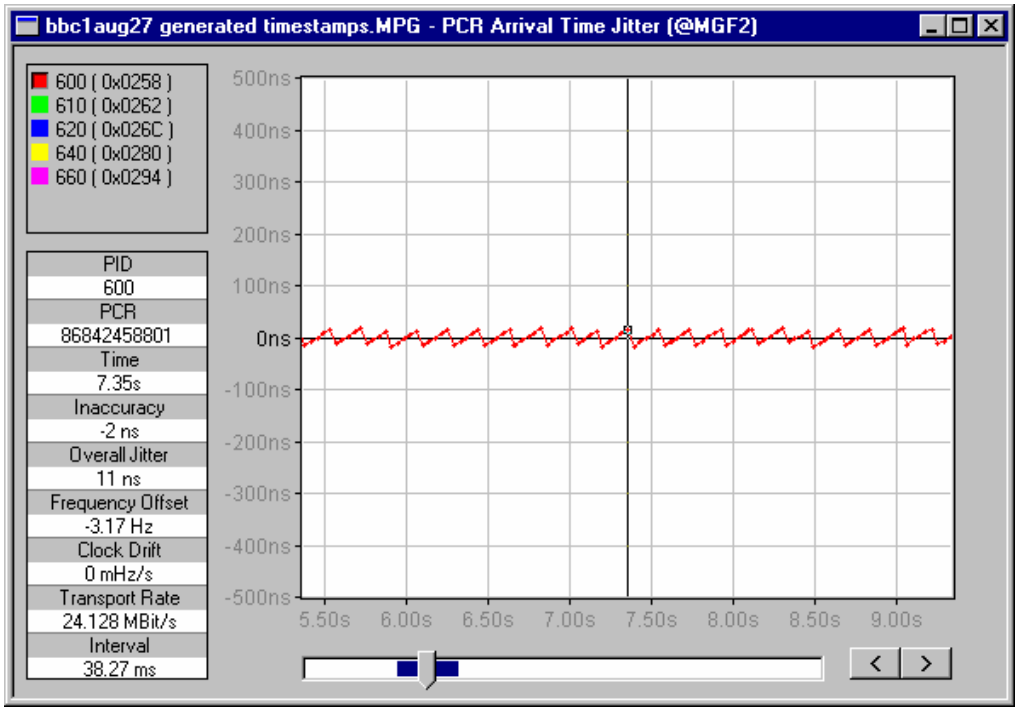
To conform to MPEG-2 the interval must be within 100ms. For conformance to DVB or ATSC the interval must be within 40ms. If the interval exceeds the 100ms threshold, the y-axis scale will be adjusted accordingly.

Arrival Time Jitter (Arrival)

Arrival (Also known as Network Jitter.) This graph displays the time interval between the actual arrival time of a PCR packet and its expected arrival time based on its byte index.

The actual arrival time is calculated using time stamping information appended to each packet when a transport stream is recorded with the Player application with Time-Stamping active. Note that the ASI+TS card must be fitted for the time-stamping feature to be available. Only time-stamped streams can be graphed in this way.

Arrival Time Jitter = PCR_OJ - PCR_AC

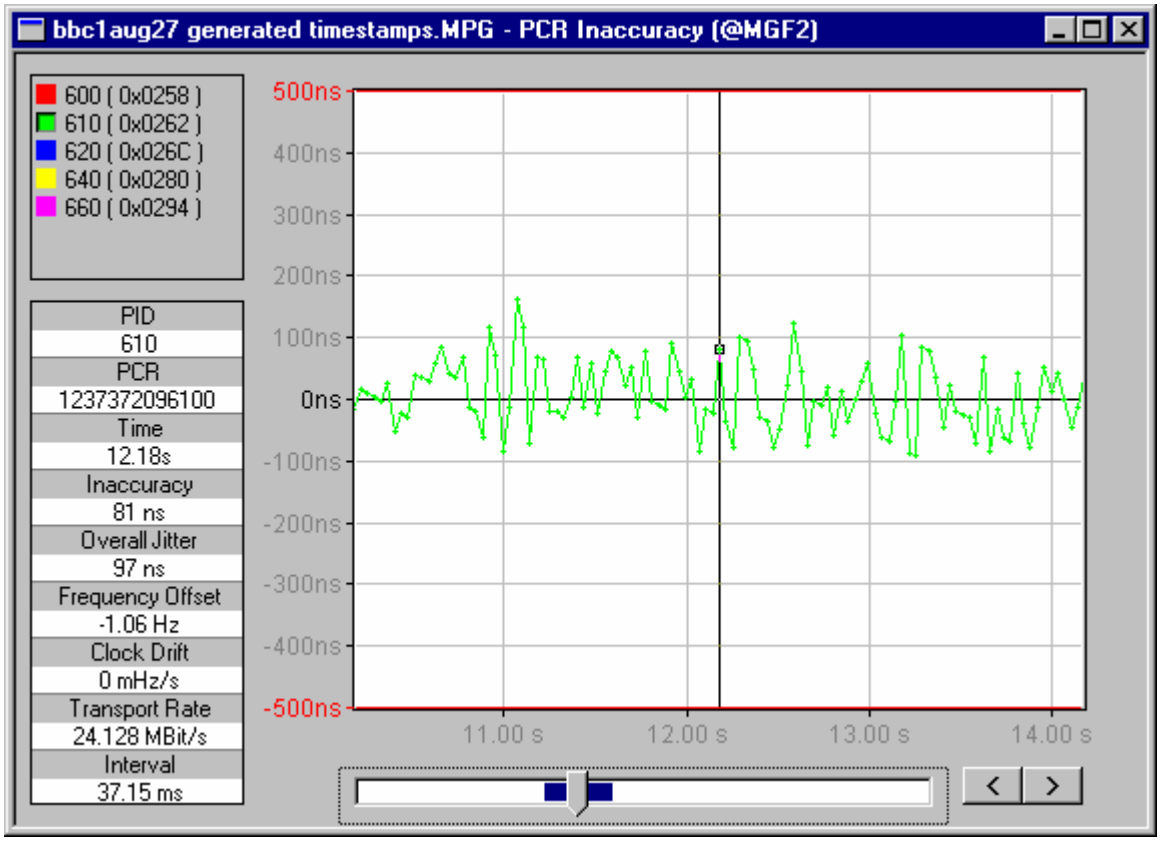


(For more information about Arrival Time Jitter, refer to Appendix I of Reference [1].)

Inaccuracy (PCR-AC)

PCR_AC The Inaccuracy graph shows the difference between the actual and expected values for each PCR on the y-axis. Expected PCR values are calculated from the byte index of the PCR.

PCR_AC = PCR_OJ - Arrival Time Jitter



The MPEG-2, DVB and ATSC standards specify that PCRs must be within ±500ns of the actual transport rate. By default the scale is set to ±500ns. If the Inaccuracy in any of the displayed PIDs is greater than ±500ns, the y-axis is drawn to show the complete range of values as full scale.

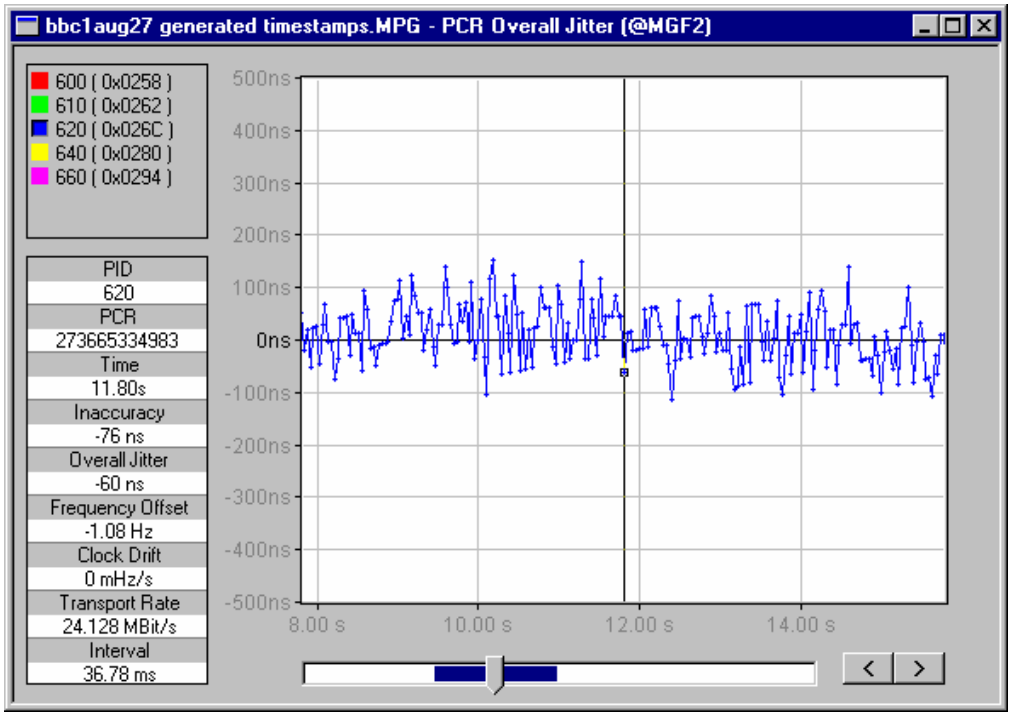
(For more information about PCR_AC, refer to Section 5.3.2.6 and Appendix I of Reference [1].)

Overall Jitter (PCR-OJ)

PCR_OJ The Overall Jitter graph shows the time interval between the actual value of the PCR and its expected value based on its arrival time.

The actual arrival time is calculated using time stamping information appended to each packet when a transport stream is recorded with the Player application with Time-Stamping active. Note that the ASI+TS card must be fitted for the time-stamping feature to be available. Only time-stamped streams can be graphed in this way.

PCR_OJ = PCR_AC + Arrival Time Jitter



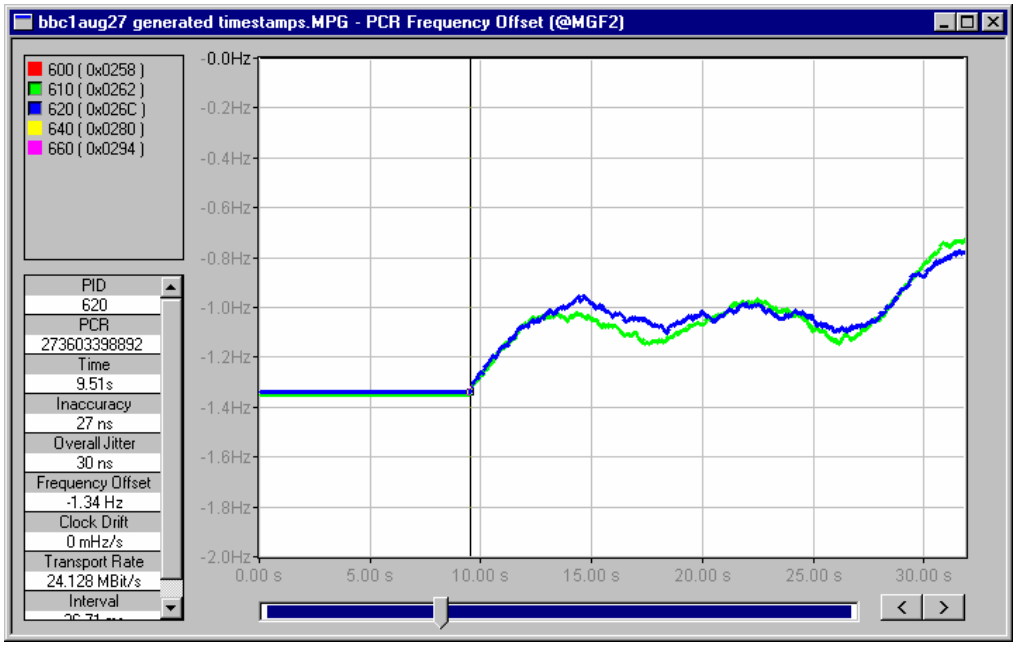
This value can be compared against the maximum error specification in ISO/IEC 13818-1 for PCR Accuracy of ±500 ns only if the jitter in the transmission is assumed to be zero.

(For more information about PCR_OJ, refer to Section 5.3.2.5 and Appendix I of Reference [1].)

Frequency Offset (PCR-FO)

PCR_FO The Frequency Offset graph shows the difference between the program clock frequency and the nominal clock frequency (measured against a reference which is not PCR or TS derived).

The frequency is calculated using time stamping information appended to each packet when a transport stream is recorded with the Player application with Time-Stamping active. Note that the ASI+TS card must be fitted for the time-stamping feature to be available. Only time-stamped streams can be graphed in this way.

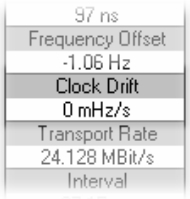


PCR_FO is a measurement of the error in the PCR frequency from the specified 27MHz; the MPEG specification sets the limits at ±810Hz.

(For more information about PCR_OJ, refer to Section 5.3.2.3 and Appendix I of Reference [1].)

PCR Drift Rate Measurement (PCR_DR)

This value (**Clock Drift**) is shown in the data table for a selected point. It is the rate of change PCR_FO and is usually very small. Since it is calculated using PCR_FO measurements, it is only available for time-stamped transport streams.

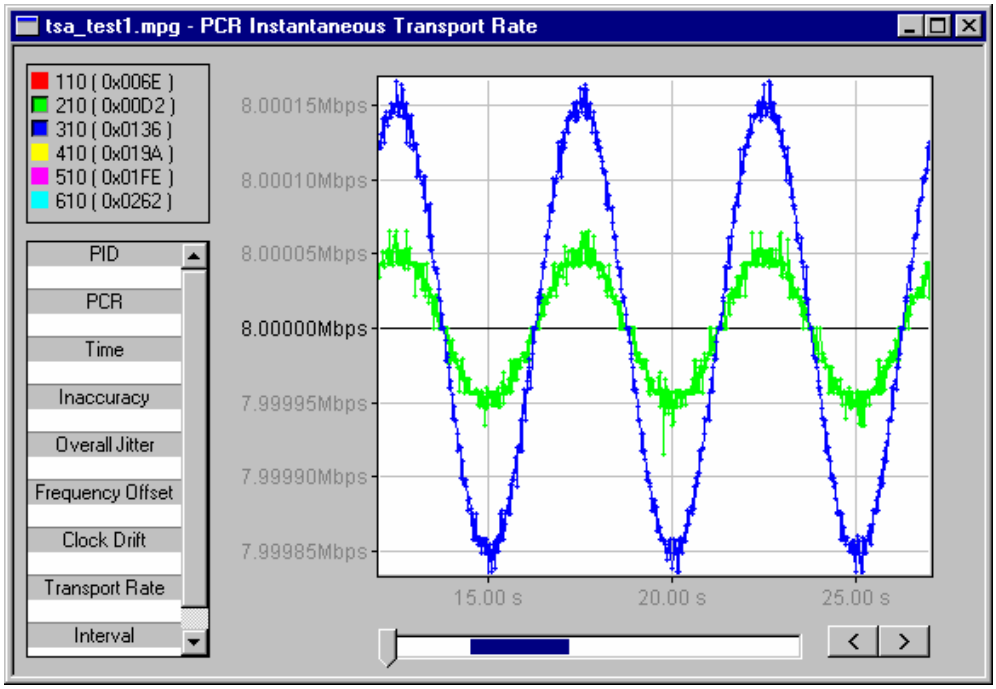


(For more information about PCR_OJ, refer to Section 5.3.2.4 and Appendix I of Reference [1].)

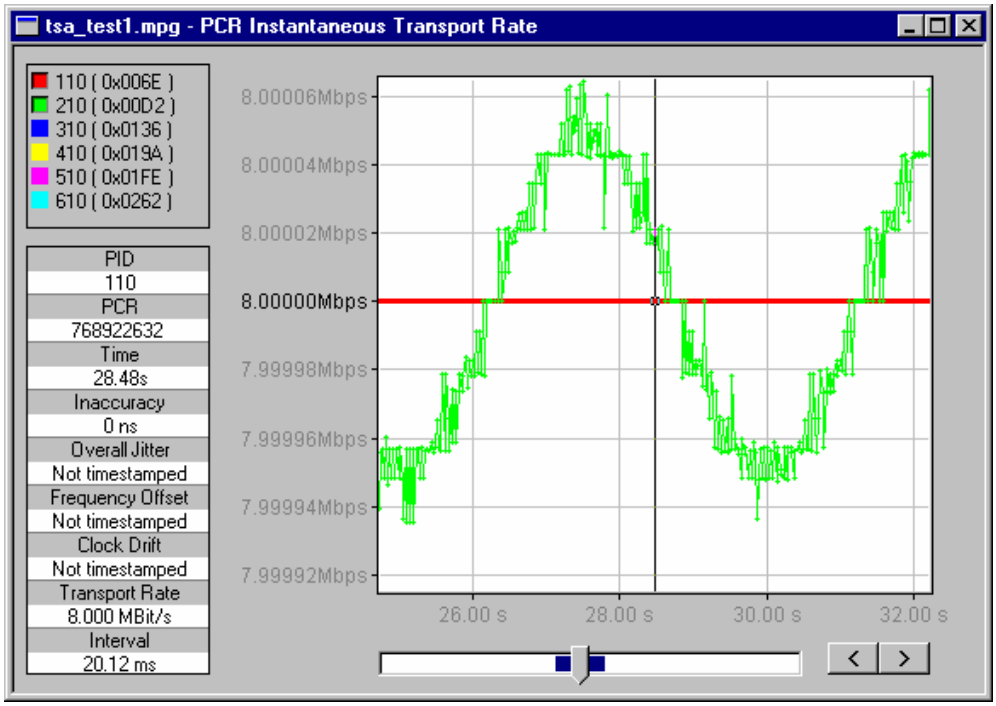
Bit Rate Graphs

Instantaneous Transport Rate (ITR)

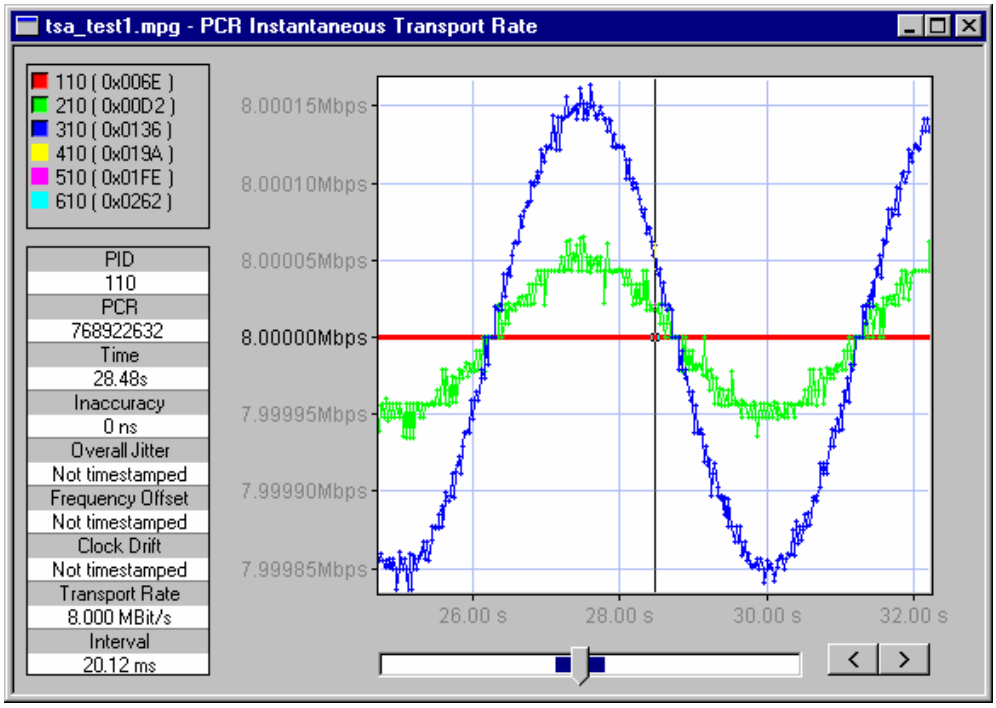
ITR This graph displays the instantaneous transport rate on the y-axis. It is derived from each pair of PCRs and displayed in the form of a scatter graph centred around the mean transport rate for the file. Each point on the scatter graph represents the rate for a particular PCR.



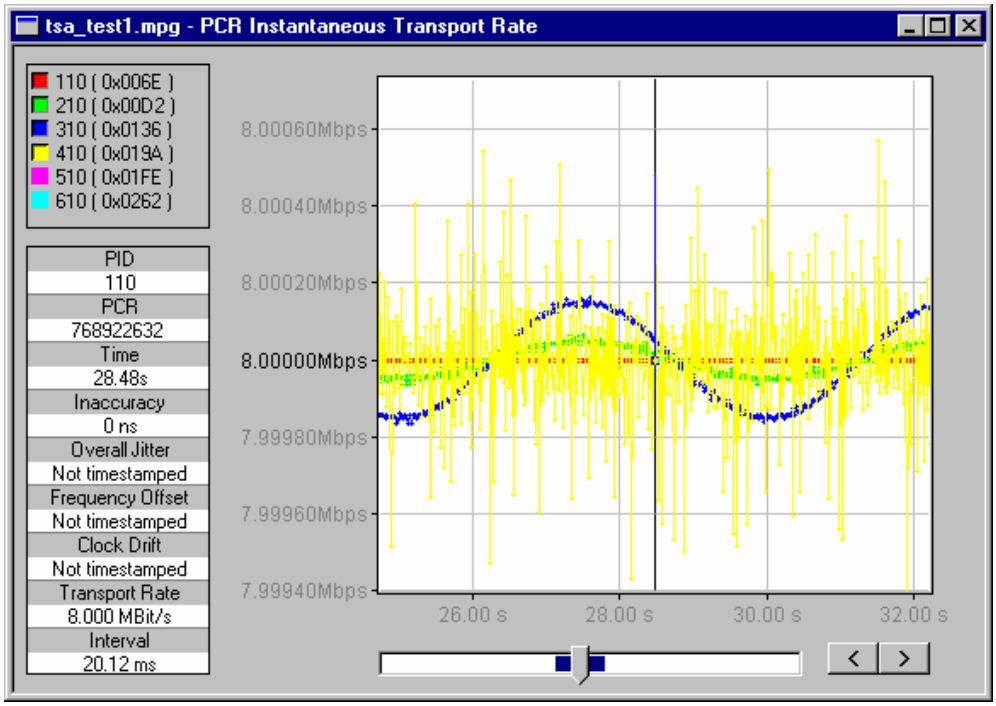
Following are some more examples from streams synthesised for Tektronix. They show different ranges and patterns in the data:



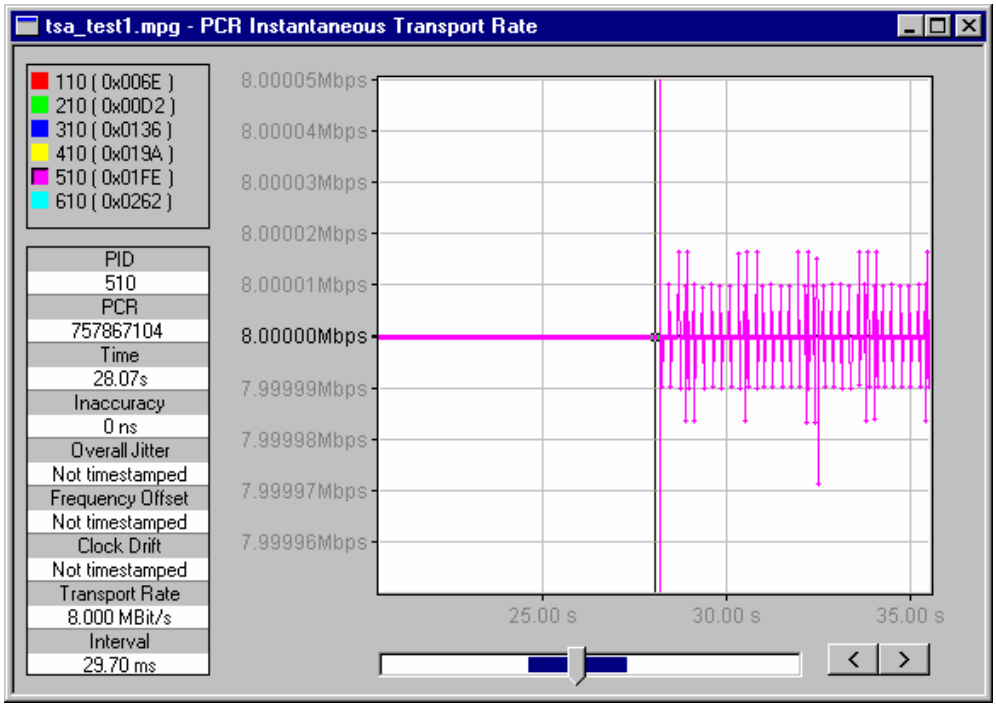
PID 110 is constant and PID 210 has a small sinusoidal variation, both centred on 8.0 Mbit/s.



PID 310 has a slightly bigger range, going from 7.9998 to 8.0001 Mbit/s. When added to the graph the range and other data is rescaled.



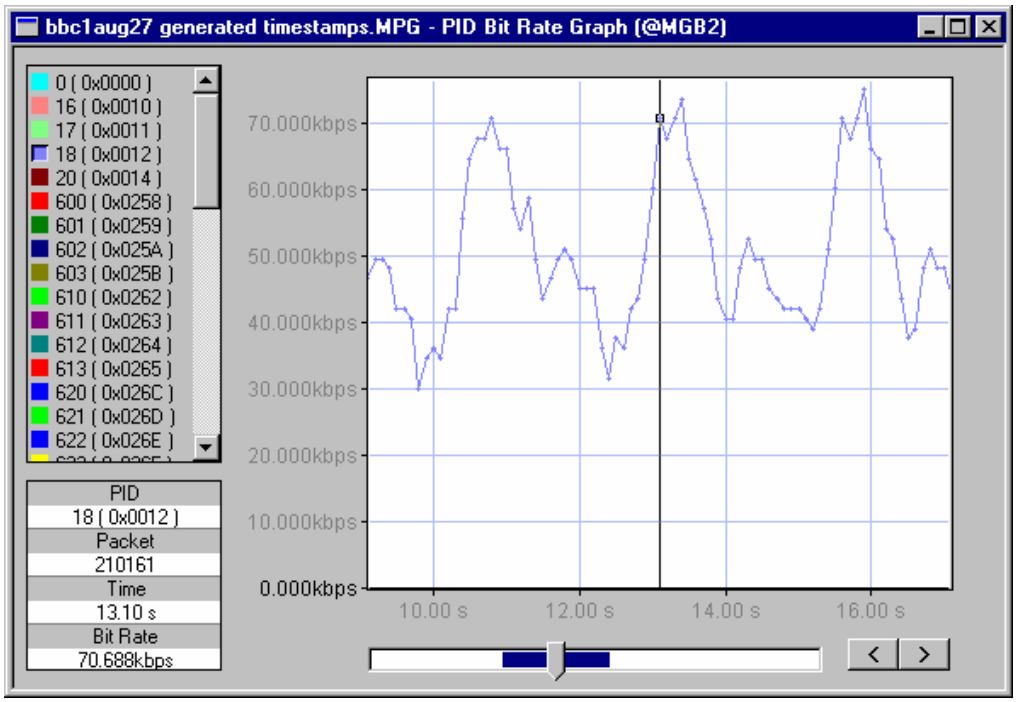
Adding PID 410 to the display changes the scales more. Because of the peak values of PID 410, PIDs 310 and 210 now occupy a smaller proportion of the scale.



The vertical line in this graph shows a discontinuity of some sort. This may have been caused by a large step in the PCR values. The general area can be determined by inspecting and analysing the PCRs on either side of the discontinuity.

PID Bitrate

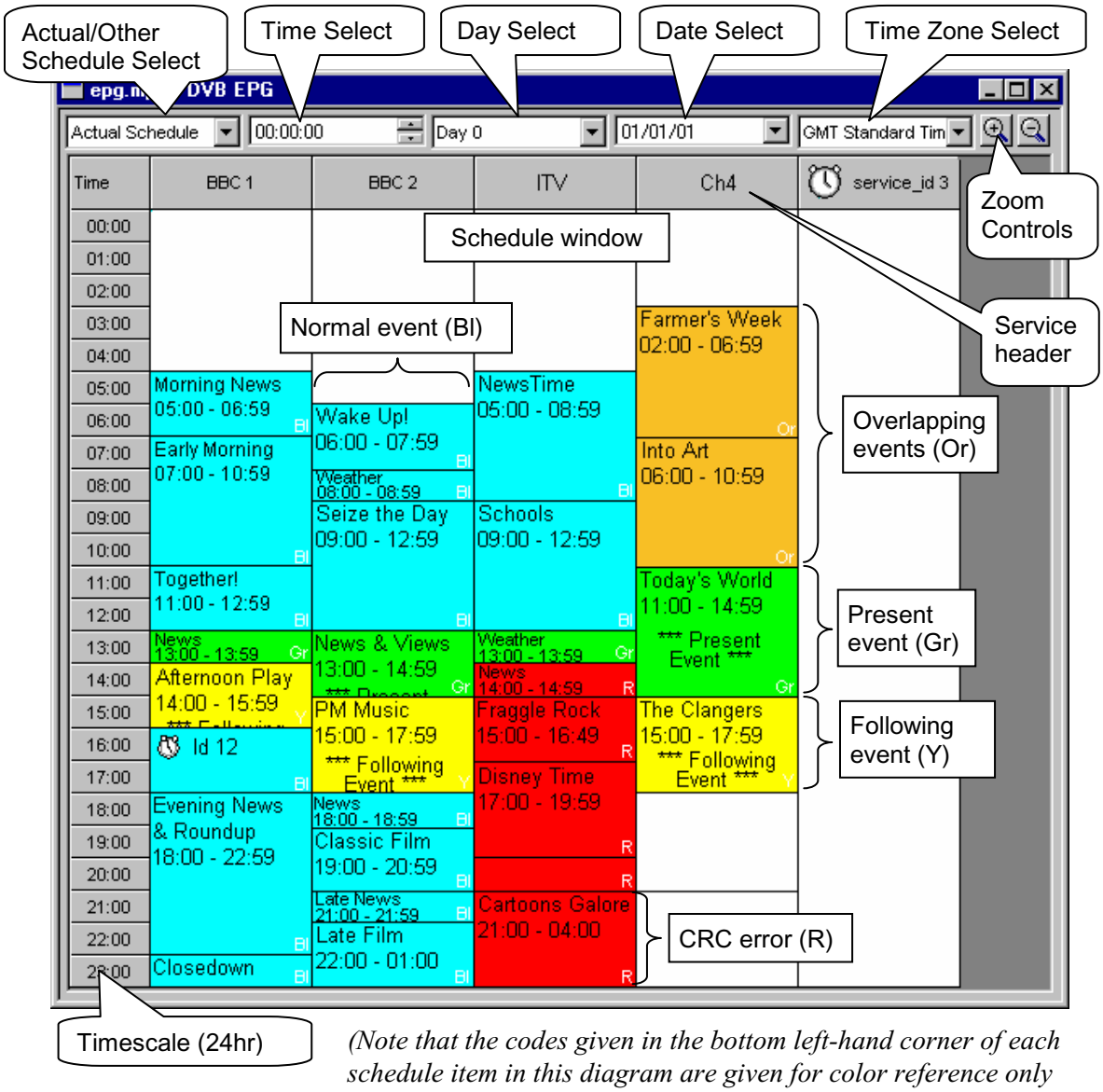
PID Bit Rate PID bitrate is calculated by counting the number of packets that occur on a specified PID over a particular interval (defined by MGB2, refer to section 5.3.3.2 in reference [1]). The bitrate can be calculated for each PID in the stream. The bitrate for each PID is calculated on-demand; a progress bar is displayed. If the **Stop** button is selected during calculation of the bitrate, the partial results are displayed in the graph window.



Electronic Program Guide

The Electronic Program Guide view (EPG), available in DVB, ATSC or ISDB mode, is a module-specific view. Information, extracted from the Service and Event SI/PSIP tables, is used to compile a graphical display.

To open the EPG view, select **View ➔ Module Specific View**. If more than one module-specific view is available, a dialog is displayed from which the required view can be selected.



(Note that the codes given in the bottom left-hand corner of each schedule item in this diagram are given for color reference only and do not appear on the actual display.)

In the EPG example shown above, the current time is between 13:00 and 14:00 hours, as implied by those events marked as 'Present'.

The screen elements are described below:

Actual/Other	The DVB, ATSC and ISDB-S standards describe two types of schedule information, i.e. the schedule for the Services transmitted in the transport stream - Actual, and the schedule for Services not carried in the transport stream - Other. The EPG can show only one schedule (Actual or Other) at a time.
Time Select	If the time selected in this field is not currently displayed, the display will immediately scroll until it is.
Day Select	A DVB and ISDB schedule may contain schedules for up to 64 days; the ATSC schedule is 16 days long. This field is used to select the day to be displayed. Note that only one day can be displayed at a time.
Date Select	This field provides an alternative way to select the day (of those that may be available) to be viewed. Note that the value in the Day select field is changed to match the date selected.
Time Zone Select	The time zone may either be derived from the transport stream, UTC (Co-ordinated Universal Time) or local time (as set on the host computer).
Zoom Controls	Zooms in or out on the day currently displayed by approximately 50%.

Note that currently the EPG view will only display events in the H-layer when in ISDB-T mode.

Schedule Window

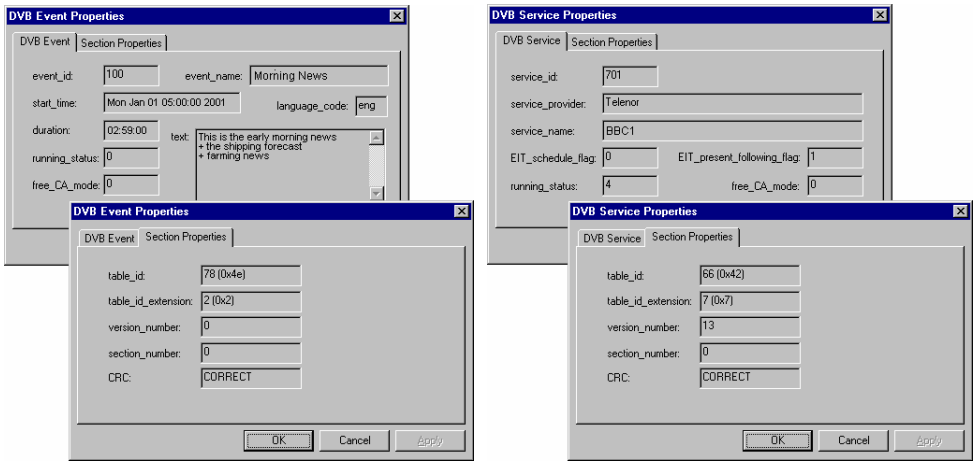
The main area or Schedule window of the EPG window displays all of the events scheduled for a single day in the selected schedule (Actual or Other).

Each event described by the Event Information Table is displayed in graphical form and associated with a Service. Included in each event block are the event name and the timing of the event. In the case of present or following events, an appropriate label is also displayed (DVB and ISDB only).

Event Properties

Double-clicking on an individual event or a service header in the schedule window will display a properties dialog. The fields displayed in the two tab pages of this dialog are derived from the EIT and SDT (DVB and ISDB) or the EIT and MGT (ATSC).

The content of the first page (left-hand tab) will vary depending on whether the item is an event or a service and whether it is time-shifted or not. The second page (right-hand tab) always displays Section Properties since both services and events, whether time-shifted or not, are always carried in sections.



(Examples of DVB Event properties)

Time-Shifting

A service or event may be displayed with a clock icon ; this indicates that the item is 'time-shifted'.

Color Coding

The status of the events is color coded for easy recognition:

Green: Present Event - An event which is signalled as the Actual or Other event currently being broadcast (DVB and ISDB only).

Yellow: Following Event - An event which is signalled as the Actual or Other event to be broadcast after the Present Event (DVB and ISDB only).

Blue: Normal Event - A normal, scheduled event that does not fall into any other category.

Red: CRC Error - The event was transmitted in a section with a bad CRC (cyclic redundancy check).

Orange: Overlapped Event - An event's duration overlaps with another event.

References

[1] European Telecommunications Standards Institute TR 101 290: Digital Video Broadcasting (DVB); Measurement Guidelines for DVB Systems.

[2] ATSC Standard A/57 (1996) Program/Episode/Version Identification.

[3] ATSC Standard A/65 Program and System Information Protocol for Terrestrial Broadcast and Cable.

[4] ATSC Standard A/66
(Draft Technical Corrigendum No.1 to ATSC Standard: Program and System Information Protocol for Terrestrial Broadcast and Cable. Doc. A/65 (23 Dec 97))

[5] ATSC Standard A/67
(Draft Amendment No. 1 to ATSC Standard: Program and System Information Protocol for Terrestrial Broadcast and Cable. Doc. A/65 (23 Dec 97))

[6] Digital Video Broadcast (DVB); DVB Mega-Frame for Single Frequency Network (SFN) synchronisation. ETSI document TS 101 191 V.1.3.1.

[7] ARIB standards B10v1.2, B15v1.3 and B24v1.2.

[8] ETSI Technical Report TR 101 211 July 2000: Digital video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI).

[9] ISO/IEC 13818-4 Information Technology - Generic Coding of moving pictures and associated audio information - Part 4: Compliance testing.

[10] ETSI TS 101 812 V1.1.1

[11] TR 101 162 (November 2000)

[12] DVB A38r1

Section 2

Packetized Elementary Stream Analyzer

Description of Features 3
Starting the Program 4
- Initial Appearance 4
- Initial Menu Options 5

Options 6
- Conformance Tests 6

Opening a file 8
Menus and Controls 11
- Toolbar 11
- Status Bar 12
- Slider Bar 13
- Menus and Options 15

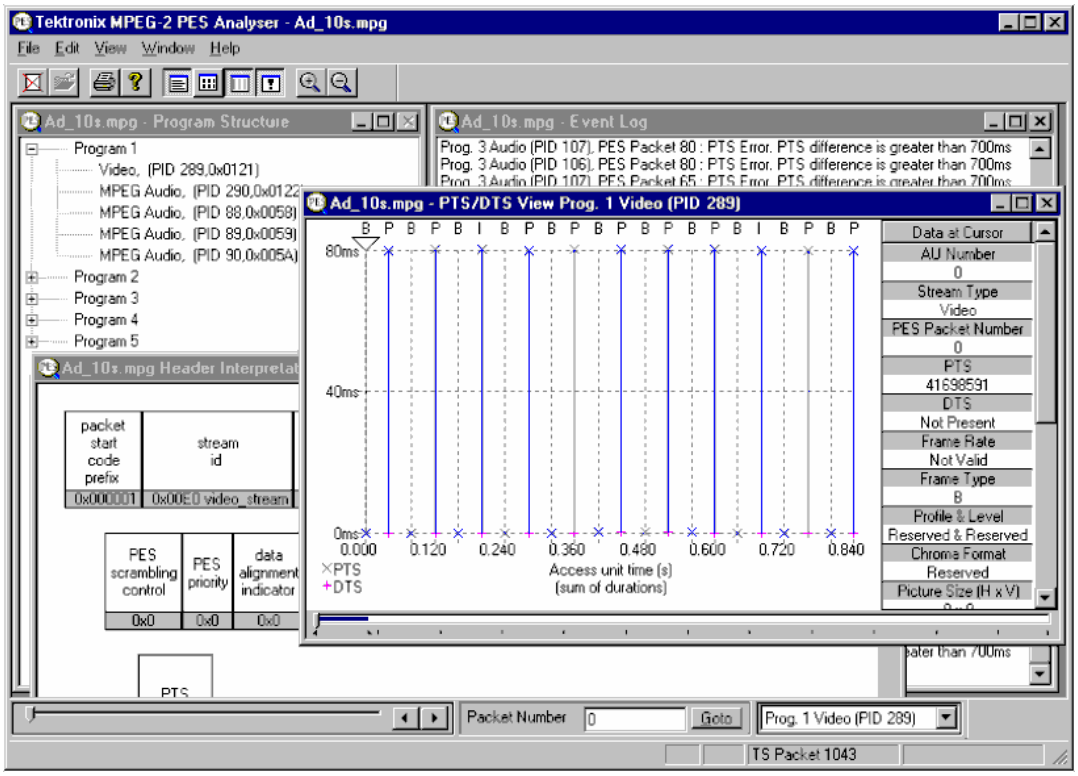
PES Packet Hex View 17
Event Log 19
- Packet Selection 19

PES Packet Header Interpretation 22
Program Structure 24
- The Diagram 25
- Selecting a Packet Type 26

PTS/DTS Timing Analysis 27
- Video Streams 30
- Audio Streams 32
- AC-3 Audio Streams 33
- AAC Audio Streams 34

Description of Features

The PES Analyzer performs a series of user selectable conformance tests on a previously recorded file. Files can be interpreted according to either the ATSC or DVB standards. Once analysed users can view the results of the selected tests and browse through the content of the PES packets.



Information can be viewed in graphical and textual formats. To analyze and view the Transport Stream packets use the companion program TS Analyzer, which can be run at the same time as this PES Analyzer.

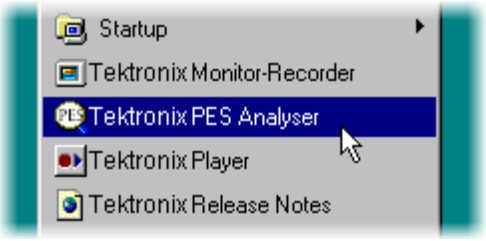
The functionality provided includes:

- Display of program structure showing the programs contained within the transport multiplex and the PES streams which comprise each program.
- Display an interpretation of PES packet for individual packets.
- Hexadecimal representation of PES packet.
- Extraction and display of Presentation Time Stamp (PTS) and Decoding Time Stamp (DTS) information from the PES packet header.
- Display of access unit information for video and audio access units.

The examples shown in this chapter are taken from both ATSC and DVB compliant transport streams. An example of each type is sometimes shown as a reminder that both standards are supported or where a difference needs explanation.

Starting the Program

The program may be started by selecting the **Tektronix PES Analyser** option from the **Start** -> **Programs** menu.



or

by double clicking on the **Tektronix PES Analyser** Shortcut on the desktop.

Initial Appearance

Once the program has started and is ready for use it will open a Main Window. When the program first starts it looks like this:

The Toolbar (row of buttons above the dark grey area of the empty window) may be hidden from view, moved to a separate window, either side or the bottom of the main window.

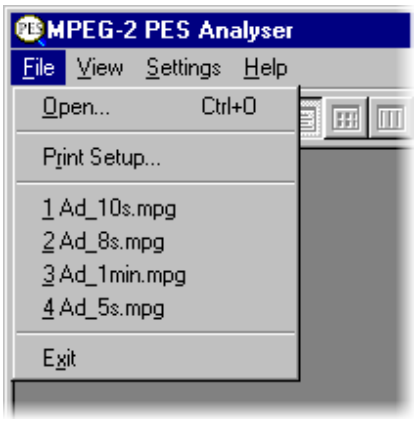
The Status Line at the very bottom of the window may be hidden from view. Because no file is open, it is displaying a message that the TS packet number is **Not Valid**.

Above the Status line is the Slider Bar. This has three groups of controls for selecting streams and packets within a file. This may be moved to the top of the window.

Initial Menu Options

PES Analyzer presents different menus and options, depending on whether or not a file is open for analysis. The menu options available when no file is open, are:

File Menu Options



Open ... — An MPEG file for analysis. The program opens the file selection dialogue allowing the user to choose the required file.

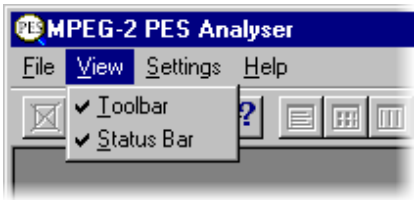
Print Setup ... — Opens a dialogue for selecting which printer and associated options to use.

1 *<filename>*
2 *<filename>*
3 *<filename>*
4 *<filename>* — A list of the four most recently analysed files. If the program has recently been installed the list may be empty or hold less than 4 files.

Selecting a filename opens that file for analysis.

Exit — Finishes running the program.

View Menu Options

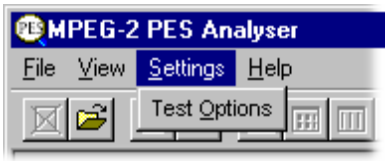


(a check mark ✓ next to an option shows that the window or toolbar is currently visible, no ✓ means that it is hidden.)

Toolbar — Toggles the Toolbar between being displayed or not. Select the option to change the state.

Status Bar — Toggles the Status Bar between being displayed or not.

Settings Menu options

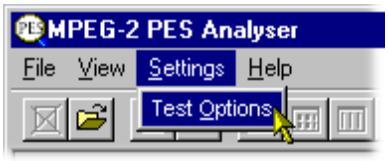


Options — Brings up a dialogue for setting the Conformance Test Options for analysing and interpreting the PES information in stream files.

Options

The MPEG and ATSC Conformance Test Options for MPEG and ATSC may not be modified when a file is open. To change them all file must be closed, the test options modified and the file opened again.

Select **Options** from the **Settings** menu to open the Conformance Tests dialogue.

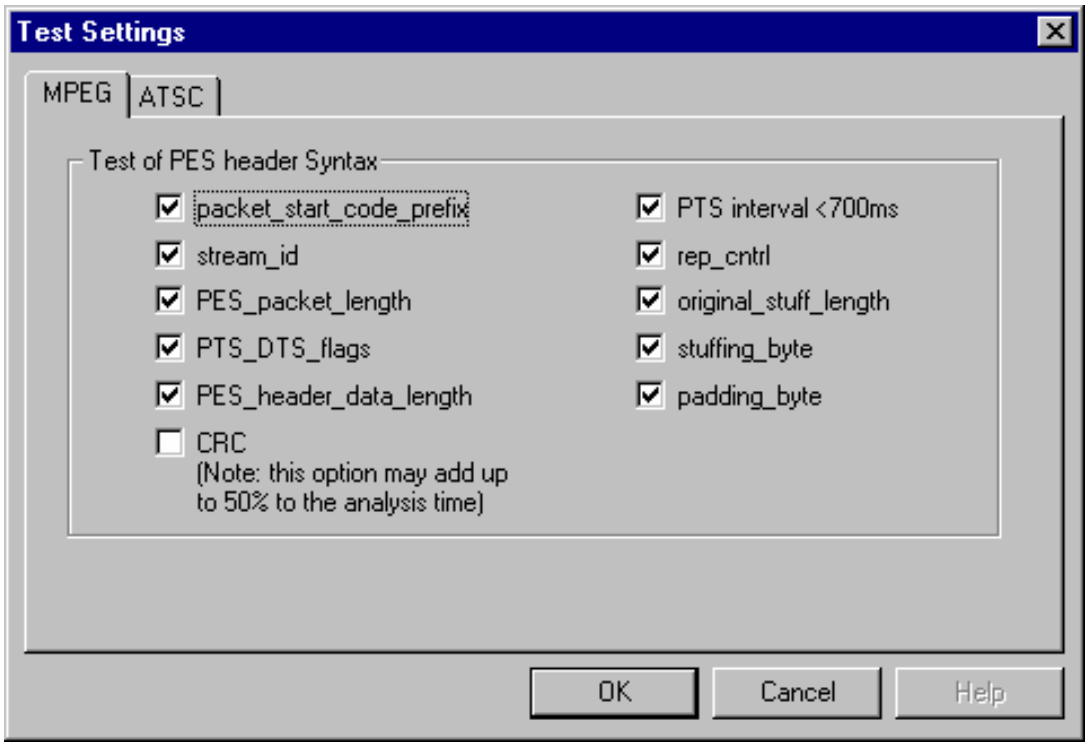


N.B. The **Settings** Menu is only available when there is no file open. It is hidden when a file is opened and re-displayed when the file is closed.

Conformance Tests

The dialog comprises two tabbed pages containing test relating to MPEG and ATSC files respectively. Note that the MPEG tests are sufficient for DVB streams.

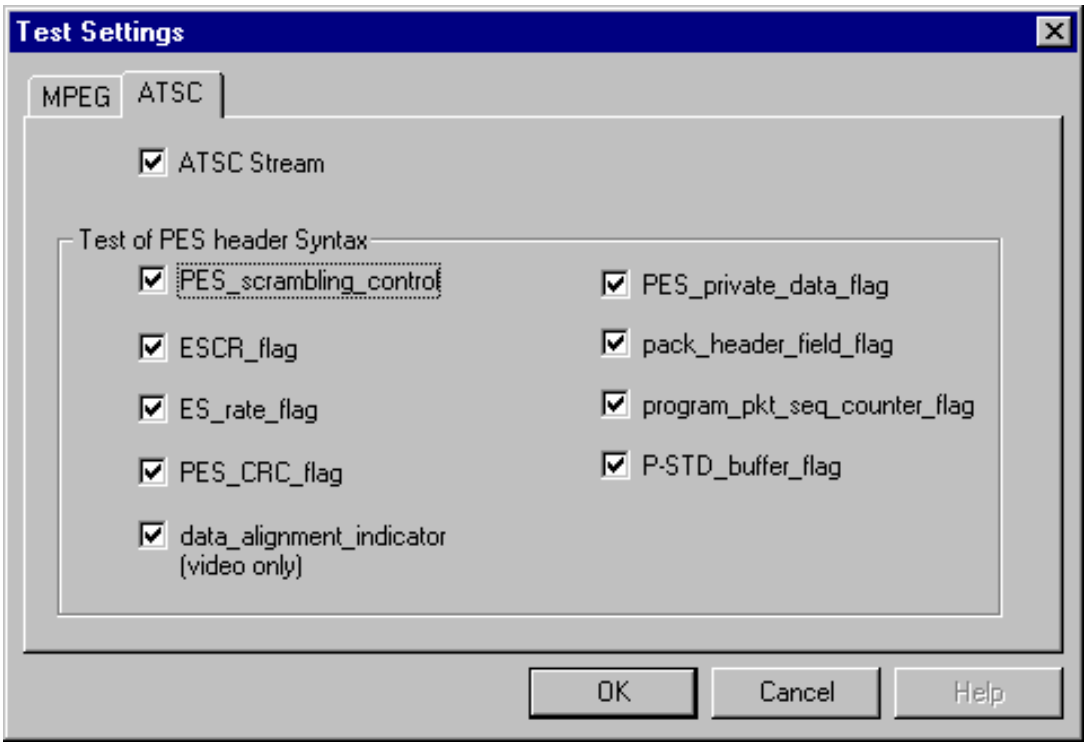
Test of PES header Syntax (MPEG)



The tests of PES header Syntax are based on the conformance requirements laid down in the standards document ISO/IEC 13818-4 for Packetized Elementary Streams. Each check box uses the same name for a particular test as the standard. For example, to test conformance to the standard for the length of PES packets select the **PESpacketlength** option.

A check mark shows that a test is selected and an empty check box indicates that the test will not be performed.

Test of PES header Syntax (ATSC)



When the **ATSC Stream** box is checked, selected streams are interpreted according to the ATSC standards, A/52 and A/53.

A check mark shows that a test is selected and an empty check box indicates that the test will not be performed.

For streams in a DVB standard stream leave the **ATSC Stream** option unchecked. The **ATSC Stream** option is disabled (greyed out) if the software license is only for the DVB standard.

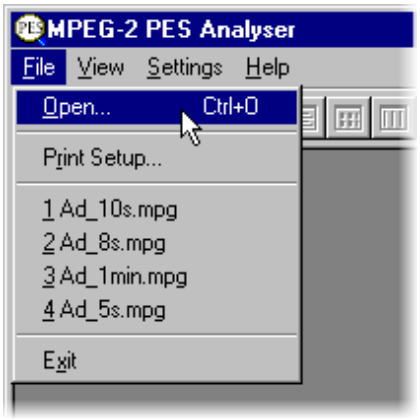
Opening a file

Any file holding a recorded or synthesised sample of a stream can be opened for PES Analysis by this program. To analyze the Transport Stream packets open the file in the TS Analyzer. A file can be opened by both the TS and PES Analyzers at the same time.

Opening a file from the Menus and Toolbar

To open a file select the **Open ...** option from the file menu. If the required file is in the list of recently analysed files then it can be opened from the list to save using the Open file dialogue.

Alternatively use the **Ctrl+O** keyboard shortcut.

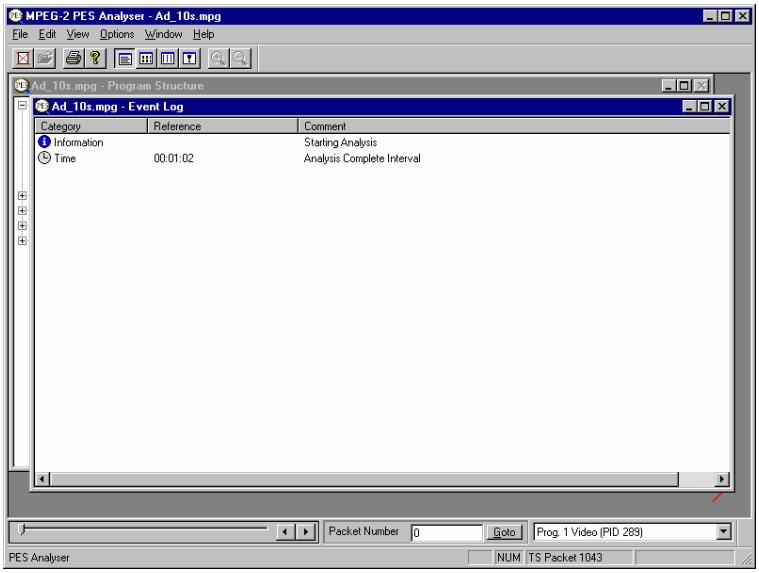


There is also a shortcut button available on the Toolbar for opening a file, which has the standard file open symbol:

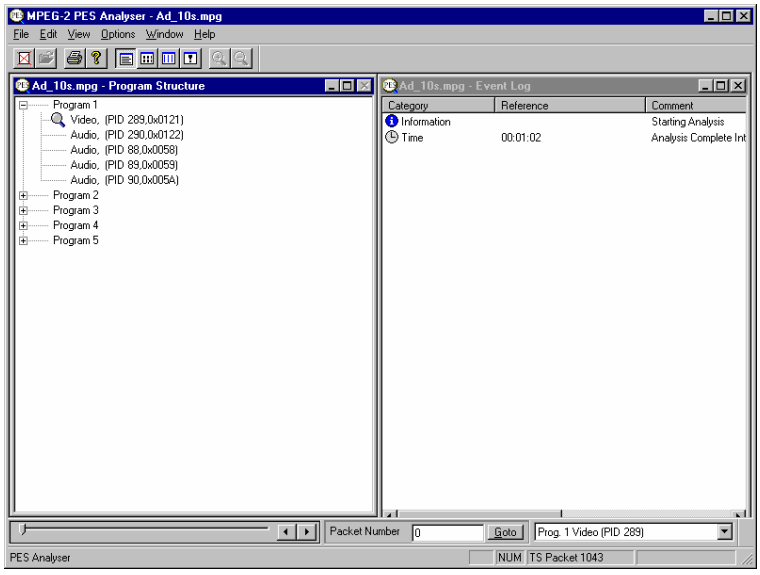
Once a file is open this button will be disabled, which is shown by being 'greyed out'.

Window Layout

Program Structure and Event Log windows are opened as soon as the file is opened. The layout of the windows will have been saved from the last time the program was used. If the program has just been installed the windows will be in the application default Cascade arrangement which looks like this:



Many users re-arrange the windows so that the Program Structure and Event Log windows do not overlap. The examples in this manual often use this arrangement:

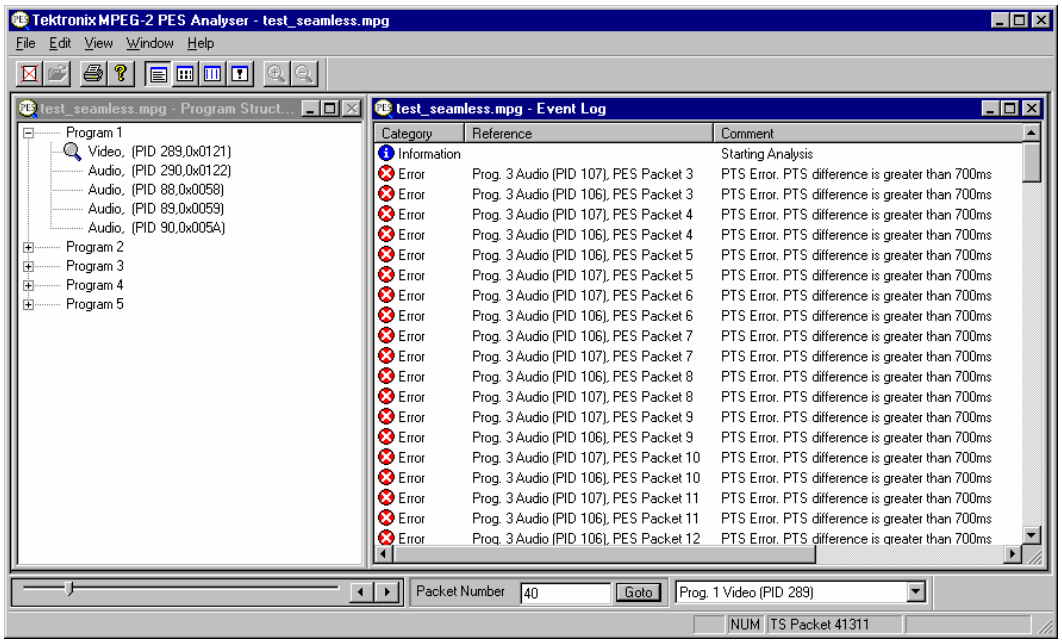


The above example is from a transport stream interpreted and labelled according to the DVB standard. If the **ATSC Stream** option is set the elementary streams will be interpreted and labelled according to the ATSC standard. For example: Audio streams would be labelled **AC-3 Audio**, instead of **Audio or AAC Audio**.

PES Analysis

The PES Analyzer program now starts to analyze the file for conformance to the selected tests. Due to the very efficient algorithms used by the program, it will analyze large files in a few minutes. Other algorithms have been seen to take much longer. The rightmost pane in the Status Bar shows a progress indicator during Analysis.

As the file is analysed messages are written in the Event Log and the structure diagram is drawn in the Program Structure window. When the processing is done an 'Analysis Complete' message is written in the Event Log.



Menus and Controls

When a file is open the program presents a different set of menus and options. They change as soon as the Program Structure and Event Log windows appear. For example, the Open file commands are replaced by Close file commands.

Toolbar

The Toolbar provides a set of convenient shortcuts for the more frequently used menu options. The available commands are:

Closes the current file. This button becomes enabled the moment a file is opened and analysis starts. If the wrong file is being opened, or the wrong options are selected, clicking on the button will abandon the analysis and close the file.

Open a file. This button is disabled when a file is open.

Print the contents of the current window.

Opens a dialogue which displays the program version number.

Toggles the Event Log window. When the button is in this state the window is not visible and clicking on the button will open the Event Log.

Toggles the Packet Hex View window. When the button is in this state the window is not visible and clicking on the button will open the Hex View.

Toggles the PTS/DTS View window. When the button is in this state the window is not visible and clicking on the button will open the PTS/DTS View.

Toggles the Header Interpretation window. When the button is in this state the window is not visible and clicking on the button will open the Header Interpretation.

Zoom In on data in the PTS/DTS View. This button is only enabled when the PTS/DTS View is current window.

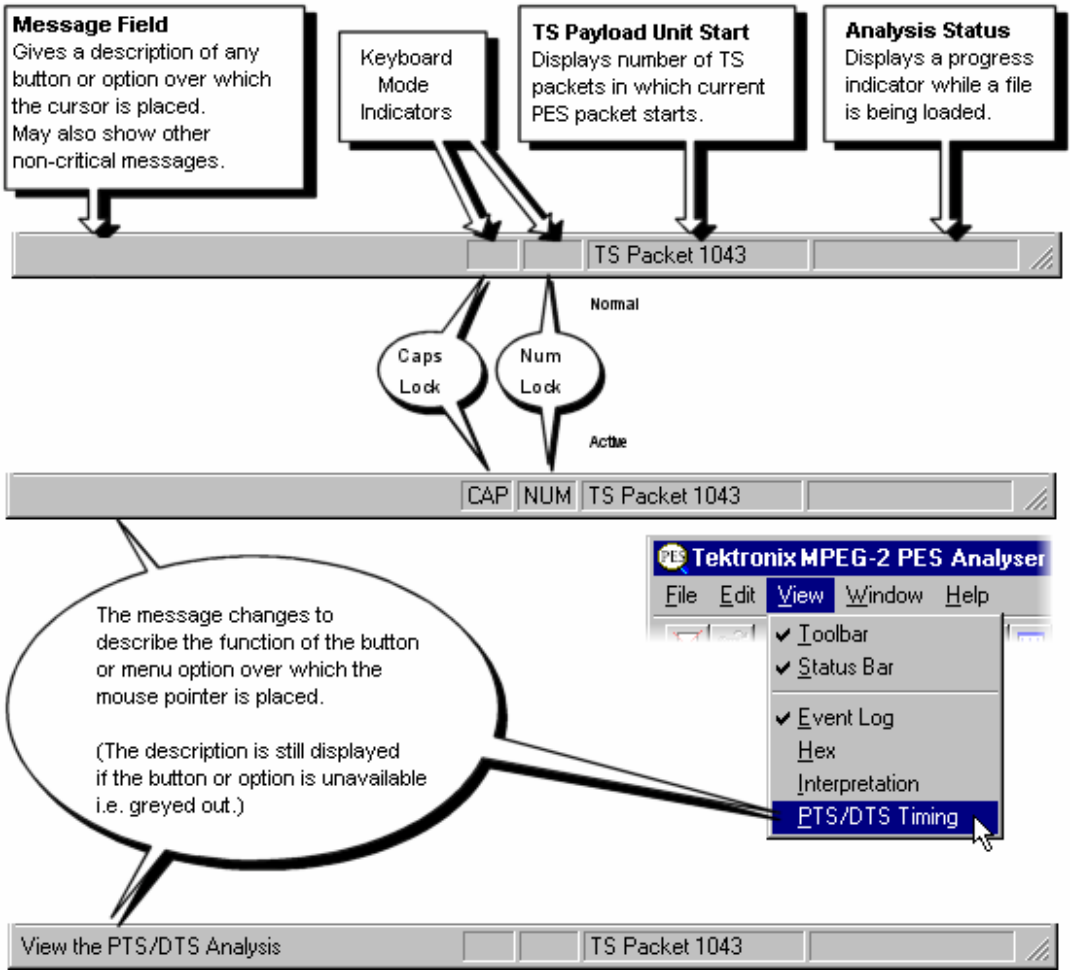
Zoom Out from the data in the PTS/DTS View. This button is only enabled when the PTS/DTS View is current window.

The Toolbar can be dragged off the edge of the main window into a floating pallet. To do this click on the background inside the Toolbar, i.e. not on one of the buttons, and drag into the main window area. The result is a self contained window which looks like this:

To replace the Toolbar on the window border drag it over the border until the outline changes shape. It can be placed on the top, bottom, left or right hand edges.

Status Bar

The Status Bar may be hidden from view, but if visible is always at the bottom of the main window. It displays the following information about the program and keyboard states:

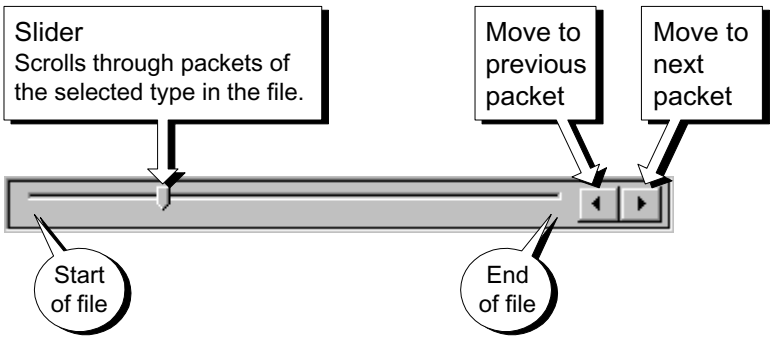


Slider Bar

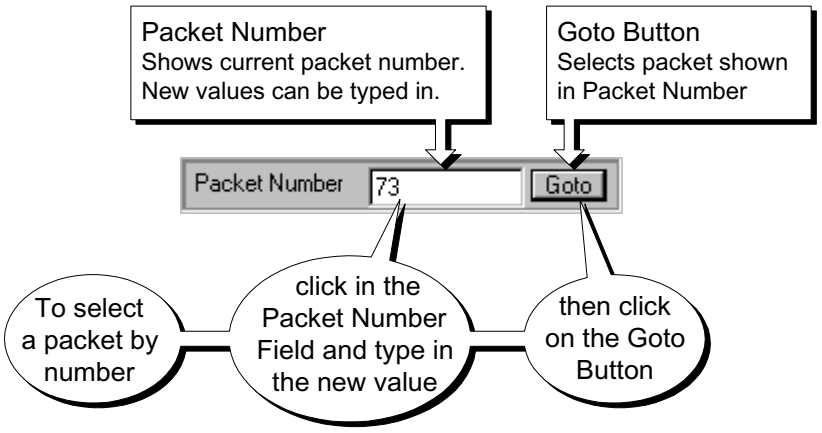
The analyzer can display the contents of any PES packet in the currently loaded file. Packets are numbered, within PID, according to their position in the file, the first PES packet of each PID being PES packet 0 (zero). The Slider Bar displays the packet number and the PID for the current packet.

The above example has been compressed slightly to fit the width of the page. At normal dimensions the controls are:

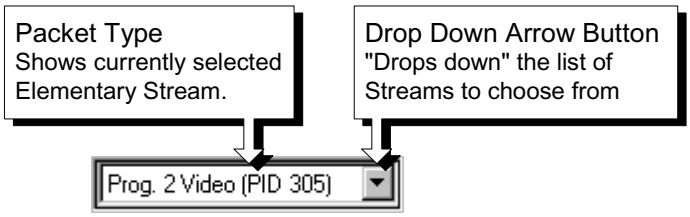
Slider



Packet number



Packet Type - Elementary Stream



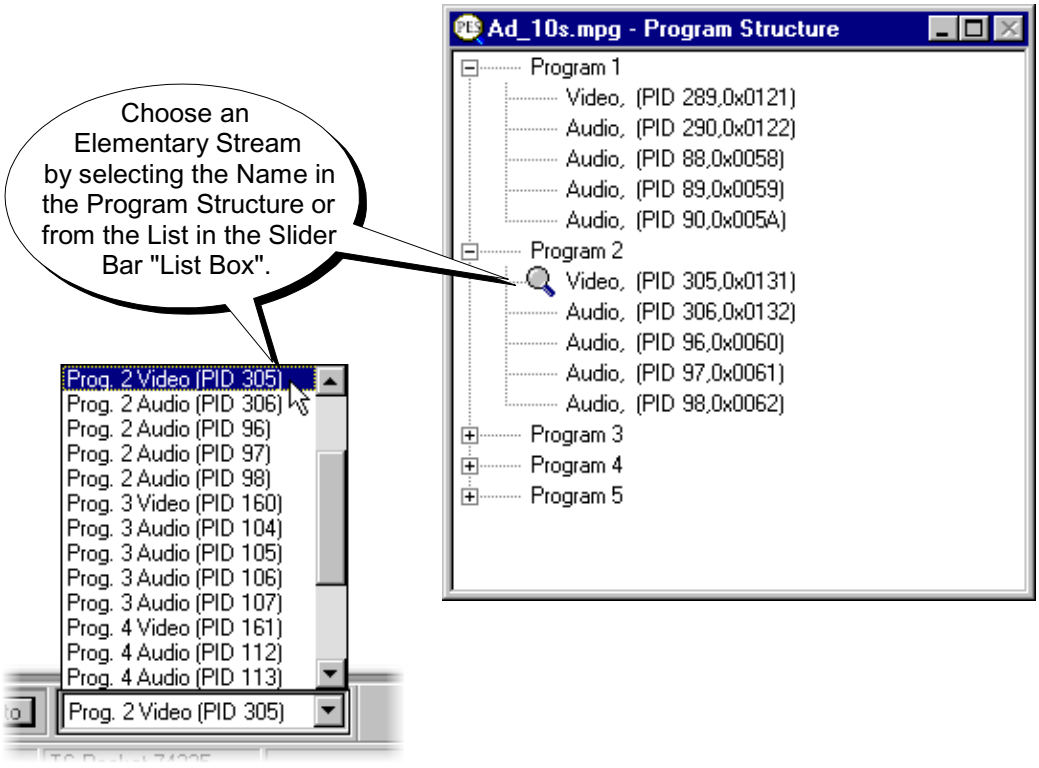
If the Slider Bar is close to the bottom of the Windows™ desktop (i.e. physical screen) the list will appear above the list box instead of below.

Like the Toolbar the Slider Bar can be dragged from the edge of the main window into a floating pallet. To do this click on the background inside the Slider Bar and drag into the main window area. The result is a self contained window which looks like this:

To replace the Slider Bar on the window border drag it over the border until the outline changes shape. Unlike the Toolbar it can only be placed on either the top or bottom edges.

Selecting Packet Type

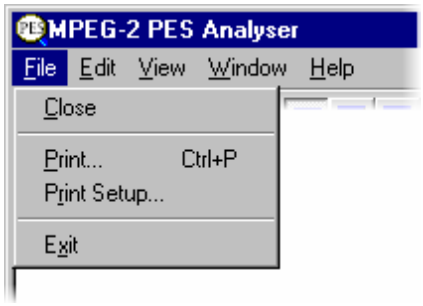
The Slider and Packet Number can only select packets in the currently selected program stream. The stream is indicated in the Packet Type drop-down list and by the magnifying glass symbol, 🔍, in the Program Structure window. A new stream may be selected from either the list box or the window.



The above example is taken from a copy of the PES Analyzer which is filling the Windows™ desktop. Since the Slider Bar is close to the bottom of the desktop the Selection List appears above the Selection Box.

Menus and Options

File Menu Options



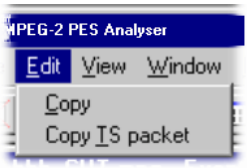
Close Closes the current file. This option is available as soon as analysis starts. If the wrong file is being opened, or the wrong Conformance Tests are being run, selecting this option will abandon the analysis and close the file.

Print Prints contents of the current window.

Print Setup Selects printer and configuration.

Exit Closes any file that is open and terminates execution the program.

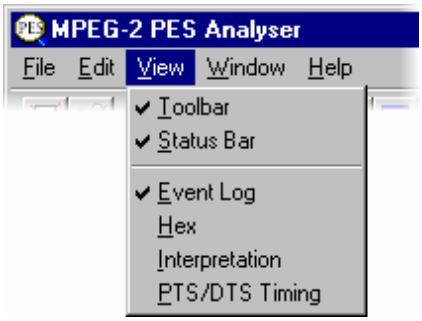
Edit Menu Options



Copy Copies the contents of the current window to the Windows™ Clipboard, from which it can be pasted into a document in another application.

Copy TS Packet Allows the user to select an AU (access unit) within the PES Analyzer, and then copy the TS packet number onto the Windows clipboard. The Stream Analyzer may then be started and **Paste TS packet** selected to goto the packet number retrieved from the clipboard.

View Menu Options



(a check mark ✓ next to an option indicates that the window or toolbar is currently visible, no ✓ means that it is hidden.)

Toolbar Shows or hides the Toolbar, which provides a set of convenient shortcuts for the more frequently used menu options.

Status Bar Shows or hides the Status Bar.

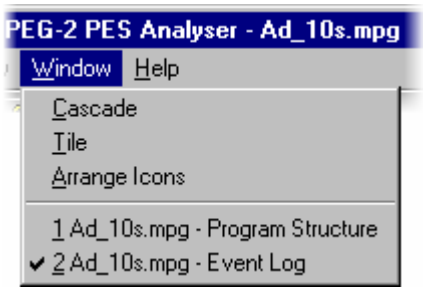
Event Log Shows or Hides the Event Log.

Hex Shows or Hides the Hex View.

Interpretation Shows or Hides the Packet Interpretation view.

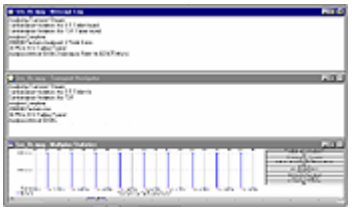
PTS/DTS Timing Shows or Hides the PTS/DTS Timing Analysis window.

Window Menu Options



Cascade Re-arranges the windows like this:

Tile Tiles the windows horizontally. For example, three windows would be tiled like this:

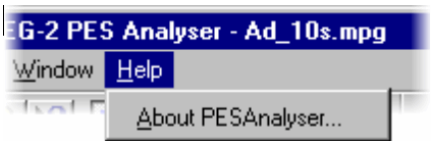


Arrange Icons Aligns icons of any minimised windows at the bottom of the program's main window.

1 *<window title>*
2 *<window title>*
3 ... etc.

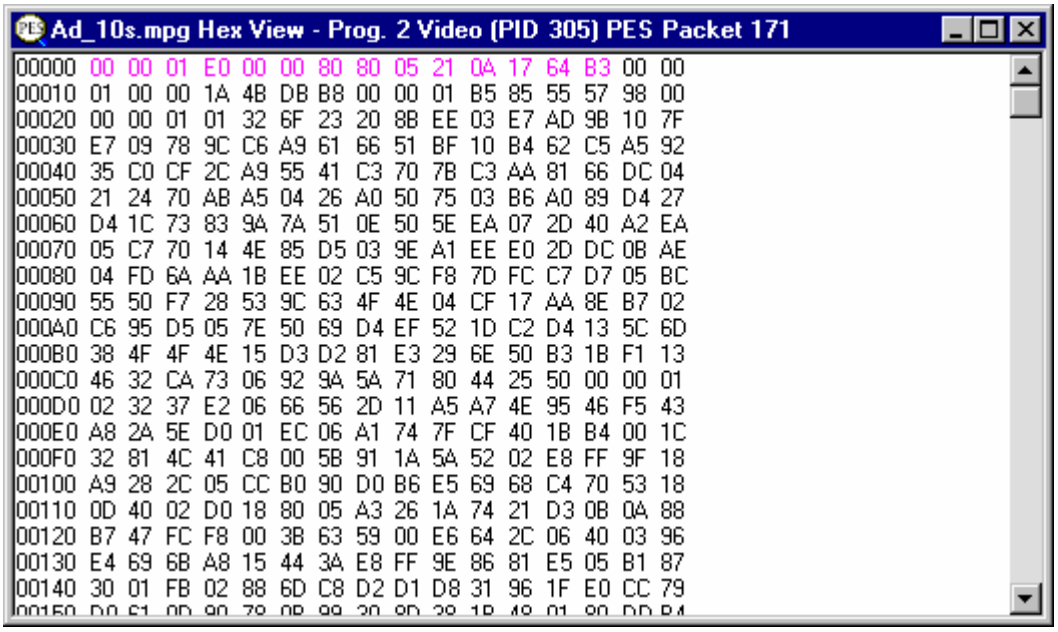
Makes the named window active, putting it on top of any windows which had been hiding all or part of it.

Help Menu Options



About PES Analyser… Opens a dialogue which displays the program version number.

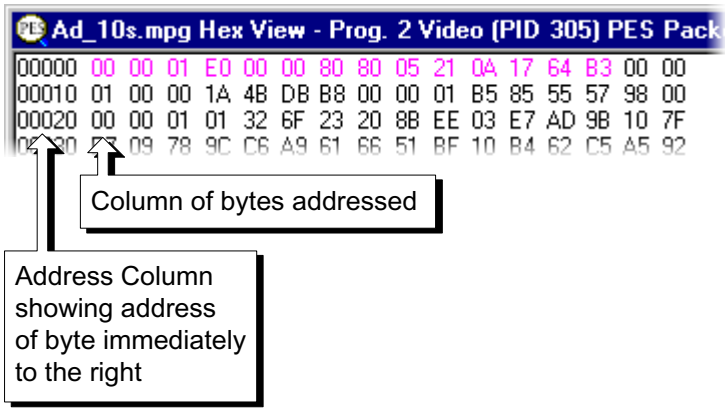
PES Packet Hex View



This is the lowest level view of the PES Packet data. It displays the contents of every byte in hexadecimal. Each byte is represented as a pair of hexadecimal digits. The window may be resized to display 16, 32, 48, … bytes of information on each row.

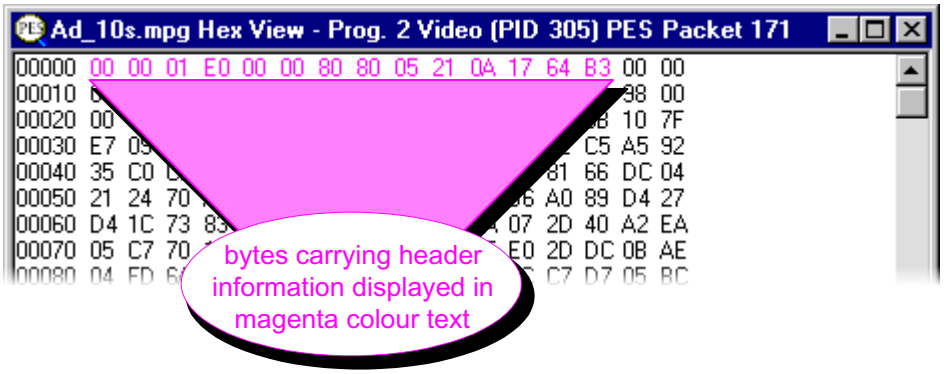
The four digit numbers in the left most column are the addresses of the first (i.e. leftmost) byte in the row.

The addresses are shown in hexadecimal.



Packet Header

The Hex View displays the bytes holding PES Packet header information in magenta colour text. For example here is a packet containing a PTS field, from a video stream:



The most significant two bits of the eighth byte (i.e. the byte at address 0x0007) contain the PTS_DTS_flags. The ninth byte (address 0x0008) contains the PES_header_data_length, which specifies how many additional bytes are present. In the above example

PTS_DTS_flag = 2

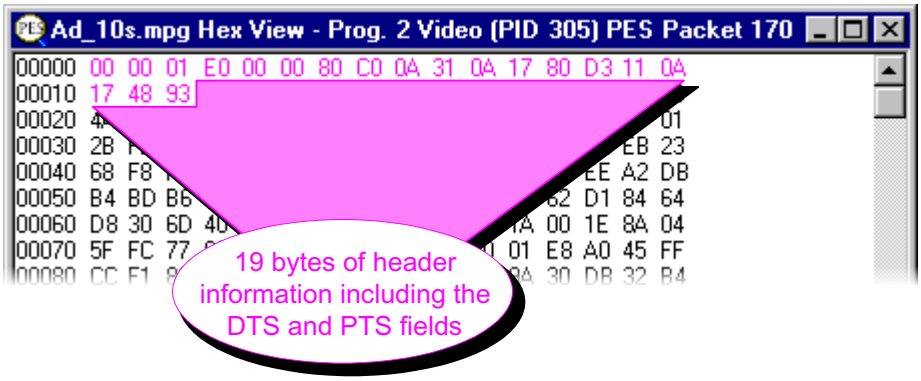
PES_header_data_length = 5

These specify that there is a 5 byte Presentation Time Stamp (PTS) field in the header. The contents of the PTS are **21 0A 17 64 B3** and they follow the PES_header_data_length.

The preceding packet, from the same stream, carried both a PTS and DTS field:

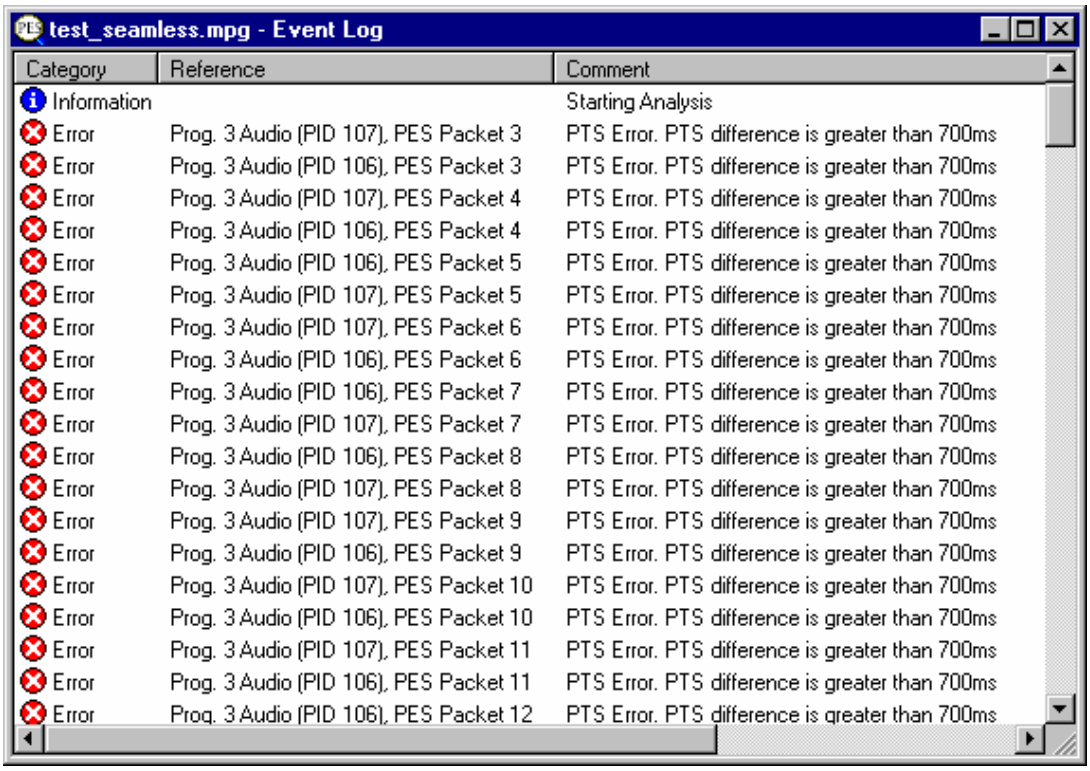
PTS_DTS_flag = 3

PES_header_data_length = 10 (shown as **0A** in hexadecimal)



Instead of having to interpret header information from the Hex View, the PES Analyzer provides the Header Interpretation window. This interprets the header and displays the contents, in table form, according to the MPEG-2 standards.

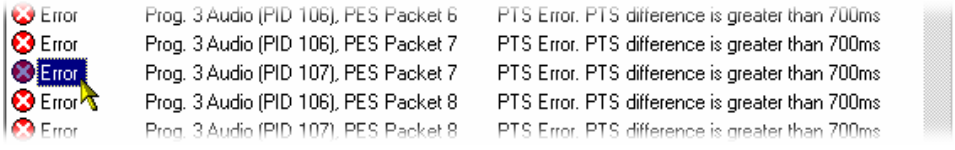
Event Log



The program always opens the Event Log window when it starts to analyze a file. As the file is analysed the program writes the results to the window as they are produced. When processing finishes an 'Analysis Complete' message is appended to the report.

Packet Selection

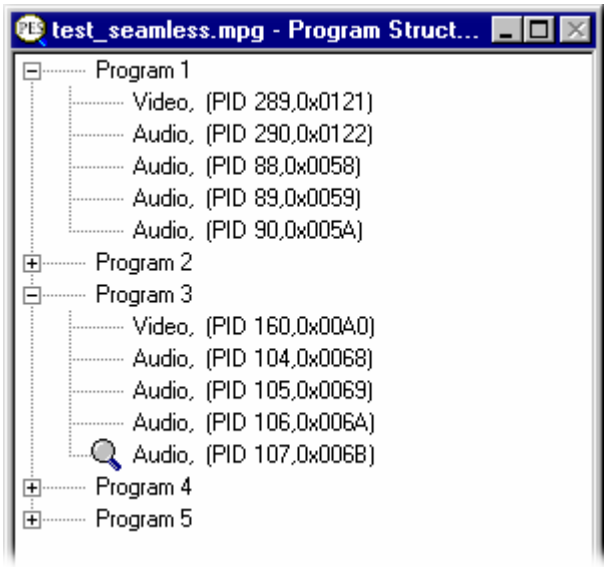
If a warning or error message gives a packet number, that packet may be inspected by selecting the message. For example, here is an extract from a file with PTS errors on two of the Audio streams:



Clicking on the message for **Prog. 3 Audio (PID 106) PES Packet 78** selects both the program stream and the packet. This is reflected by the Slider Bar, in the Program Structure, Hex View, Header interpretation and PTS/DTS Views.

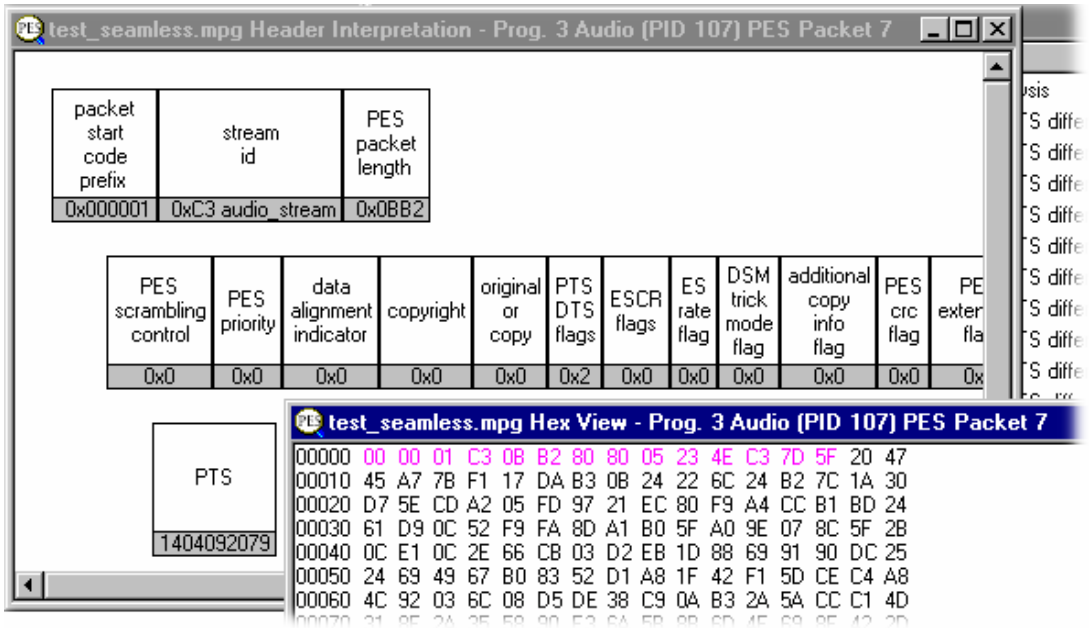
The Slider bar will look like this:

In the program Structure. The magnifying glass icon, , appears on the selected stream in the structure diagram:

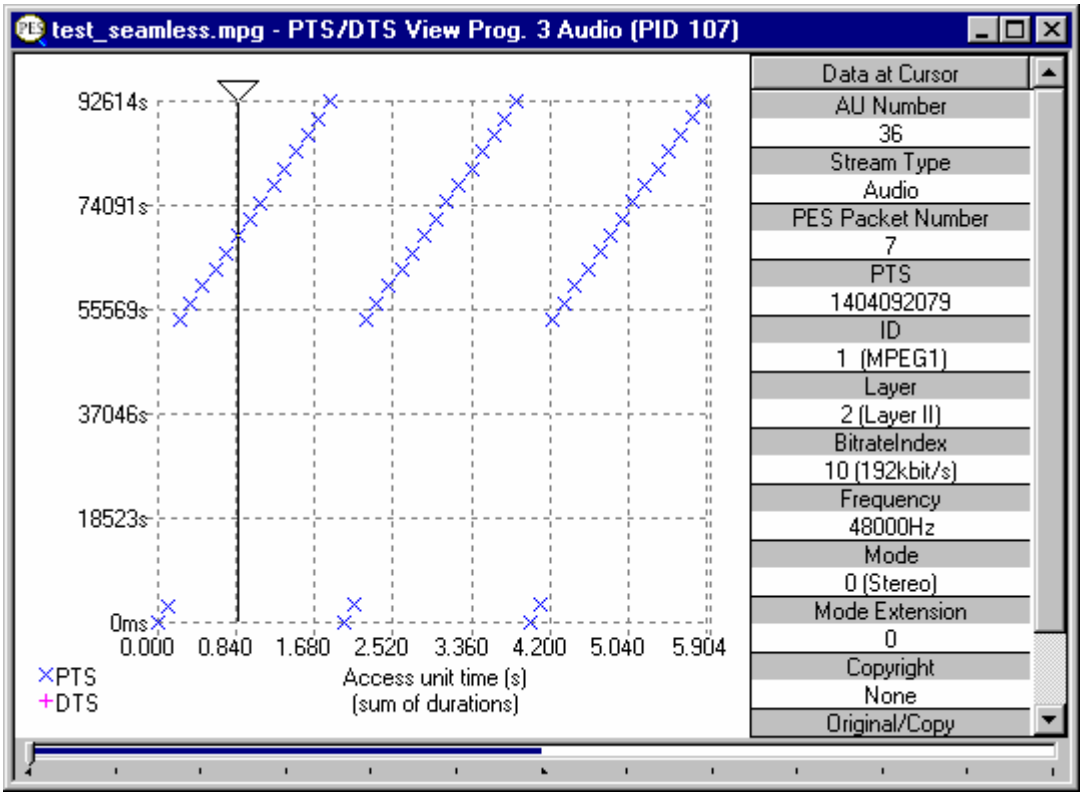


If the **Hex View** and/or **Header Interpretation** windows are open they will be updated to show the contents of the selected packet. If the **PTS/DTS View** window is open the cursor is placed on the packet and the panel showing the **Data at Cursor** is updated.

Having selected the packet it can now be inspected with other tools. The information in the Header Inspection and Hex View windows will look like this:

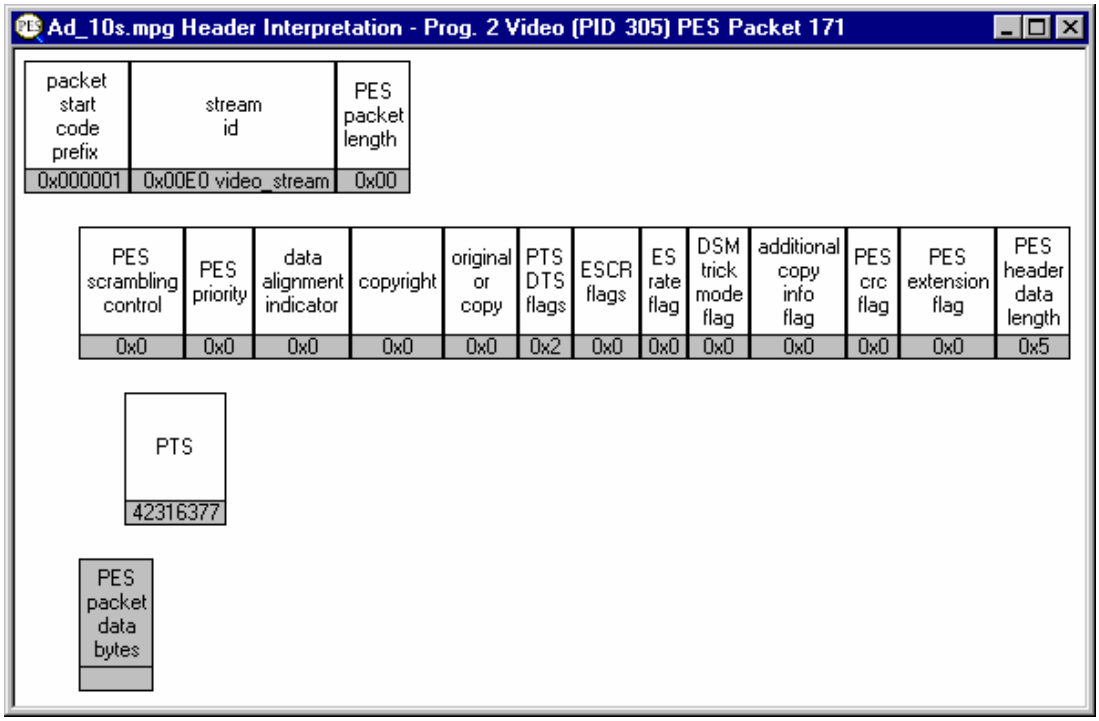


To look at the timing of all the PTS carrying packets, open the PTS/DTS View:



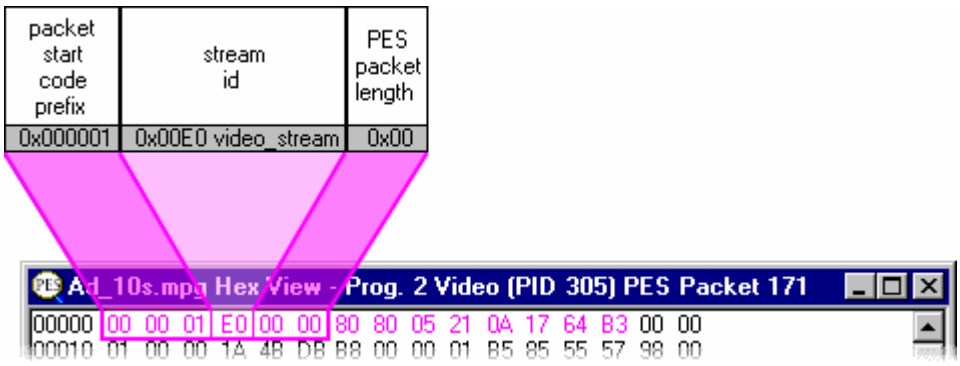
This shows all the PES packets for the selected PID. See the section on the PTS/DTS View for more information on selecting a particular packet.

PES Packet Header Interpretation

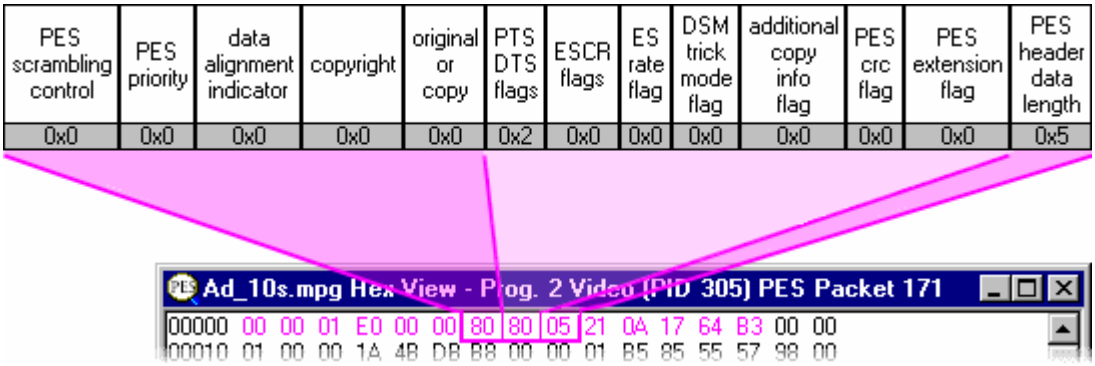


This window interprets and displays the header of the currently selected packet. The above example shows a packet which carries a Presentation Time Stamp (PTS).

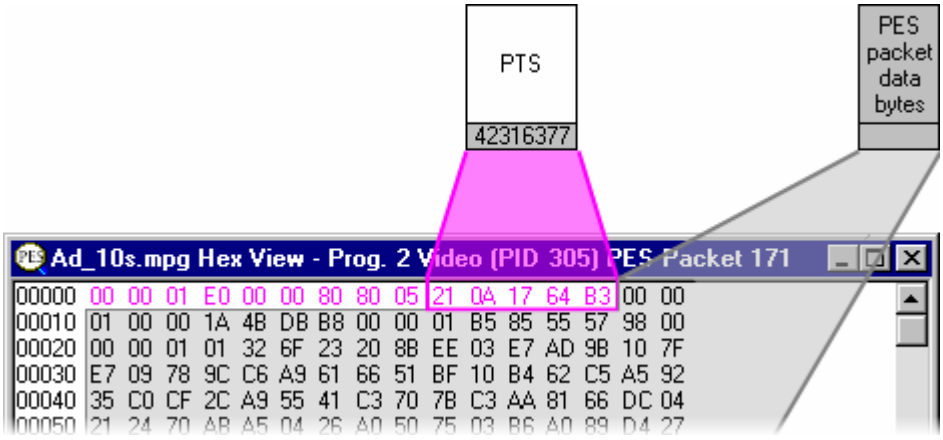
The relationship between the top row of information displayed in the Header Interpretation, for this packet, and the Hex View is:



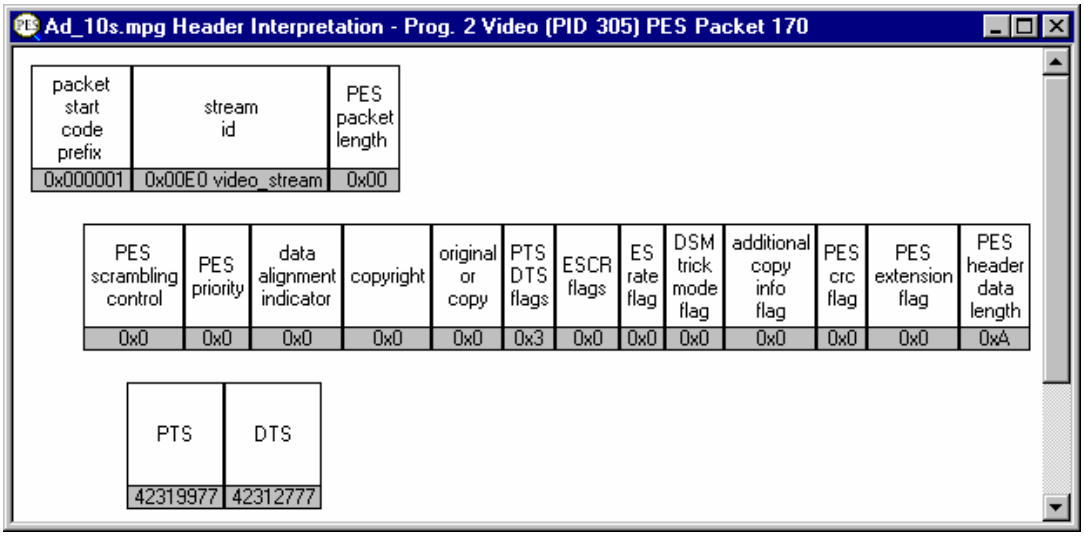
The next row completes the compulsory header information. The mapping between the Header Interpretation and Hex View is:



The last row is a reminder that after the header comes the packet data. Any other rows represent additional fields, such as the Presentation Time Stamp (PTS) carried in this example. The relationship of these rows to the Hex view is:



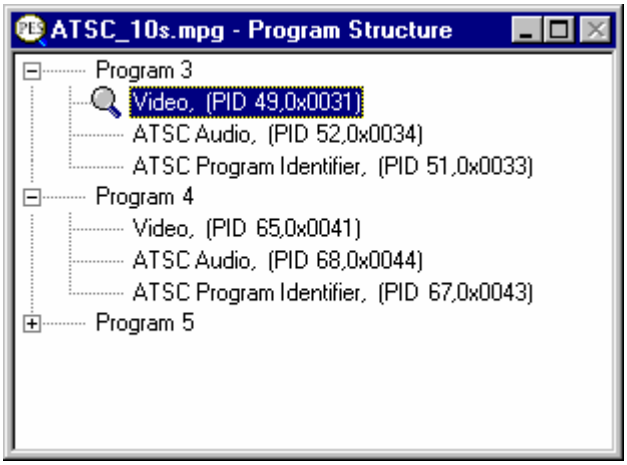
The size of the header depends on the fields it carries. Here is the Header Information view of the preceding packet which carries PTS and DTS fields:

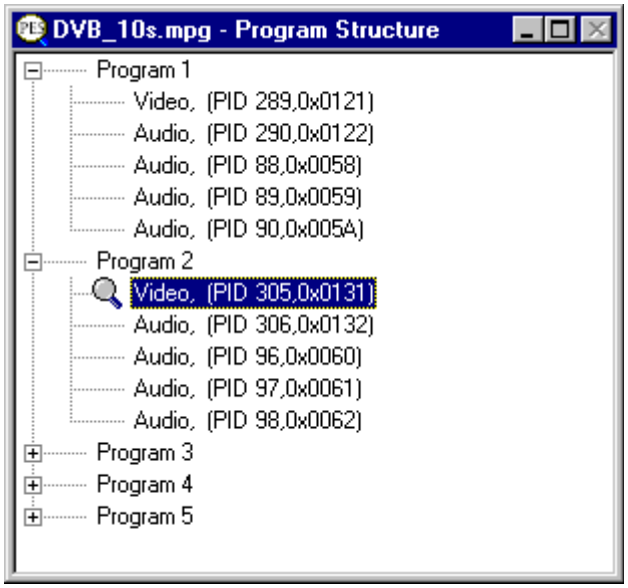


Program Structure

The Program Structure window displays a list of all available programs and the elementary streams which they comprise. It shows which stream is currently selected for inspection and may be used to select a different stream.

The example on the right shows a program structure from a file conforming to the ATSC standard.





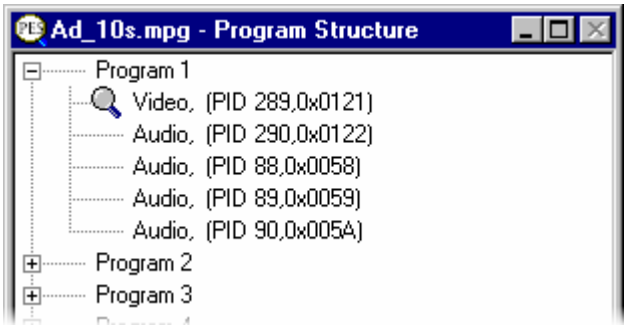
The example on the left is a program structure from a file compliant to the DVB standard.

The Diagram

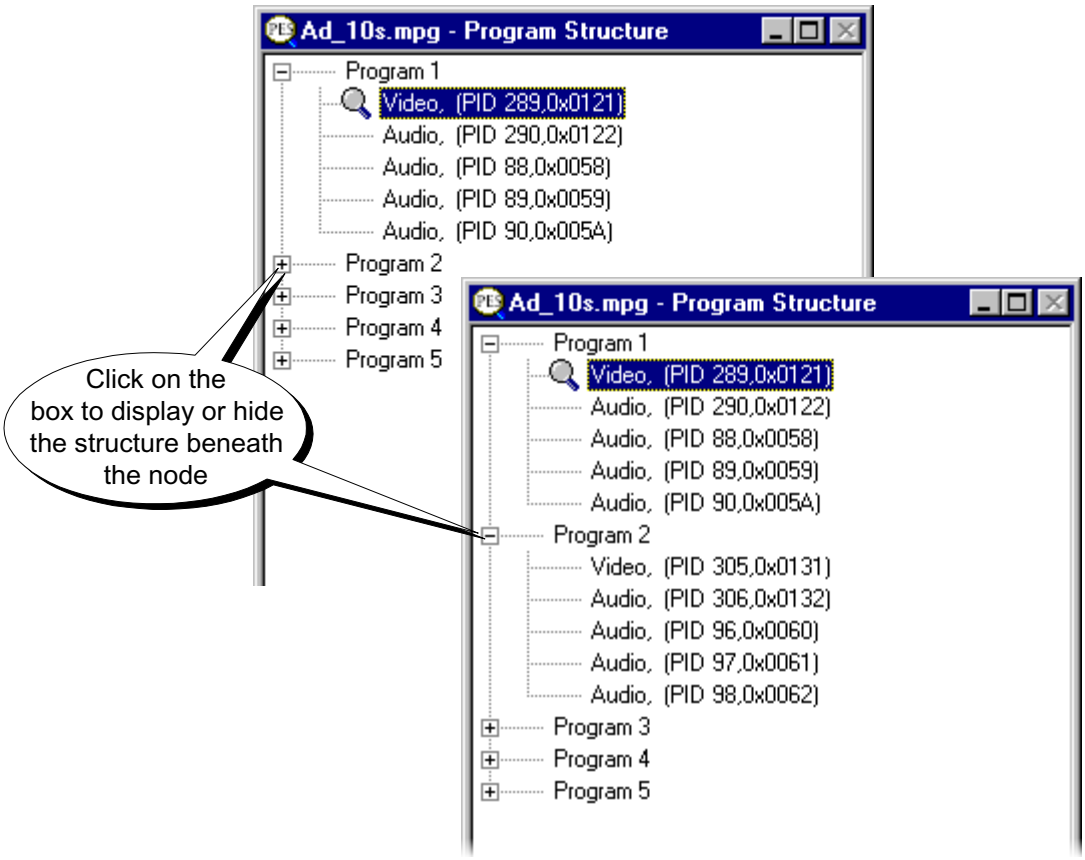
The Program Structure is displayed by the program as soon as a file is opened. As the file is analysed the top levels of a structure diagram are drawn in the window:

An Elementary Stream is selected by default. The diagram shows the selected stream and other streams in the same program. The first program is expanded to show the streams in the next level.

Streams in the other programs are initially hidden from view.



The structure is represented by a tree diagram, with the 'root node' or highest level component at the top. Components which contain more information beneath them in the structure are indicated by a square box.



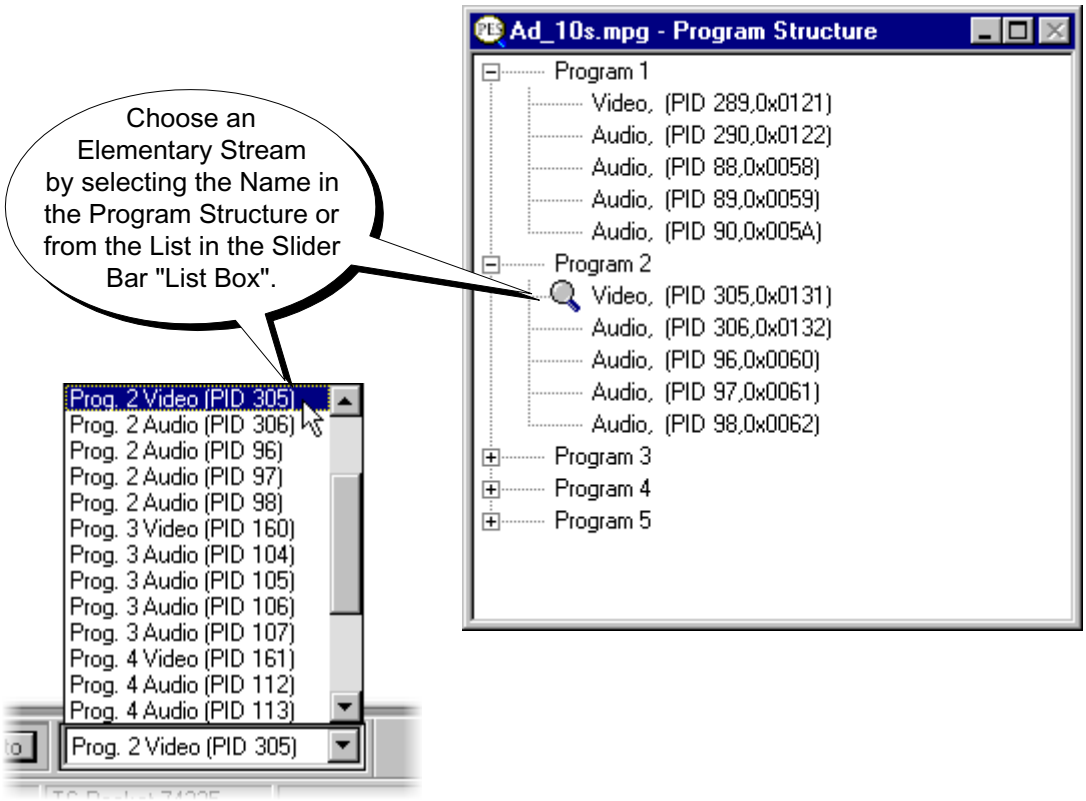
If the node (Program) has a minus sign ⊟ in the box, the level of detail (Elementary Streams) below it is displayed. The streams can be hidden by clicking the mouse pointer on the box.

If the box contains a plus sign, ⊞, there are streams contained by the program which are currently hidden. Click the mouse pointer on the box to display the next level of information under the node.

Components which are connected to a branch of the tree without a square box are leaf nodes. In this case the Video and Audio streams are leaf nodes. They display the lowest and finest level of detail.

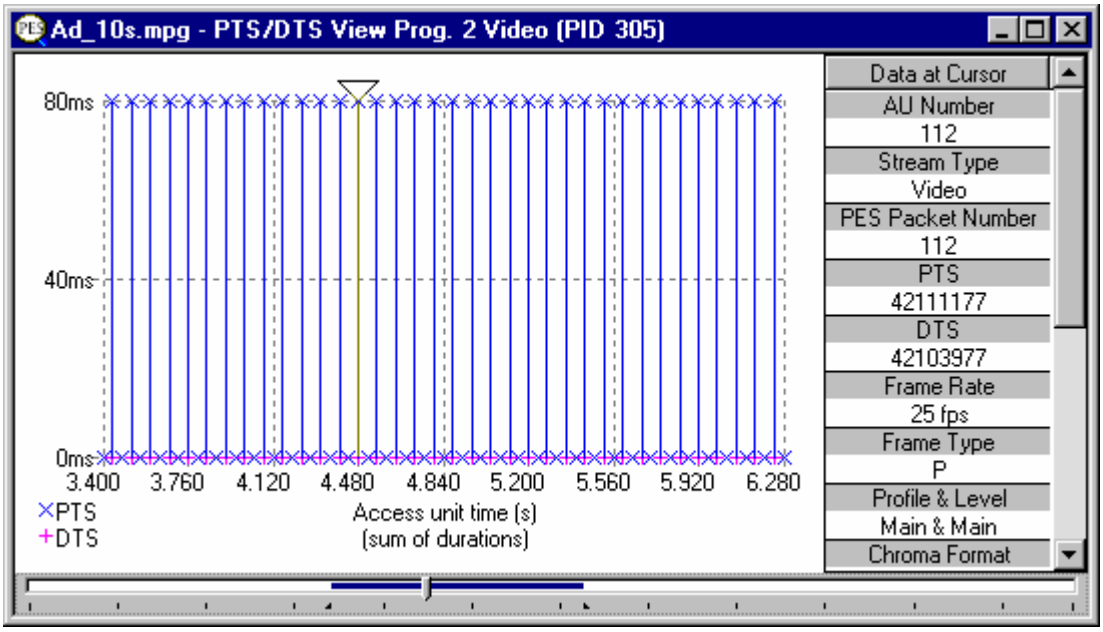
Selecting a Packet Type

When a file is first opened and analysed a stream will be selected by default. The type is indicated by the magnifying glass symbol, 🔍, in the Program Structure. It is also displayed in the Packet Type 'list Box' on the Slider Bar. A new stream may be selected from either the list box or the window.



The above example is taken from a copy of the PES Analyzer which is filling the Windows ™ desktop. Since the Slider Bar is close to the bottom of the desktop the Selection List appears above the Selection Box.

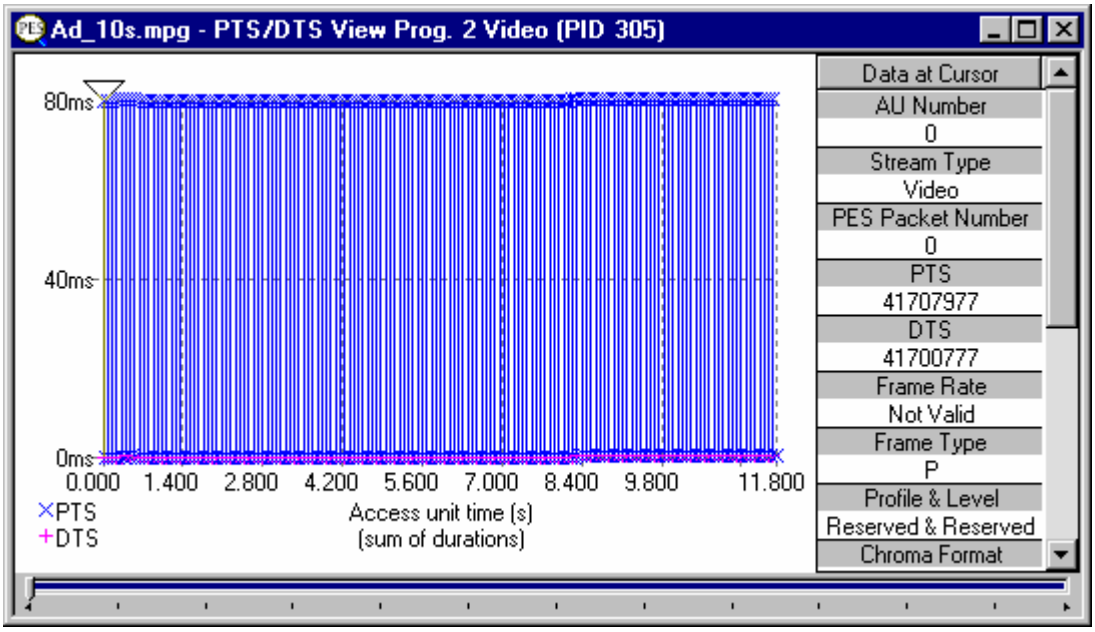
PTS/DTS Timing Analysis



The PTS/DTS View shows timing analysis of the selected stream. The x-axis shows the duration of the stream in seconds. The y-axis shows the differences between the expected and actual DTS values. A vertical blue line is used to show the difference between the PTS and DTS for each Access Unit (AU). Therefore, a compliant stream will exhibit each DTS on the 0ms y-axis. Streams with errors usually exhibit a 'stepped' graphical effect.

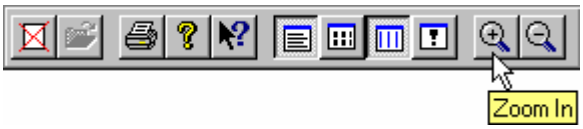
Any AU in the stream may be selected to view additional information in the panel on the right. If the panel is not tall enough to show all of the information a scroll bar appears.

When first opened the entire stream is shown. Even a small file may display data points packed too closely together to be read. E.g. here is just under 12 seconds of video:

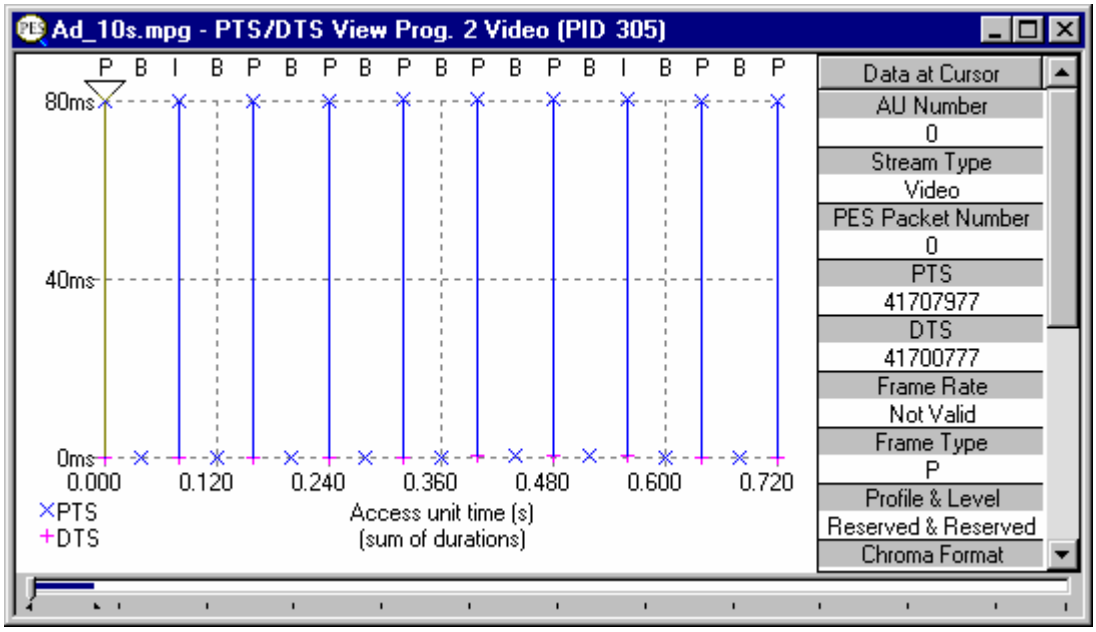


A longer sample may appear as a solid band of blue.

To see the individual packets or access units click on the **Zoom In** button on the Toolbar:



In this example, clicking the on the **Zoom In** button 4 times gave a much clearer view:

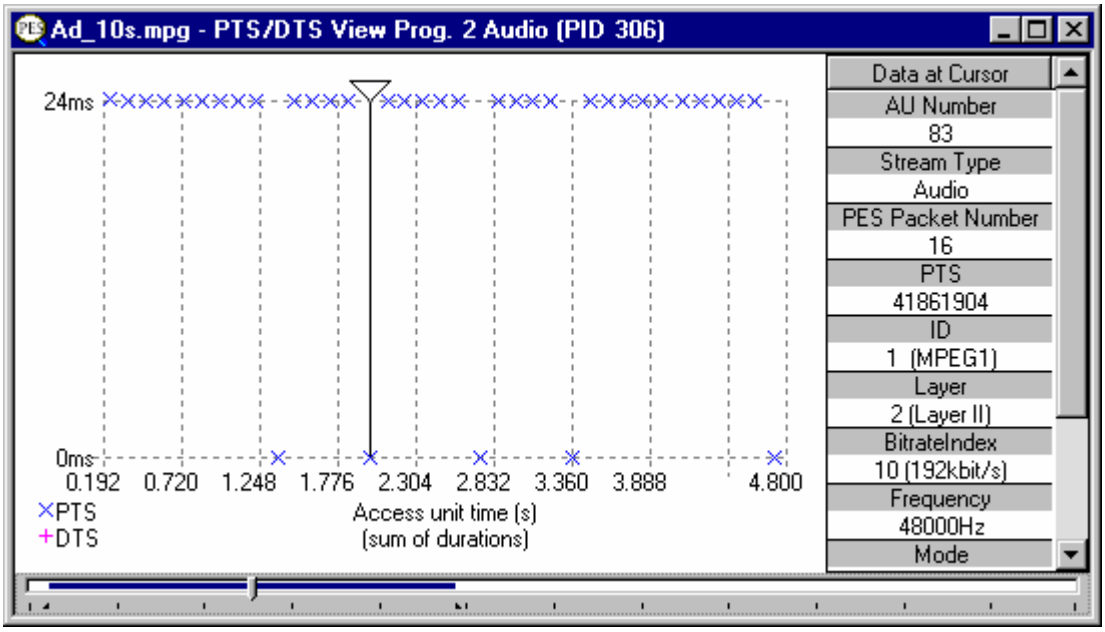


The blue × crosses of Presentation Time Stamps and the magenta + crosses of Decoding Time Stamps can now be differentiated.

To Zoom back out click on the **Zoom Out** button as many times as required:

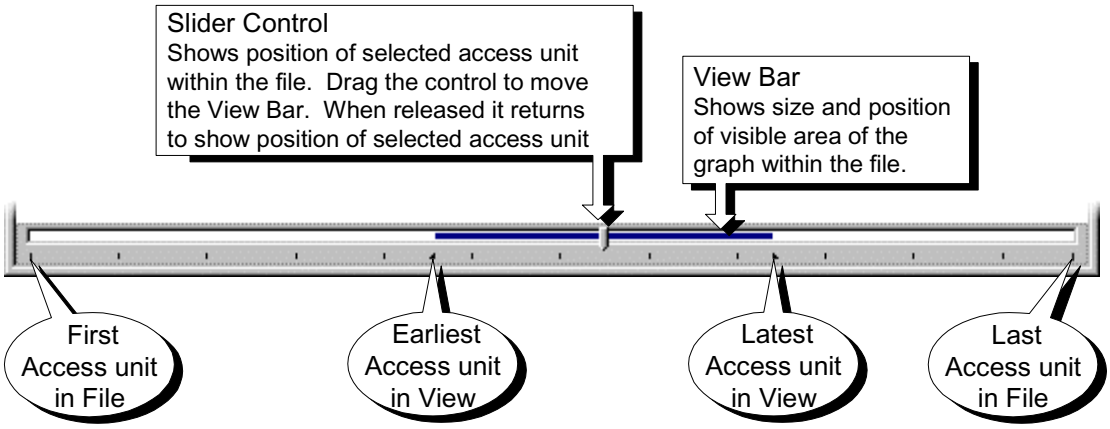
Access Unit Selection

The triangular cursor above the graph indicates the selected access unit. Extra information about that access unit is displayed in the Panel on the right of the Graph.



Scrolling the View

The Slider at the bottom of the window indicates where the displayed packets / access units are in relation to the rest of the file. It can be used to scroll the display through the data in the same way as a standard window scroll bar.



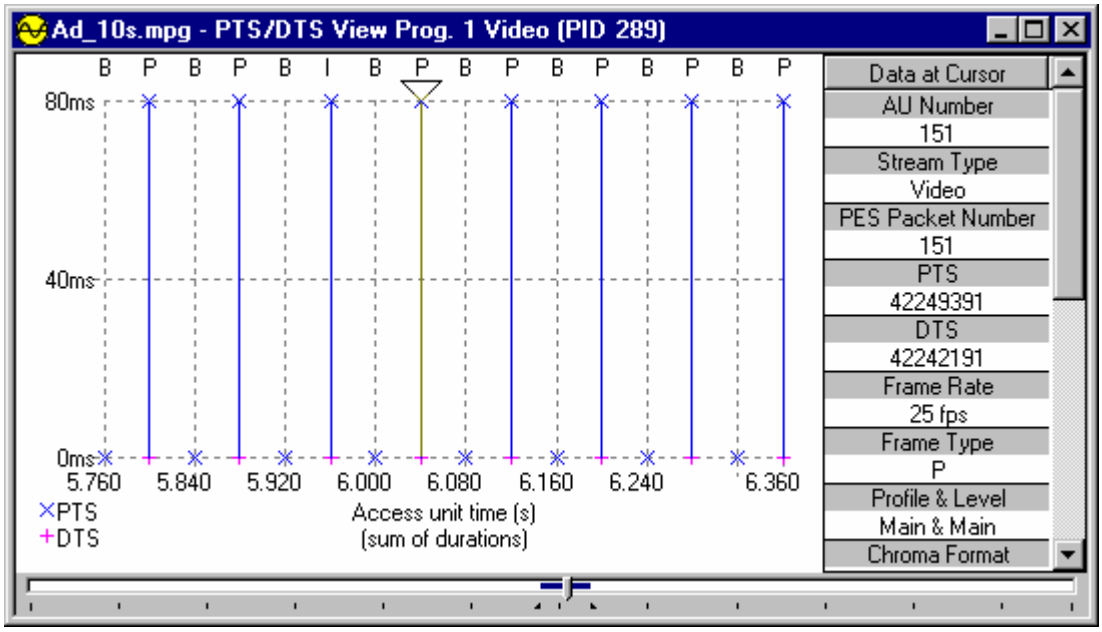
To scroll the stream through the view drag the Slider Control left or right with the mouse. After dragging the Slider Control it returns to the previous position showing the location of the selected access unit.

Click the mouse pointer on the white space either side of the View Bar to centre the displayed graph about the currently selected access unit.

When an access unit is selected on the graph, the Slider Control is automatically re-positioned within the View Bar. The placement of the Slider Control reflects the position of the selected packet in the field of view.

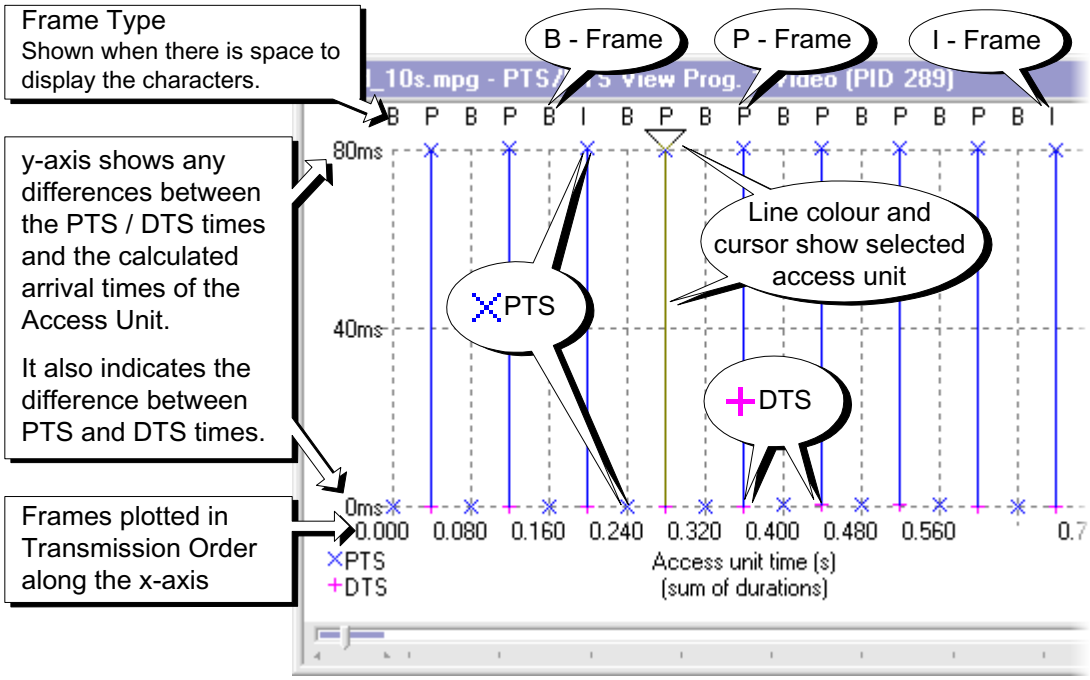
Selecting an Access Unit on the graph also changes the selection for all of the other views to the packet containing that Access Unit.

Video Streams



The panel on the right shows information about the selected access unit. For video streams these are always complete packets. Some of the information shown in the panel is specific to video streams, i.e. Frame rate and frame type.

The graph shows the frames of video in transmission order analysis and, when 'Zoomed In' close enough, the type of each packet plotted along the x-axis. The graph scale is drawn in grey dashed lines. It is the equivalent of the scale or graticule on an oscilloscope or logic analyzer.



X Axis

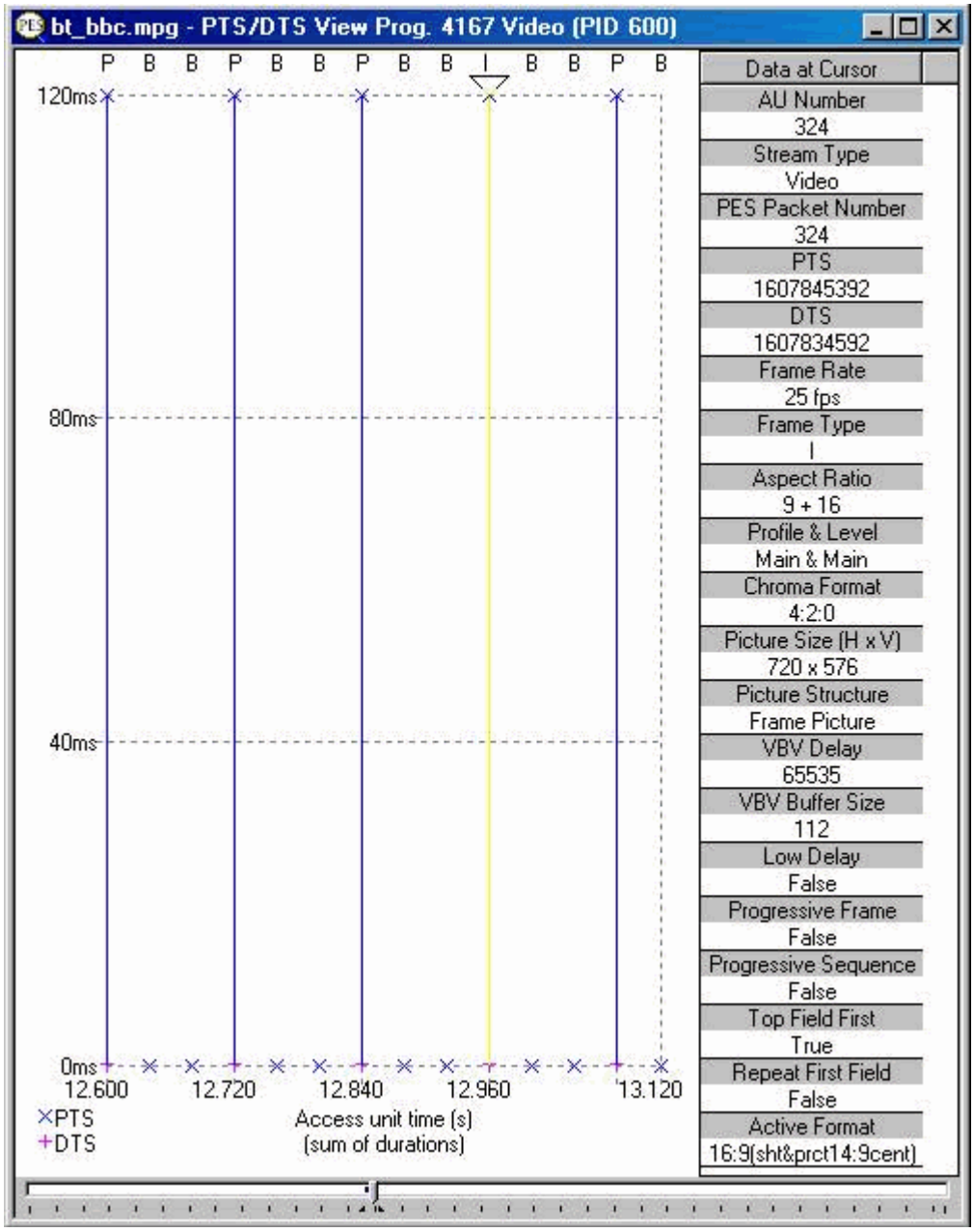
The x-axis shows the nominal time of an access unit. The first access unit displayed is taken to have a nominal time of zero. Each access unit has a nominal duration, calculated from parameters within the elementary stream. These parameters include ‘low_delay’ and ‘repeat_first_field’, which allow analysis of effects such as 3:2 pulldown. These effects alter the access unit duration, which is nominally equal to a video frame period.

Y Axis

The position on the y-axis of a PTS or DTS shows the relative timing of the timestamps. The first timestamp (PTS, or DTS) is taken to have a y-value of zero. Each Subsequent timestamp has a y-value given by the difference between their timestamp and the first timestamp, less the difference in nominal time of their access unit and the first access unit.

The solid blue vertical lines show the time difference between the PTS and DTS from the same Access Unit.

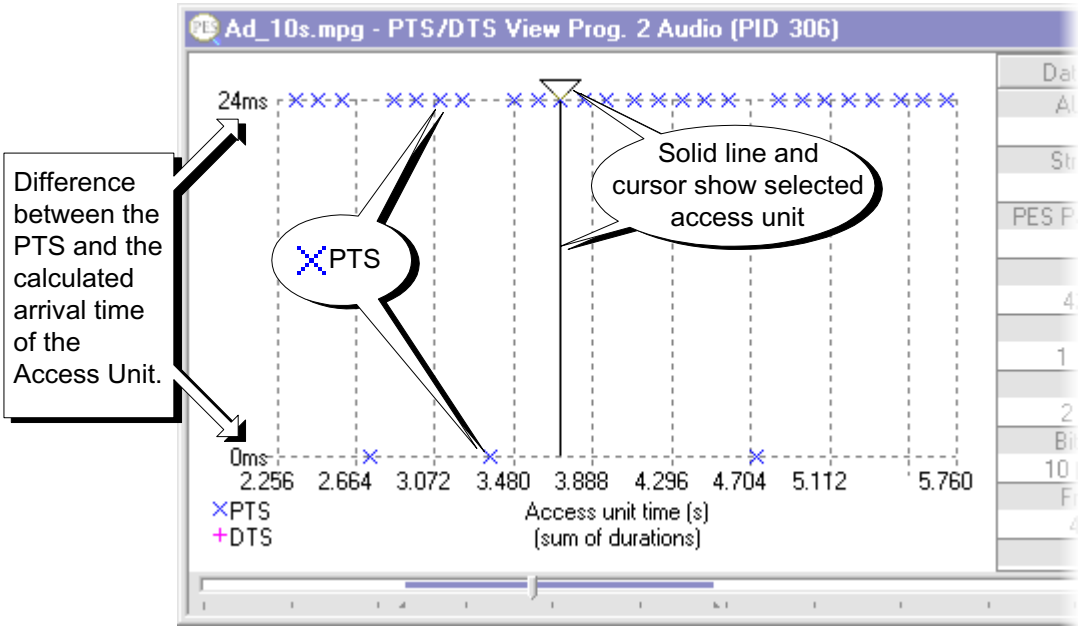
Audio Streams



The panel on the right shows information about the selected access unit. For video streams these are always complete packets. Some of the information shown in the panel is specific to video streams, i.e. Frame rate and frame type. The 'Picture Size (H x V)' information is taken from the display_horizontal_size and display_vertical_size values in the sequence display extension, or if that is not present the horizontal_size_value and vertical_size_values in the sequence header, as modified by the sequence header extension values horizontal_size_extension and vertical_size_extension in the sequence header extension.

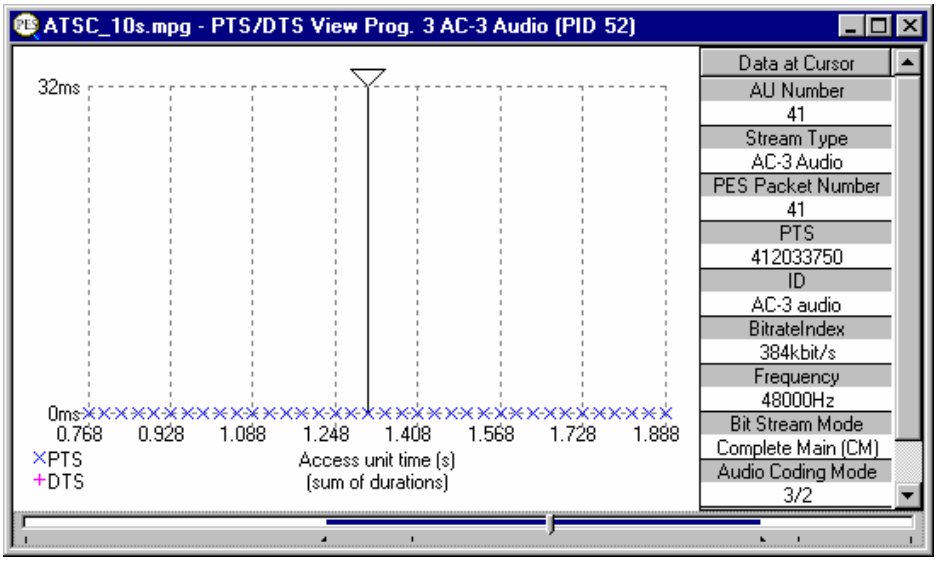
Some of the information shown in the panel is specific to audio streams. AC-3 Audio streams will differ from Audio streams.

The graph shows timing analysis of the PTS. There are no DTS in an audio stream. Select an access unit by clicking on it with the mouse. Clicking between two PTS will select an access unit which does not carry a PTS.



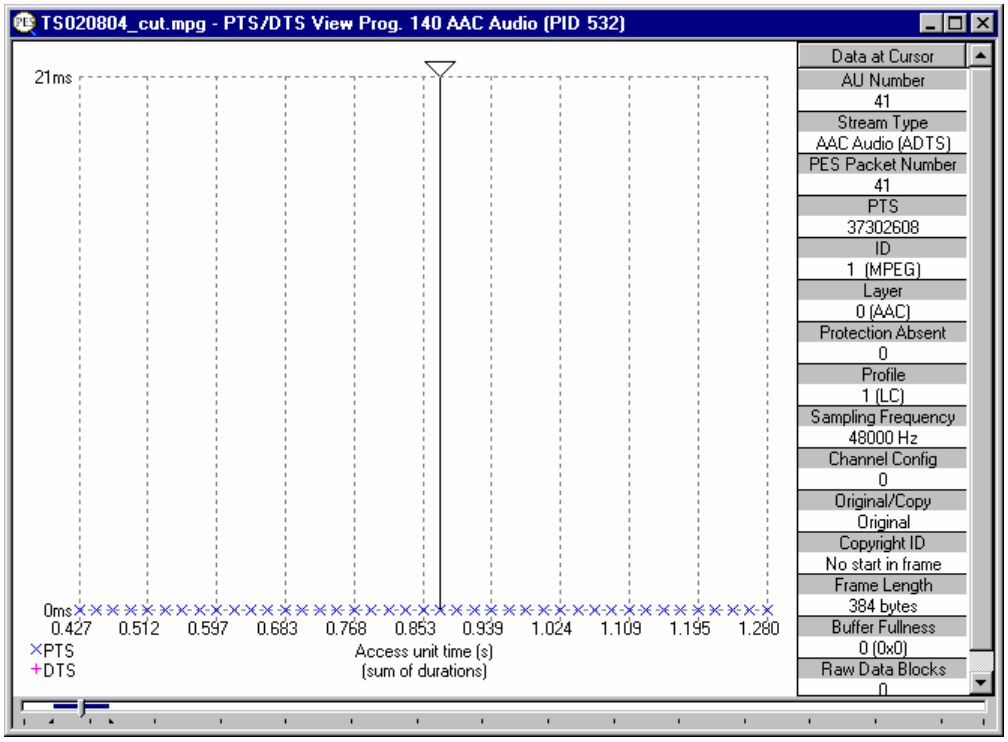
The graph scale is drawn in grey dashed lines for each value on the axes. In this example there are only two values on the y-axis, at 0ms and 24ms.

AC-3 Audio Streams



The Data at Cursor panel of the PTS/DTS View shows different information for AC-3 Audio streams. Otherwise the window works in the same way as for Audio streams.

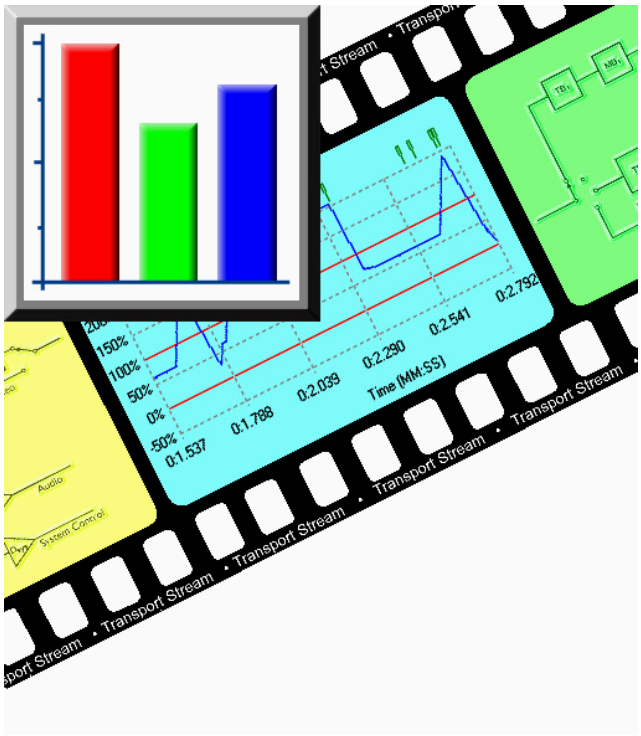
AAC Audio Streams



The Data at Cursor panel of the PTS/DTS View shows different information for AAC Audio streams. Otherwise the window works in the same way as for Audio streams.

Section 3

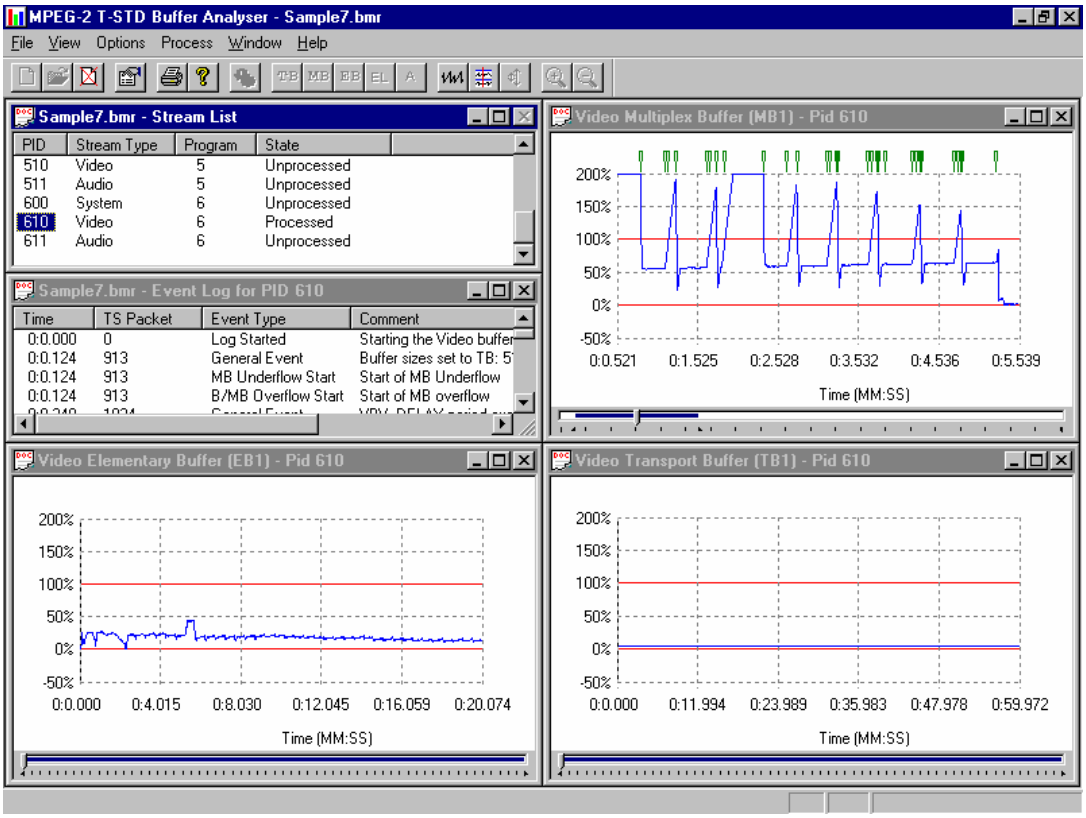
T-STD Buffer Analyzer



Introduction 3
Suitable Streams 3
Table Handling 4
Starting the Program 5
Initial Appearance 5
Initial Menu Options 6
Settings 7
System Settings 7
Video Settings 8
Audio Settings 9
Opening an MPEG file 11
Opening a BMR file 12
Initial processing of MPEG files 13
Initial processing of BMR files 14
Menus and Controls 14
Toolbar 14
Status Bar 16
File Menu Options 17
View Menu Options 17
Options Menu Options 18
Process Menu Options 18
Window Menu Options 19
Help Menu Options 19
Stream List 20
Selecting Streams 21
Processing Streams 22
Supported Profiles & Levels 22
Start-Up 22
Approximations 23
Global Event Log 23
PID Event Log 24
Event Selection 24
Results Graphs 25
Elementary Buffer Graph 32
Multiplex or Main Buffer Graph 33
Transport Buffer Graph 34
Detail Message Logging 35

Introduction

The T_STD Buffer Analyzer models the behaviour of the buffers in the hypothetical Transport Stream System Target Decoder, as specified in ISO/IEC 13818-1. It will process video, audio and system control streams. The results of the analysis are displayed as graphs of the buffer capacity over time and a log of exceptions and noteworthy events.



Suitable Streams

Any valid MPEG file, recorded or synthesised, can be processed by this application. A valid file is one which starts on a transport stream (TS) packet boundary. That is the first byte of the file must contain the first byte of a TS packet.

The Buffer Analyzer will process video, audio and system control streams which are compliant with the 1996 standard ISO/IEC 13818 parts 1-3.

It will handle transport streams which contain PCR and/or PTS/DTS discontinuities. The PTS/DTS and PCR in a stream must, however, use the same timebase.

Buffer Analyzer is unable to work on scrambled streams. If it fails to make sense of a stream use TS Analyzer to determine if the stream is scrambled.

Table Handling

Multiple PAT and PMT Versions

Buffer Analyzer forms a list of which elementary streams are present in the transport stream. This is called the Stream List. It creates the Stream List by reading the first occurrence of the Program Association Table (PAT) and Program Map Table (PMT).

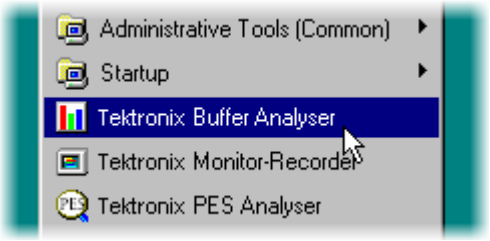
If more than one version of the PAT and/or PMT are present TS Cutter may be used to isolate a particular section for analysis.

MPEG-2, DVB and ATSC Tables

Only PIDs carrying MPEG-2 PSI tables are included in the System model. Any DVB or ATSC tables which are present in the Transport Stream are ignored.

Starting the Program

The program may be started by selecting the **Tektronix Buffer Analyser** option from the **Start -> Programs** menu.

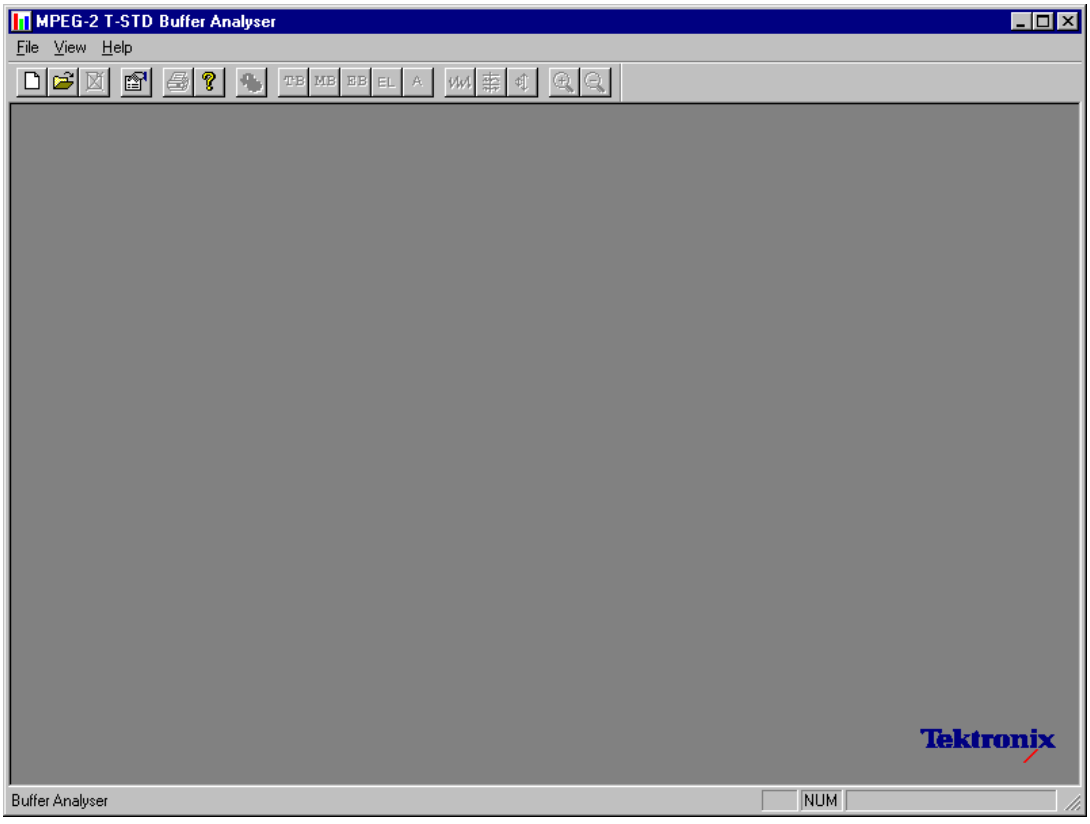


or

by double clicking on the **Tektronix Buffer Analyser** Shortcut on the desktop.

Initial Appearance

Once the program has started and is ready for use it will open a Main Window. When the program starts the main window looks like this:



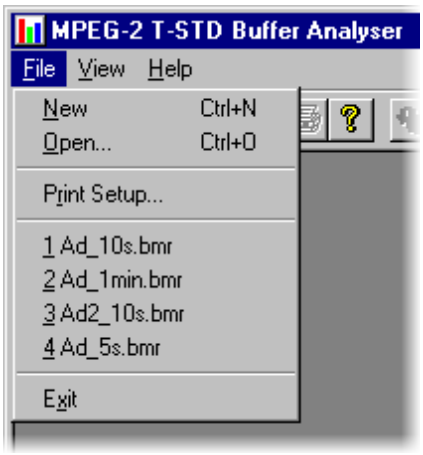
The Toolbar (row of buttons above the dark grey area of the empty window) may be hidden from view, moved to a separate window, either side or the bottom of the main window.

The Status line at the very bottom of the window may be hidden from view. It displays information about the application and keyboard status.

Initial Menu Options

The application presents different menus and options, depending on whether or not a file is open for analysis. The menu options available when Buffer Analyzer has just been started, or after a file is closed, are:

File Menu Options



New — Opens a stream file for analysis and opens or creates a Buffer Model Results (BMR) file in which to store the results.

The application opens a file selection dialogue allowing the user to choose the stream file. It then opens another file selector dialog to specify the BMR file.

Open... — Opens an existing BMR file to review results of a previous analysis. The application opens the file selection dialogue allowing the user to choose the required file.

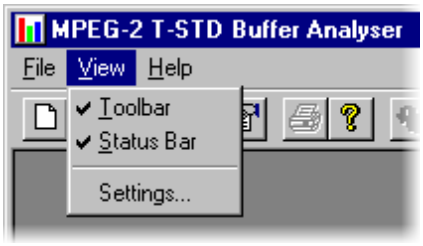
Print Setup... — Opens a dialogue for selecting which printer and associated options to use.

1 *<filename>*
2 *<filename>*
3 *<filename>*
4 *<filename>* — A list of the four most recently used BMR files. If Buffer Analyzer has recently been installed the list may hold less than 4 files.

Selecting a filename opens that BMR file for review.

Exit — Finishes running the program.

View Menu Options



(a check mark ✓ next to an option shows that the toolbar is currently visible, no ✓ means that it is hidden.)

Toolbar — Toggles the Toolbar between being displayed or not. Select the option to change the state.

Status Bar — Toggles the status bar between being displayed or not.

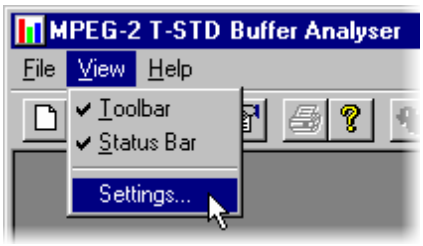
Settings… — Opens the Settings dialogue for specifying **Video Buffer Sizes** and **Video Data Transfer** method.

Settings

Various configuration parameters, including **Packet Interpretation**, **Pre-Scan Packets**, **PES Private Interpretation**, **Video Buffer Sizes**, **Video Data Transfer** method and **Audio Buffer** sizes, may be modified both before and after opening an MPEG file. When a file is open one or more streams may be analysed, the settings changed, and then other streams analysed with the new settings. If the settings are changed, to re-analyze streams analysed with previous settings, the MPEG file must be closed and opened again.

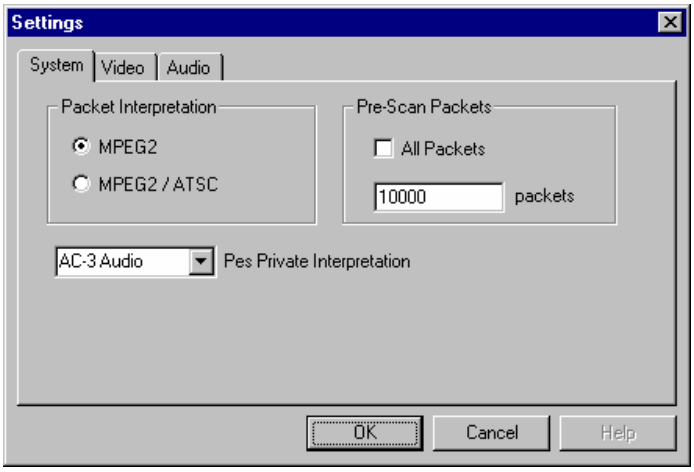
It is a good idea to check the settings before opening a file to verify the method with which video streams will be analysed.

Select **Settings...** from the **View** menu to open the Settings dialogue.



This opens the Settings dialog which has three tabs: **System**, **Video** and **Audio**.

System Settings



These options can only be set before analysing a file. They are disabled (greyed out) while a file is open.

The **MPEG2 / ATSC** option is available on ATSC or ATSC/DVB dual standard MPEG Test System products. It is disabled (greyed out) on single standard DVB systems.

Packet Interpretation

Specifies which standards will be used for interpreting the packets in the Transport Stream when a file is opened for analysis. The options are:

- **MPEG2** — Interprets the packets according to the standards for DVB streams.
- **MPEG2 / ATSC** — Interprets the packets according to the ATSC standards. This option is required to allow AC-3 audio stream content to be analysed.

Pre-Scan Packets

During the initial processing of an MPEG file, a number of packets are pre-scanned for information that will result in a more accurate analysis of the initial parts of the transport stream. The greater the number of pre-scanned packets, the greater the chance of locating all of the information required for accurate analysis. The drawback is increased processing time. By default, 10000 packets are pre-scanned, which should be sufficient for most streams, excluding High Definition Video.

All Packets — Select this checkbox to cause all packets to be pre-scanned. If this checkbox is selected, the **packets** field will be disabled (greyed out).

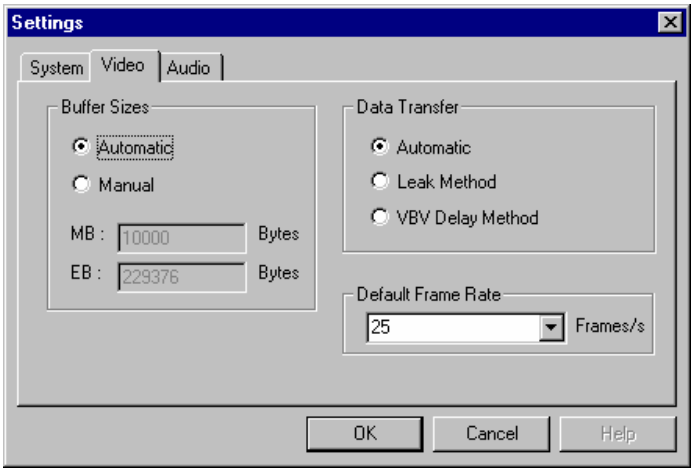
Packets — If the **All Packets** checkbox is not selected, enter the number of packets to be pre-scanned in this field.

PES Private Interpretation

This setting specifies the model type to use for streams signalled as PES Private (stream_type = 6)

The selections available include the following: AC-3 Audio, AAC Audio, MPEG-2 Audio and Video and System. The default setting is **AC-3 Audio**.

Video Settings



Buffer Sizes

Specifies the sizes which will be used for the Main and Elementary Buffers, when interpreting the stream. The options are:

Automatic — Automatically detect the buffer sizes from the Sequence Headers and Extensions in the elementary stream being processed. This is the default option when the application is started.

Manual — Enables the size of the Main or Multiplex buffer (MB) and Elementary Buffer (EB) to be specified manually. The **MB** and **EB** fields are available for editing when this option is enabled.

Data Transfer

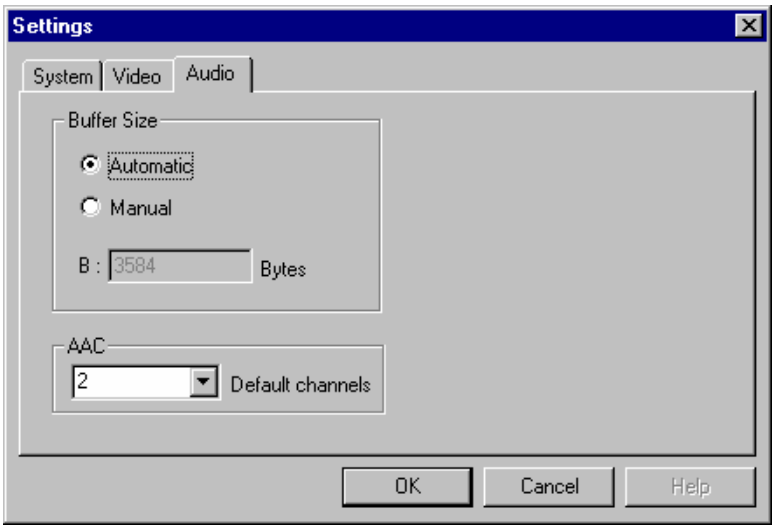
By default Buffer Analyzer inspects the stream to determine which transfer method to use. This can be overridden if required. The options are:

- **Automatic** — Examine the stream to determine the transfer method. This is the default option when the application is started.
- **Leak Method** — Forces modelling of the stream using the Leak Method.
- **VBV Delay Method** — Forces modelling of the stream using the Video Buffer Verifier (VBV) Delay Method.

Default Frame Rate

The frame rate is one of the parameters that is searched for during the pre-scan phase of analysis. However if it is not found, then the default value selected from the drop-down list in the **Default Frame Rate** field is used.

Audio Settings



Buffer Size

Specifies the size that will be used for the audio buffer when interpreting the stream. The options are as follows:

- **Automatic** — Automatically detect the buffer sizes from the Sequence Headers and Extensions in the elementary stream being processed. This is the default option when the application is started.
- **Manual** — Enables the size of the buffer (B) to be specified manually. The **B** field is available for editing when this option is enabled.

AAC

Select the number of AAC channels required from the drop-down list.

Within the ADTS (Audio Data Transfer Stream) fixed header, the channel configuration field is used to indicate the number of channels required by AAC. If the number in this field is zero, then the value in the **AAC Default channels** field is used.

Note that the associated ADIF (Audio Data Interchange Format) is unsupported.

Ref:
Information technology – Generic coding of moving pictures and associated information, Part 7: Advanced Audio Coding (AAC)
ISO/IEC 13818-7:1997

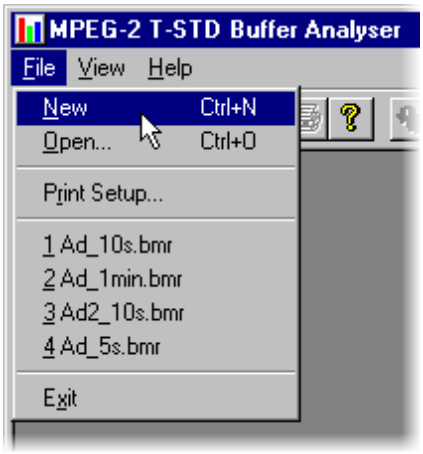
Remember that if the settings are modified the new settings are used for all video streams which are subsequently processed. The settings are reset to the default option when the application is started.

Opening an MPEG file

Any file holding a recorded or synthesised sample of a Transport Stream that carries video, audio and/or system control streams may be analysed. These files are referred to as MPEG files to distinguish them from Buffer Model Results (BMR) files. The results of analysis are written to a BMR files.

Opening a file from the Menus and Toolbar

To open a file for analysis, select the **New** option from the **File** menu. Alternatively use the **Ctrl+N** keyboard shortcut.



The list of previously used files shows BMR not MPEG files, as can be seen by their **.bmr** extension.

There is a shortcut button, for the New command, on the Toolbar:

In response to the **New** command Buffer Analyzer opens a file selection dialog to choose an MPEG file for processing. When the MPEG file has been chosen, the MPEG file selector closes and another file selection dialog is opened. This is for choosing a Buffer Model Results File (BMR) which holds the results of any analysis performed on the MPEG file.

Buffer Analyzer suggests an output file with the same name as the MPEG file but a file extension of **.bmr** to hold the Buffer Model Results. Select **OK** to accept the suggested filename. Otherwise select a different file or type in a different name and then select **OK**.

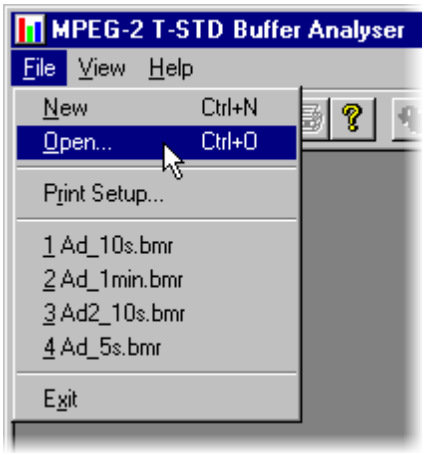
Choosing an existing BMR file will erase all results which had previously been saved in that file.

Opening a BMR file

An existing Buffer Model Results (BMR) file can be opened to review the results saved in it from previous Buffer Model Analysis.

Opening a file from the Menus and Toolbar

To open a BMR file select the **Open...** option from the **File** menu. Alternatively use the **Ctrl+O** keyboard shortcut.

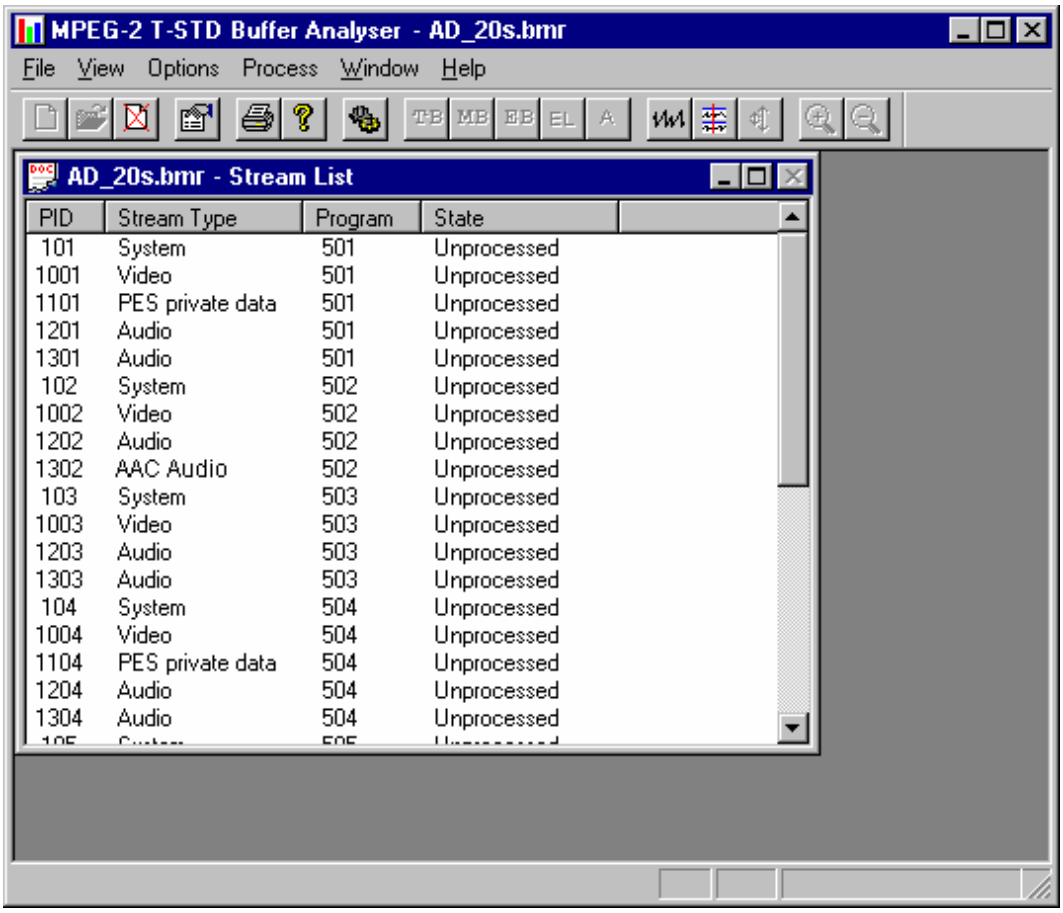


If the required file is in the list of recently analysed BMR files, it can be opened from the list to save using the open file dialogue.

There is a shortcut button available on the Toolbar for opening a file, which has the standard file open symbol:

Window Layout

The **Stream List** window is opened as soon as either an MPEG or BMR file is opened. The application inspects the file to find what program streams are present according to the **Packet Interpretation** setting. For example:



PID	Stream Type	Program	State
101	System	501	Unprocessed
1001	Video	501	Unprocessed
1101	PES private data	501	Unprocessed
1201	Audio	501	Unprocessed
1301	Audio	501	Unprocessed
102	System	502	Unprocessed
1002	Video	502	Unprocessed
1202	Audio	502	Unprocessed
1302	AAC Audio	502	Unprocessed
103	System	503	Unprocessed
1003	Video	503	Unprocessed
1203	Audio	503	Unprocessed
1303	Audio	503	Unprocessed
104	System	504	Unprocessed
1004	Video	504	Unprocessed
1104	PES private data	504	Unprocessed
1204	Audio	504	Unprocessed
1304	Audio	504	Unprocessed

Initial processing of MPEG files

If an MPEG file is opened the program performs initial analysis to form the Stream List and calculate the mean transport rate. All streams in the list are marked as **Unprocessed**, because no analysis has been performed on them in this session.

To build the Stream List the MPEG file is scanned for the PAT and PMT table contents. It is assumed that the contents are constant, which is the general case. If the program changes in a drastic way, such as streams disappearing between PMTs, the model will give meaningless results.

Only the first occurrence of complete PAT and PMT are read when forming the Stream List. Use TS Cutter to isolate a section when multiple versions of the tables occur.

A number of packets in the file are scanned for the Sequence Header and Extension start codes (containing profile and level) (see Settings, page 7). If they are not found the Main Profile and Level setting are assumed together with the maximum VBV buffer size.

Initial processing of BMR files

If a BMR file is opened the **State** column indicates which streams had been processed. The file only holds results for those streams marked as **Processed**. To obtain results for **Unprocessed** streams the original MPEG file will have to be opened again and analysed.

Menus and Controls

When a file is open, the program presents a different set of menus and options. They change as soon as the Stream List window appears. For example, the Open file commands are replaced by Close file commands.

Toolbar

The Toolbar provides a set of convenient shortcuts for the more frequently used menu options. The available commands are:

Opens dialogs to select an MPEG file for analysis and a BMR file for saving the results. This button is disabled (greyed out) when a file is open.

Opens a dialog to select a BMR file to review the results of a previous analysis session. This button is disabled (greyed out) when a file is open.

Closes the current file. This button becomes available the moment a file is opened. If the wrong file is being opened, or the wrong options are selected, clicking on the button will abandon the analysis and close the file.

Opens the Settings dialog.

Prints the contents of the current window.

Opens a dialogue which displays the program version number.

Analyses the stream(s) from the PID(s) which are currently selected in the **Stream List**. This button is only enabled when one or more PIDs which are marked as **unprocessed** are selected.

The next group of 5 buttons open Results Views for the selected streams.

Opens a graph of the Transport Buffer for the selected stream. This button is only enabled when the PID of a **Processed** stream is selected in the **Stream List** window.

Opens a graph of the: Multiplexing Buffer of a video stream; Main Buffer of an audio stream or of a system information stream. The button is only enabled when the PID of a **Processed** stream is selected in the **Stream List**.

Opens a graph of the Elementary Stream Buffer for the selected video stream. This option is only available when a PID carrying a **Processed** Video stream is selected in the **Stream List**.

Opens the Event Log for the selected stream. The button is only enabled when the PID of a **Processed** stream is selected in the **Stream List** window.

Opens all of the relevant graphs and the event log for the selected stream. This option is only available when a PID carrying a **Processed** Video stream is selected in the **Stream List**.

The remaining buttons control display options for Graphs of buffer analysis results.

Toggles the graph displays between having all points drawn and sampling the points for drawing.

Synchronise Graphs toggles the graphs between using the same position and zoom settings or operating independently.

Auto Scale toggles the selected graph between fixed and auto scaling of the y axis.

Zoom In increases the magnification along the x-axis (time scale) of the currently selected graph. All graphs are affected if Synchronise Graphs is enabled.

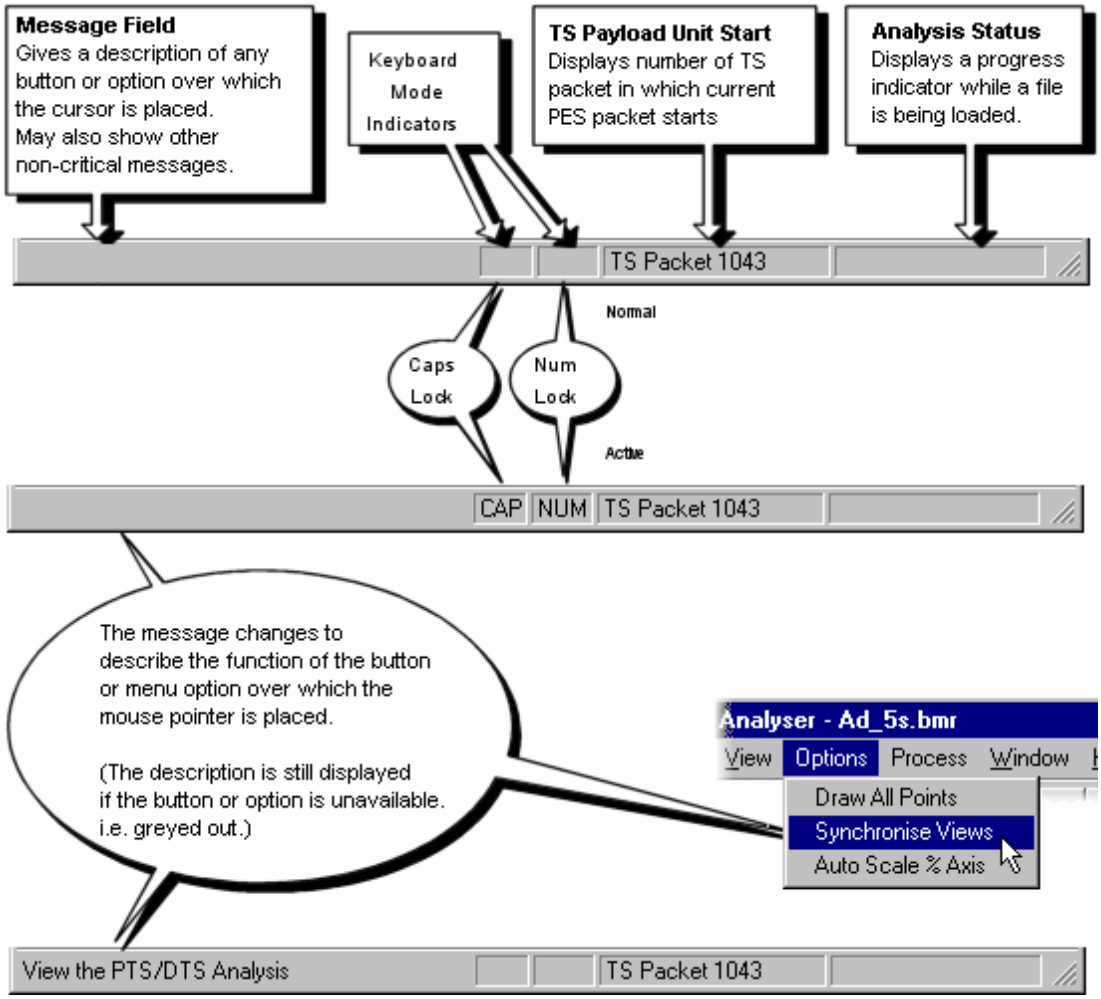
Zoom Out reduces the magnification along the x-axis (time scale) of the currently selected graph. All graphs are affected if Synchronise Graphs is enabled.

The Toolbar can be dragged off the edge of the main window into a floating pallet. To do this place the mouse pointer on the background inside the Toolbar, i.e. not on one of the buttons, hold the left button down and drag into the main window area. The result is a self contained window which looks like this:

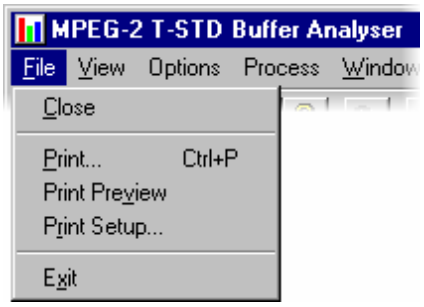
To replace the Toolbar on the window border drag it over the border, until the outline changes shape, and release it. It can be placed on the top, bottom, left or right hand edges.

Status Bar

The Status Bar may be hidden from view, but if visible is always at the bottom of the main window. It displays the following information about the program and keyboard states:

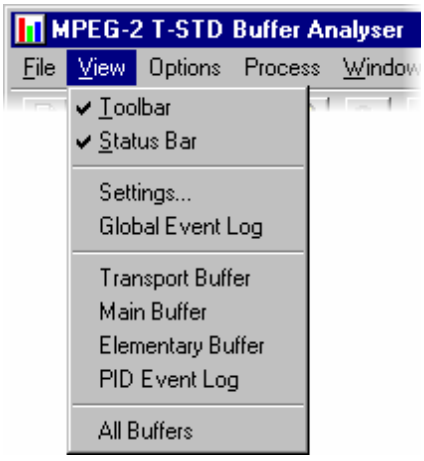


File Menu Options



Close	Closes the current file. This option is available as soon as analysis starts. If the wrong file is being opened, or the wrong options are selected, selecting this option will abandon the analysis and close the file.
Print	Prints contents of the current window.
Print Preview	Prints contents of the current window.
Print Setup	Selects printer and configuration.
Exit	Closes any file that is open and terminates execution the program.

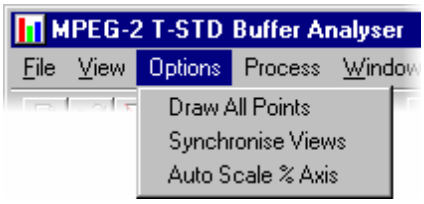
View Menu Options



(a check mark ✓ next to an option indicates that the toolbar is currently visible, no ✓ means that it is hidden.)

Toolbar	Shows or hides the Toolbar.
Status Bar	Shows or hides the Status Bar.
Settings…	Opens the Settings dialog.
Global Event Log	Shows or hides the Global Event Log window.
Transport Buffer	Opens a graph of the Transport Buffer for the selected PID.
Main Buffer	Opens a graph for the selected PID in the Stream List. The graph shows results for the Main Buffer of audio and system streams or the Multiplex Buffer for video streams.
Elementary Buffer	Opens a graph of the Elementary Buffer for the selected PID.
PID Event Log	Displays the Event Log for the selected PID.
All Buffers	Opens all graphs and the log for the selected PID.

Options Menu Options



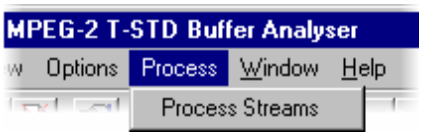
(a check mark ✓ next to an option would indicate that it is enabled)

Draw All Points Toggles between drawing all points on the graphs, or drawing every n^{th} point. '**n**' is calculated from the total number of data points and the screen space for the graph.

Synchronise Views Toggles the graphs between using the same position and zoom settings or operating independently.

Auto Scale % Axis Toggles the selected graph between fixed and auto scaling of the y axis.

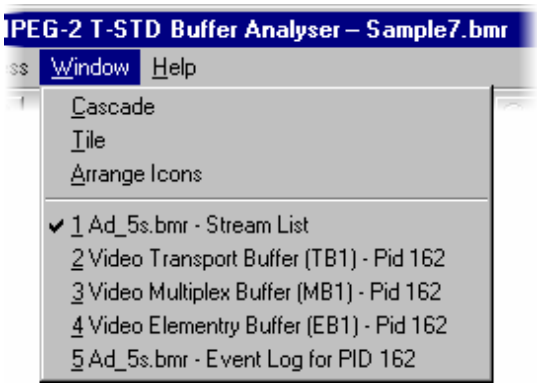
Process Menu Options



Process Streams Applies the stream(s) from the PID(s) selected in the **Stream List** to the System Target Decoder Buffer Model.

This option is only enabled when one or more **unprocessed** PIDs are selected in the **Stream List**.

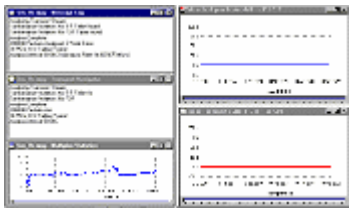
Window Menu Options



(A check mark ✓ next to an option indicates that the window is on top.)

Cascade Arranges the windows like this:

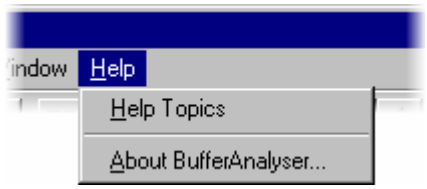
Tile Tiles the windows. For example, five windows would be tiled like this:



Arrange Icons Arranges any minimised windows along the bottom of the main window. Aligns icons of any minimised windows at the bottom of the program's main window.

1 <*window title*> Lists all of the available windows. A tick mark indicates the active window. Select an option to bring that window to the top.

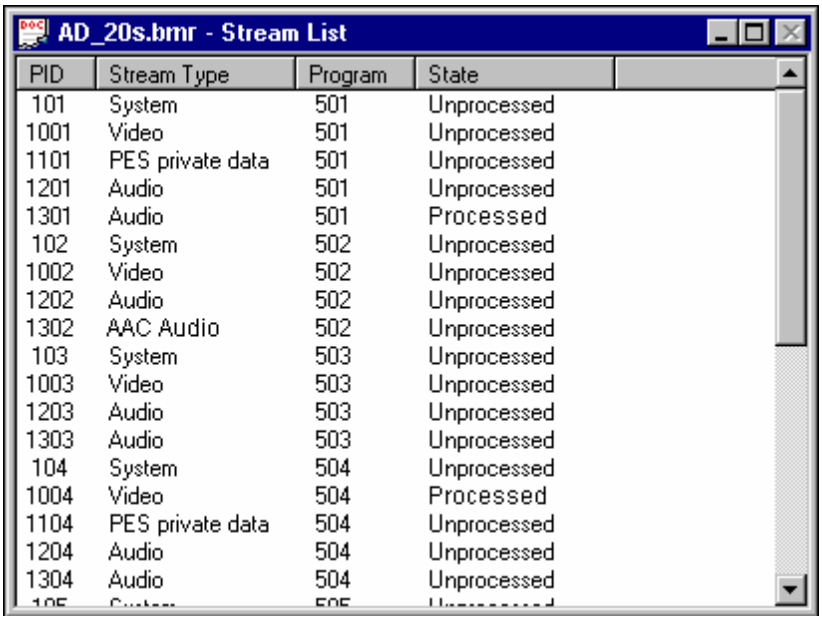
Help Menu Options



About BufferAnalyser… Opens a dialogue which displays the program version number.

Stream List

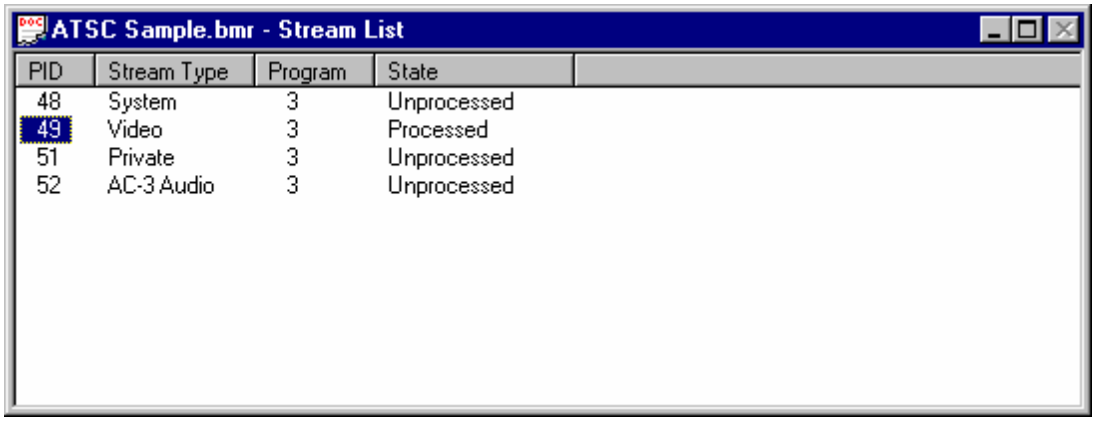
The Stream List displays all of the elementary streams in the file. The streams are sorted and grouped together by **Program** number. Within each program the streams are sorted in ascending **PID** number.



PID	Stream Type	Program	State
101	System	501	Unprocessed
1001	Video	501	Unprocessed
1101	PES private data	501	Unprocessed
1201	Audio	501	Unprocessed
1301	Audio	501	Processed
102	System	502	Unprocessed
1002	Video	502	Unprocessed
1202	Audio	502	Unprocessed
1302	AAC Audio	502	Unprocessed
103	System	503	Unprocessed
1003	Video	503	Unprocessed
1203	Audio	503	Unprocessed
1303	Audio	503	Unprocessed
104	System	504	Unprocessed
1004	Video	504	Processed
1104	PES private data	504	Unprocessed
1204	Audio	504	Unprocessed
1304	Audio	504	Unprocessed

Stream Type indicates whether the stream is **Video**, **Audio**, **AC-3 Audio, AAC Audio**, **System** or **Private**. Private streams cannot be processed but may show more information in the type, for example **ISO/IEC 13818 Auxiliary**. The **Packet Interpretation** from the **System** tab of the **Settings** dialog sets which standard is used for identifying these types.

The above example is from a DVB compliant transport stream. An ATSC stream might look like this:



PID	Stream Type	Program	State
48	System	3	Unprocessed
49	Video	3	Processed
51	Private	3	Unprocessed
52	AC-3 Audio	3	Unprocessed

State indicates if the stream has been processed, i.e. analysed in the buffer model. A stream may only be processed once while the file is open. To process a stream again the file must be closed and then opened again.

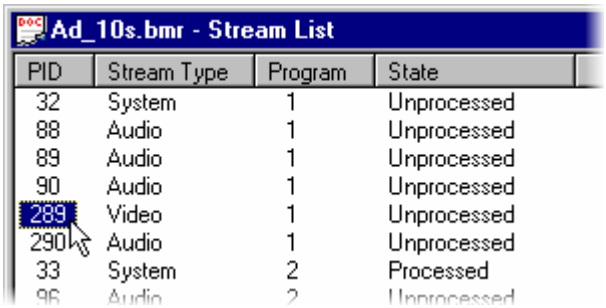
When an MPEG file is first opened the program streams are all marked as **Unprocessed**. This is because no buffer model analysis has yet been performed in this session.

If a BMR file is opened the **State** column indicates which streams have been processed. The file only holds results for those streams marked as **Processed**. To obtain results for **Unprocessed** streams the original MPEG file will have to be opened and analysed.

Selecting Streams

To analyze or open the results views for a stream, or streams, they must first be selected in the Stream List. To select a stream click on the **PID** number.

For example to select the Video stream carried in PID 289, click on the number **289**.



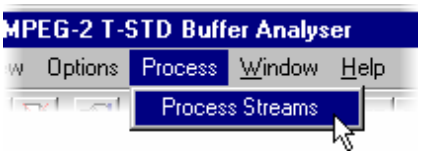
To select a contiguous range of streams: click on the first streams **PID**, then hold the **Shift** or ⇧ key down and click on the last stream's **PID** number. If the required streams are not adjacent hold the **Ctrl** key down and click on the **PID** number for each stream.

All streams can be deselected by double clicking the mouse pointer over any item of data other than in the **PID** column. To deselect a particular stream whilst leaving others selected hold the **Ctrl** key down and click on the stream's **PID** number.

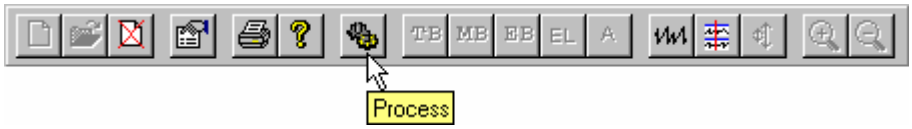
Processing Streams

Having selected one or more streams from the Stream List they can be analysed in the buffer model.

To start analysis select the **Process Streams** option from the **Process** menu.



Alternatively click on the Process button in the toolbar.



Supported Profiles & Levels

Buffer Analyzer supports the 6 Profiles: **Simple**, **Main**, **SNR**, **Spatial**, **High** and **4:2:2**.

It supports the 4 Levels: **High**, **High - 1440**, **Main** and **low**.

Details of valid combinations of profile and level are given in standards document *ISO/IEC 13818 part 2* section *8.5*.

Start-Up

The hypothetical T-STD specified in *ISO/IEC 13818 part 1* section *2.4.2* assumes a processing steady state. To handle the start-up processing before reaching the steady state Buffer Analyzer performs as follows:

- The fraction of the first video frame leading up to the first picture start code is not passed through the Buffer Analyzer. This is because it is not possible to determine whether the Leak or VBV Delay method is being used. During this period the PES header, Sequence Header and Extension information are extracted. This information is used to determine the initial DTS, size of the MB and EB buffers.
- The Decoding Time Stamp (DTS) for the first frame is assumed to be correct. It is used to base the timing of all subsequent frames. MB underflow errors are suppressed during the first frame.

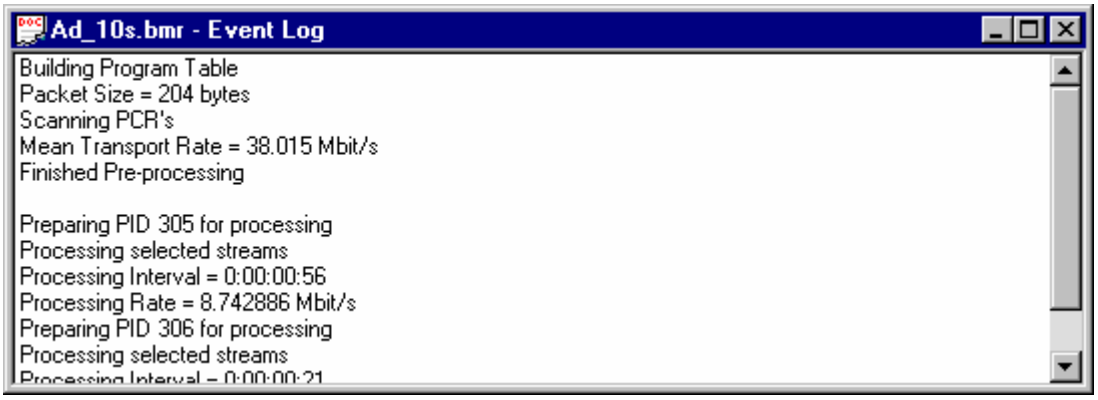
If the DTS of the first frame is not correct use TS Cutter to remove the suspect frame(s) from the file

Approximations

The application uses the following approximations to model the behaviour of the hypothetical T-STD.

- Data is processed in one packet (188 bytes) at a time. An underflow/overflow condition which occurs and clears within the period of one packet will be missed.
- Processing one packet at a time causes the buffers to be emptied in block fashion, thus giving a stepped graphical output.
- Slight quantisation effects occur because the model is processed at discrete time intervals, corresponding to a single packet length. This may affect the VBV Delay calculations. The timing intervals for transferring frames from MB to EB are dynamically adjusted to compensate.

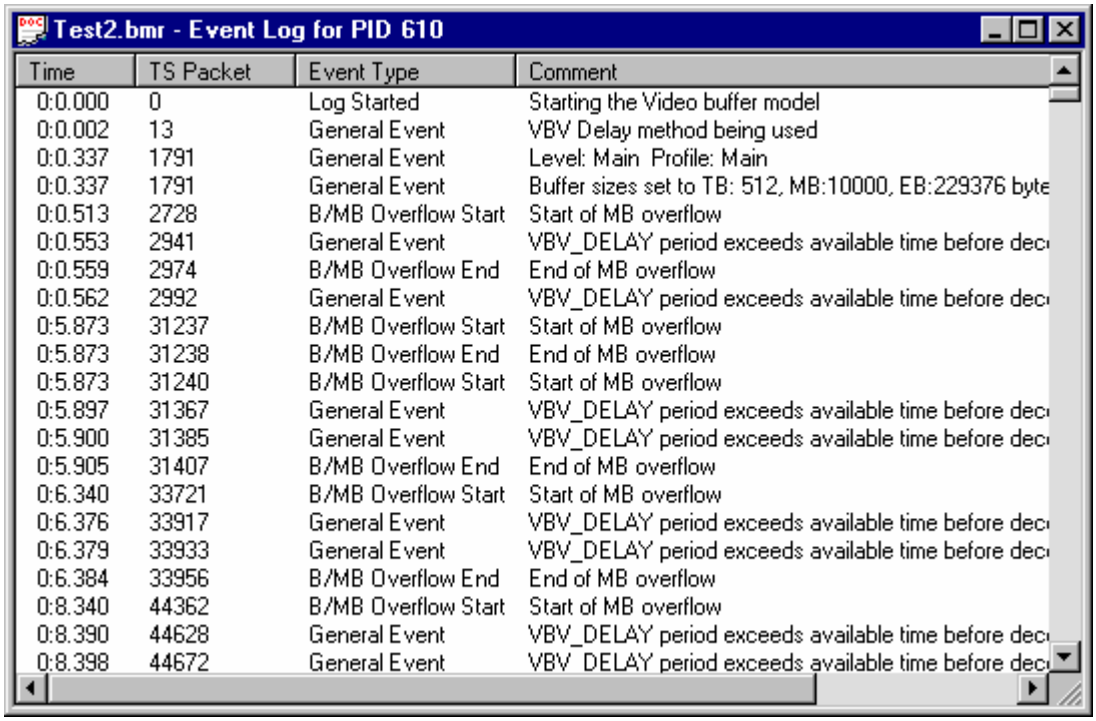
Global Event Log



The Global Event Log displays: reports from the initial analysis, PID independent information (e.g. Transport Stream errors) and high level details for each stream processed.

For details of events detected during the processing of a stream, open the PID Event Log for that stream.

PID Event Log



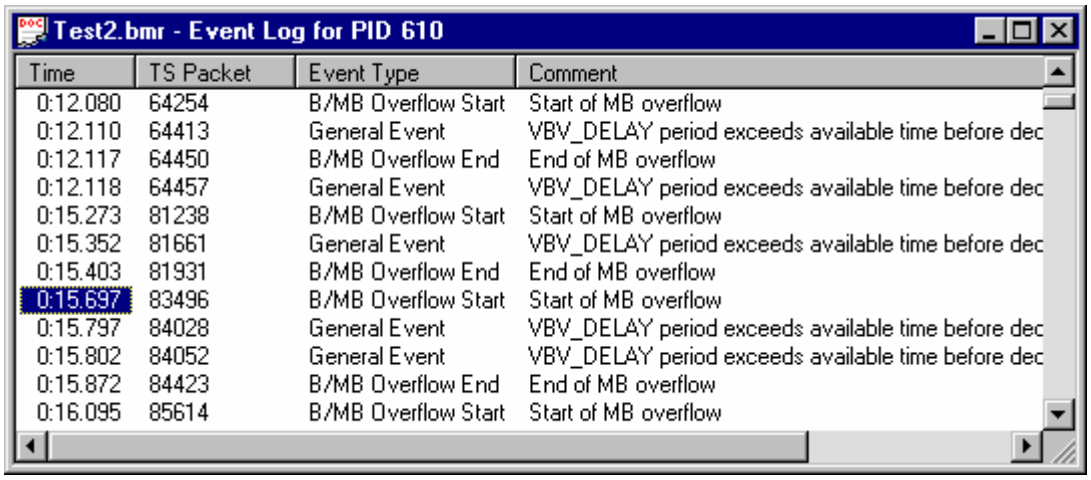
Time	TS Packet	Event Type	Comment
0:0.000	0	Log Started	Starting the Video buffer model
0:0.002	13	General Event	VBV Delay method being used
0:0.337	1791	General Event	Level: Main Profile: Main
0:0.337	1791	General Event	Buffer sizes set to TB: 512, MB:10000, EB:229376 byte
0:0.513	2728	B/MB Overflow Start	Start of MB overflow
0:0.553	2941	General Event	VBV_DELAY period exceeds available time before dec
0:0.559	2974	B/MB Overflow End	End of MB overflow
0:0.562	2992	General Event	VBV_DELAY period exceeds available time before dec
0:5.873	31237	B/MB Overflow Start	Start of MB overflow
0:5.873	31238	B/MB Overflow End	End of MB overflow
0:5.873	31240	B/MB Overflow Start	Start of MB overflow
0:5.897	31367	General Event	VBV_DELAY period exceeds available time before dec
0:5.900	31385	General Event	VBV_DELAY period exceeds available time before dec
0:5.905	31407	B/MB Overflow End	End of MB overflow
0:6.340	33721	B/MB Overflow Start	Start of MB overflow
0:6.376	33917	General Event	VBV_DELAY period exceeds available time before dec
0:6.379	33933	General Event	VBV_DELAY period exceeds available time before dec
0:6.384	33956	B/MB Overflow End	End of MB overflow
0:8.340	44362	B/MB Overflow Start	Start of MB overflow
0:8.390	44628	General Event	VBV_DELAY period exceeds available time before dec
0:8.398	44672	General Event	VBV_DELAY period exceeds available time before dec

An Event Log window may be opened for each PID which has been or is currently being processed. Results are written to the log as they are produced.

All times and packet numbers are given relative to the start of the file.

Event Selection

Selecting the time of an event from the Event Log will place a cursor at that time in each of the Buffer results Graphs. To select an event click on its **Time** in the left hand column. For example to select the **B/MB Overflow Start** for packet **83496** click on the time **0:15.697**



Time	TS Packet	Event Type	Comment
0:12.080	64254	B/MB Overflow Start	Start of MB overflow
0:12.110	64413	General Event	VBV_DELAY period exceeds available time before dec
0:12.117	64450	B/MB Overflow End	End of MB overflow
0:12.118	64457	General Event	VBV_DELAY period exceeds available time before dec
0:15.273	81238	B/MB Overflow Start	Start of MB overflow
0:15.352	81661	General Event	VBV_DELAY period exceeds available time before dec
0:15.403	81931	B/MB Overflow End	End of MB overflow
0:15.697	83496	B/MB Overflow Start	Start of MB overflow
0:15.797	84028	General Event	VBV_DELAY period exceeds available time before dec
0:15.802	84052	General Event	VBV_DELAY period exceeds available time before dec
0:15.872	84423	B/MB Overflow End	End of MB overflow
0:16.095	85614	B/MB Overflow Start	Start of MB overflow

To deselect an event click the mouse pointer over any part of the data, other than in the **Time** column. Alternatively hold the **Ctrl** key down and click on the selected event Time.

Results Graphs

The results of the analysis are plotted on a separate graph for each buffer. When a graph is opened for a stream which is still being processed, each result is plotted as soon as it is produced from the model.

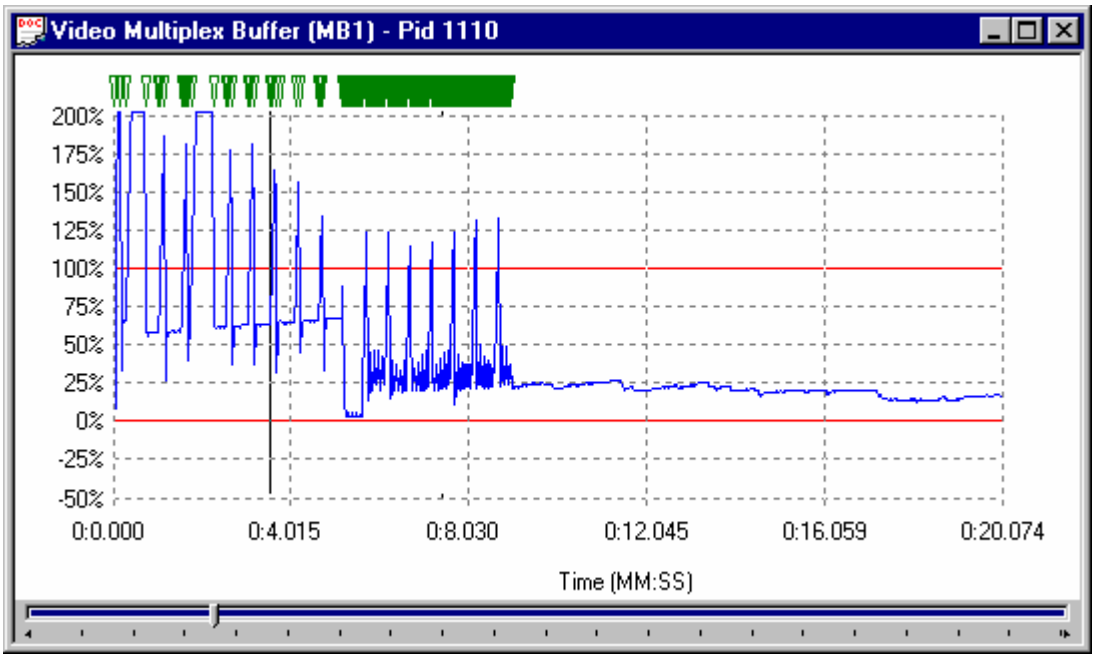
All of the graphs have a similar format and controls. The common features are:

The Axes

All of the graphs plot time from the start of file on the x-axis and current space used in the buffer on the y-axis.

Zoom

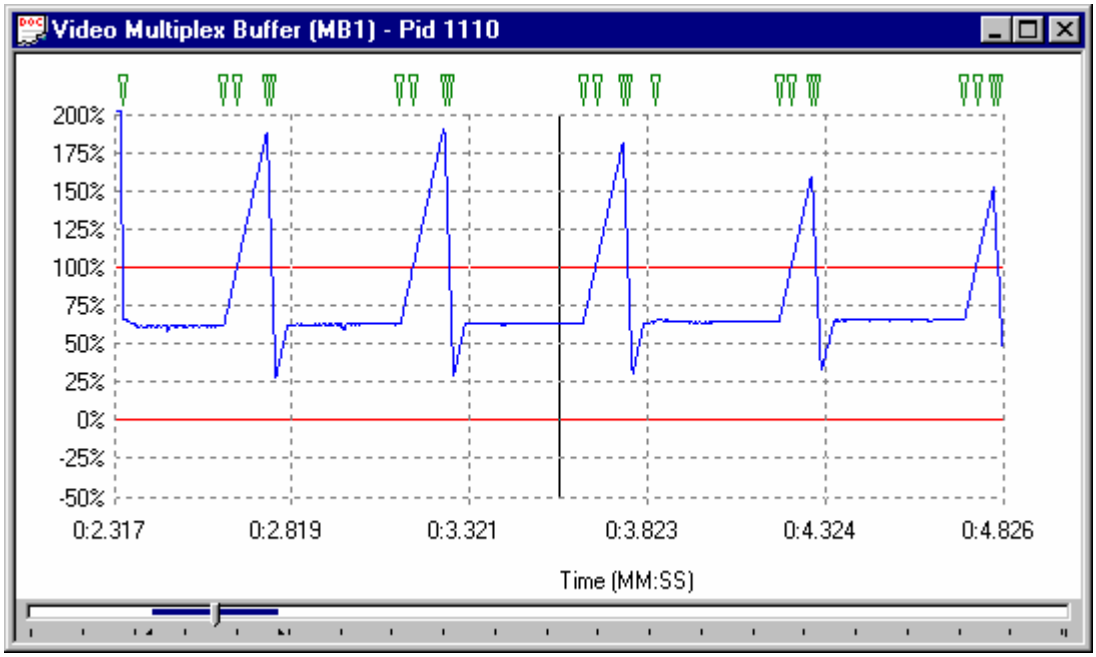
When first opened the entire graph is shown. Even a small file may display data points packed too closely together to see the features clearly. For example here is just under 20 seconds of a video stream which generated a lot of events:



Even this small sample holds some solid bands of blue lines and green event markers, from which only general trends can be determined. To change the time scale (x-axis) to resolve finer detail click on the **Zoom In** button on the Toolbar:

Do this as many times as required to achieve the desired magnification. The magnification is doubled each time the button is clicked.

In this example, clicking the on the **Zoom In** button 3 times gave a much clearer view:

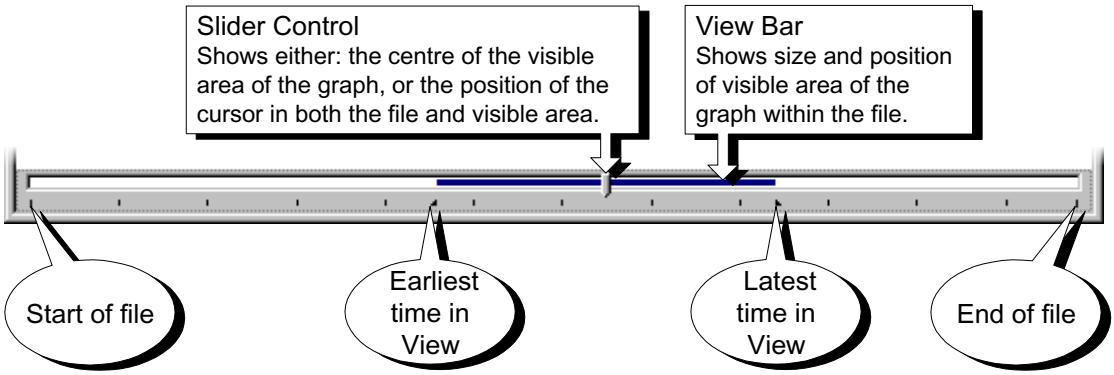


To Zoom back out click on the **Zoom Out** button as many times as required:

Each time the Zoom Out button is clicked the magnification is halved, until the full graph is again displayed.

Scrolling the View

The Slider at the bottom of the window indicates where the displayed area is in relation to the rest of the file. It can be used to scroll the display through the graph in a similar way to a window scroll bar.



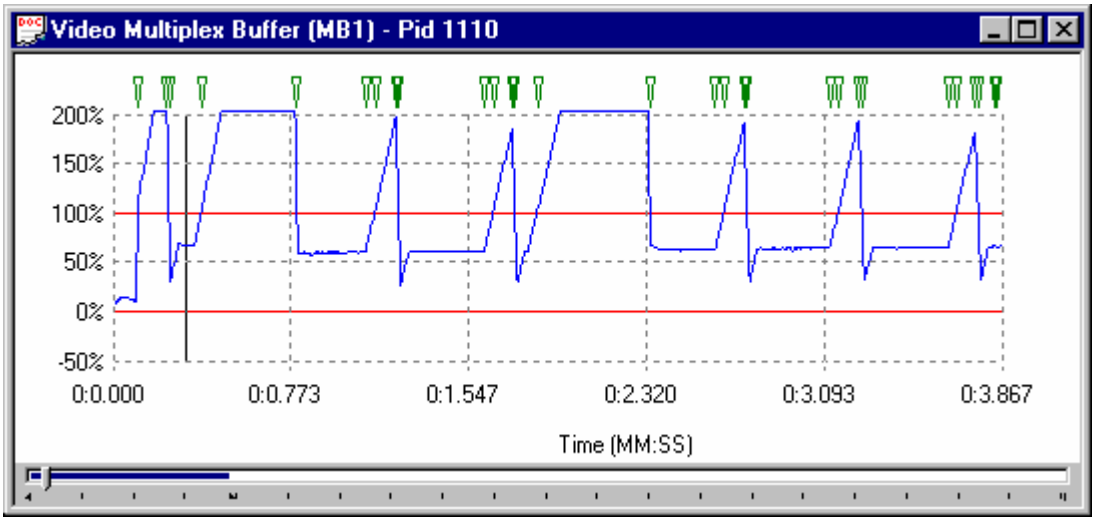
To scroll the stream through the view:

- drag the Slider Control left or right with the mouse,
- click the mouse pointer in the slider bar (either the clear sections or the view bar) to the side of the Slider Control,

When a time or event is selected on the graph, the Slider Control is automatically re-positioned within the View Bar. The placement of the Slider Control reflects the position of the selected packet in the field of view.

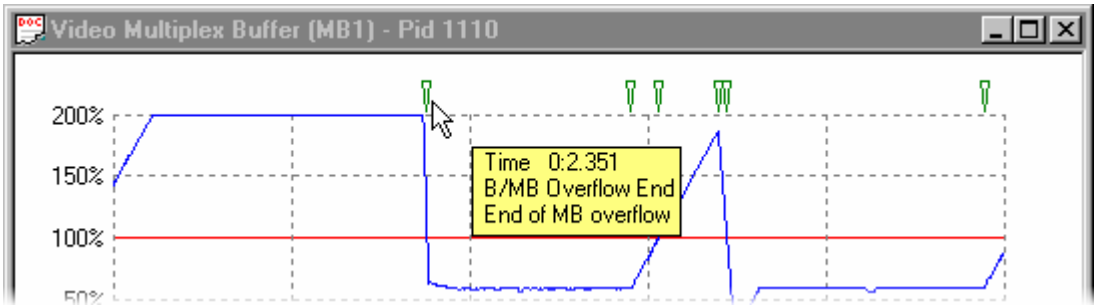
Event Markers

A graph may show one or more green triangular markers along the top. Each marker indicates the time a particular event, listed in the **PID Event Log**, occurred.

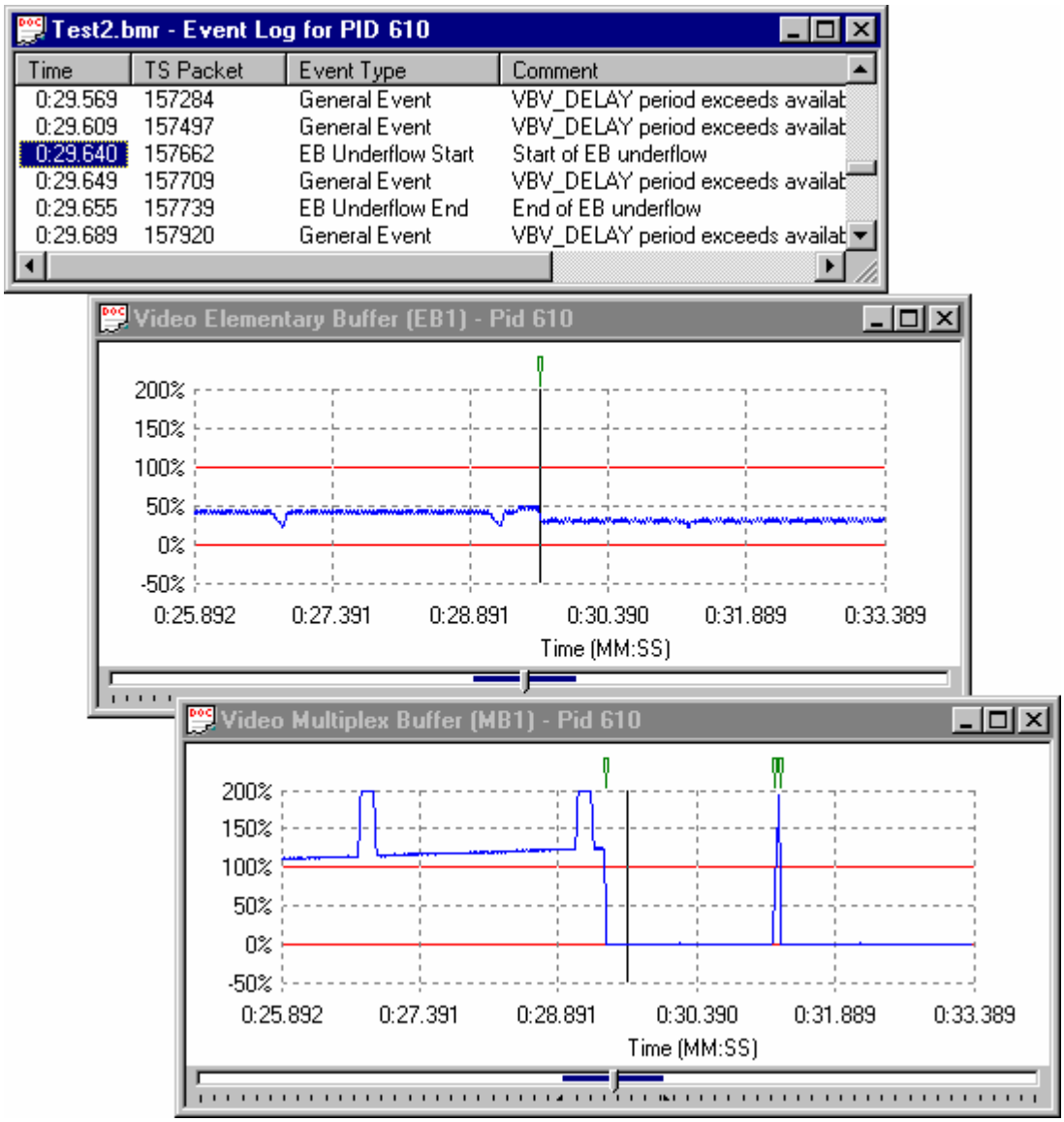


Only events that relate to the points plotted on the graph are displayed in that graph. Hence an event relating to a Video Multiplex Buffer will only be marked on the Video Multiplex graph and not on the Elementary or Transport Buffer graphs.

Double clicking on a marker will display a pop-up window. This shows the time and a brief description of the event which is marked.

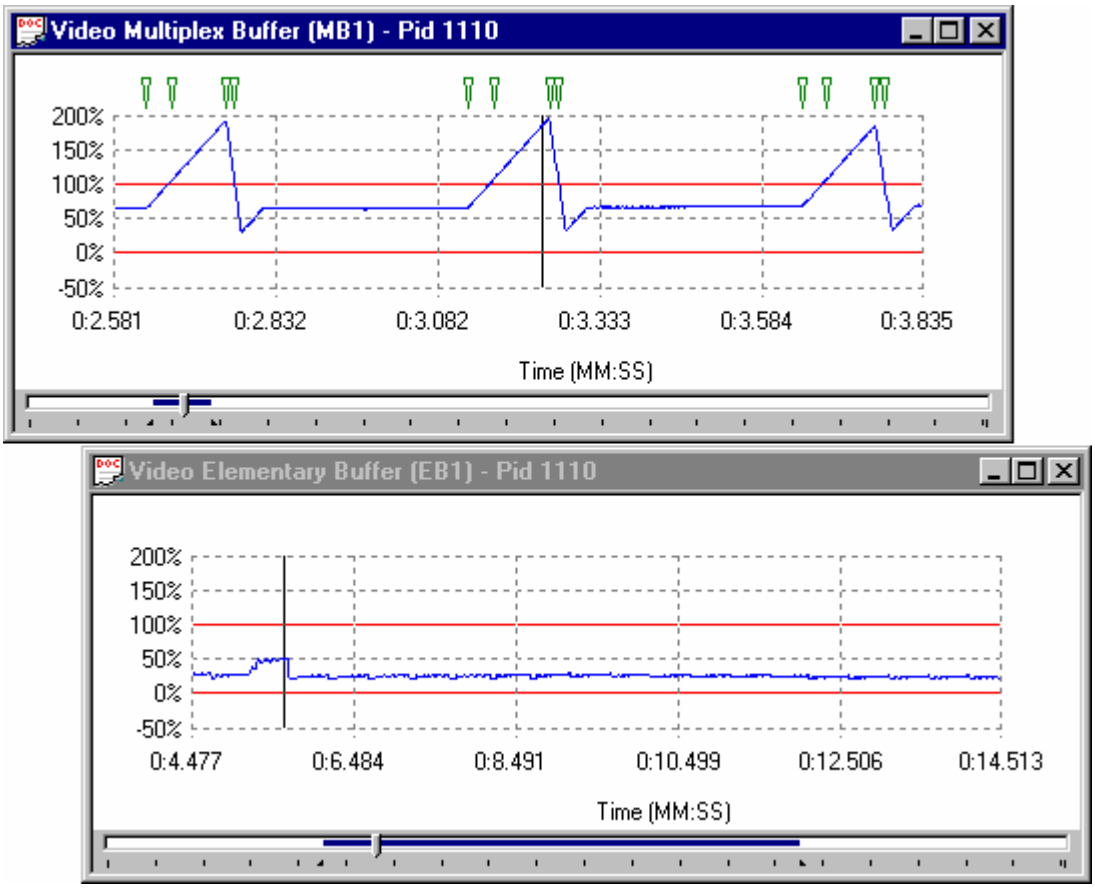


For example: selecting an event relating to the Elementary Buffer from the Event Log of a video stream will place a cursor at the time of the event in the buffer results graphs. Looking at the graphs, a marker of the event has been placed on the Elementary Buffer graph but not the Multiplex Buffer graph.



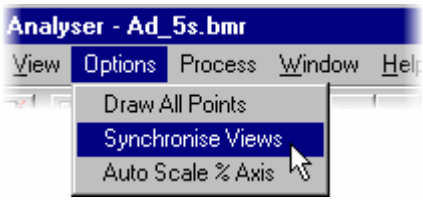
Synchronise Views

Graphs of results may be open for one or more streams. For each stream one or more graphs may be displayed. The graphs may have their zoom, cursor position and visible section manipulated separately or all the graphs may be synchronised. For example in unsynchronised operation the open graphs may look like this:



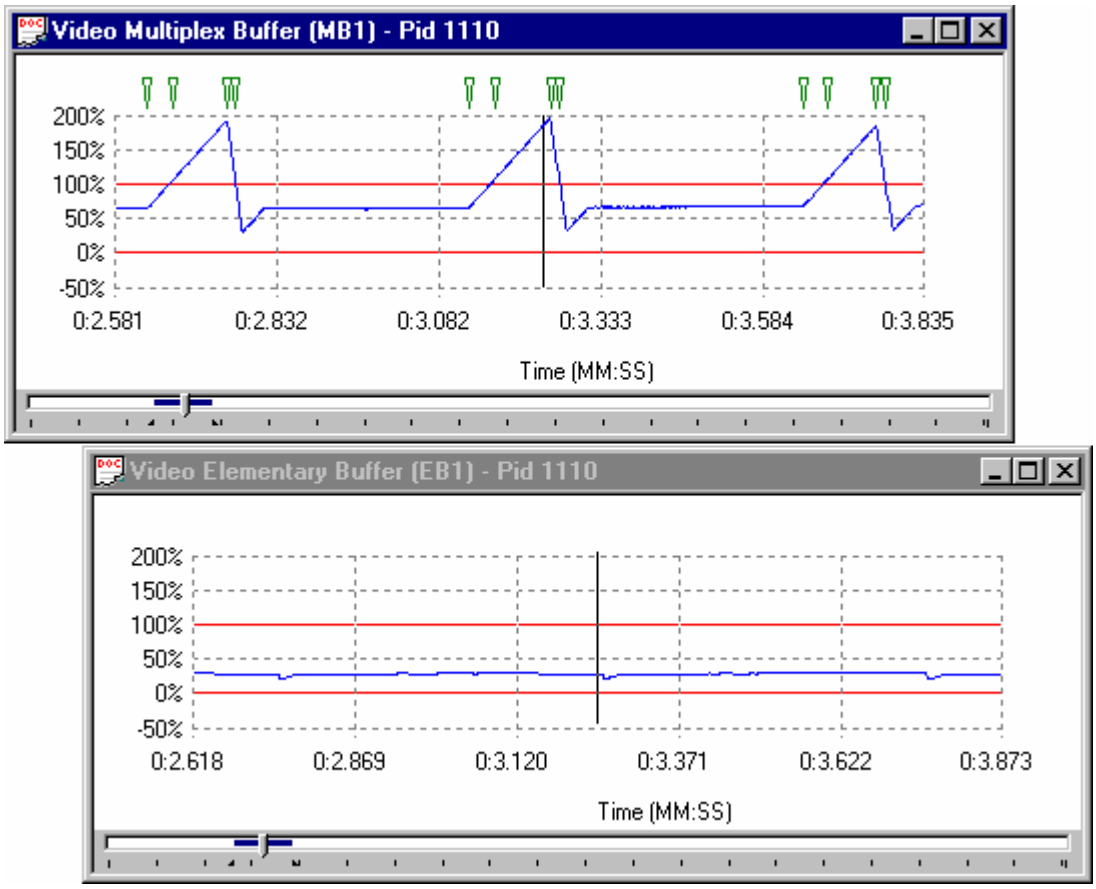
This pair of graphs show different periods in the file at different magnifications.

To synchronise the views select the **Synchronise Views** option from the **Options** menu.



Alternatively click on the equivalent shortcut button.

This will apply the zoom, cursor and visible section of the active window to all of the other graphs. While **Synchronise Views** is enabled a change to any graph is immediately applied to all of the other graphs. After selecting Synchronise Views the previous example looked like this:



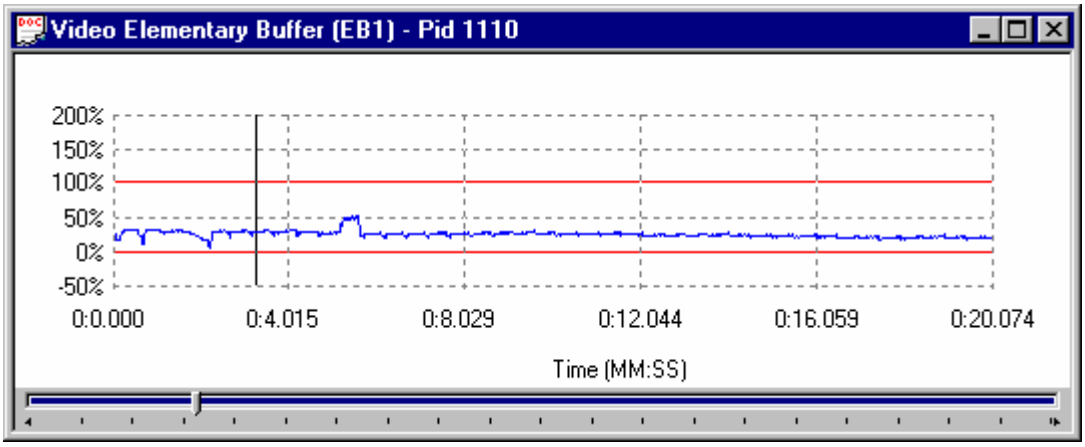
To separate the control of the graphs disable synchronise views by selecting the menu option or clicking on the shortcut button again.

Selection

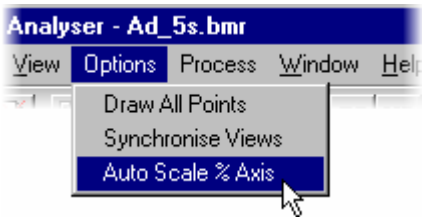
The cursor may be repositioned within a graph by clicking on the required point. This is useful when Synchronise Views is selected as a way of marking the same time in all the graphs for ease of comparison.

Auto Scale

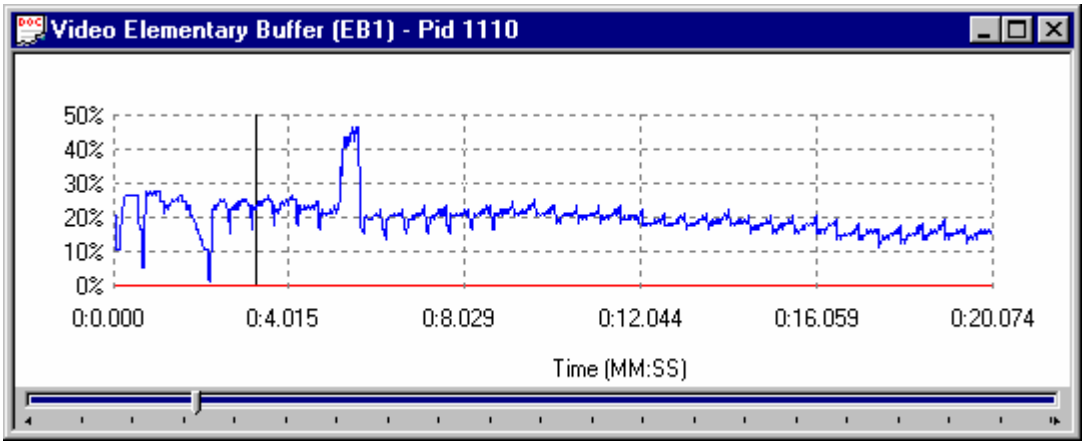
The scale on the y-axis of the graphs shows space used in the buffer as a percentage. By default all of the graphs have a vertical scale that goes from -50% to 200%. For example:



Selecting the **Auto Scale % Axis** option from the **Options** menu changes the y-axis for the currently active graph. Alternatively select the equivalent shortcut button.



The y-axis is now drawn so that the full scale contains the range of values in the graph, to the nearest 25%. For example if the range of values was from 30% to 64% the y-axis would go from 25% to 75%. The earlier example will be rescaled to look like this:



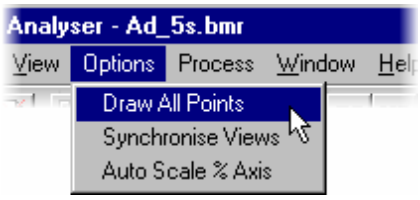
To revert to the default scale select the menu option or click on the shortcut button again.

Draw All Points

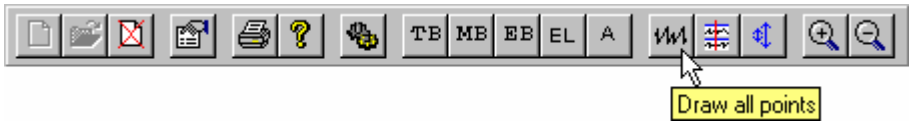
The graphs will often contain more data points than can be resolved on the screen. By default, to avoid drawing points on top of each other the application will plot every n^{th} point. This also speeds up drawing process. How many points to plot is determined from the available width of the graph on the screen and the total number of points to plot.

Use the Draw All Points option to look for outlying points and to resolve the fine detail when zoomed in on the data.

Selecting the **Draw All Points** option from the **Option** menu will cause the application to plot every point.

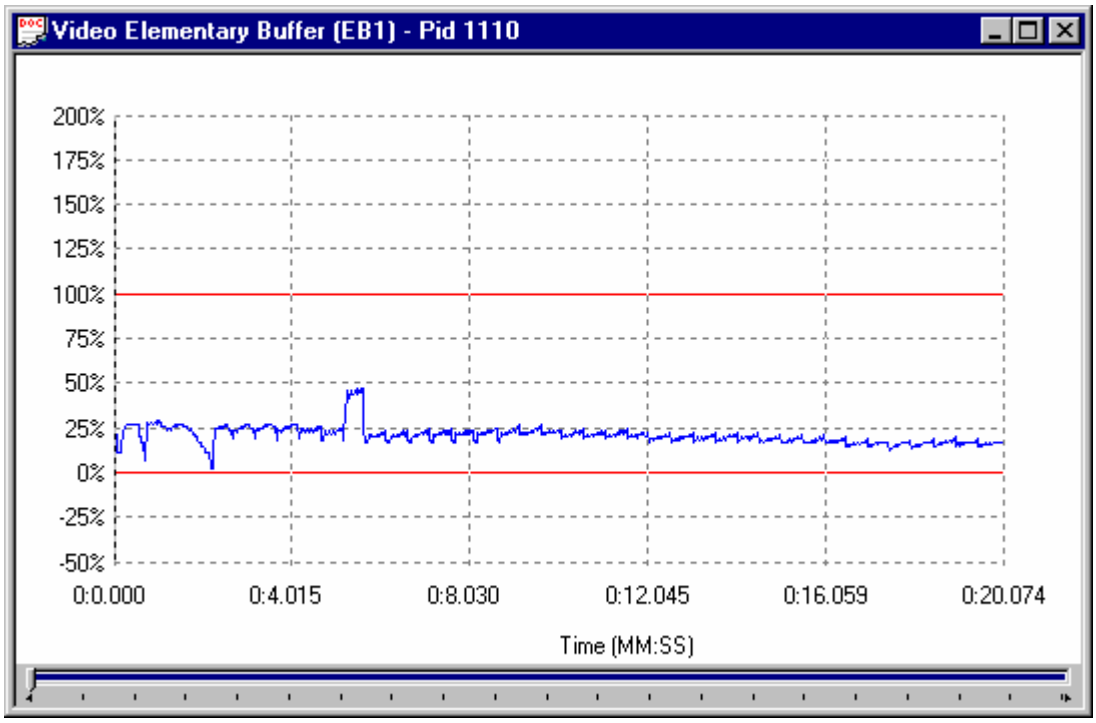


Alternatively select the equivalent shortcut button. This may take much longer for larger files than the default option.



The option may be disabled by clicking on the shortcut button again or deselecting the option from the menu. This can be done even while still re-drawing the graphs.

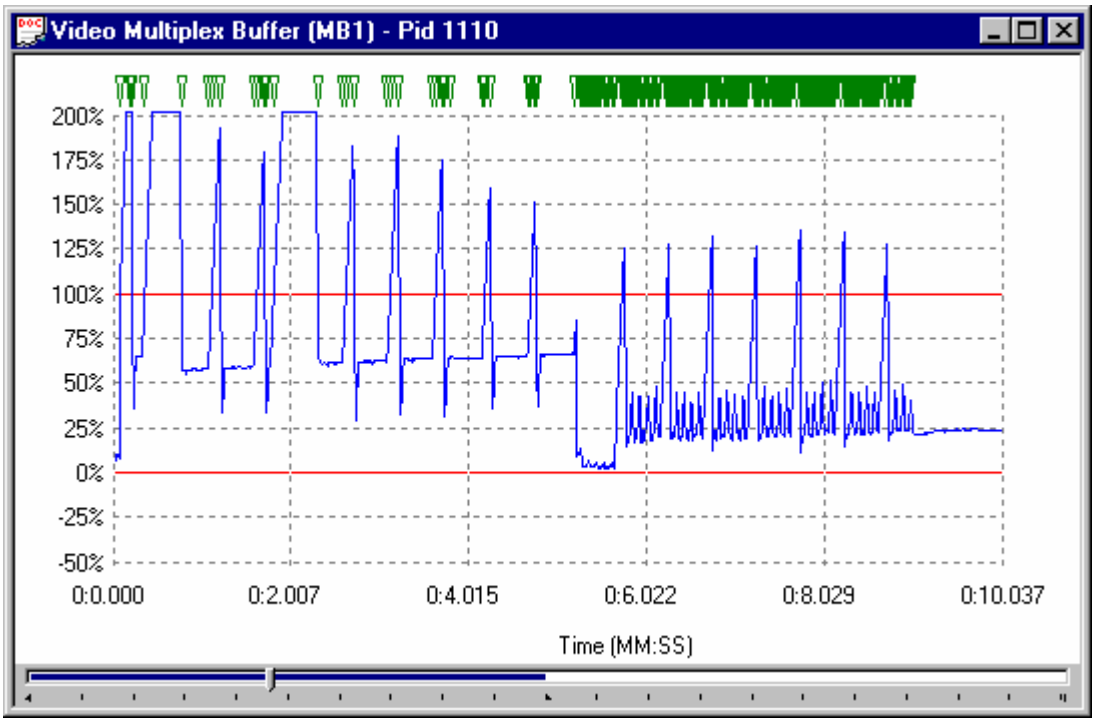
Elementary Buffer Graph



An Elementary Buffer graph can only be opened for Video Streams, since these are the only type which have an elementary buffer.

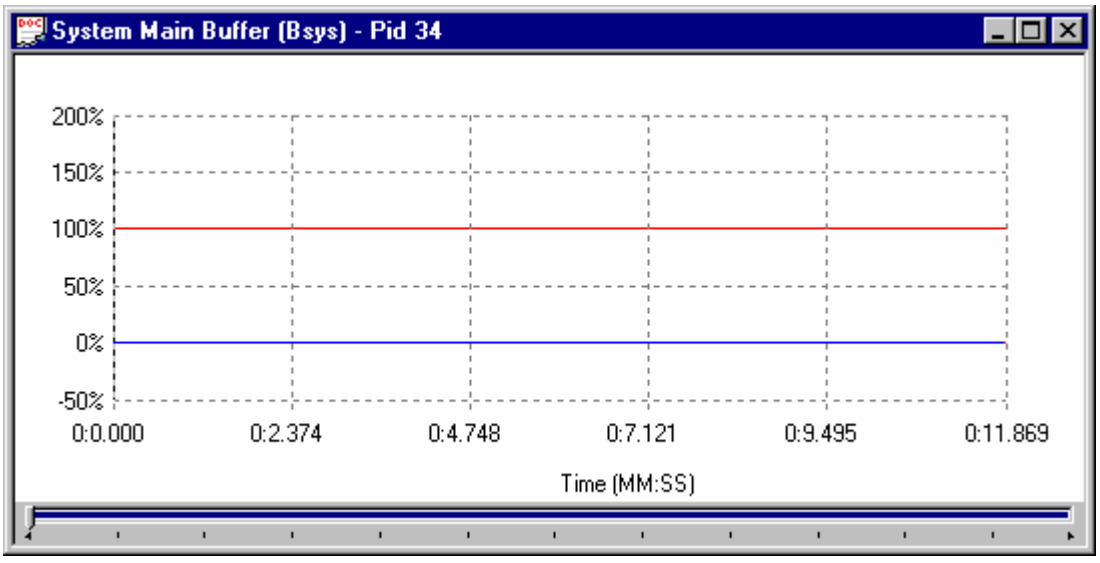
Elementary Buffers are not allowed to overflow, hence the graph of the results never goes above 100%. The graph uses the scale -50% to +250% to make comparison easy.

Multiplex or Main Buffer Graph

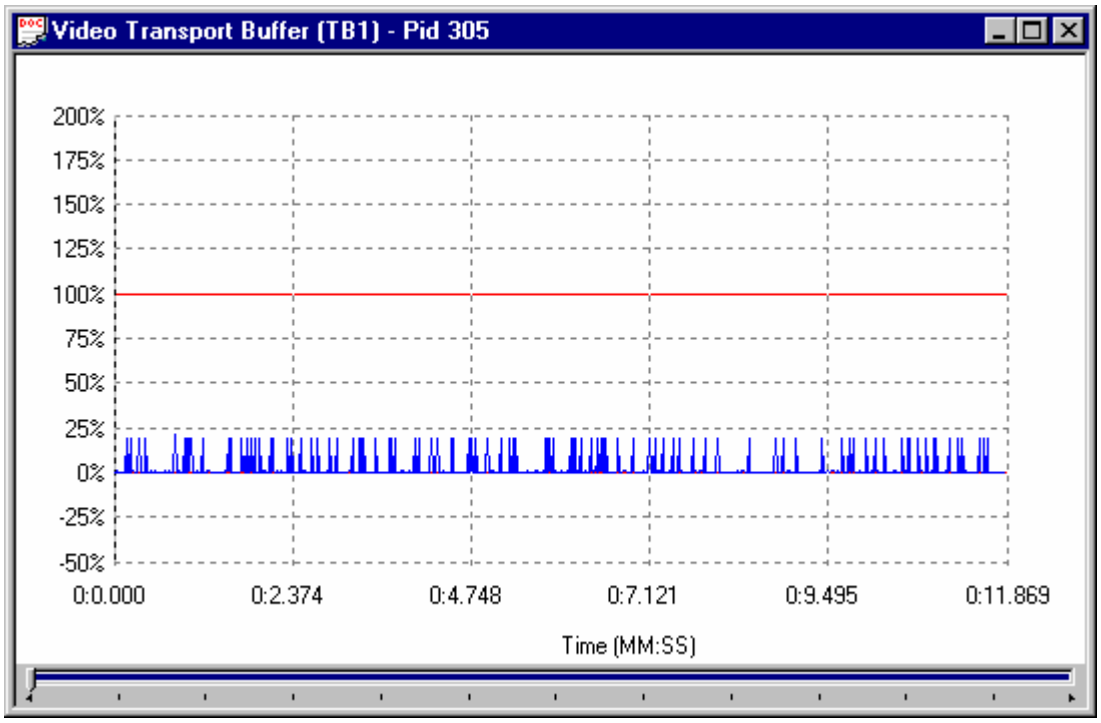


For Video streams this graph shows the results for modelling a Multiplex Buffer. For Audio and System Control streams the graph shows the results for the Main buffer. The title bar shows the stream type.

Here is an example to show the title for a graph of a System Control stream, on PID 34, taken from a different file:

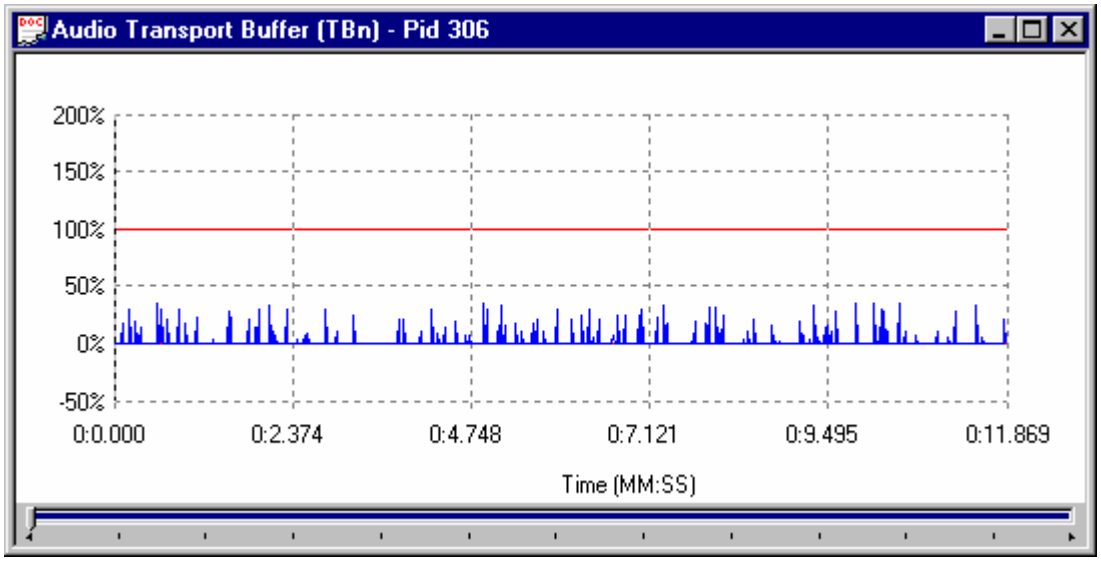


Transport Buffer Graph



The Transport Buffer graph shows results of modelling the Transport Buffer for Video, Audio or System Control streams. The type of stream is shown in the title bar. In the above example the results plotted are for a Video stream carried in PID 305.

Here is an example of an audio stream, on PID 306, from the same transport stream:



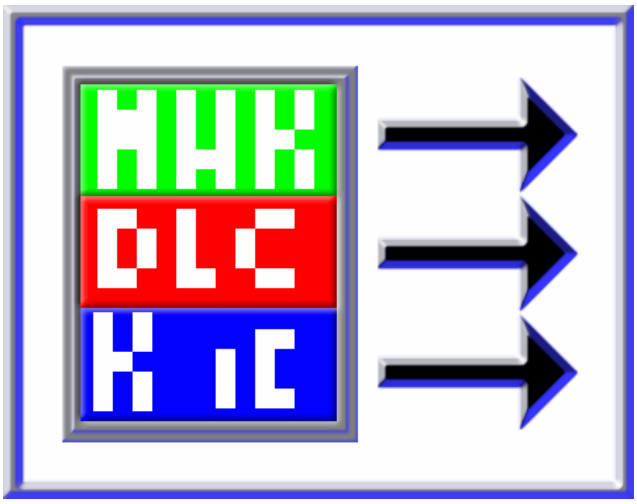
Detail Message Logging

The Buffer Analyzer may be used with the software developers utility **Tracer** to reveal more detail. When executed with the **-d** command line option the Buffer Analyzer produces a detail message log, which may be read with the Tracer program.

These messages may be useful for in-depth analysis of the internal processing, particularly for the video stream type. Tracer has filtering capabilities which allow the user to focus on message types of particular interest. Detail messages generated by Buffer Analyzer while Tracer is not running may be lost.

Refer to the separate sub-section on Tracer, for details of how to set up and use Buffer Analyzer and Tracer together.

Section 4



Tracer

A utility for use with the T-STD Buffer Analyzer

Introduction 3
- Important Information About Tracer 3

Setting Up Tracer and Buffer Analyzer 4
- Enabling Detail Message Log 4
- Desktop Shortcuts for Tracer 5

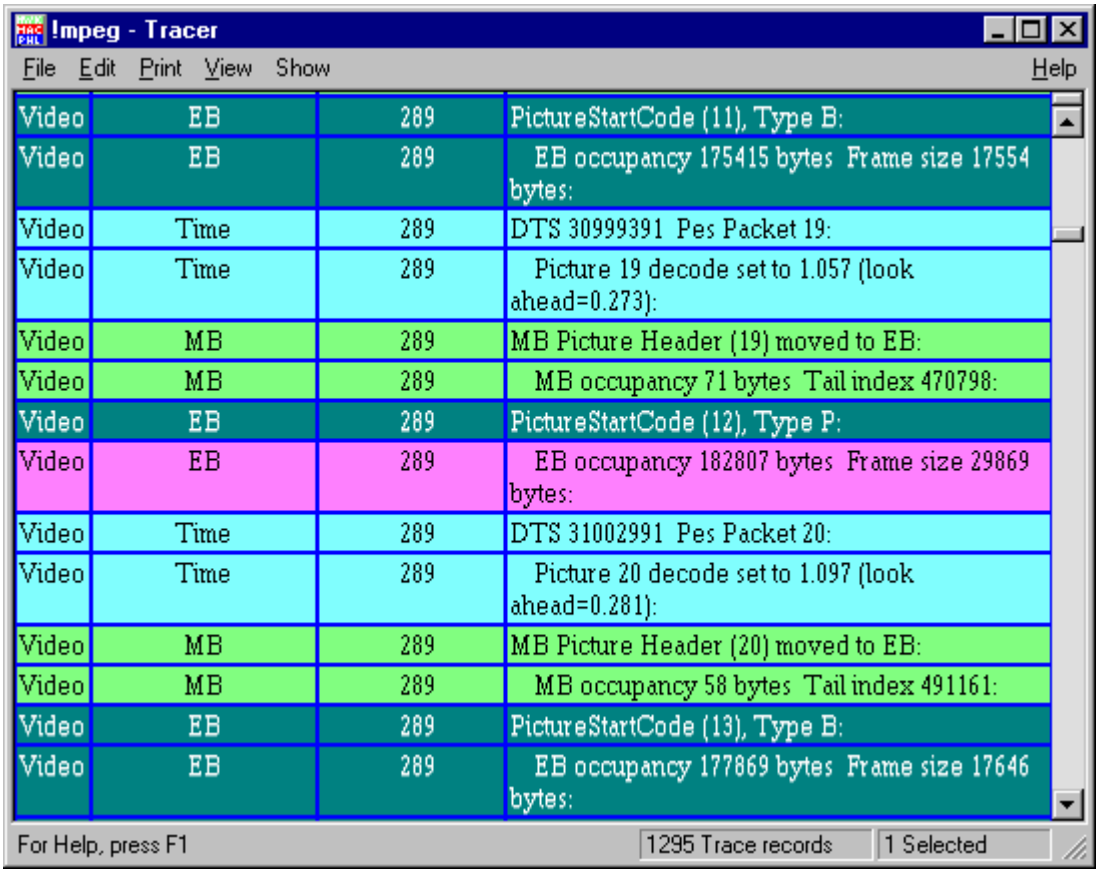
Starting Tracer 6

The Main Window 7
- Initial Appearance 7
- Status Bar 7
- Detail Message Records 8
- Selecting Records 9
- Colour Schemes 10
- Column Options 11
- Split Window Operation 12

Menus & Options 13
- File Menu Options 13
- Edit Menu Options 13
- Print Menu Options 14
- View Menu Options 14
- Show Menu Options 15
- Help Menu Options 15

Introduction

The Tracer application is a utility developed and used by Tektronix software developers for analysing message logs. It may be used in conjunction with the T-STD Buffer Analyzer application to view the message log which Buffer Analyzer can produce.



Important Information About Tracer

Tracer is not a component of the MPEG Test System Product Family and is supplied, free of charge, for use on an as is basis. It is included for use where an in depth analysis of how Buffer Analyzer processes a stream may be helpful.

Please send any comments on the use and value of Tracer to Tektronix. If the facilities in Tracer are found to be of value, they may be incorporated into Buffer Analyzer or another application in a later release.

Setting Up Tracer and Buffer Analyzer

When the software components of a MPEG Test System product which includes the Buffer Analyzer are installed:

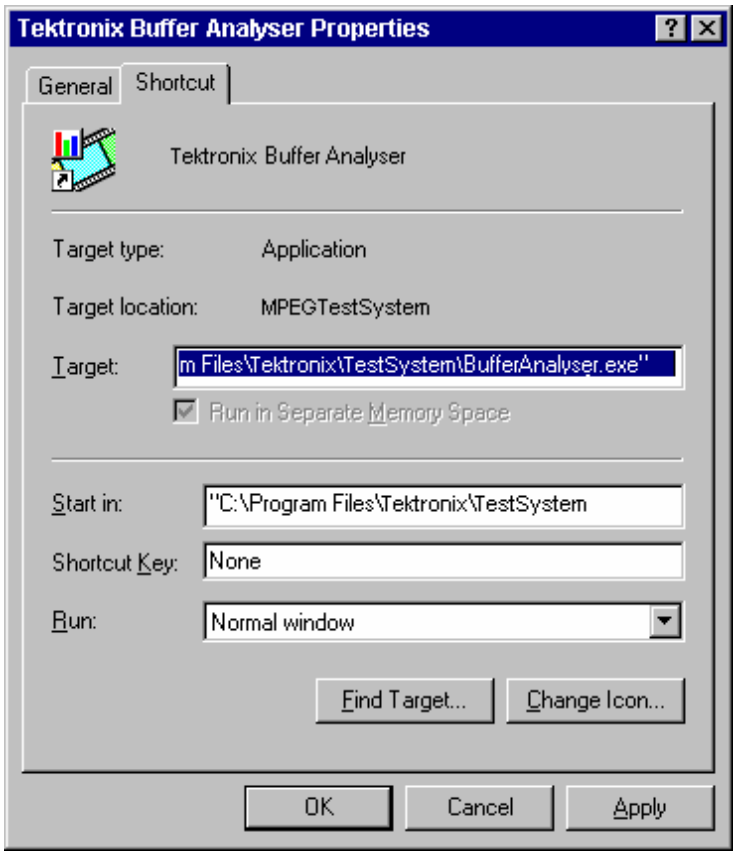
- Buffer Analyzer is configured with the detail message log output disabled.
- Tracer is set up ready for use. A menu option is created under the **Tektronix Start** menu. By default, there is no desktop shortcut set up for Tracer.

The command line of Buffer Analyzer must be configured to output the detail message log in the format for the Tracer utility. Processing will be slower when Buffer Analyzer is operating in the detail message configuration.

Enabling Detail Message Log

To enable detail message logging the properties of an existing shortcut for Buffer Analyzer must be changed or a new shortcut created. A shortcut is any program option in the start menu or program icon on the desktop.

Create a new shortcut or select an existing shortcut. Then open the properties dialog for that shortcut. Refer to the "*Windows NT Workstation, Start Here*" user guide supplied with the Windows NT™ Workstation Operating System or the Help system for detailed instructions if required.



By default the dialog opens with the **General** tab on top.

Select the **Shortcut** Tab.

The dialog should now look something like this:

The entry in the target field needs a '**-d**' option appending to the application name.

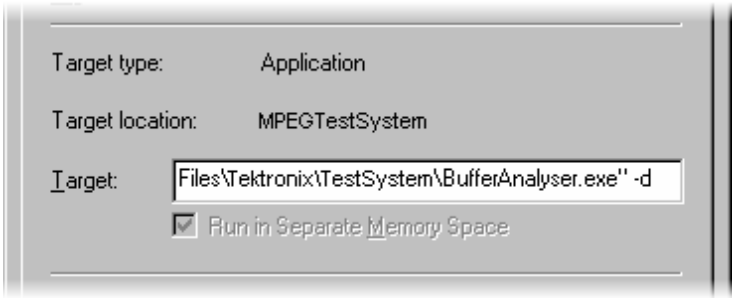
For a standard installation of the MPEG Test System software the current command line will look like this

"C:\Program Files\Tektronix\TestSystem\BufferAnalyser.exe"

Add the '**-d**' option to the end of the line after the quotes and separated from them by a single space. That is:

"C:\Program Files\ Tektronix\TestSystem\BufferAnalyser.exe" -d

The modified Target field should now look like this:



Select the **OK** button to commit the change and close the dialog.

Desktop Shortcuts for Tracer

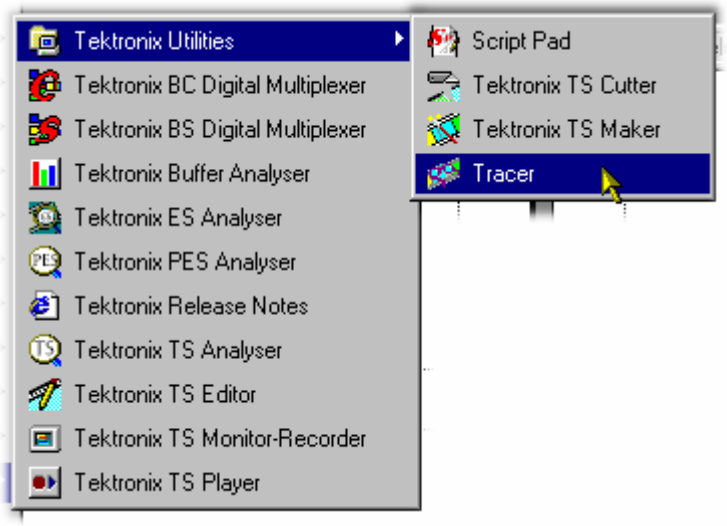
A shortcut for Tracer may be added to the desktop if required. Refer to the "*Windows NT Workstation, Start Here*" user guide supplied with the Windows NT™ Workstation Operating System or the Help system for instructions.

If a shortcut is created a **!mpeg** argument must be appended to the command line so that it looks like this:

"C:\Program Files\Tektronix\TestSystem\Tracer.exe" !mpeg

Starting Tracer

Tracer may be started by selecting the **Tracer** option from the **Tektronix Utilities** sub-menu of the **Start -> Programs** menu.



Alternatively double click on a Tracer desktop shortcut if one has been created.

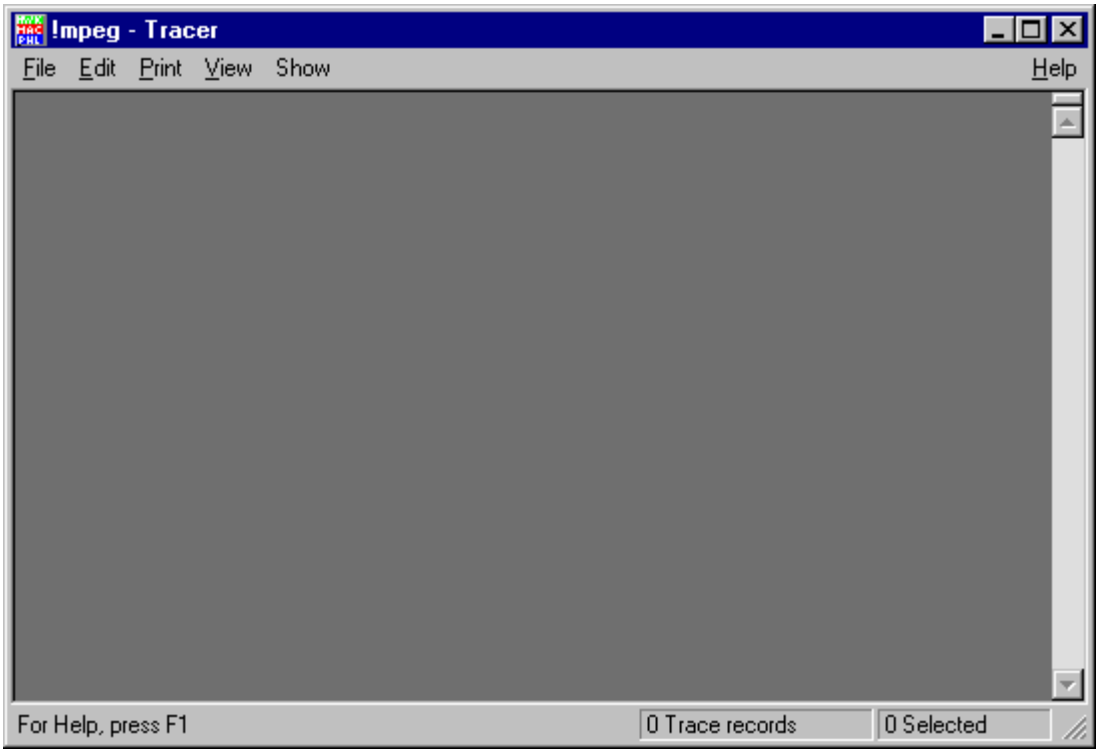
Only run one copy of Tracer and one of Buffer Analyzer when using the Tracer facilities. Buffer Analyzer writes messages to a circular buffer from which Tracer captures them.

To ensure that no records are missed Tracer should be started before Buffer Analyzer opens an MPEG file.

The Main Window

Initial Appearance

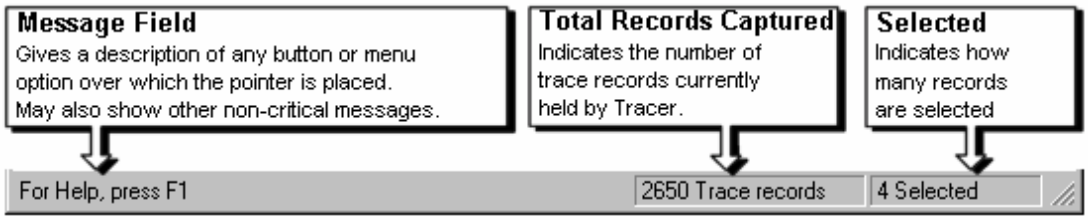
Once the program has started and is ready for use it will open a Main Window. When the program starts the main window looks like this:



Tracer displays the detail message log in the main window. It has a Status bar at the bottom of the window and a scroll bar on the right hand side.

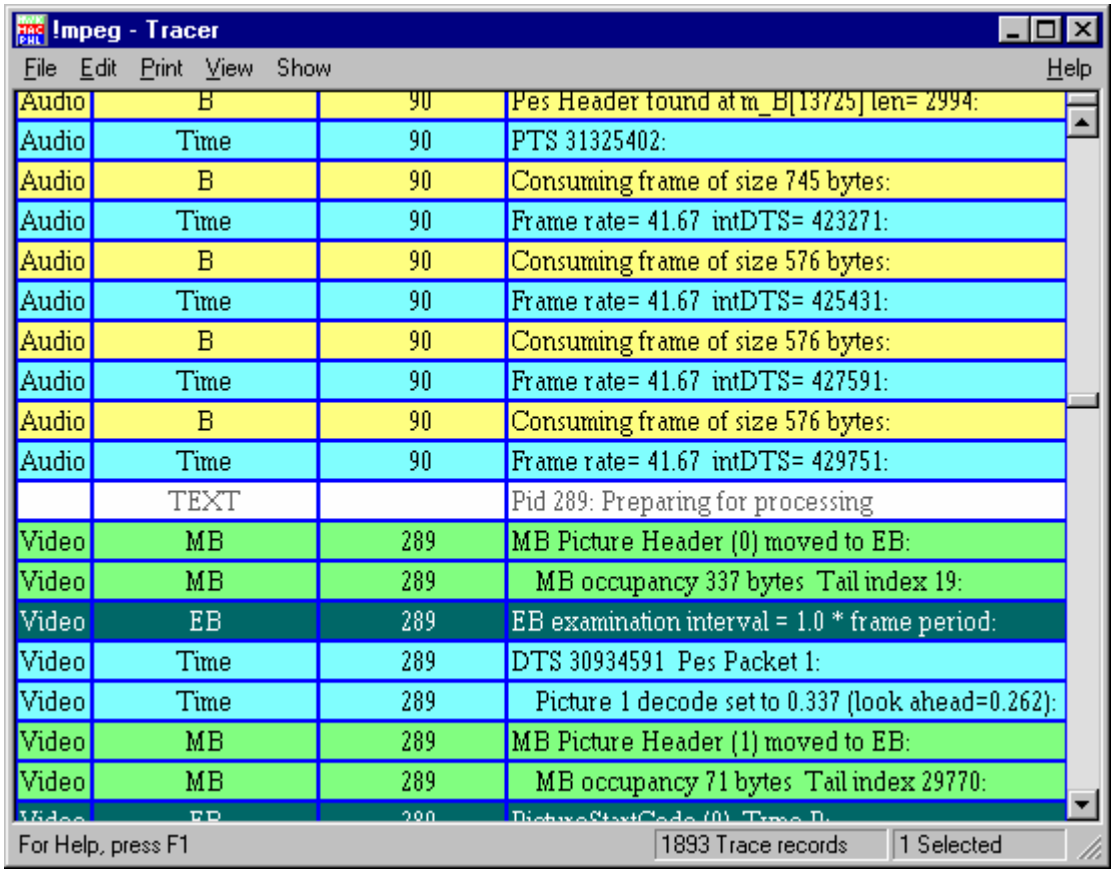
Status Bar

The Status Bar may be hidden from view, but if visible is always at the bottom of the main window. It displays the following information about the program status:



Detail Message Records

These are displayed in the main window in the form of a table. Each record is represented by a single row of the table.



The above example shows a log in which a PID (PID 90) carrying audio was analyzed first and then another (PID 289) carrying video was analyzed. A general **TEXT** message is output at the start of processing for each PID.

Options to select which types of message are displayed are available from the **Show** menu.

To move forwards and back through the log use: the scroll bar on the right of the window, the Page Up, Page Down, Cursor Up Arrow and Cursor Down Keys.

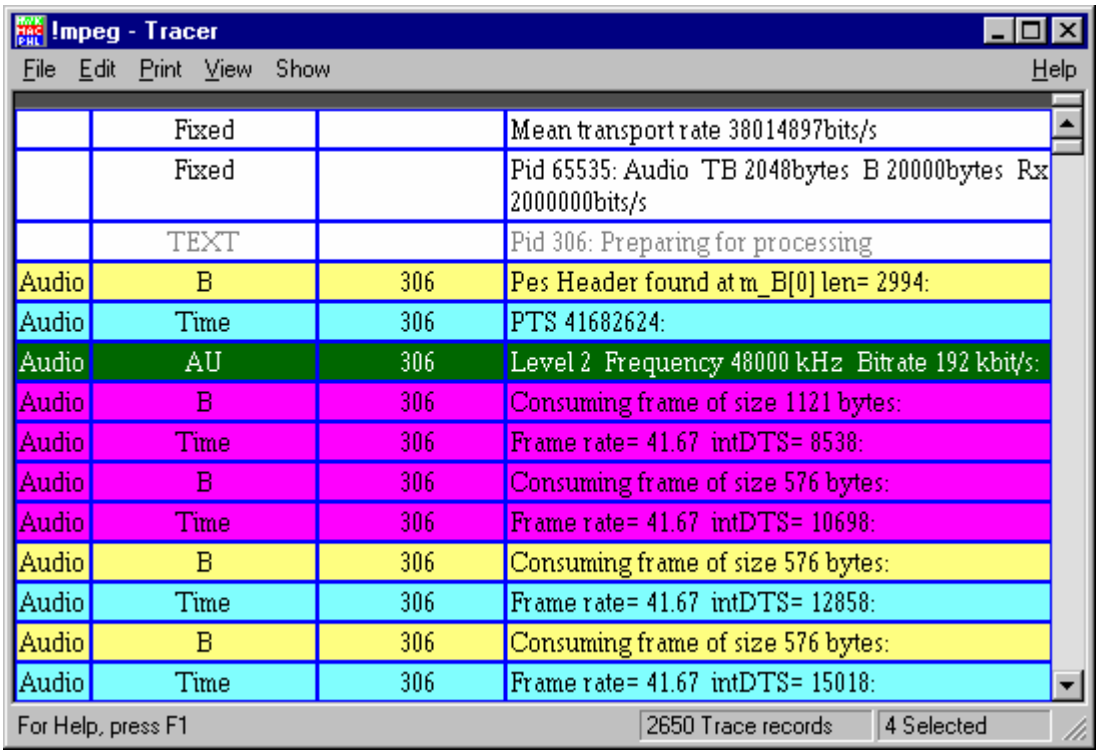
If more than one PID is processed concurrently by Buffer Analyzer the records will be interleaved in the Tracer display. Unless this interleaving is required, processing one PID at a time will make it easier to follow the messages for each stream.

Selecting Records

Records may be selected for printing, copying deleting and other **Edit** menu operations. To do this they must first be selected.

A single record may be selected by clicking on it. To select a contiguous range of streams: click on the first record to be selected, then hold the **Shift** or ⇧ key down and click on the last record required. Alternatively click on the first record, hold the left mouse button down and drag the pointer to the last record.

Selected records are indicated by being repainted in the highlight colour scheme. By default this is black text on a magenta background. For example:

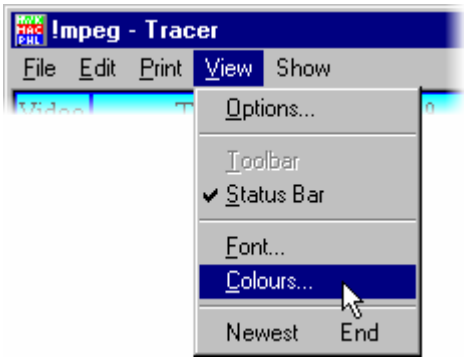


Unless they are deleted the selected records stay selected until a new selection is made. This does not affect the operation of the other facilities in Tracer.

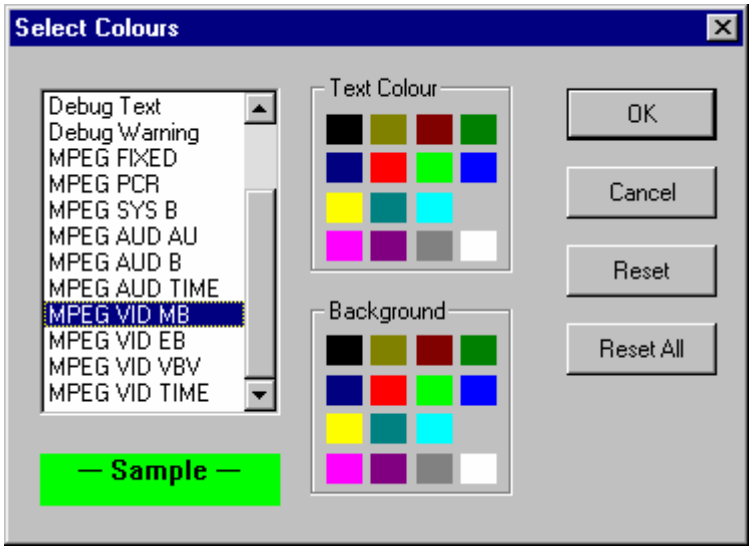
Colour Schemes

The colour scheme for each message type and for highlighting selections may be changed using the Select Colour dialog.

To modify the colour schemes select the **Colours** option from the **View** Menu.



This opens the Select Colours dialog:



Select the message type to be changed from the list box on the left. The current colour scheme will be displayed in the **Sample** underneath the list box. Click on the swatch (coloured square) for the required colour in the **Text Colour** and **Background** panels.

Repeat the procedure for each message type which is to be changed. Then select **OK**.

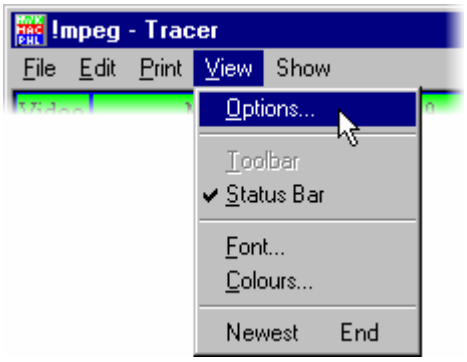
The **Reset** button restores the selected message type to the default colour scheme.

The **Reset All** button restores all of the colour schemes to their defaults.

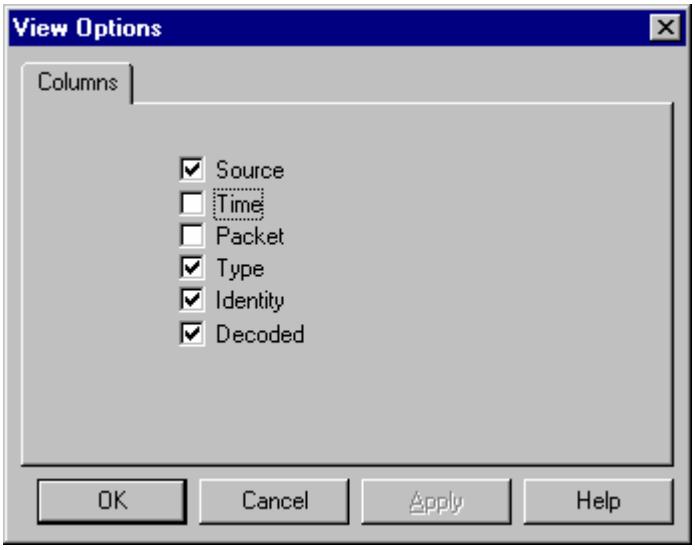
Column Options

The **Options…** option under the **View** menu opens the dialog to select which columns of information are displayed in the table.

To modify the colour schemes select the **Colours** option from the **View** Menu.



This opens the View Options dialog:

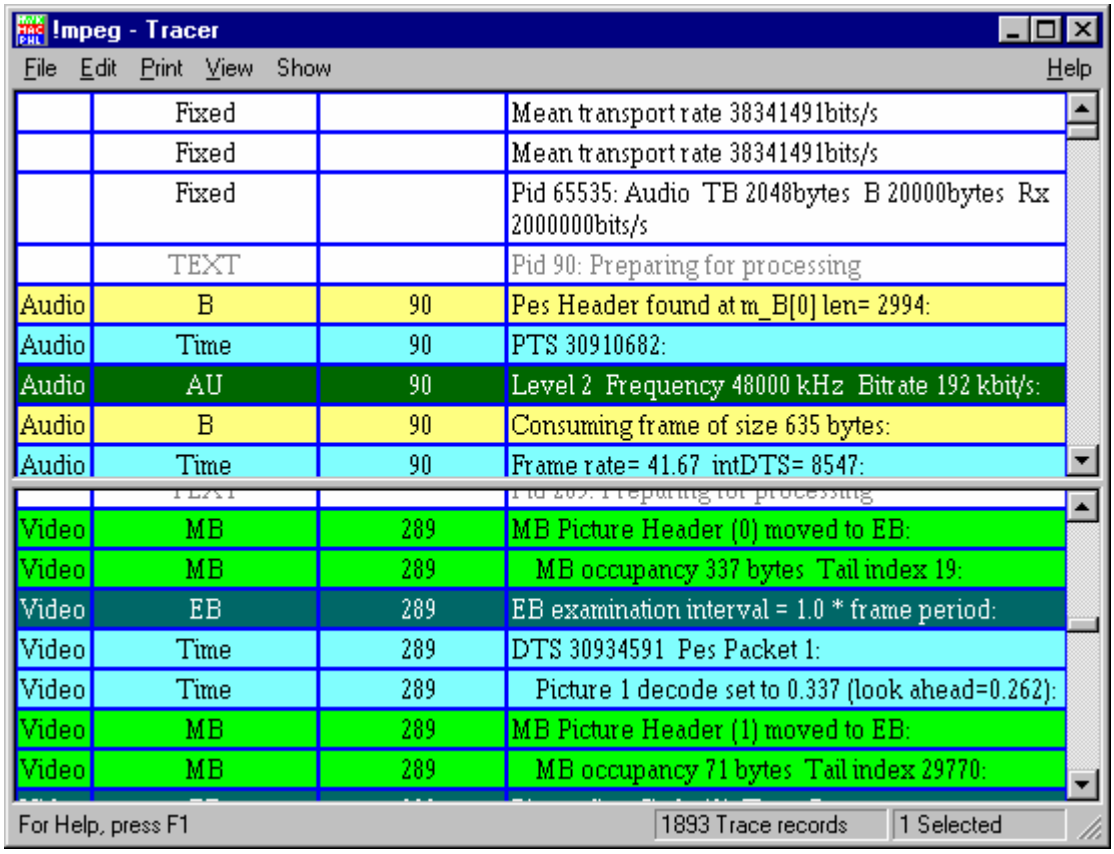


A column is shown for each option which is enabled. These are indicated by the check mark ✓.

Clicking on an option toggles it between being shown or hidden.

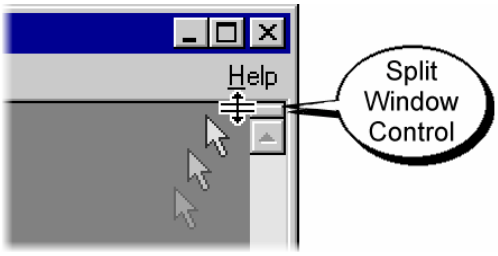
Split Window Operation

The main window may be split into two views, each of which may be scrolled independently. For example here is a split view showing the start of processing of an Audio stream in the upper view and the start of processing for a Video stream in the lower view:



To split the window move the mouse pointer over the small horizontal bar at the top of the scroll bar. This is the split window control.

As the mouse pointer moves over the control it will change shape to show that it is in position to move the control.

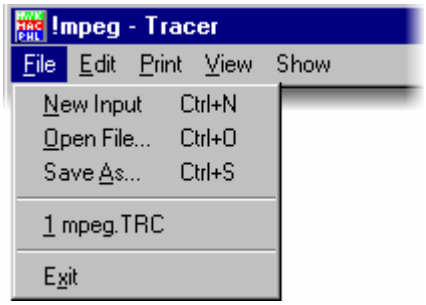


Hold down the left mouse button and drag the control down to split the window. Release the mouse button when the views are a suitable size.

To revert to a single view drag the split window control back to the top of the scroll bar.

Menus & Options

File Menu Options



New Input Not applicable with Buffer Analyzer.

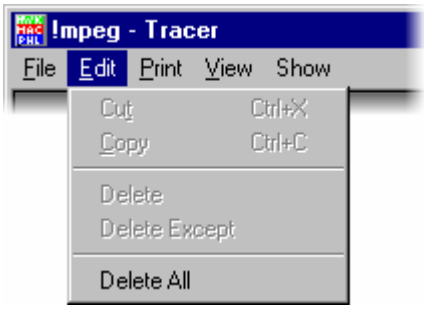
Open File… Opens a previously saved file of detail message log records. Buffer Analyzer does not need to be running to use this facility.

Save As… Saves the records currently held in Tracer to a file.

1 <*filename*> Lists most recently used files of detail message log records, up to a maximum of four files.

Exit Discards any unsaved records and terminates execution of the program.

Edit Menu Options



Cut Moves the currently selected records from the main window to the clipboard.

Copy Copies the contents of the currently selected records to the clipboard. They are not removed from the main window.

Delete Deletes the selected records from the main window.

Delete Except Deletes all records except those selected from the main window.

Delete All Deletes all records.

Print Menu Options

(a check mark ✓ next to an option indicates that it is enabled)

Printer Setup.. Selects printer and configuration.

Page Setup… Not available with Buffer Analyzer.

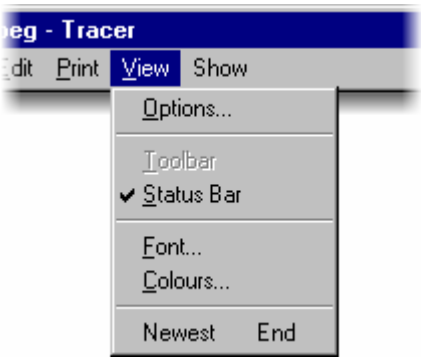
Font… Selects which font is used for printing text.

Colours… Not available with Buffer Analyzer.

Print Preview Not available with Buffer Analyzer.

Print… Prints all or just the current selection of records.

View Menu Options



(a check mark ✓ next to an option indicates that the toolbar is currently visible, no ✓ means that it is hidden.)

Options… Opens the options dialog for selecting what columns of information to display.

Toolbar Not available.

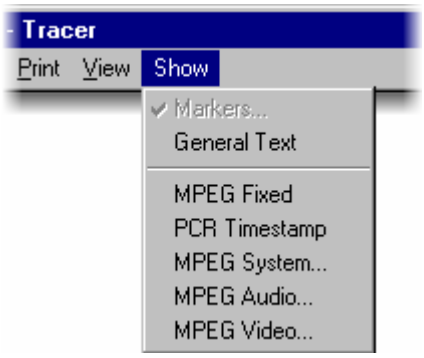
Status Bar Shows or hides the Status Bar.

Font… Opens a dialog to select which font is used for displaying the text of detail message log records.

Colours… Opens a dialog to configure which background and text colours are used to display each type of message.

Newest Scrolls the main window to the end to display the newest record.

Show Menu Options



Markers Showing markers is permanently selected for using Tracer with the Buffer Analyzer.

General Text Show or hide general messages. E.g. messages indicating start of processing for a particular PID.

MPEG Fixed Show or hide MPEG-2 information such as transport rates and buffer sizes.

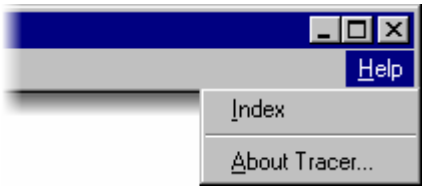
PCR Timestamp Show or hide messages about PCRs and associated instantaneous transport rates.

MPEG System… Opens dialog for selecting which types of MPEG-2 system messages to show.

MPEG Audio… Opens dialog for selecting which types of MPEG-2 audio messages to show.

MPEG Video… Opens dialog for selecting which types of MPEG-2 video messages to show.

Help Menu Options

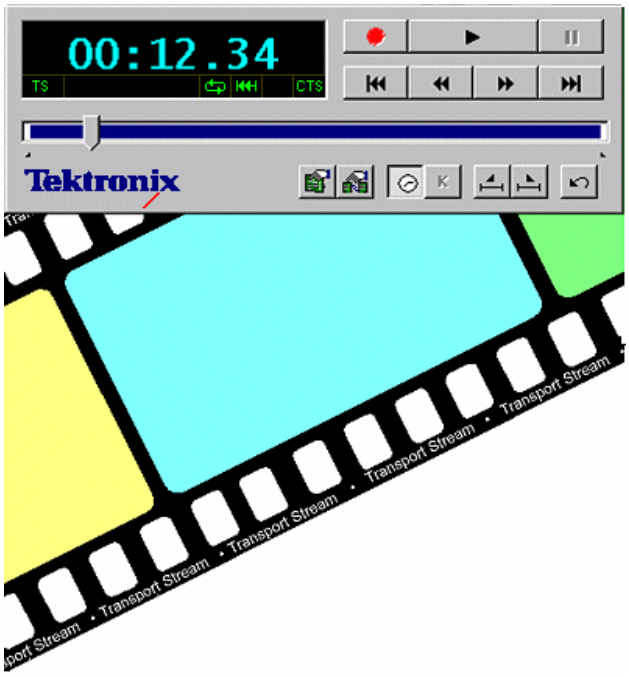


Index On-line help is not available when using Tracer with Buffer Analyzer.

About Tracer... Opens a dialogue which displays the program version number.

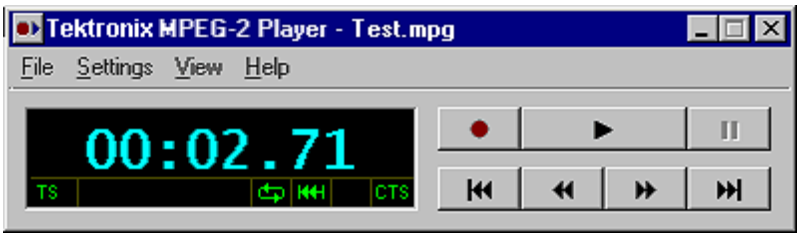
Section 5

Player

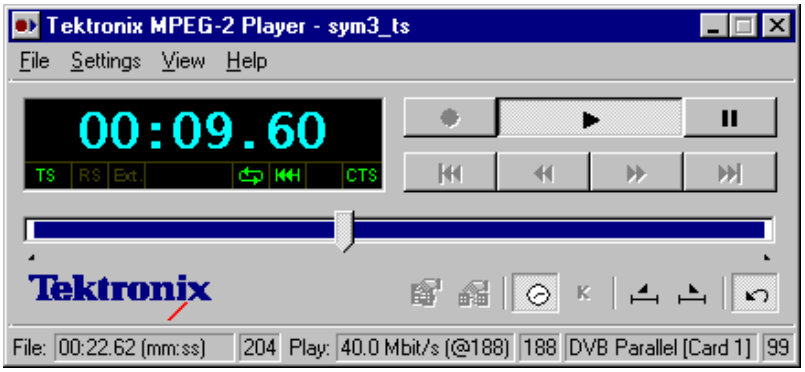


Introduction 3
Starting the Program 4
Messages on starting Player 4
Opening and Creating Files 6
Generic Settings 7
Playout 7
Record 8
Interface Selection 9
Stream Type 10
Interface Specific Settings 11
Continuous Time Stamping 12
Configuring Continuous Time-Stamping 13
The Main Window 15
The Clock/Counter Display 15
Display Status Bar 15
Stop, Start, Record etc. 16
Tool Bars 16
Status Bar 19
Right Click Options 20
Menus and Options 21
File Menu Options 21
Settings Menu Options 21
View Menu Options 22
Help Menu Options 22

Introduction



Based on the typical control layout of a VCR, the user interface has some controls that may be displayed or hidden. The above example had all the optional controls hidden. This is how the user interface looks, with the complete set of controls displayed, while playing a transport stream file:



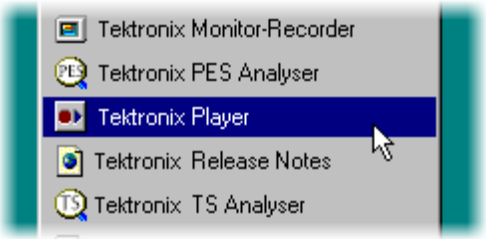
The Player program can record to disk and playback files of transport stream data. Data may be recorded and played at rates from *250 kbit/s* up to *90 Mbit/s*.

In playback the program can be set to playout all or a selected part of the file. It can also loop to play the file or selected part continuously. This is ideal as a source of repeatable MPEG-2, DVB and ATSC data for use in fault diagnosis and performance/conformance testing of other equipment.

The clock rate for playout may be specified manually or determined automatically from the PCR values in the file. The Playout byte clock may be supplied by an external source or internally generated

Starting the Program

The program may be started by selecting the **Tektronix Player** option from the **Start ➔ Programs** menu.

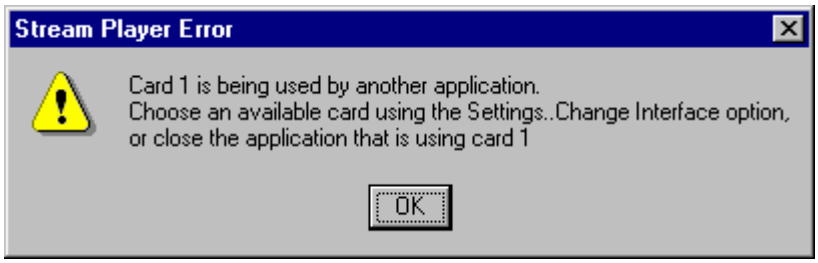


or

by double clicking on the **Tektronix TS Player** shortcut on the desktop.

Messages on starting Player

Player saves the interface configuration that was used the last time it was run. An MPEG Interface Card (and connected daughter card if installed) can only be used by one instance of an application at a time. If the interface adapter is in use by another program (e.g. Monitor/Recorder or another instance of Player) or is not available an error message is displayed on starting. For example:



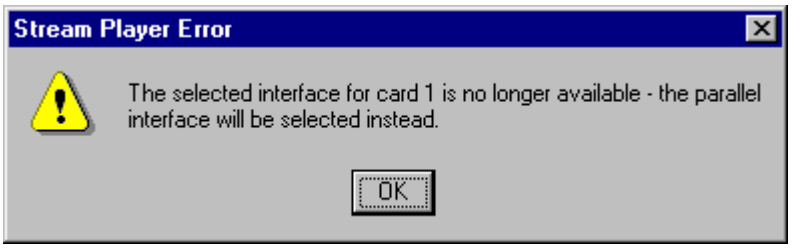
Click on the **OK** button to continue. The card selection is reset to none for the newly started instance of Player.

Select another card, if one is available, using the **Card Configuration** dialog. Alternatively release the card from the other application, then select it with the **Card Configuration** dialog. This is available via the **Change Interface…** option from the **Settings** menu.

Player may be configured with no card selected to release a card for another program without shutting down Player. If this configuration is saved a reminder that a card must be selected for playout or record is displayed:

As above, select a card, if one is available, using the **Card Configuration** dialog. Alternatively release the card from the other application, then select it with the **Card Configuration** dialog.

If a daughter card has become unavailable, perhaps because it has been removed, since Player last ran, the Parallel MPEG Interface Card will be selected instead. A message is displayed advising that this has happened. For example:



Opening and Creating Files

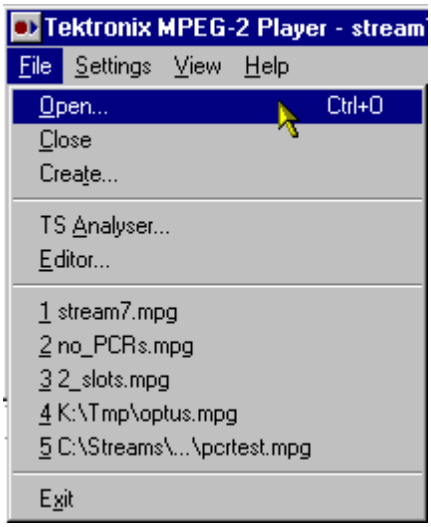
A file must be opened before playout or recording can be performed. Once opened the file may be closed for protection. Selecting a new file automatically closes any file that is open.

Specifying an Existing File

To specify an existing file select the **Open...** option from the File menu.

Select a file on the Video disk, usually Drive E. Do not open a file on another type of disk, e.g. Drive C:, since they lack the necessary performance.

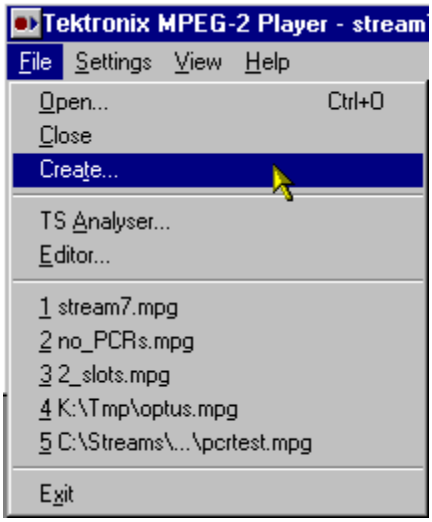
Player examines the file to calculate the clock rate as indicated by the Program Clock References (PCR) and whether it was recorded in 188 or 204 byte packet formats. These calculated values can be overridden by the **Generic Settings** and interface specific **Settings…** options from the **Settings** menu.



Creating a New File

To create and open a new file select the **Create...** option from the file menu.

This runs the TS Maker Wizard. (Refer to the section on the Wizard for more details.) When the file is ready it is automatically opened for recording.

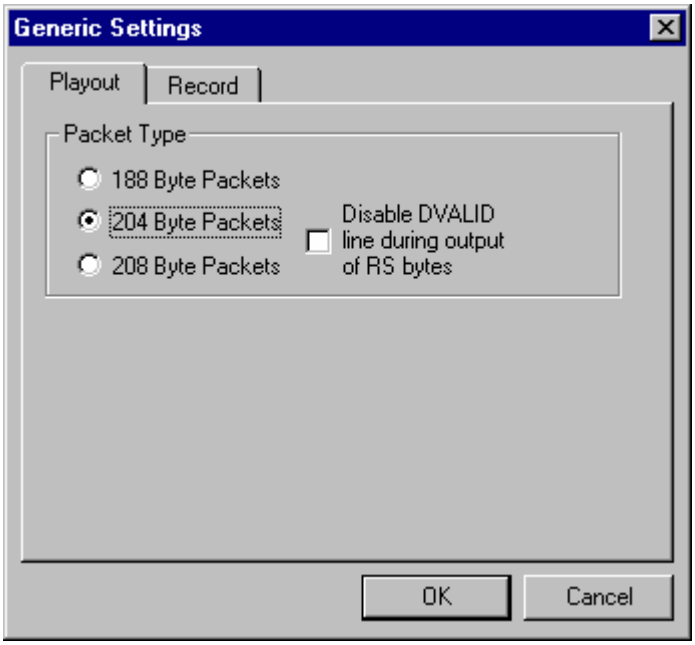


Generic Settings

These are the settings common to all interfaces. Selecting the **Generic Settings…** option from the **Settings** menu will open the Generic Settings dialog. This contains two “tabs”: one for playout and another for record settings. The Playout tab will be on top when the dialog is opened.

Playout

The Playout tab is used to view and change the packet size for playing out an MPEG-2 file.



The **208 Byte Packets** option is currently only available with a GPSI adapter.

Packet Type

The packet type will default to the size in the file, but it may be played out in another format. The Playout transformations are:

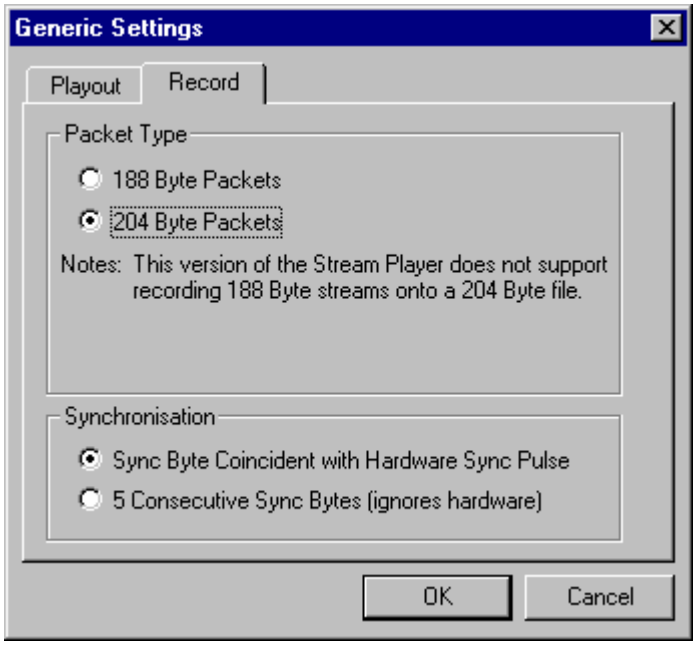
Storage Format	Output Format		
	188 byte	204 byte	208 byte (only via GPSI)
188 byte	✔	✔ (dummy RS)	✔ (dummy RS)
204 byte	✔	✔	

The Disable DVALID tick box is relevant when the selected file is stored in 204 byte format and the interface is set to play in 204 format. It controls the DVALID signal on the DVB interface that is used to indicate whether the last 16 bytes of each packet contain valid Reed Solomon data. If the box is ticked then the DVALID signal on the DVB parallel port will be driven low during bytes 189-204 of the packet indicating that the ‘dummy’ Reed Solomon data is present.

The Clock Rate and Source are specified from the interface specific settings dialogs for each type of interface.

Record

The Record tab is used to view and change the packet size and synchronisation mechanism for recording a stream to file.



Packet Type

The packet type is set by the packet size of the file opened for recording to. A 204 byte packet input stream can be stored in 188 or 204 byte packet format files. A 188 byte packet input may only be recorded in a 188 byte packet format file.

The available transformations are:

Input Format	Output Format	
	188 byte	204byte
188 byte	✔	
204 byte	✔	✔

Note that if a stream is being recorded with time-stamp information (ASI+ TS interface only), the record packet type must be set to 204 byte packets.

Synchronisation

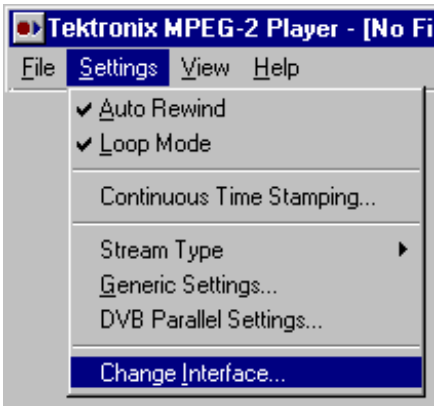
Synchronisation may be slaved to the Hardware Sync or achieved by looking at the input stream for 5 Consecutive Sync Bytes. Sync bytes are recognised by being 188 or 204 bytes apart and holding the value 0x47.

Interface Selection

Player can be configured to use any of the installed interface adapters, providing that another program (e.g. Monitor/Recorder) is not using that adapter. More than one copy of Player may be in use concurrently, but not using the same adapter.

The current selection is shown in the second pane from the right of the Status Bar. It is also indicated by the interface specific interface Settings… option in the Settings menu. In the menu shown below the Parallel interface is selected.

To select an interface use the **Change Interface...** option from the **Settings…** menu.

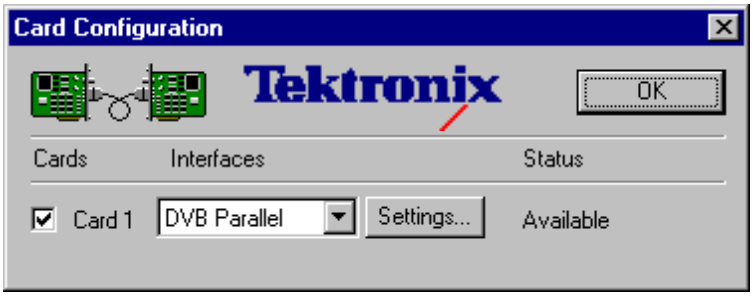


Alternatively click on the Interface Settings button on the Toolbar:

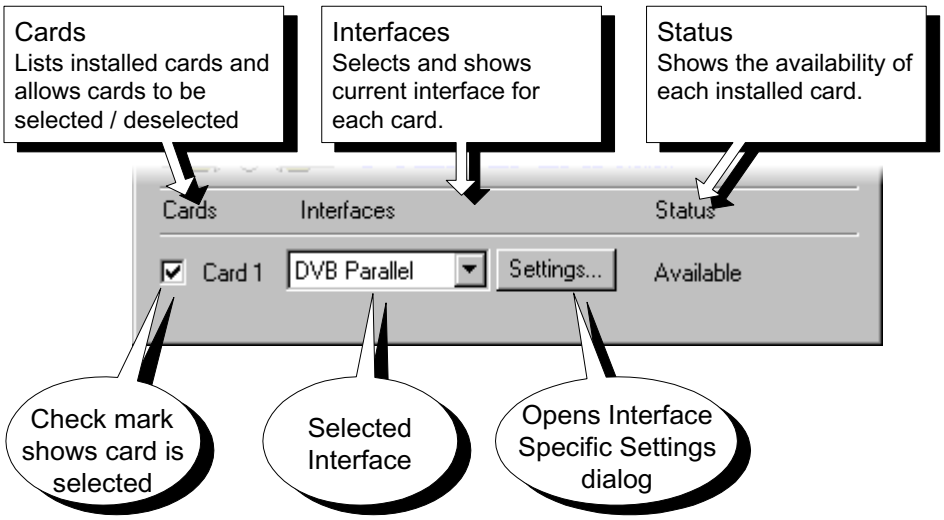
Both of these methods open the **Card Configuration** dialog.

At present MPEG Test Systems are only fitted with one Card and optionally one daughter card.

If extra cards are installed they will all be listed in this dialog.

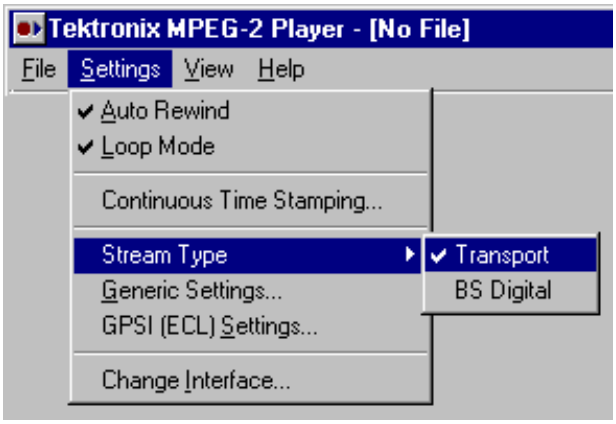


The dialog displays the Card number, selected interface and status. It allows one card to be selected (or all cards deselected). The interface can be selected and its settings changed.



Stream Type

The stream to be played out must be identified as either a standard transport stream of specifically a BS Digital stream. The selection is made via the **Stream Type** option on the **Settings** menu.



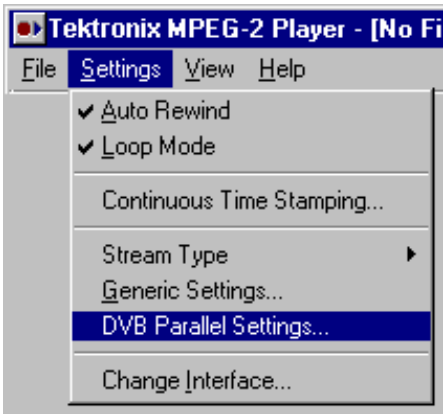
A check mark is shown next to the currently selected stream type.

The selection is also reported in the Display Status bar (see page 15).

Interface Specific Settings

Under the **Generic Settings…** option on the **Settings** menu there will be an option for configuring the specific settings for the currently selected interface.

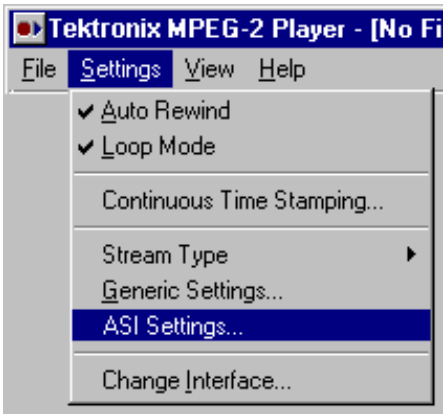
If the parallel MPEG Interface Card is selected the option will be **DVB Parallel Setting…** For example:



Only the MPEG Interface Card can be used to playout BS Digital streams.

If a daughter card is fitted and selected, the menu option will reflect the type of the daughter card interface.

For example if an Asynchronous Serial Interface is in use the option will be **ASI Setting…**



When there is no card available or selected this option is disabled (greyed out).

Select the appropriate **Settings…** option to open the interface specific dialog for the selected card/interface. Refer to the chapter for the specific interface, in section 2 of this User Guide, for a description of the dialog and settings.

Continuous Time Stamping

When looping a transport stream to simulate continuous playout, errors can be generated at the loop point caused by discontinuities in timing information derived from the stream itself. The Continuous Time Stamping function allows the user to specify which time components in a transport stream should be modified to allow a looped stream to correct these timing errors.

Continuous Time Stamping only affects *Playout* (not Record) and only applies when Loop mode is selected.

The following timing components are available for modification:

Sequence counters

Continuity count: The continuity counter is a 4-bit field which increments with each transport stream packet having the same PID

Relative time values

PCR (Program Clock Reference): A timestamp in the transport stream from which decoder timing is derived.

PTS (Presentation Time-Stamp): A PES packet header field that, if present, indicates the time that a presentation unit is presented in the system target decoder.

DTS (Decoding Time-Stamp): A PES packet header field that, if present, indicates the time that an access unit is decoded in the system target decoder.

Absolute time values

TDT (Time and Date Table): A DVB-specific SI table which carries current date and time of day information.

TOT (Time Offset Table): A DVB-specific SI table which carries current date and time of day offset information.

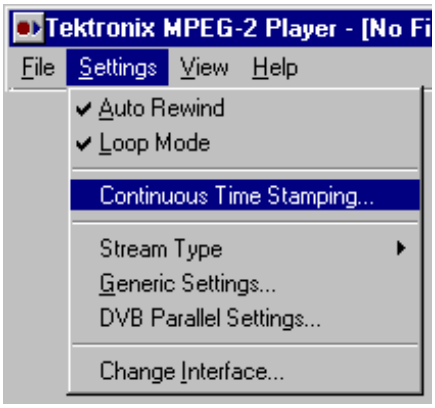
STT (System Time Table): An ATSC-specific table which carries current date and time of day information.

Note that other errors may occur at the loop point if the stream has not been pre-processed for seamless looping. These errors are not dealt with by Continuous Time Stamping. Refer to the Continuous Time Stamping Technical Note for further information.

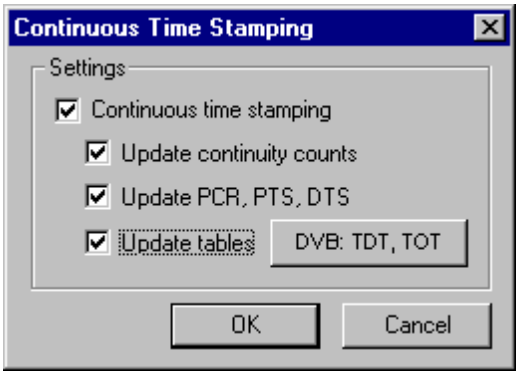
Configuring Continuous Time-Stamping

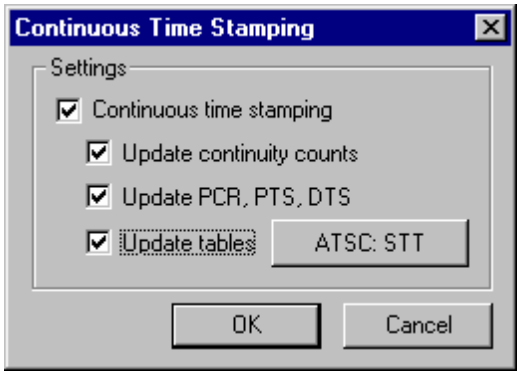
Provided that a file is not being played out, the CTS settings may be changed at any time. If a file is playing out, the menu option is disabled (greyed out). Similarly, if the BS Digital stream type is selected, the menu option is disabled.

To open the CTS settings dialog, select **Continuous Time-Stamping…** from the **Settings** menu.



The dialog displayed is shown below:





The toggle-action **Update tables** button indicates the standard for which time values will be updated. If the stream is of the 'other' standard, the table will not be found and the time stamping cannot take place

If **Continuous time stamping** is not selected, the all selections are disabled (greyed out).

Error messages are displayed at the bottom of the Settings dialog.

Enable the settings required and select OK.

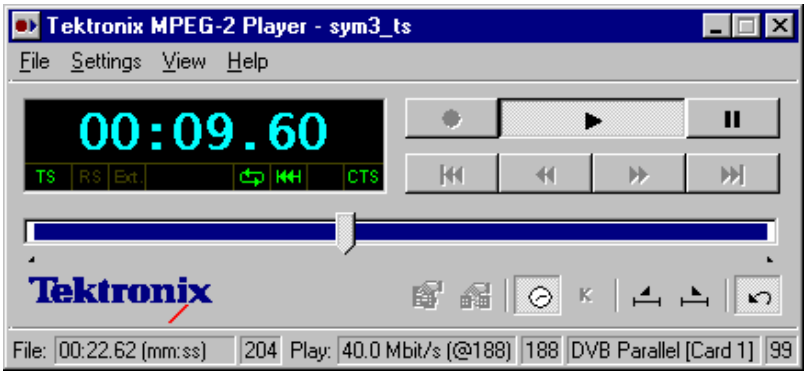
Error Messages

A text area at the bottom of the dialog is reserved for error messages; e.g. **size not multiple of packet size**. The messages displayed are derived by analysing the currently selected stream file and give an indication of the probability of successfully time-stamping a looped playout.

The following error messages are currently implemented:

Message Text	Interpretation
file to small	The file does not have enough data to loop
size not multiple of packet size	The file does not contain a whole number of packets
file sync error	The files does not start with a new packet

The Main Window



The Clock/Counter Display

or

The Clock/Counter Display shows the current record/replay position in the file. It can show either elapsed time or number of packets from the start of the file. To select the display use the options under the View menu or the Toolbar buttons described further on.

Display Status Bar

The Display Status bar provides visual feedback on the following settings:

- **TS** — Indicates the transport stream type selected: **TS** – DVB; **BSD** – BS Digital
- Loop mode is active.
- Auto-rewind is active.
- **CTS** — Continuous time stamping is active.
- **RS** — Reed Solomon: Indicates whether the file is to be played out with the **Dvalid** signal asserted or negated during the last 16 bytes of each 204 byte packet to validate/invalidate the Reed Solomon data that is expected here.
- **Ext.** — External Clock: Indicates whether the MPEG Test System is configured to operate off an internally synthesised clock (blank) or an external clock (**Ext.**).

If the legend is dimmed, the function is inactive.

Stop, Start, Record etc.

These are the main controls for Playout, Recording, Rewinding and Winding Forward an MPEG-2 file. The controls are:

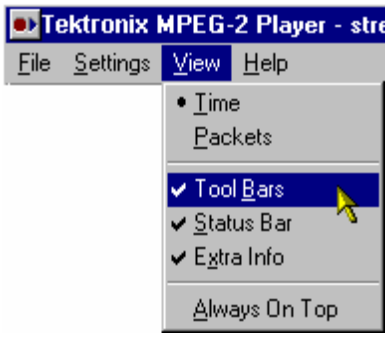
	Record	Selecting this button will puts the MPEG Test System into record mode. Recording begins when the Start/Stop button is selected. Deselecting Record puts the MPEG Test System into play mode.
	Start / Stop	Selecting the Start / Stop button begins playout or recording depending on the state of the Record button. Deselecting it stops playout or record. In play mode playout starts from the current file position. Stopping playout leaves the pointer at the current point in the file. Recording can only begin from the start of the file, so player resets the position to the start of the file.
	Pause	Only enabled during playout, selecting this button pauses the replay. Playout is resumed when Pause is deselected.
	Previous	Moves the current file position back to the start marker.
	Rewind	Rapidly moves the current position within the file back toward the start. Only enabled when playback or recording has been stopped.
	Fast Forward	Rapidly moves the current position within the file forward towards the end. Only enabled when playback or recording has been stopped.
	Next	Moves the current file position forward to the end marker.

Tool Bars

There are two Tool Bars, a Slider to view/set file positions and a bar of Shortcut Buttons.

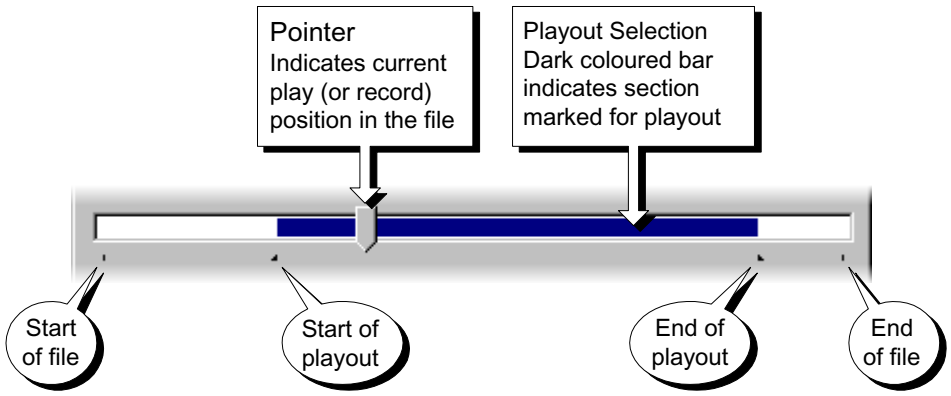
Select the **Tool Bars** option in the **View** Menu to show or hide the Tool Bars.

A check mark is shown next to the option when the Tool Bar is displayed.



Slider Bar

The Slider represents the file as a bar with a pointer to show the current position of playout or recording within the file. A sub section of the file may be selected for playout using options in the Button Toolbar, described further on.

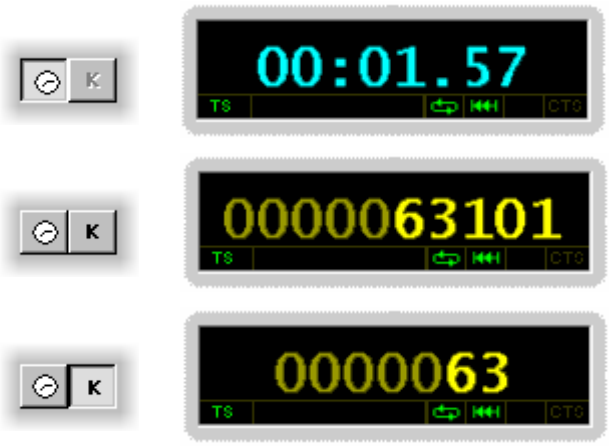


When this is the case, the dark coloured bar shows the selected section. The start or end of the playout section may be at the start or end of file.

Button Toolbar

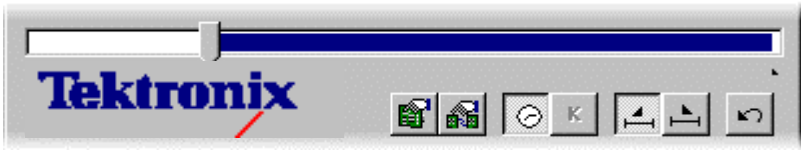
The Button Toolbar has: two buttons for setting interface options; two for selecting the Clock/Counter Display options; and three for selecting playout options.

	Time/ Packets	This toggles the Counter display between showing the current position within the file in terms of time or packets (or kilo-packets).
	Kilo-Packets	This toggles the Counter display between showing the current position within the file in packets or kilo-packets.



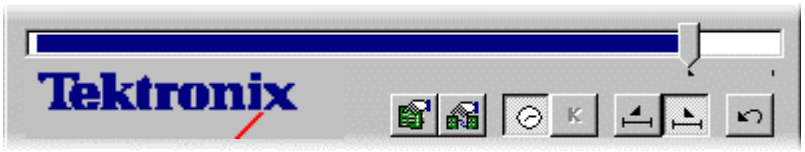
The setting of the packets button is ignored when the Clock display is selected.

Mark Start	To set a start marker within the file, move the pointer to the beginning of the section to playout then select the Mark Start button.



Playout will begins at the start of the dark coloured bar and ▟ mark. To reset playout to the beginning of file deselect the button.

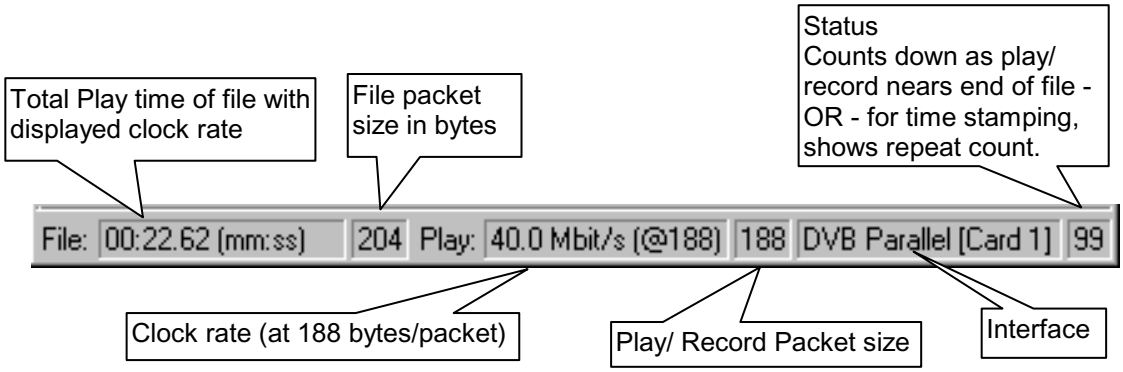
Mark End	To set an end marker within the file, move the pointer to the end of the section to playout then select the Mark End button.



Playout will finish at the end of the dark coloured bar and ▙ mark. To reset playout to the beginning of file deselect the button.

Loop	Selecting this option puts Playout into loop mode, i.e. the file or selected sub-section will be replayed continuously.
Interface Settings	Opens the **Settings…** dialog for the currently selected interface adapter. This button is a shortcut for the interface specific **Settings…** option from the **Settings…** menu.
Change Interface	Opens the **Card Configuration** dialog for the currently selected interface card. This button is a shortcut for the interface specific **Change Interface…** option from the **Settings…** menu.

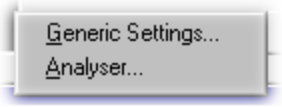
Status Bar



Total Play Time	Shows the play time for the selected file at the clock rate displayed.
File Packet Size	Indicates the format of the open file.
Play/Record Packet Size	In playout this shows whether the selected file is to be played out in 188 byte or 204 byte packets at the DVB interface. In Record mode it shows whether the incoming stream consists of 188 or 204 byte packets.
Clock Rate	Displays the bit rate at which the current file will be played. The value is calculated at 188 bytes/packet irrespective of the actual packet size.
Interface	Displays the interface that is selected, including any daughter card.
Status	Indicates the state of the play/record buffer. Normally shows 99 or 98 during a run, it drops to zero as the buffer empties at the end of file. When Continuous Time Stamping is active, this field indicates the current repeat number (1, 2, 3 etc.). If this number is followed by x (1x, 2x etc) the Timestamp software is reporting a error. In this case try reloading or re-starting the file.

Right Click Options

Three options are available by clicking the right mouse button with the cursor anywhere in the Main window.

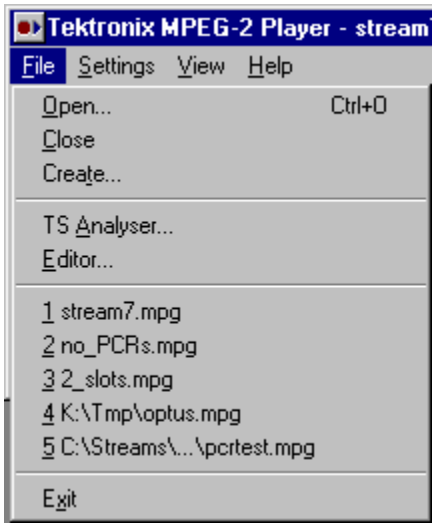


Generic Settings… Opens the **Generic Setting** dialog to set the **Packet Type** and **Synchronisation** options for record and playout.

TS Analyser… Opens the current file in the Transport Stream Analyzer.

Menus and Options

File Menu Options



Open… Opens a file for playing or making a recording to.

Close… Closes the current file.

Create… Runs the TS Maker wizard to create a new, empty, file for recording to.

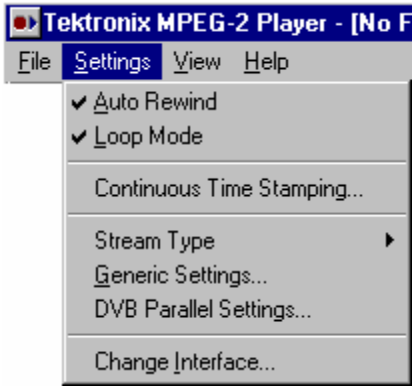
TS Analyser … Opens the current file in the Transport Stream Analyzer.

Editor… Opens the file in the Transport Stream Editor. An opportunity is offered to copy the file since any changes will be recorded immediately.

1 *<filename>*
2 *<filename>*
3 … A list of the most recently analyzed files. If the program has recently been installed the list may be empty.

Exit Terminates execution the program.

Settings Menu Options



(N.B. The menu shows the **DVB Parallel Settings…** option because in this example the Parallel MPEG Interface Card is the currently selected interface.

The option always reflects the selected adapter. For example if the Asynchronous Serial Interface is installed and selected the menu option would be: **ASI Settings…**)

Auto Rewind Turns Auto Rewind on and off. This option has a check mark next to it when turned on.

Loop Mode Selecting this option causes Player to playout the file or selected sub-section continuously.

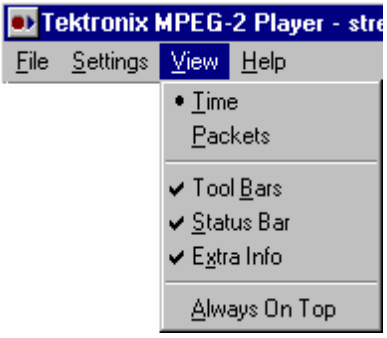
Continuous Time Stamping… Opens the Continuous time stamping dialog to select which timestamp options will be applied.

Stream Type ▶ Opens a side-menu to select the stream type to be played out: **Transport** (DVB) or **BS Digital**.

Generic Settings… Opens the **Generic Setting** dialog to set the **Packet Type** and **Synchronisation** options for record and playout.

< I/F > **Settings…**	Opens a dialog for setting the interface specific options. This example shows the menu option for the MPEG Interface Card, **DVB Parallel Settings…** When there is no card available or selected this option is disabled (greyed out).
Change Interface…	Opens the **Card Configuration** dialog to select which of the installed interface adapters will be used by Player.

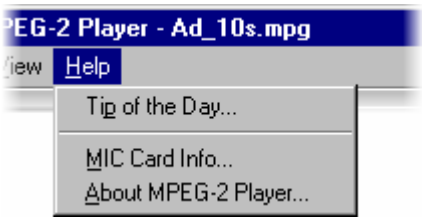
View Menu Options



(a check mark ✓ next to an option indicates that it is currently selected, no ✓ means that it is deselected.)

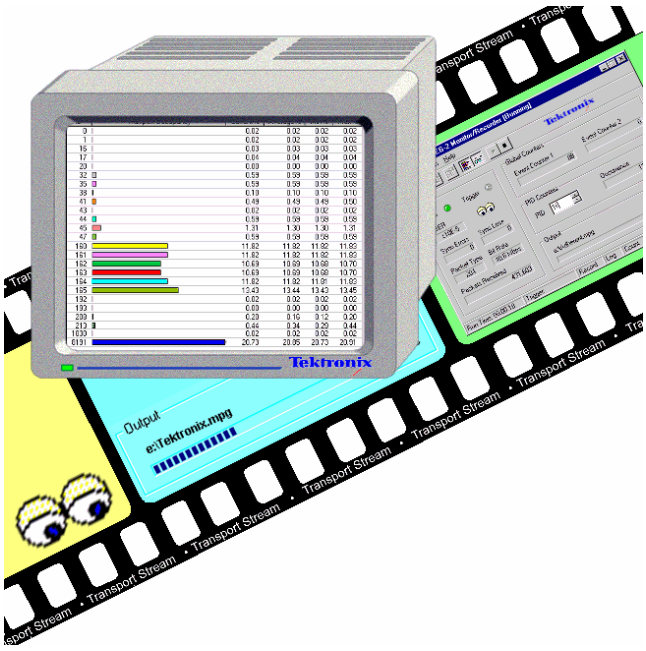
Time	Switches the Clock/Counter display to show file position in elapsed time.
Packets	Switches the Clock/Counter display to show file position in packets from the start of file.
Tool Bars	Shows/Hides the Toolbars.
Status Bar	Shows/Hides the Status Bar.
Extra Info	Shows/Hides the Display Status bar.
Always On Top	Prevents other windows from covering Player.

Help Menu Options



Tip of the Day…	Displays a window containing hints and tips.
MIC Card Info…	Displays configuration and version information for the installed MPEG Interface Card(s).
About ...	Opens a dialogue which displays the program version number.

Section 6 Monitor/Recorder



Introduction & Overview 3
Starting the Program 5
- Initial Appearance 5
- Important Next Steps ! 5
- Messages on starting the Program 6

Choosing an Output file 7
Interface Selection 8
Interface Specific Settings 9
Operating Modes 10
Selecting Monitor Mode Settings 11
Selecting Trigger Mode Settings 12
- Control Tab 13
- Global Events Tab 19
- PID Events Tab 24
- Saving and Loading Settings 26

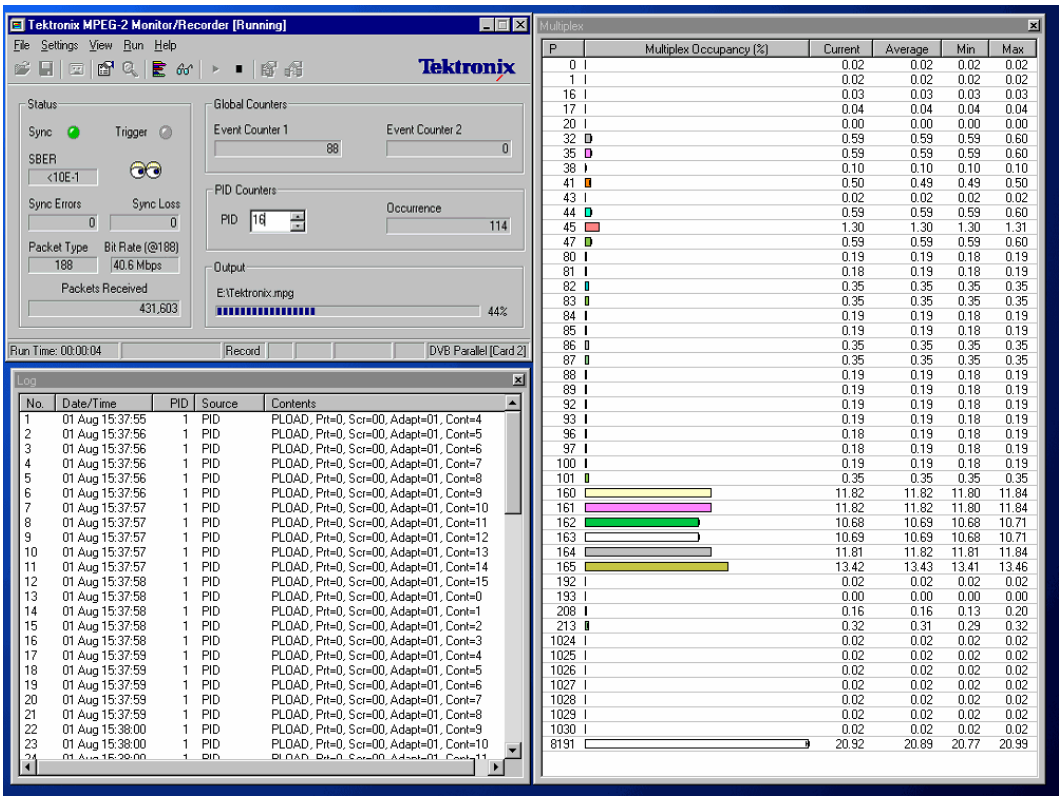
Main Window 27
- Title Bar 27
- Menus and Options 28
- Toolbar Buttons 30
- Status Bar 31
- Status Panel 32
- Global Counters 33
- PID Counters 33
- Output Panel 33

Multiplex Window 34
- Trigger Mode 34
- Monitor Mode 36
- Common Features 41

Log Window 43
Performing a Monitor/Record Run 45
- Preparation 45
- Starting the Run 45
- Viewing Displays in Real Time 46
- Stopping the Run 46

Introduction & Overview

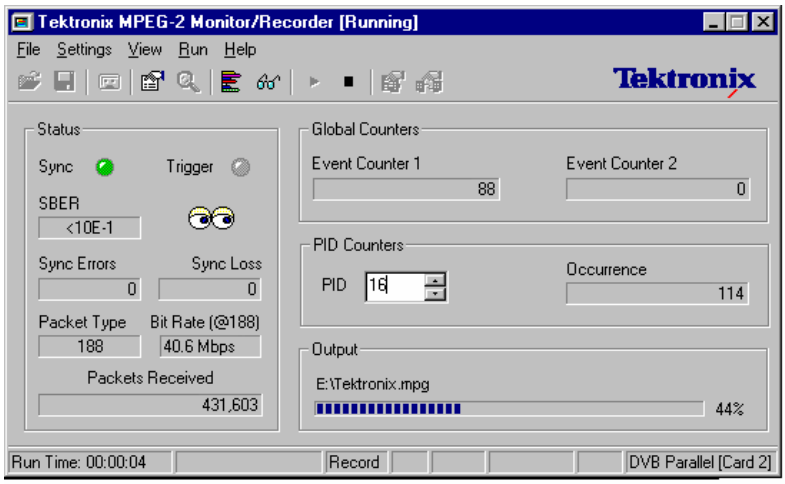
The Monitor/Recorder provides facilities to record transport streams to disk, to view the stream multiplex in real time and to monitor for sets of user selected events. Events can be used to trigger recording of a stream to disk for replay and off-line analysis. Monitor/Recorder presents an instrumentation style main window for the operational controls and status displays.

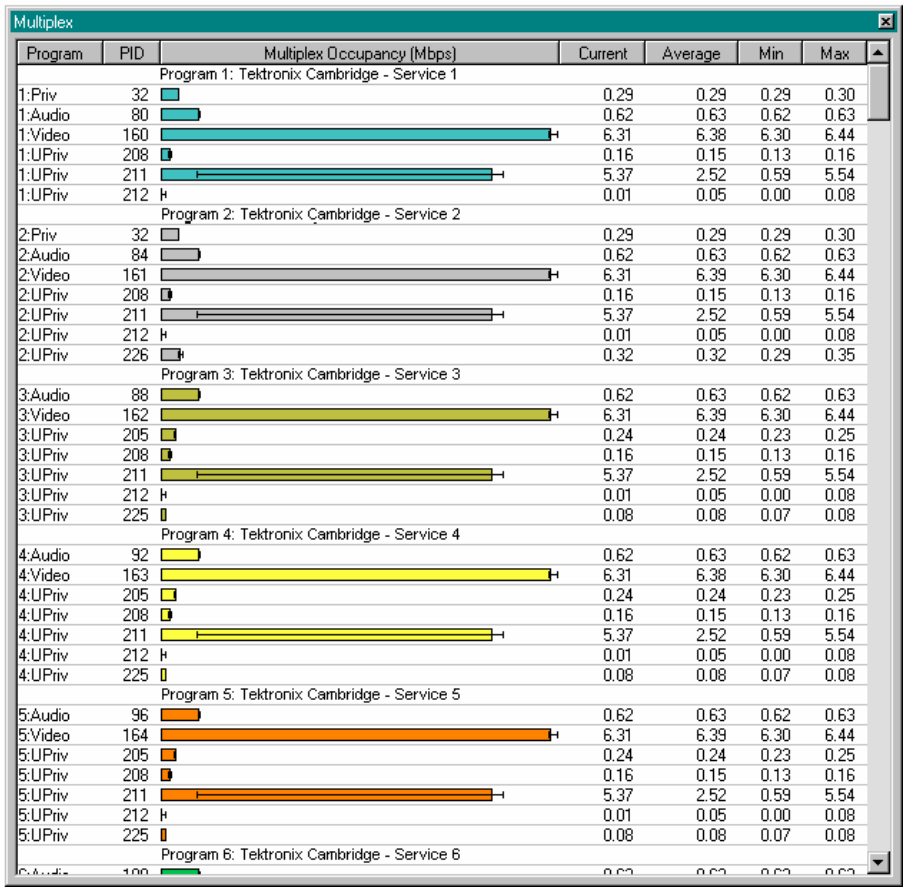


There are two operating modes. The above screen shot shows the Trigger Mode. A real time display of the stream multiplex can be opened, as shown on the right. All or a selected sub-set of the detected events may be reported in the Log window, shown to the left of the Multiplex window and below the main window.

Before starting a Trigger Mode monitor/recording run, read the sections: *Choosing an Output file* (page 7), *Operating Modes* (page 10) and *Selecting Trigger Mode Settings* (page 12). The section *Performing a Monitor/Record Run* (page 45) provides a useful a check list.

In Monitor Mode the stream multiplex display indicates what program and type of information is being carried by each PID. The graphs of PIDs carrying program streams are grouped together by Program number. Record, Event Triggering and Logging functions are disabled when operating in Monitor Mode.

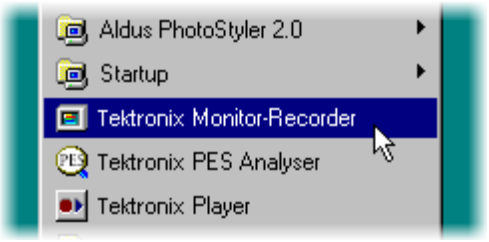




Refer to the sections Operating Modes (page 10) and *Selecting Monitor Mode Settings* (page 11) to specify how Monitor/Recorder will interpret the Program and Table data. The section Performing a Monitor/Record Run (page 45) provides a useful a checklist.

Starting the Program

The program may be started by selecting the **Tektronix Monitor-Recorder** option from the **Start -> Programs** menu.

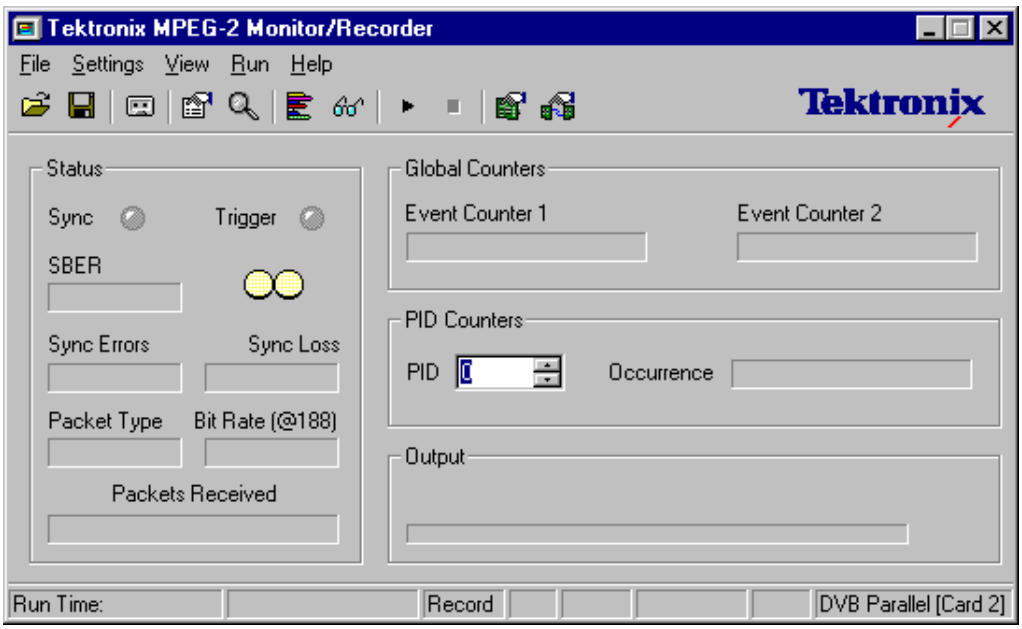


or

by double clicking on the **Tektronix TS Monitor-Recorder** Shortcut on the desktop.

Initial Appearance

As the program starts, it opens a main window. This contains the Menus, Toolbar and various status displays for monitoring and recording Transport Streams.



The pair of pale yellow circles represents a pair of eyes. The program is currently inactive, so the eyes are closed. When the program is looking at the input Transport Stream the eyes are open and appear to look around themselves.

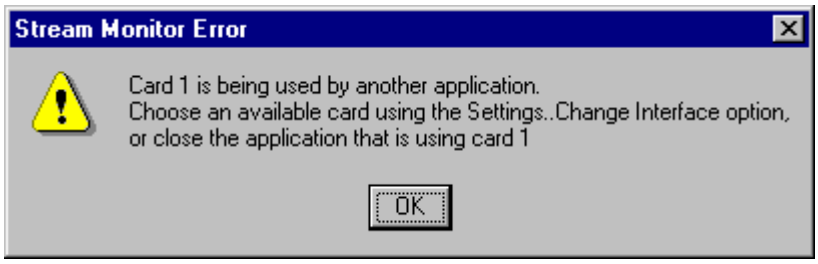
Important Next Steps !

Check the Output file specification, Interface Selection, Interface Settings, Operating Mode, Trigger and Monitor mode Settings. The state of all of these is saved from the last time the Monitor/Recorder program was run.

When the program is installed the Output file, Operating Mode and Settings have default states, which are likely to need changing for the work about to be done.

Messages on starting the Program

Monitor/Recorder saves the interface configuration which was used the last time it was run. An MPEG Interface Card (and connected daughter card if installed) can only be used by one instance of an application at a time. If the interface adapter is in use by another program (e.g. Player or another instance of Monitor/Recorder) or is not available an error message is displayed on starting. For example:



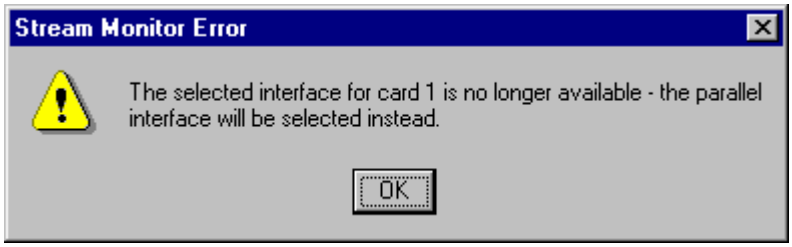
Click on the **OK** button to continue. The card selection is reset to none for the newly started instance of Monitor/Recorder.

Select another card, if one is available, using the **Card Configuration** dialog. Alternatively release the card from the other application, then select it with the **Card Configuration** dialog. This is available via the **Change Interface…** option from the **Settings** menu.

Monitor/Recorder may be configured with no card selected to release a card for another program without shutting down Monitor/Recorder. If this configuration is saved a reminder that a card must be selected for monitoring or recording is displayed:

As above, select a card, if one is available, using the **Card Configuration** dialog. Alternatively release the card from the other application, then select it with the **Card Configuration** dialog.

If a daughter card has become unavailable, perhaps because it has been removed, since Monitor/Recorder last ran, the Parallel MPEG Interface Card will be selected instead. A message is displayed advising that this has happened. For example:



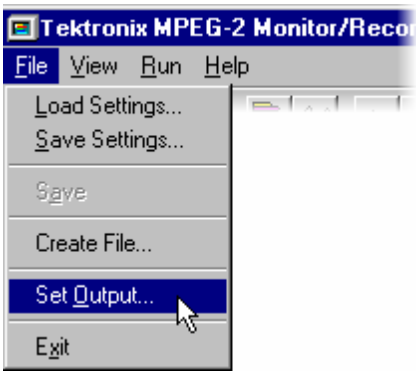
Choosing an Output file

Before recording a section of Transport Stream, the Monitor/Recorder should be given a file to Output the stream to. This may be an existing file (to be overwritten) or a new file.

It is a good idea to have a 'scratch file' that can be specified when no recording is intended. This avoids over-writing a valuable file by accident. It also gives somewhere to record to quickly - saving a few seconds of work for specifying a new file.

Specifying an Existing File

To specify a file select the **Set Output ...** option from the **File** menu.



Alternatively select the Output button on the Toolbar:

Both of these methods open a standard file browser dialog.

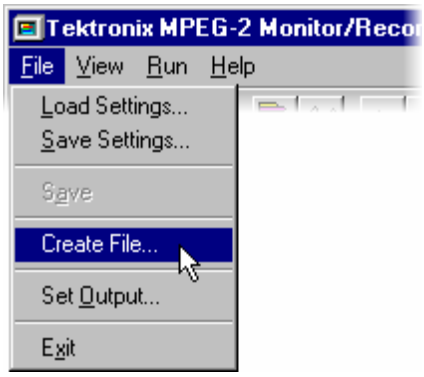
Select an MPEG file on the Video disk, this is an NTFS Striped volume set, usually Drive E. Only such a drive has the speed needed to reliably record streams to and replay them from. Do not select a file on any other disk drive.

Creating a New File

A new file may be created and selected for output.

To create a file select the **Create File ...** option from the **File** menu.

This will start the TS Maker Wizard. (Refer to the section on the Wizard for more details.) The file is automatically set as the Output file once the wizard has created it.

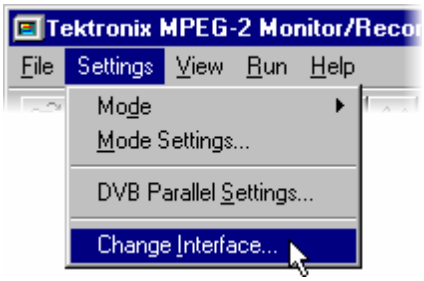


Interface Selection

Monitor/Recorder can be configured to use any of the installed interface adapters, providing that another program (e.g. Player) is not using that adapter. More than one copy of Monitor/Recorder may be in use concurrently, but not using the same adapter.

The current selection is shown in the right most pane of the Status Bar. It is also indicated by the interface specific interface Settings… option in the Settings menu. In the menu shown below the MPEG Interface Card, **DVB Parallel Settings…** is selected.

To change interface select the **Change Interface...** option from the **Settings…** menu.

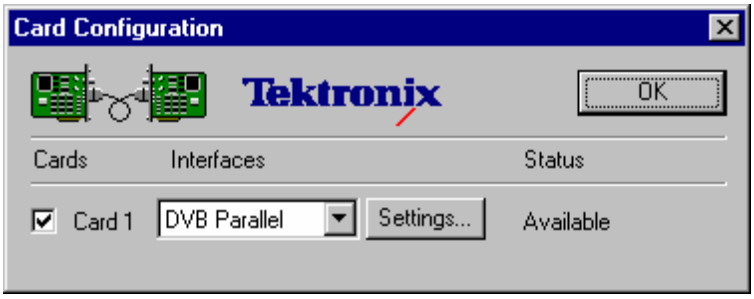


Alternatively select the Interface Settings button on the Toolbar:

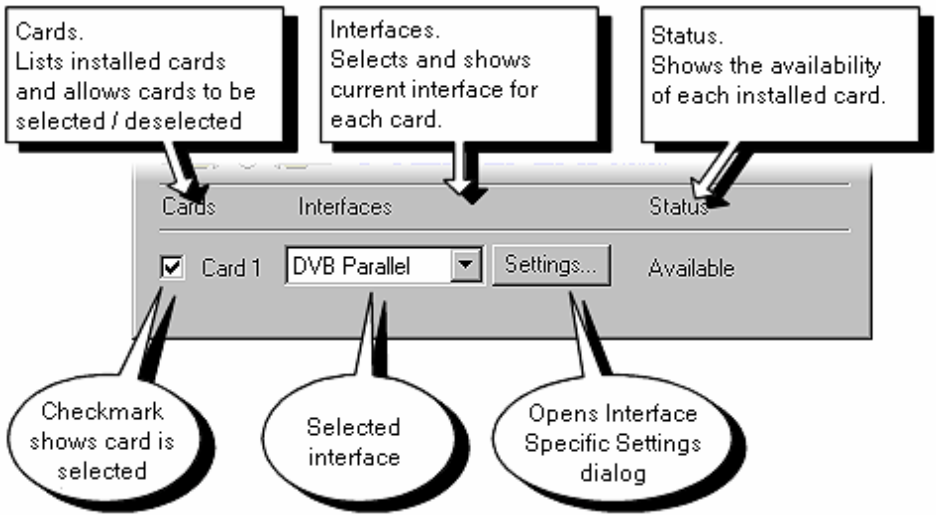
Both of these methods open the **Card Configuration** dialog.

At present AD951A/AD953As are only fitted with one Card and optionally one daughter card.

If extra cards are installed they will all be listed in this dialog.



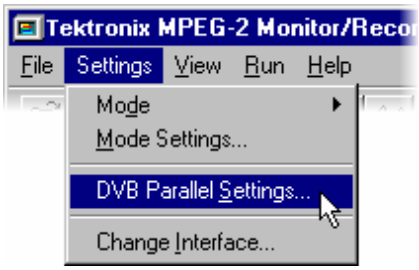
The dialog displays the Card number, selected interface and status. It allows one card to be selected (or all cards deselected). The interface can be selected and its settings changed.



Interface Specific Settings

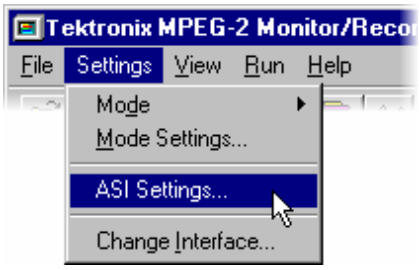
Under the **Mode Settings…** option on the **Settings** menu there will be an option for configuring the specific settings of the currently selected interface.

If the parallel MPEG Interface Card is selected the option will be **DVB Parallel Settings…** For example:



If a daughter card is fitted and selected the menu option will reflect the type of the daughter card interface.

For example if an Asynchronous Serial Interface is in use the option will be **ASI Settings…**



Select the appropriate Settings… option to open the interface specific dialog for the selected card/interface.

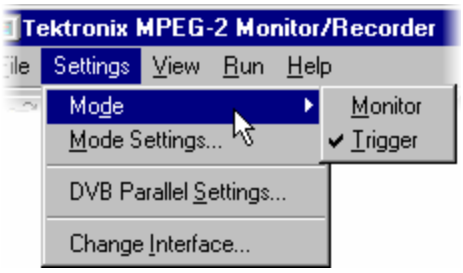
Refer to the chapter for the specific interface, in section 2 of this User Guide, for a description of the dialog and settings.

Operating Modes

The Monitor/Recorder can record transport streams to disk, display the stream multiplex in real time and detect sets of user selected events. Events can be counted, detailed in the Event Log, used to trigger recording and sending alarm signals to external equipment.

There are two Operating Modes, Monitor and Trigger, which determine the type of functionality available for analysing and displaying the stream multiplex.

Monitor or **Trigger** mode is selected using the **Mode** sub-menu from the **Settings** menu. The currently selected mode is indicated by a check mark, ✓, next to the sub-menu option.



A shortcut button on the toolbar toggles the application between Trigger and Monitor mode.

When the button is 'Out' Monitor/Recorder is in Trigger mode.

When the button is 'In' the application is operating in Monitor mode.

Monitor Mode

In Monitor Mode the stream multiplex display indicates which program and what type of information each PID is carrying. The graphs of PIDs carrying program streams are grouped together by Program number.

All of the Record, Event detection, Triggering and Logging functions are disabled when the application is operating in Monitor Mode.

Trigger Mode

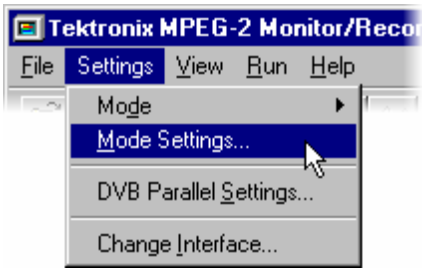
In Trigger Mode transport streams can be recorded to disk, events can be detected, counted, logged, used to trigger recording and alarms.

The stream multiplex is analyzed and displayed without program or table information.

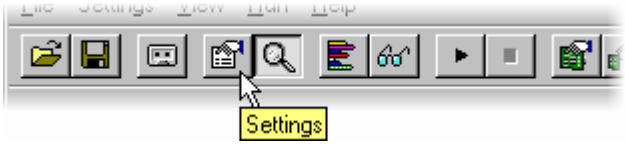
Selecting Monitor Mode Settings

In Monitor mode there are only two options for selecting which standard is used to interpret the packet information. These settings affect what information is displayed in the Multiplex window.

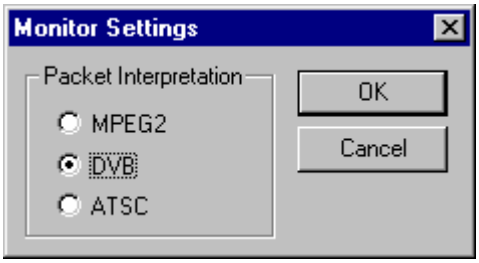
To alter the settings select the **Mode Settings...** option from the **Settings** menu.



Alternatively click on the Settings button:



This opens the Monitor Settings dialog, which looks like this:



The available options are:

MPEG2 Interprets the PAT to label each PID in the Multiplex window with the appropriate program and stream type or MPEG-2 table. PIDs carrying DVB or ATSC tables or other unknown information are labelled as **Unref**. The SDT is not part of the MPEG-2 specification, hence it is not interpreted. The Multiplex window displays the Provider and Service names as **Unknown**.

DVB Interprets the Program Association Table (PAT) and Program Map Table (PMT) to show the type of information carried by each PID. The **Program** column of the Multiplex window indicates the program and stream type; the SI/PSI table or other information as appropriate. The stream type field of PIDs carrying unknown information are left blank. Information carried in the Service Description Table (SDT) is used to interpret and display the Provider Name and Service Name.

ATSC Interprets the PAT and PMT to show the type of information carried by each PID. The **Program** column of the Multiplex window indicates the program and stream type; the PSIP table or other information as appropriate. The stream type field of PIDs carrying unknown information are left blank. Information carried in Virtual Channel Tables is used to interpret and display the Service Name and other Channel information.

Selecting Trigger Mode Settings

It is important to understand how the Settings work to make Monitor/Recorder perform the right operations for the required task. The program can monitor the transport stream for selected events. It can perform one or more operations in parallel. It can use the monitored events to affect how and when the operations are performed.

Events

Sets of events are specified for monitoring and interacting with other operations. Each set may contain zero, one or more events. A set containing zero events is not active. An event action is performed each time any one of the events in a set occurs.

Up to three separate sets of events may be specified. Two are always global, i.e. they apply to all PIDs in the transport stream. These are called 'Global Events'.

The third set of events applies to a selected sub-set of set of 1 or more PIDs in the transport stream. It is possible to select all PIDs making this set work like a global set. These are called the 'PID Events'.

Operations and Interactions

The program can Record Streams, Log events, Count events and send Alarm signals to other equipment. The Global and PID events can interact with these operations. Each set of events has six flags that indicate how it can affect the operations as follows:

Record

Record all or just selected data from a transport stream. Recording may be set to start immediately or when some pre-selected events occur.

Trigger	Start recording when one of the specified events is detected.
Filter	Only records packets that match at least one of the events specified.

Log

Reports events in the Log window.

Log	Write a one-line description of each event in the Log window

Count

Count selected events - just displaying a total. There are two separate counters, for selecting different sets of events to count.

Counter 1	Increment counter 1 each time one of the specified events occurs
Counter 2	Increment counter 2 each time one of the specified events occurs

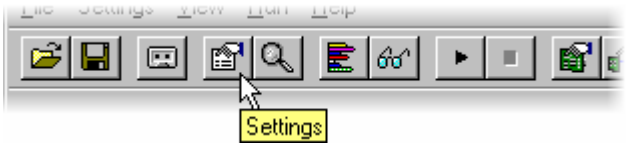
Alarm

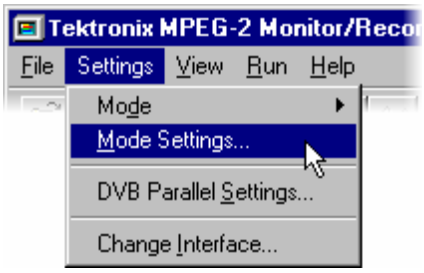
Raise an alarm when any selected event occurs.

Alarm	sends out an alarm signal (to another piece of equipment perhaps) via the Alarm interface, when one of the events in the set occurs.

Specifying Settings

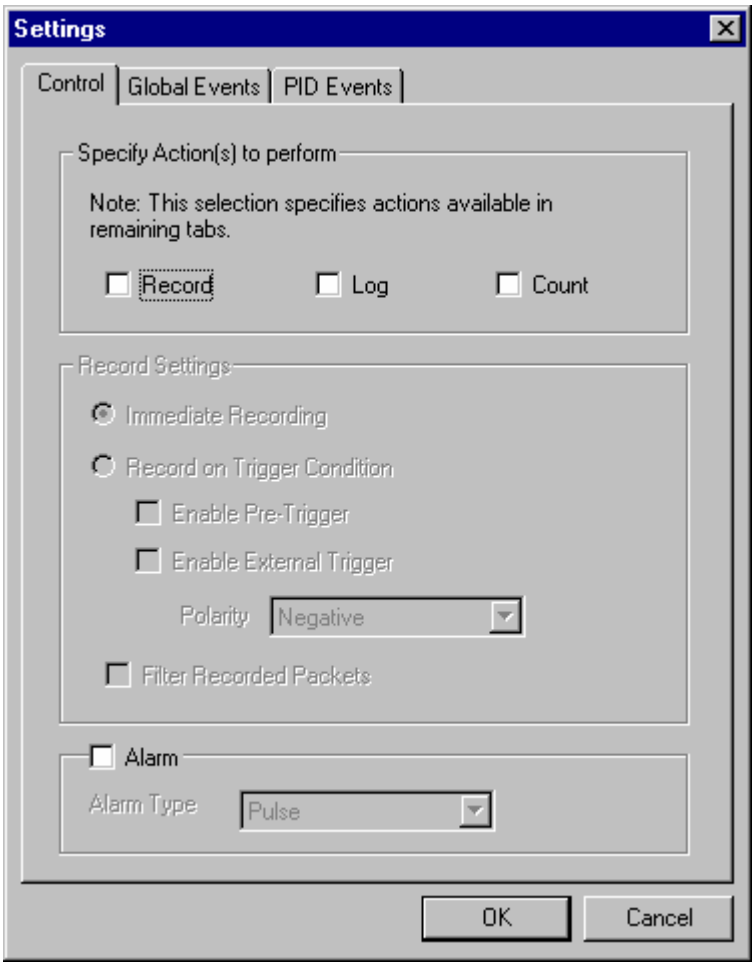
To configure the settings open the Settings dialogue by either: selecting **Mode Settings...** from the **Settings** menu, or clicking on the Settings button in the Toolbar:





The Settings dialogue contains three tabs. It opens with the **Control** Tab in front.

Control Tab



When the program is first installed there are no actions checked in the **Control** Tab.

All changes made to the settings are recorded, so that when the program is started again it presents the most recent settings.

The Settings can be saved to a file on disk using the **Save Settings…** option under the **File** menu.

Similarly previously defined settings can be loaded in from file using **Load Settings…**

When no actions are specified in the **Control** Tab, the only operation the Monitor/Recorder will perform is calculating the Multiplex Occupancy information. To perform other operations their actions must be checked from this Tab. When an action is checked it can be associated with one or more sets of events in the **Global Events** and **PID Events** Tabs.

All of the actions, except for **Immediate Recording** and **Record on Trigger Condition** with **Enable External Trigger**, must be associated with at least one set of events from the other Tabs.

Record

When the top-level **Record** action is checked the options in the **Record Settings** panel are enabled. These give a choice of how recording is started and the option to record a sub-set of the packets from the steam.

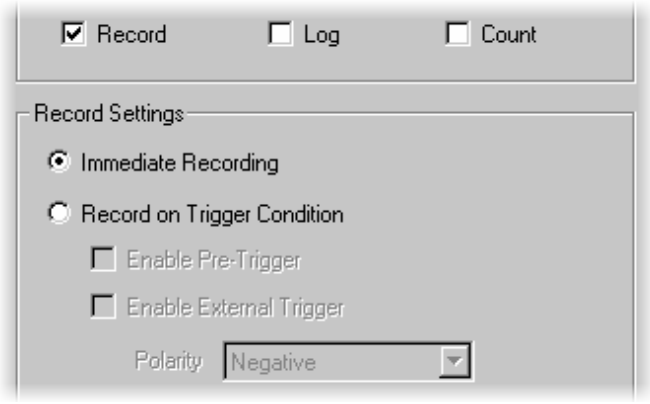
Record can be used by itself or with any combination of the **Log**, **Count** and **Alarm** actions.

Immediate Recording

When **Immediate Recording** is selected the program will start to record stream data as soon as possible after the Start Run command is given.

For recording manually select the **Immediate Recording** option in the Record Settings.

This will disable (grey out) out the **Enable Pre-Trigger** and **Enable External Trigger** options.



Record on Trigger Condition

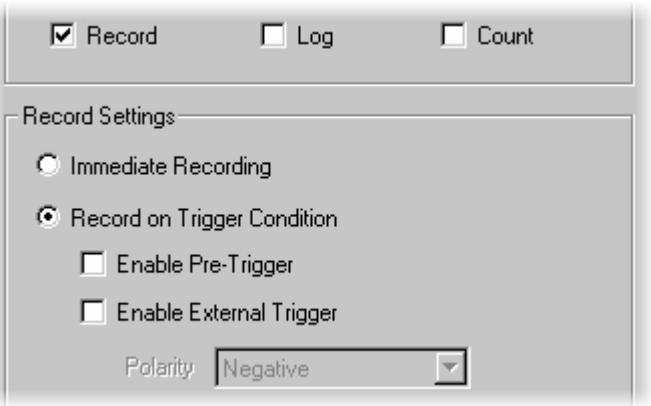
The Monitor/Recorder can use a detectable event in the transport stream or an external signal to trigger recording. When **Record on Trigger Condition** is selected the **Run**->**Start** command causes the program to monitor for the trigger. The program can either: Record to file from the moment of trigger, or include data from the period just prior to the trigger. This is called Pre-Trigger. If filtering is selected, then only the packets that match the filter event selections will be recorded.

Transport Stream Event Trigger

For recording stream data from the time when a selected event occurs in the transport stream. The output includes the packet which caused or was incoming during the event.

These settings cause recording to take place as soon as an incoming packet causes a selected trigger event.

At least one set of events from the **Global Events** and **PID Events** Tabs must be associated with the **Trigger** action.

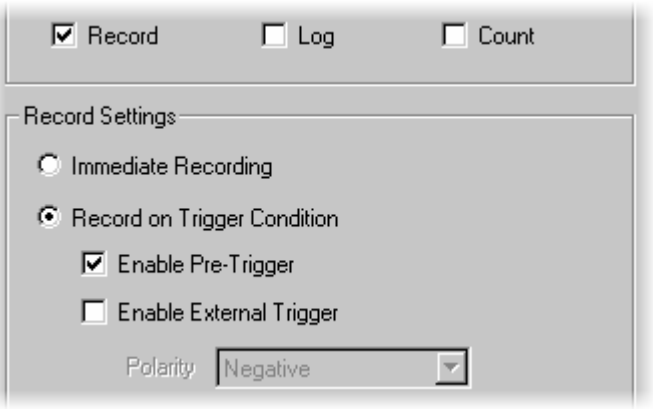


Transport Stream Event with Pre-Trigger

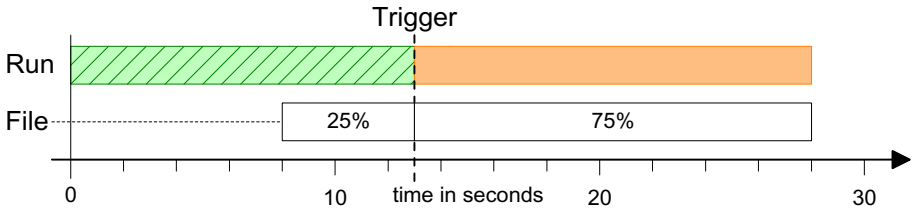
This option saves packets from before and after the Trigger event. Use it when off-line analysis is needed to discover what led up to an event.

With the **Enable Pre-Trigger** option selected, up to 25% of the recorded output file is from the time immediately before the trigger event.

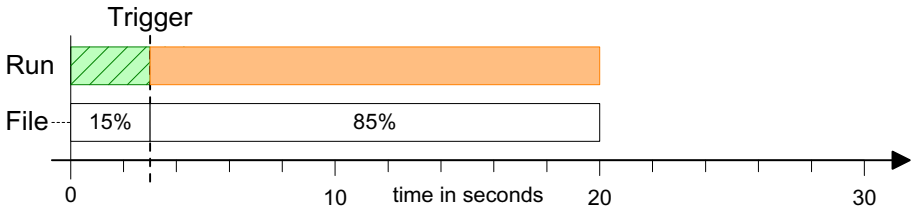
At least one set of events from the **Global Events** and **PID Events** Tabs must be associated with the **Trigger** action.



For example if a 20 second recording is made and an event triggered recording 5 seconds or more in to the run the contents of the file will be:



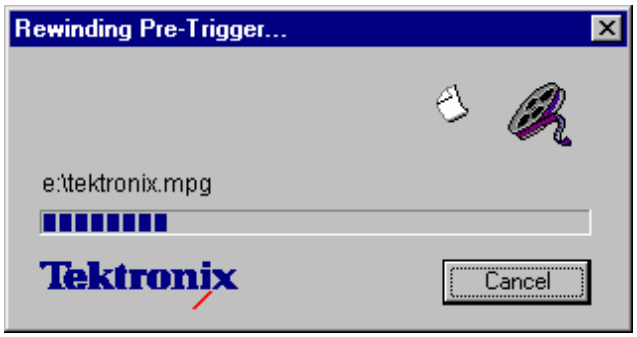
If the Trigger event was detected earlier than 5 seconds into the run, the 20 second file will contain all of the data up to the Trigger. Say recording was triggered at 3 seconds only the first 15% of the file would hold pre-trigger data. The file contents would be:



In order to capture pre-trigger data the program uses the output file as a buffer. Once the run has finished it 'rewinds' the file to position the start of the recording at the start of file.

While the program is rewinding the file it displays this progress indicator to show what it is doing.

Once rewinding has finished the file is available for investigation by other programs.



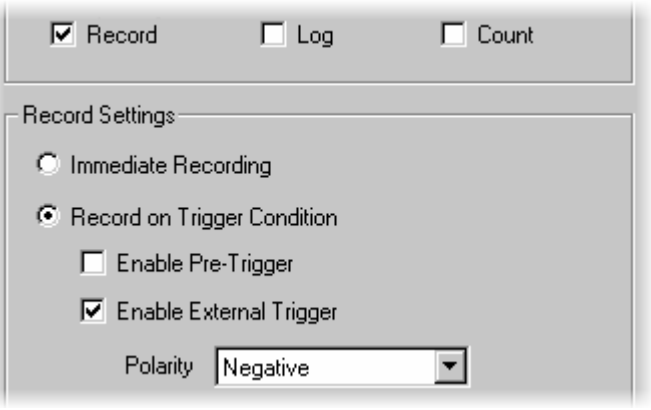
External Trigger

The MPEG Test System can take an external trigger signal via the Trigger Interface. When both external and transport stream event triggers are enabled recording is triggered by whichever occurs first.

Select these options to start recording from an external trigger source.

Recording starts with the first complete packet, subject to good sync, to be received after the trigger signal arrived.

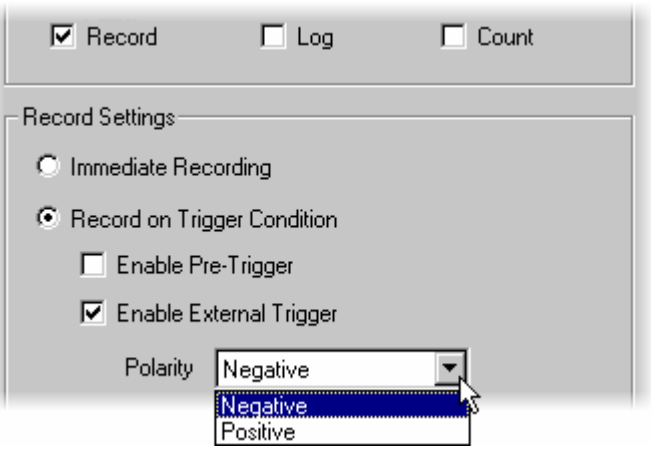
If filtering is enabled recording starts with the first complete packet that gets through the filter after the trigger signal arrived.



The program can trigger recording on a negative going or a positive going signal edge. This is selected using the **Polarity** drop down list.

TTL signal levels are used for the external trigger.

A **Negative** polarity trigger occurs on a falling edge and the **Positive** polarity trigger occurs on a rising edge.

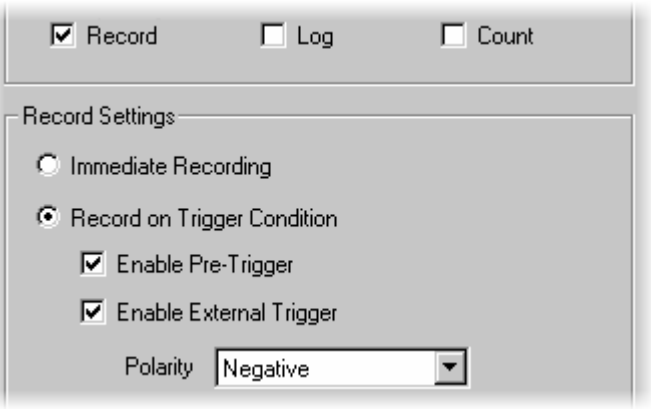


External Trigger with Pre-Trigger

The **Enable Pre-Trigger** and **Enable External Trigger** options may be used together.

These settings will trigger from the external source and save data from before that trigger.

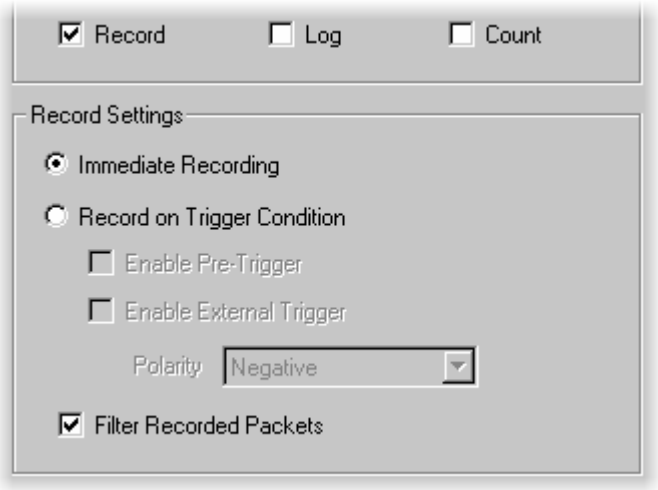
Remember, if filtering is selected, then only the packets that match the filter conditions will be recorded, before and after, the trigger event.



Refer to the previous descriptions of the Pre-trigger and External Trigger options for details.

Filter Recorded Packets

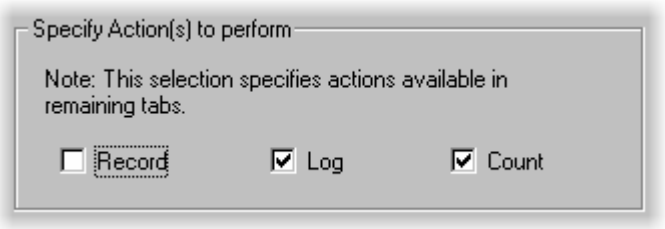
Filtering controls which packets are recorded, based on the contents of the packet header. The packets are selected by using one or more of the sets of events from the **Global Events** and **PID Events** tabs.



Filtering can be used with any of the other Record actions. It can also be used with any combination of the Log, Count and Alarm actions.

Events associated with the Filter action may also be associated with any combination of the other actions.

Log & Count Actions



The **Log** and **Count** actions may be used separately or together.

They can be used with any combination of the **Record** and **Alarm** actions.

Log

Enabling the **Log** action causes a message to be written in the Log window for each event detected in an associated set of events. The event log is sized to contain 2048 events. Once the event log is full, further events will not be logged.

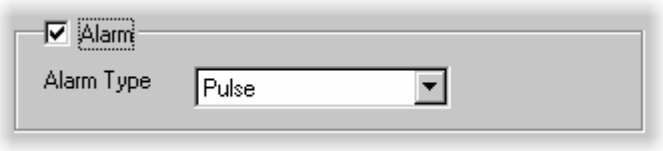
At least one set of events must be associated with the **Log** action when it is enabled. Avoid associating events that by occurring frequently are likely to fill the log window before the events of interest are captured.

Count

When the Count action is enabled, events associated with **Counter 1** increment **Global Counter 1** by one each time they are detected. Similarly events associated with **Counter 2** cause **Global Counter 2** to be incremented.

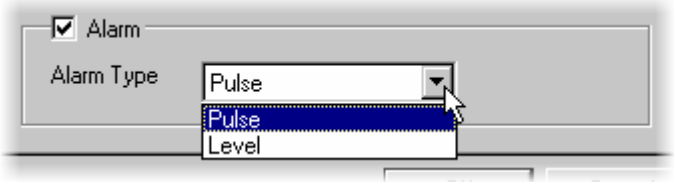
If the **Count** action is enabled one or both of the Counters must be associated with events in the **Global** or **PID Events** tabs.

Alarm



An external 'alarm signal' may be generated when an event is detected. When the **Alarm** action is checked an event from an associated set of events causes a Trigger Out signal. This is sent, via the Trigger Interface, to any externally connected equipment.

The **Alarm Type** specifies whether a pulse or change in level is used to signal the alarm.



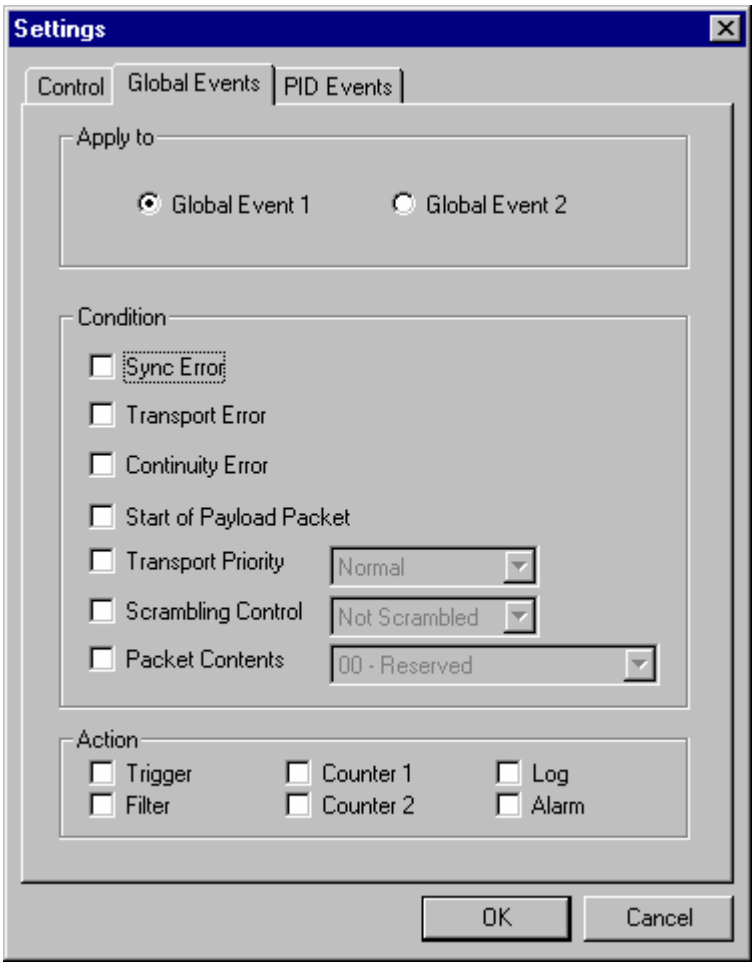
When the **Alarm Type** is set to **Pulse**, a signal pulse will be generated for each incoming packet for which an event is detected. The duration of the signal pulse is equal to the duration of the incoming packet.

If the **Alarm Type** is set to **Level**, the signal level will change on the occurrence of the first event after Run Start. It does not change on subsequent events in that run.

Global Events Tab

Two separate sets of global events can be tested for, on all packets in the transport stream. The sets are referred to as **Global Event 1** and **Global Event 2**. Each set is composed of one or more event generating conditions selected from the **Condition** panel.

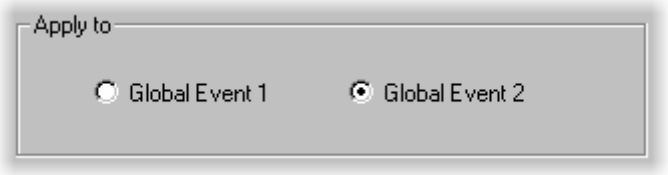
The set of events is also associated with one or more of the actions in the **Action** panel.



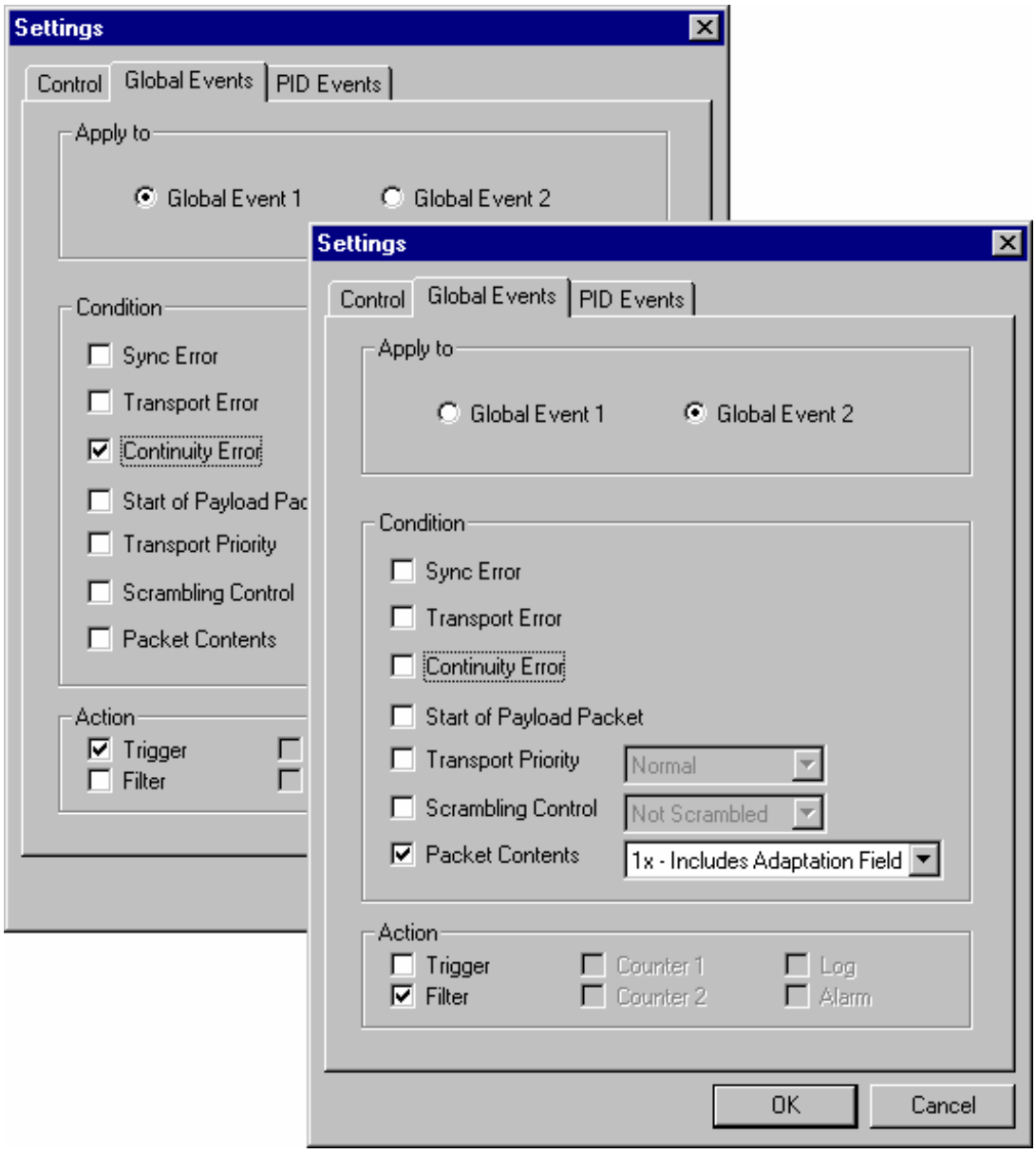
Apply to

The **Apply to** panel selects which of the two Global Events is displayed in the tab. To view and modify the settings for **Global Event 1** it must first be selected in the Apply to panel. When it is selected the settings for **Global Event 2** are hidden from view and protected from alteration.

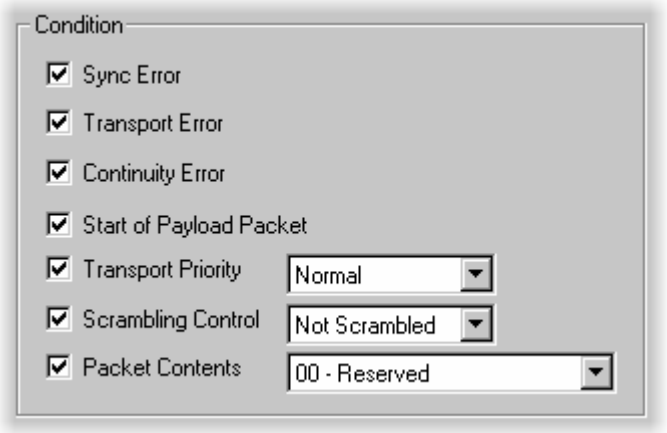
To view and modify the settings for **Global Events 2**, select the **Global Event 2** option in the **Apply to** panel. This hides and protects the settings for **Global Events 1**.



For example: **Global Event 1** could trigger recording when a **Continuity Error** is detected; **Global Event 2** could specify a filter so that only Packets carrying an adaptation field are recorded. Here is a screenshot of each, shown next to each other for comparison.



Condition



The examples in the description of the **Apply to** panel show a single **Condition** being selected to generate events for each Global Event set.

Any combination of Conditions or all of the Conditions may be selected. A condition may be selected in both **Global Event 1** and **Global Event 2**.

The conditions for generating events are:

Sync Error — Generate an event when a packet is received containing an invalid sync byte.

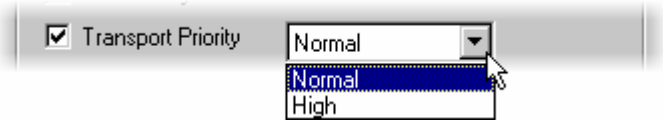
Transport Error — Generate an event if the transport error indicator is set in the packet header.

Continuity Error — Events occur if the packet header continuity counter is not incremented by one between successive packets of the same PID, in accordance with standard *ISO/IEC 13818-1 section 2.4.3.3.*

As defined in the MPEG-2 standard, the continuity count test is applied to all packets except null packets (PID 8191). Single packet duplications containing identical continuity counts do not constitute continuity errors and so will not cause an event.

Start of Payload Packet — Produces events when a payload start indicator bit is set, in the received packet

Transport priority — Generates an event if the transport priority bit in the packet header matches the selected state. The test state is selected using the drop down list:

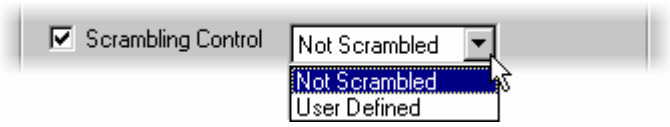


Normal - generates events when the packet header transport priority bit is set to 0 (zero).

High - generates events when the packet header transport priority bit is set to 1.

Scrambling Control

Generates an event if the state of the 2 bit transport scrambling control field matches the selected test state. The test state is selected with the drop down list:

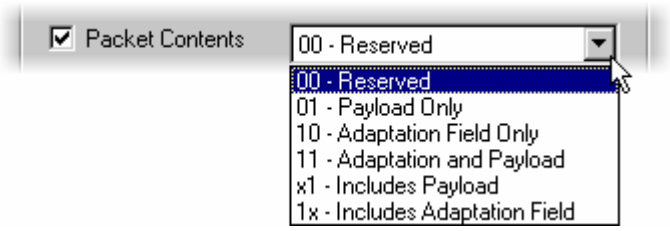


Not Scrambled - Events occur if the transport scrambling control is set to 'off' (value 00).

User Defined - gives an event if the transport scrambling control is set to any of the three user defined values. In binary these are: 01, 10, and 11.

Packet Contents

Events are generated if the contents of the adaptation control field match the selection from the drop down list. The possible test patterns to match are:



00 - Reserved - generates an events when the adaptation field control bits have the value ‘00’. This value is reserved for future use by ISO/IEC.

01 - Payload Only - generates an events when the bits have the value ‘01’, indicating that the packet contains payload data but no adaptation field.

10 - Adaptation Field Only - causes an event when adaptation field is et to the value ‘10’, indicating that the packet contains an adaptation field but no payload data.

11 - Adaptation and Payload - Events occur if the packet header adaptation field control bits have the value ‘11’ indicating that the packet contains payload data and an adaptation field.

x1 - Includes Payload - Events occur if the packet header adaptation field control bits have the value ‘01’or ‘11’, indicating that the packet contains payload data.

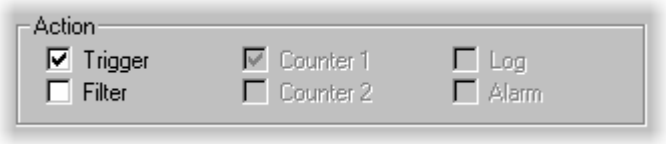
1x - Includes Adaptation Field - Events occur if the packet header adaptation field control bits have the value ‘10’ or ‘11’, indicating that the packet contains an adaptation field.

Action

Global Events can be associated with one or more of the six actions from the **Control** tab. When an action is enabled in the control tab it is made available to be set in the **Action** panel at the bottom of the **Global Events** tab.

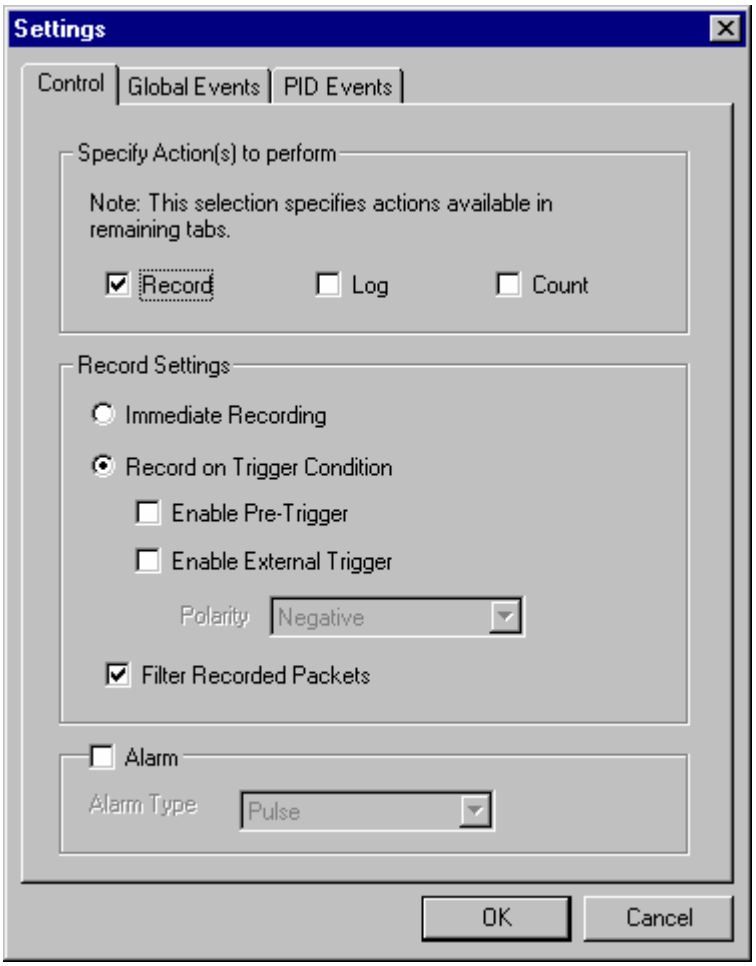
When an action is not set in the **Control** tab the associated action check box will be greyed out in the **Global Events** tab. If the action was checked in the **Global Event** tab when disabled in the **Control** tab it will still contain a tick, ✓, but that will also be greyed out.

For example, when **Record** is enabled with the **Trigger** and **Filter** actions set, these will be available to be selected in the **Global Events** tab.



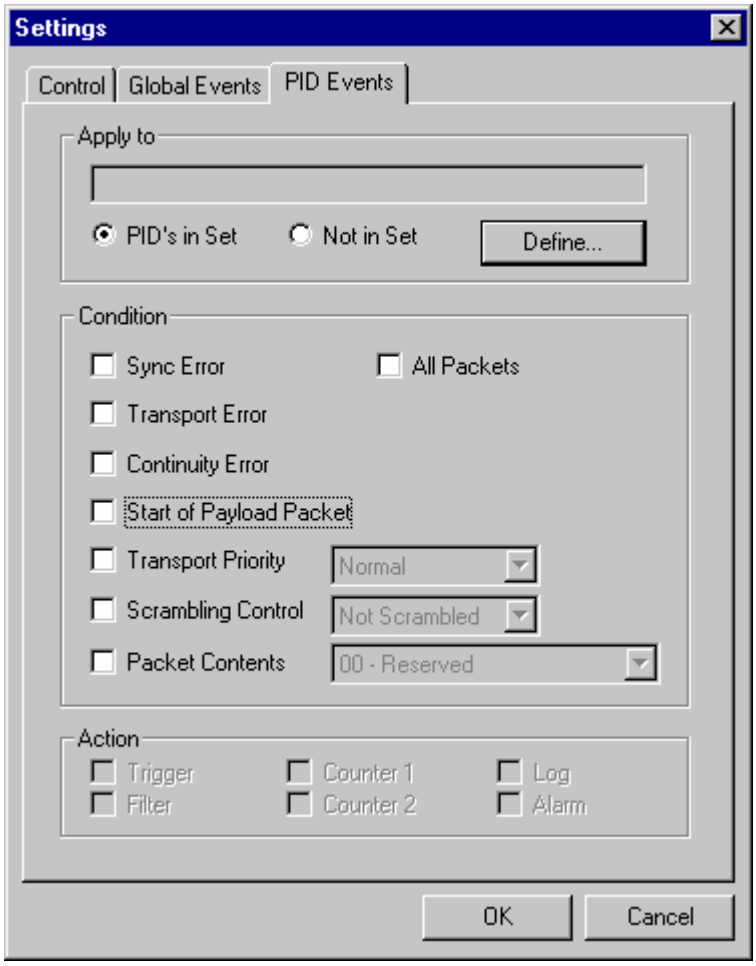
When the **Log**, **Count** and **Alarm** actions are not set in the **Control** tab they are greyed out in the **Global events** tab. The greyed out tick, ✓, in **Counter 1** shows that it was enabled and selected before **Count** was turned off in the **Control** tab. Any actions that are checked but greyed out will be re-enabled when the Action is re-enabled in the **Control** tab.

The **Control** tab settings used to produce the above example were:

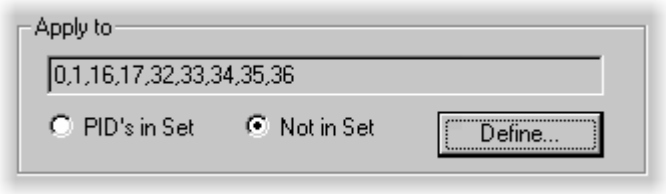


PID Events Tab

The PID Events can test packets in a selected sub-set of the PIDs for the same conditions as the Global Events. If all PIDs are selected the effect is the same as a that of a Global Event. An extra condition is available to generate events for any packet in the selected PIDs.

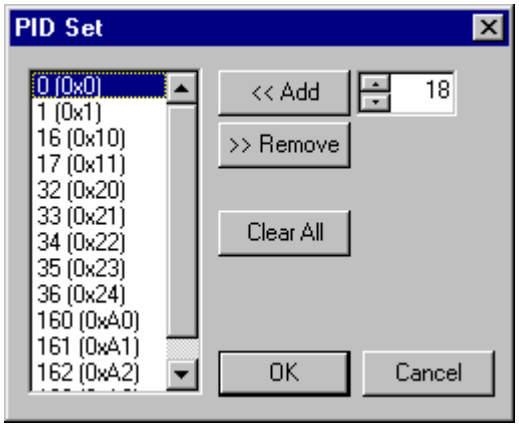


Apply to



The **Apply to** panel lists the selected set of PIDs. Either the packets belonging to the listed set of PIDs or all those outside the set may be tested for event generating conditions. To add and/or remove PIDs from the list click on the **Define..** button.,

The program then opens the PID Set dialog, which looks like this:



Condition

This provides the same conditions as the panel in the **Global Events** tab with an extra condition for **All Packets**. Please refer to the Global Events section for more information on the other conditions.

All Packets — Setting the **All Packets** condition for the PID event means that all packets having PID values in the specified set will cause the event to occur. It overrides the setting of the other seven conditions.

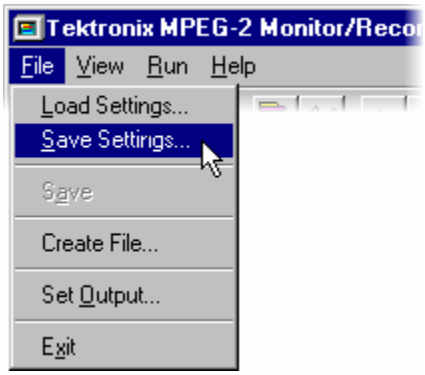
Action

This is identical in operation to the **Action** panel in the **Global Events** tab (see page 23).

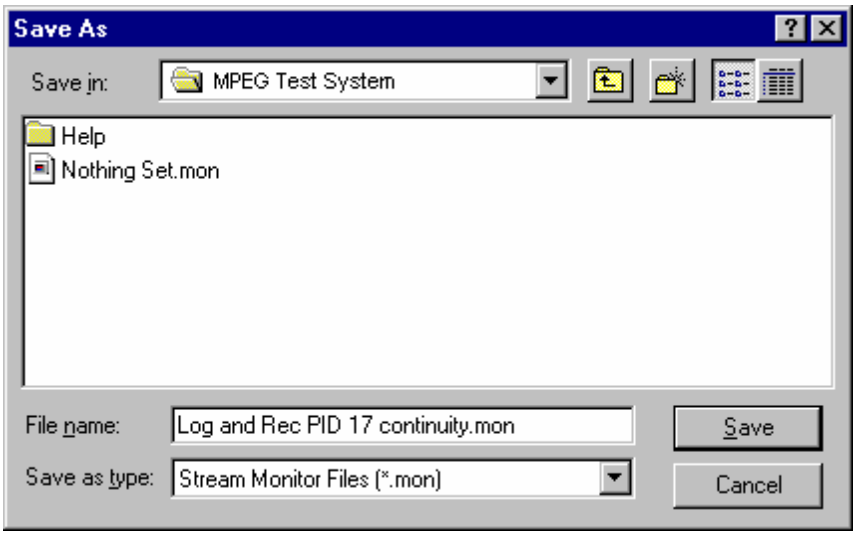
Saving and Loading Settings

It is a good idea to save sets of frequently used settings. Each set may be written to a separate file using the **Save Settings…** option from the **File** menu.

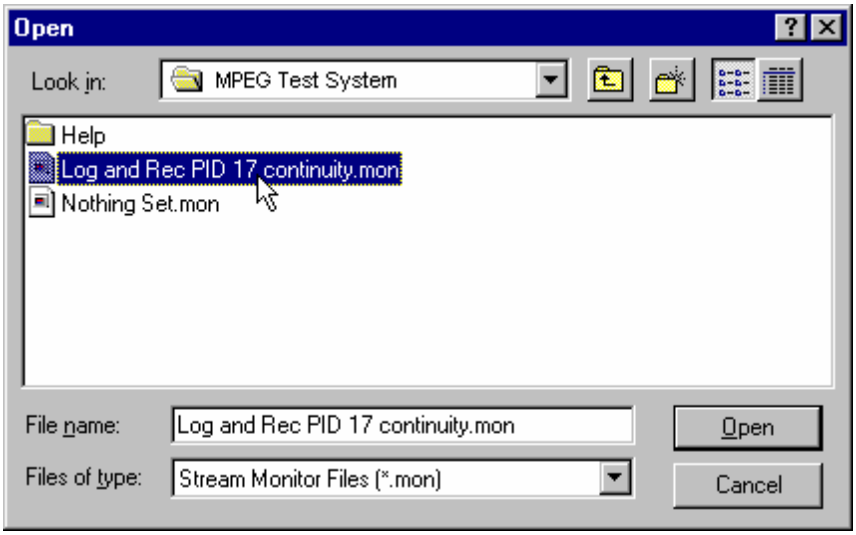
Meaningful file names can and should be given to the saved settings.



For example settings to Monitor and Record a continuity problem in PID 17 could be:

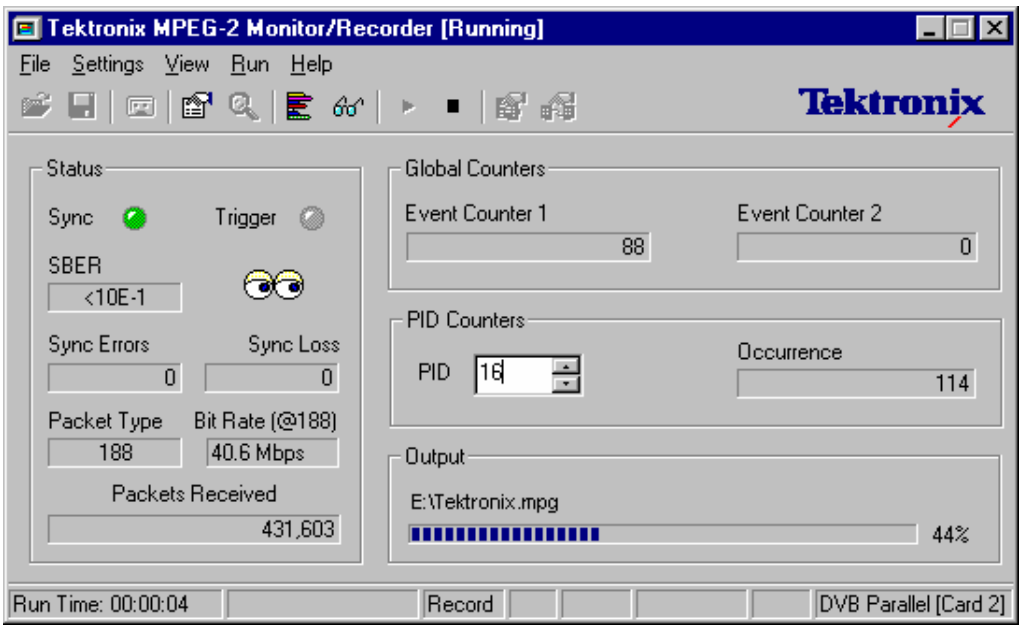


To load a previously saved configuration use the **Load Settings…** option. Then select the file from the Open file browser:



Main Window

The main window provides all of the Menu Options, with shortcut buttons on a toolbar, for using Monitor/Recorder. It displays information about program settings, current state of operation and the transport stream.



When Monitor/Recorder is in the Run state under Trigger mode; the **Status**, **Global Counters** and **PID Counters** displays are updated in real time. When the application is recording a stream to disk, the **Output** display shows how much data has been written to the allocated file.

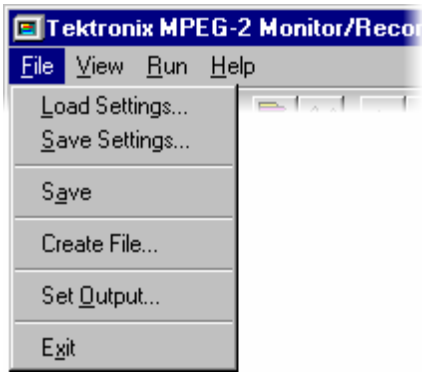
In Monitor mode the **Status**, and **PID Counters** displays are updated in real time. The **Global Counters** and **Output** are inactive since recording and event detection are disabled.

Title Bar

At the top of the main window is the Title Bar, which displays the program title. Additional information may be displayed next to the title.

Menus and Options

File Menu Options



Load Settings… Loads pre-defined settings from a file. Useful configurations can be saved for loading by this option.

Save Settings … Save the current settings to a file for future use. Once saved the settings can be loaded with the **Load Settings…** option.

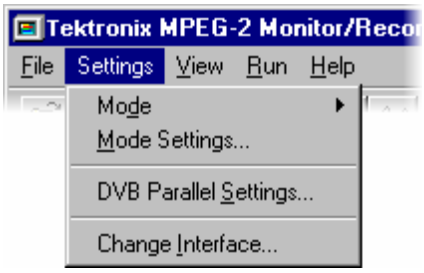
Save Saves the contents of the Event Log window to a file.

Create File … Runs the TS Maker wizard to create a new, empty, file for Monitor/Recorder output.

Set Output … Select file for Transport Stream to be recorded in.

Exit Terminates execution the program.

Settings Menu Options



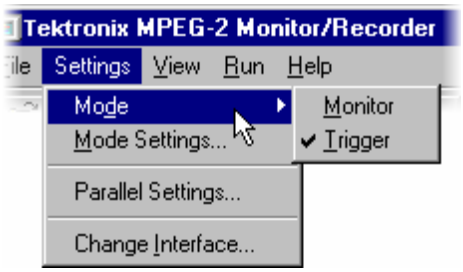
Mode Pops up a side menu for selecting the Operating mode.

Mode Settings… Opens the Settings Dialog related to the current mode.

Parallel Settings… Select the settings for the current interface. In this example the Parallel MPEG Interface Card.

Change Interface… Opens the Card Configuration dialog for interface selection.

Mode - Side Menu



(The check mark, ✓, next to an option indicates that it is the current operating mode)

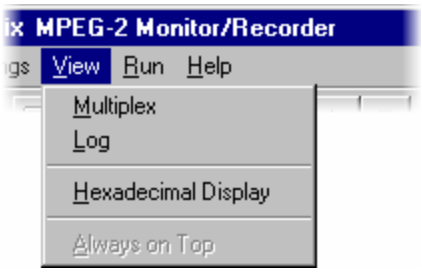
Monitor Enables Monitor mode, providing program and table information in the stream multiplex display.

Disables record, event detection and triggering functions

Trigger Enables Trigger mode, providing record, event detection, logging and trigger functions.

Stream Multiplex is shown without any program or table information.

View Menu Options



(A check mark, ✓, next to the **Hexadecimal Display** option would indicate that PID values are displayed in hexadecimal.)

Multiplex Opens the Real Time Multiplex Statistics display window.

Log Opens the Log Window which shows details of logged events.

Hexadecimal Display Toggles PID values between being displayed in decimal and hexadecimal notation

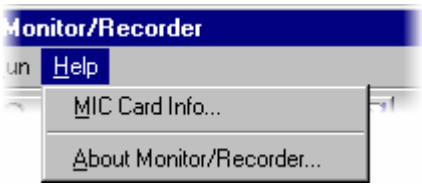
Always on Top This option is not enabled in Monitor/Recorder.

Run Menu Options

Start Starts the monitor & recording operations.

Stop Stops all operations.

Help Menu Options



MIC Card Info… Displays information about the MPEG Interface Card.

About ... Opens a dialogue which displays the program version number.

Toolbar Buttons

These buttons provide a set of shortcuts for the more frequently used menu options. The available commands are:

- Load new Settings from file.
- Save current Settings to a file for future recall.
- Set output to a different file. Opens the file browser dialogue.
- Open Settings dialog.
- Toggle Operating Mode.
- Open or close the Multiplex window.
- Open or close the Log window.
- Start selected stream monitor / record operations.
- Stop all stream operations.
- Opens the Settings dialog for the currently selected interface.
- Opens the Card Configuration dialog for selecting the card and interface.

Status Bar

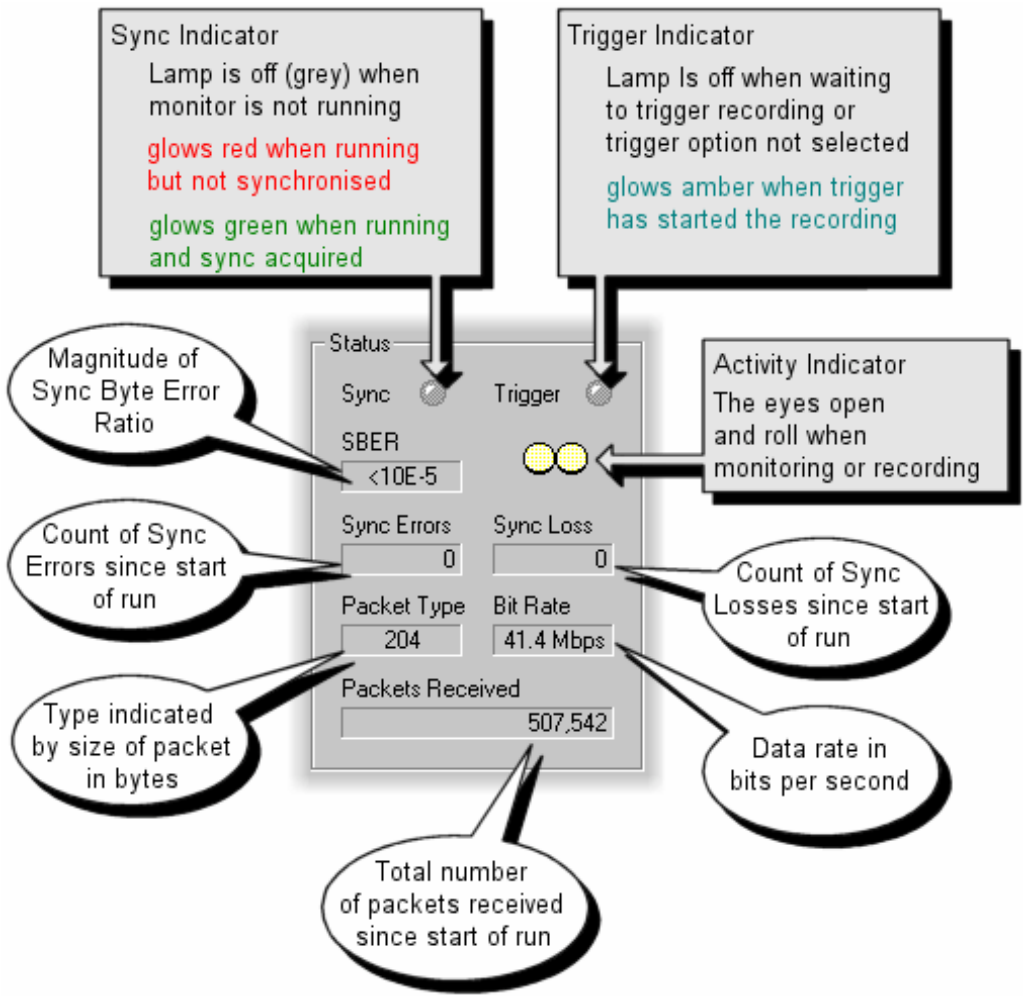
The Status Bar at the bottom of the window displays elapsed run times. It also provides indicators of which actions are selected in the Trigger Mode Settings dialog. When none of the actions are selected only the Run Time: is displayed.

Prior to a new run the Run Time is blank as shown above. The Run Time shows the time, in hours minutes and seconds, since Sync was first acquired for the run. When the run has finished the time is still displayed to show the length of the run. For example:

When the **Record** and **Trigger** actions are selected, the field next to Run Time shows the time of Trigger. This is given as the Run Time at which the Trigger event was detected. If the run started 2 minutes 43 seconds ago and the trigger was detected 2 minutes 25 seconds after that the Status Bar would look like this:

The 'Record' flag in the next field shows that the **Record** action is selected. The complete set of flags that may be displayed is:

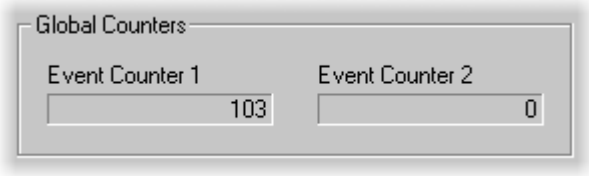
Status Panel



Sync Indicator	shows the current synchronisation state of the monitored transport stream. During a run, it glows green when the monitor is synchronized with the incoming transport stream and red when not synchronized. The LED is grey when monitoring is not active.
Trigger Indicator	shows the current 'trigger state' for a triggered recording run. The LED glows orange when recording has been triggered and is grey prior to trigger.
SBER	this field shows the magnitude of the synchronisation byte error ratio. The Sync Errors and Sync loss fields show the number of synchronisation byte errors and synchronisation losses that have occurred (as defined in ETR 290 - 2 successive incorrect sync bytes for sync loss, 5 successive correct sync bytes for sync acquisition).
Packet Type	indicates if the incoming packets contain 188, 204 or 208 bytes.
Packets Received	shows the count of packets received since the start of the current monitoring run.
Bit Rate	displays the bit rate of the incoming transport stream. Note that this value is calculated based on 188 byte packets, irrespective of the actual packet type.

Global Counters

When Monitor/Recorder detects a selected event it can increment one (or both) of the two counters.

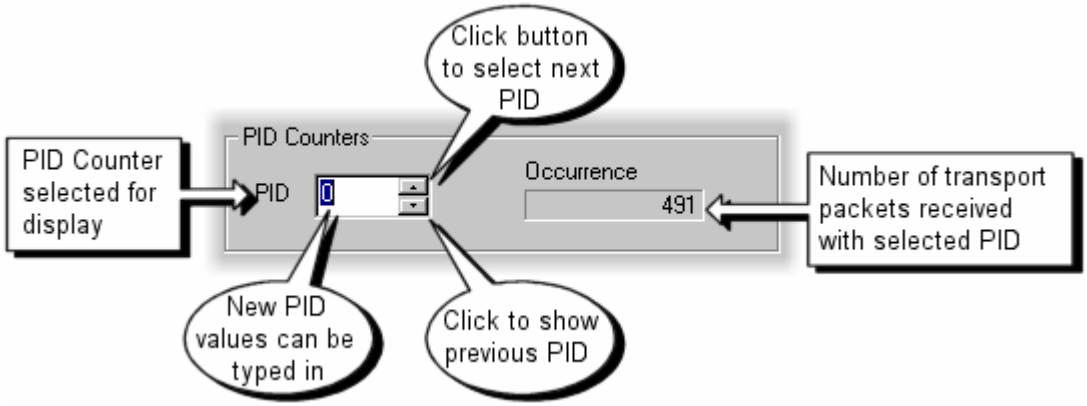


The Settings dialog maintains the specification of which events to count with each counter.

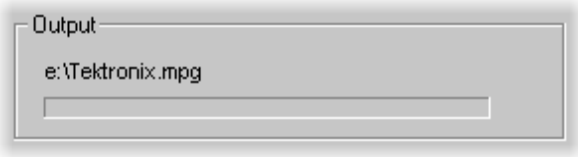
The counts are updated in real-time to show the running total. When the run is finished they retain the final counts until the next run.

PID Counters

There are 8192 PID counters, one for each possible PID that may be present in the stream. The counter in the panel displays the number of packets received for the specified PID. The PID number is specified in a windows spin box. This allows the value to be changed in 3 ways: a new value may be typed in, select the up arrow button to add one or the down arrow button to subtract one from the value.

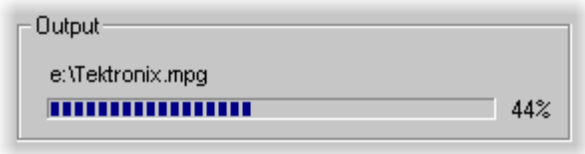


Output Panel



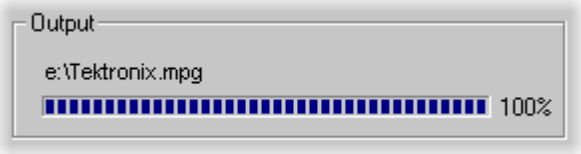
Displays name of the MPEG file set for output and a recording progress bar.

An empty bar indicates that nothing has been recorded.



As a stream is recorded the progress bar shows how much of the Output file has been filled.

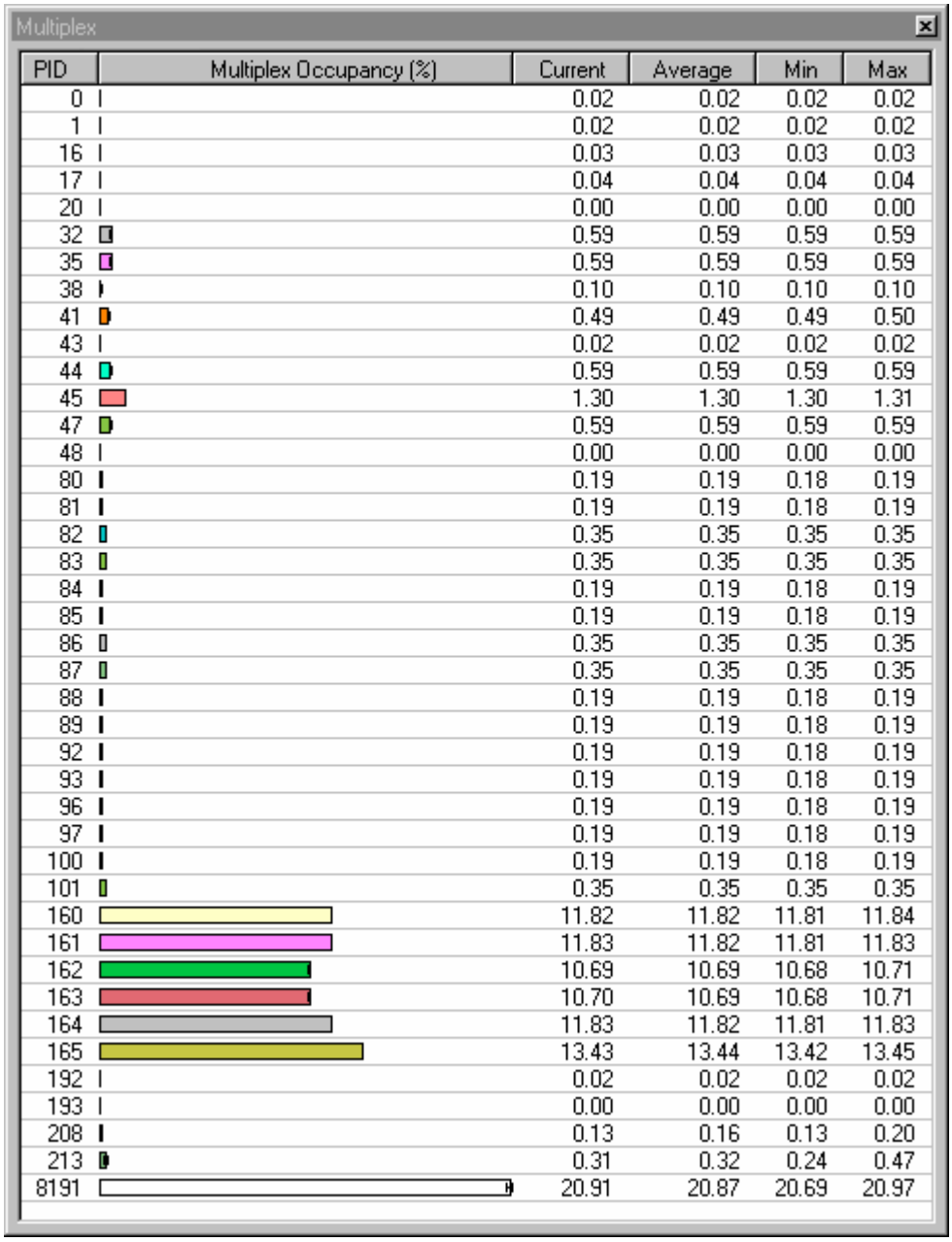
Recording is complete when progress reaches 100%.



Multiplex Window

The Multiplex window shows how much of the transport stream is occupied by each PID. How much information is displayed depends upon the selected Operating Mode.

Trigger Mode



PID	Multiplex Occupancy (%)	Current	Average	Min	Max
0		0.02	0.02	0.02	0.02
1		0.02	0.02	0.02	0.02
16		0.03	0.03	0.03	0.03
17		0.04	0.04	0.04	0.04
20		0.00	0.00	0.00	0.00
32		0.59	0.59	0.59	0.59
35		0.59	0.59	0.59	0.59
38		0.10	0.10	0.10	0.10
41		0.49	0.49	0.49	0.50
43		0.02	0.02	0.02	0.02
44		0.59	0.59	0.59	0.59
45		1.30	1.30	1.30	1.31
47		0.59	0.59	0.59	0.59
48		0.00	0.00	0.00	0.00
80		0.19	0.19	0.18	0.19
81		0.19	0.19	0.18	0.19
82		0.35	0.35	0.35	0.35
83		0.35	0.35	0.35	0.35
84		0.19	0.19	0.18	0.19
85		0.19	0.19	0.18	0.19
86		0.35	0.35	0.35	0.35
87		0.35	0.35	0.35	0.35
88		0.19	0.19	0.18	0.19
89		0.19	0.19	0.18	0.19
92		0.19	0.19	0.18	0.19
93		0.19	0.19	0.18	0.19
96		0.19	0.19	0.18	0.19
97		0.19	0.19	0.18	0.19
100		0.19	0.19	0.18	0.19
101		0.35	0.35	0.35	0.35
160		11.82	11.82	11.81	11.84
161		11.83	11.82	11.81	11.83
162		10.69	10.69	10.68	10.71
163		10.70	10.69	10.68	10.71
164		11.83	11.82	11.81	11.83
165		13.43	13.44	13.42	13.45
192		0.02	0.02	0.02	0.02
193		0.00	0.00	0.00	0.00
208		0.13	0.16	0.13	0.20
213		0.31	0.32	0.24	0.47
8191		20.91	20.87	20.69	20.97

The histogram displays the current occupancy with range bars to show the minima and maxima. Current, average, minimum and maximum values may be displayed as percentages or bandwidth in the right hand columns. A pop up menu selects which columns to display.

The list of PIDs, their statistics and the histogram are updated every two seconds throughout a run. The occupancy figures are sampled every 2 seconds and the current PID occupancy figures are based on the last 2 second sample.

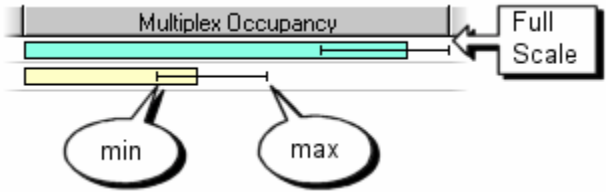
From left to right the columns displayed in Trigger Mode are:

PID Shows the PID which the each row of the table applies to. The table displays a histogram and statistics for all PIDs found in the headers of transport stream packets. The Multiplex window only shows the active PIDs. The value of the PID may be displayed in decimal or hexadecimal notation.

Multiplex Occupancy Displays the current occupancy of each PID relative to the other PIDs. The scale is automatically adjusted so that the PID occupying the greatest proportion of the transport stream is drawn full scale.

The units of measurement, (%) or (Mbps), are displayed in the Multiplex Occupancy title.

When the **Min** and **Max** columns are displayed the histogram also shows range bars. These represent the minima and maxima for each PID.



This is especially helpful when looking at PIDs which are using Statistical Multiplexing. As monitoring progresses the range bars grow whenever a PID drops to a new minimum or reaches a new maximum occupancy. They can be reset with the Refresh option from the pop up menu.

Current Proportion of the packets in the transport stream containing that PID value. The figure is based on the most recent 2 second sample of the transport stream contents.

Average Average PID occupancy, as measured from the start of the monitoring run or the last **Refresh** command.

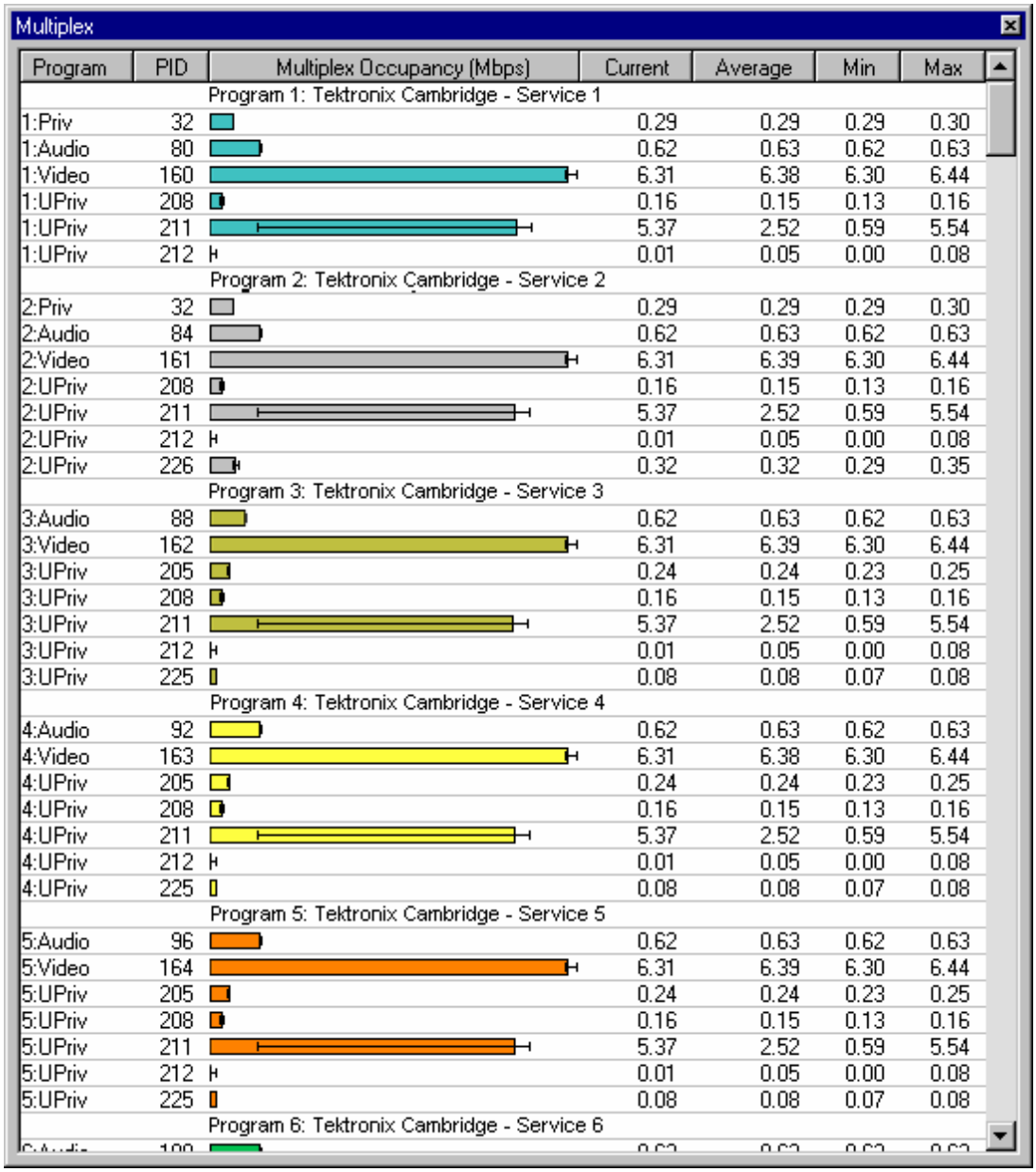
Min Minimum value that the **Current** figure has taken since the start of the monitoring run or the last **Refresh** command.

Max Maximum value that the **Current** figure has taken since the start of the monitoring run or the last **Refresh** command.

The statistics for the multiplex occupancy can be displayed as a percentage of the stream or given as an absolute bit rate. Select which measurement to use via the Pop Up menu described in the sub-section on Common Features. The units of measurement, (%) or (Mbps), are displayed in the Multiplex Occupancy title.

Monitor Mode

Information about which Program or table is carried by each PID is displayed when the application is in Monitor mode. All of the information and options available in the Multiplex window when the application is in Trigger mode are present in Monitor mode.

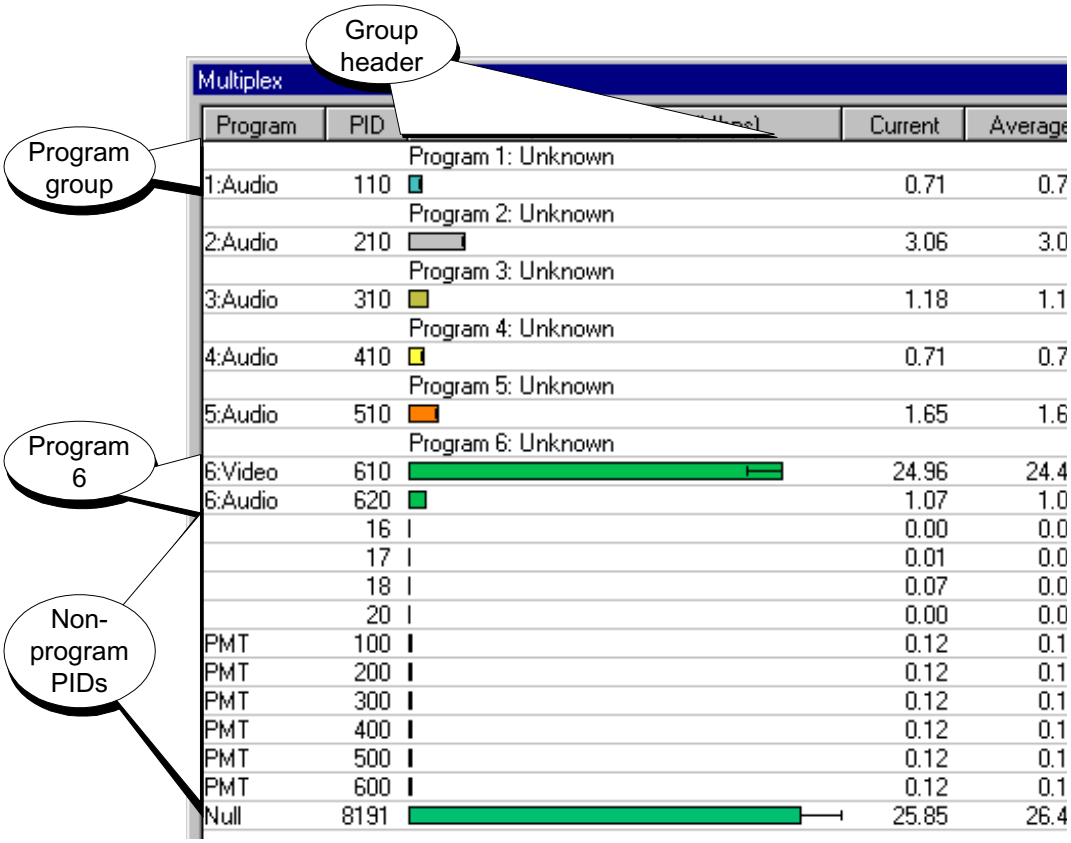


Program	PID	Multiplex Occupancy (Mbps)	Current	Average	Min	Max
		Program 1: Tektronix Cambridge - Service 1				
1:Priv	32		0.29	0.29	0.29	0.30
1:Audio	80		0.62	0.63	0.62	0.63
1:Video	160		6.31	6.38	6.30	6.44
1:UPriv	208		0.16	0.15	0.13	0.16
1:UPriv	211		5.37	2.52	0.59	5.54
1:UPriv	212		0.01	0.05	0.00	0.08
		Program 2: Tektronix Cambridge - Service 2				
2:Priv	32		0.29	0.29	0.29	0.30
2:Audio	84		0.62	0.63	0.62	0.63
2:Video	161		6.31	6.39	6.30	6.44
2:UPriv	208		0.16	0.15	0.13	0.16
2:UPriv	211		5.37	2.52	0.59	5.54
2:UPriv	212		0.01	0.05	0.00	0.08
2:UPriv	226		0.32	0.32	0.29	0.35
		Program 3: Tektronix Cambridge - Service 3				
3:Audio	88		0.62	0.63	0.62	0.63
3:Video	162		6.31	6.39	6.30	6.44
3:UPriv	205		0.24	0.24	0.23	0.25
3:UPriv	208		0.16	0.15	0.13	0.16
3:UPriv	211		5.37	2.52	0.59	5.54
3:UPriv	212		0.01	0.05	0.00	0.08
3:UPriv	225		0.08	0.08	0.07	0.08
		Program 4: Tektronix Cambridge - Service 4				
4:Audio	92		0.62	0.63	0.62	0.63
4:Video	163		6.31	6.38	6.30	6.44
4:UPriv	205		0.24	0.24	0.23	0.25
4:UPriv	208		0.16	0.15	0.13	0.16
4:UPriv	211		5.37	2.52	0.59	5.54
4:UPriv	212		0.01	0.05	0.00	0.08
4:UPriv	225		0.08	0.08	0.07	0.08
		Program 5: Tektronix Cambridge - Service 5				
5:Audio	96		0.62	0.63	0.62	0.63
5:Video	164		6.31	6.39	6.30	6.44
5:UPriv	205		0.24	0.24	0.23	0.25
5:UPriv	208		0.16	0.15	0.13	0.16
5:UPriv	211		5.37	2.52	0.59	5.54
5:UPriv	212		0.01	0.05	0.00	0.08
5:UPriv	225		0.08	0.08	0.07	0.08
		Program 6: Tektronix Cambridge - Service 6				

Unlike the display in Trigger mode the PIDs are grouped together according to the data they carry. The list is sorted by program stream, then PID number within each program. Each group of PIDs belonging to the same program stream are preceded by a group heading.

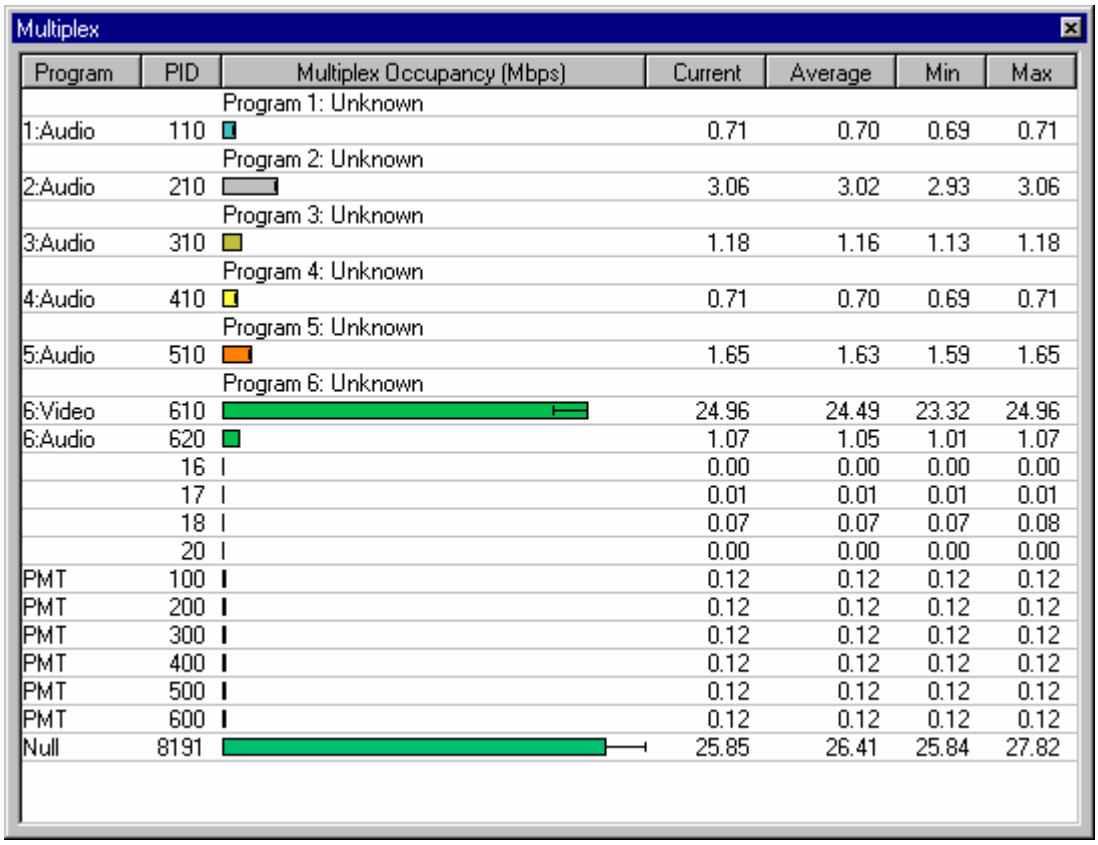
PIDs which do not carry data belonging to a program are grouped together after those carrying program streams. These are also sorted by PID within that group.

For Example here is a Transport Stream, with a small number of PIDs, which can all be viewed in the window:



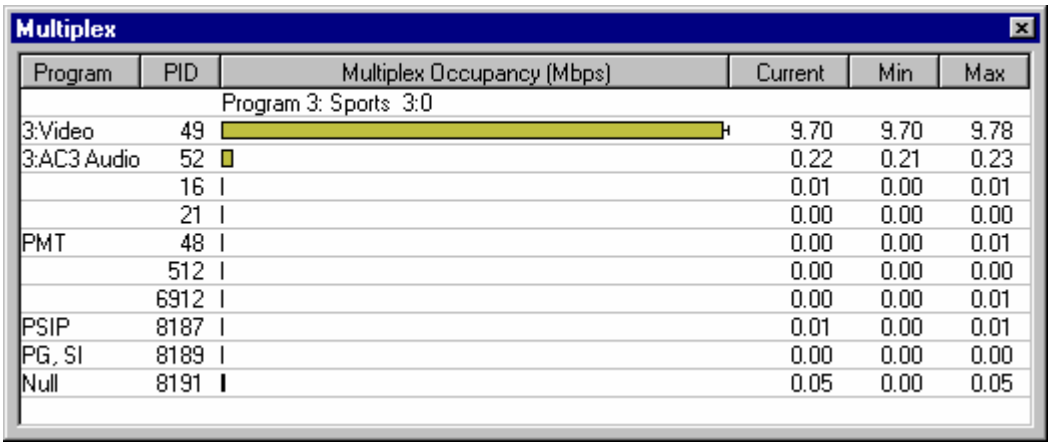
This is an example of a DVB Standard conformant Transport Stream with the **DVB** interpretation selected in the Monitor Settings dialog.

The Service Description Table (SDT) is not specified in the MPEG-2 standard. Hence when the **MPEG2** interpretation is selected the Provider Name and Service Name in the group headers are shown as **Unknown**. Any PIDs carrying DVB or ATSC tables or other unreferenced PIDs are labelled as **Unref**. For example:



Program	PID	Multiplex Occupancy (Mbps)	Current	Average	Min	Max
		Program 1: Unknown				
1:Audio	110		0.71	0.70	0.69	0.71
		Program 2: Unknown				
2:Audio	210		3.06	3.02	2.93	3.06
		Program 3: Unknown				
3:Audio	310		1.18	1.16	1.13	1.18
		Program 4: Unknown				
4:Audio	410		0.71	0.70	0.69	0.71
		Program 5: Unknown				
5:Audio	510		1.65	1.63	1.59	1.65
		Program 6: Unknown				
6:Video	610		24.96	24.49	23.32	24.96
6:Audio	620		1.07	1.05	1.01	1.07
	16		0.00	0.00	0.00	0.00
	17		0.01	0.01	0.01	0.01
	18		0.07	0.07	0.07	0.08
	20		0.00	0.00	0.00	0.00
PMT	100		0.12	0.12	0.12	0.12
PMT	200		0.12	0.12	0.12	0.12
PMT	300		0.12	0.12	0.12	0.12
PMT	400		0.12	0.12	0.12	0.12
PMT	500		0.12	0.12	0.12	0.12
PMT	600		0.12	0.12	0.12	0.12
Null	8191		25.85	26.41	25.84	27.82

The program information in an ATSC conformant stream is carried in the PSIP tables, in particular the Terrestrial Virtual Channel Table (TVCT) and the Cable Virtual Channel Table (CVCT). Program information such as the name and major and minor channel numbers is extracted and displayed above each group. For example:



From left to right the columns displayed in Monitor Mode are:

Program For program streams this displays the program number and type of data carried by each PID. The data types are:

Video PID carries packets of video

Audio PID carries packets of audio

AC3 Audio PID carries packets of a ATSC compressed audio

Priv PID carries Private data

UPriv PID carries User Private data

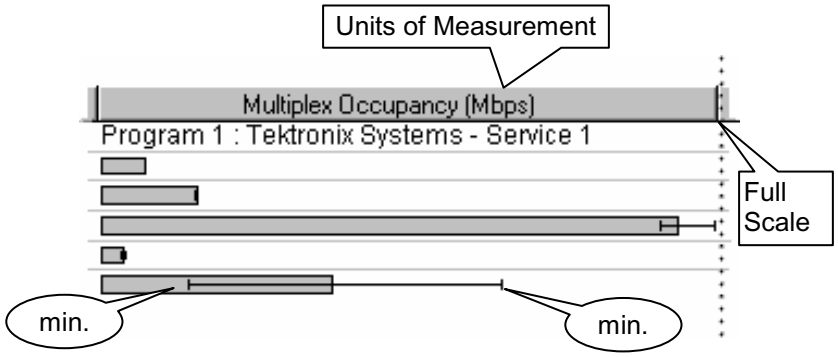
For non-program PIDs a name or mnemonic is given if it can be determined from the relevant tables. PIDs carrying DVB or ATSC tables will not be recognized as such when **MPEG2** interpretation is selected. The type field of any PID carrying unrecognized data is left blank.

PID Shows the PID which the each row of the table applies to. The value may be displayed as a decimal or hexadecimal integer.

Multiplex Occupancy Displays the current occupancy of each PID relative to the other PIDs. The scale is automatically adjusted so that the PID occupying the greatest proportion of the transport stream is drawn full scale.

The units of measurement, (%) or (Mbps), are displayed in the Multiplex Occupancy title.

When the **Min** and **Max** columns are displayed the histogram also shows range bars. These represent the minima and maxima for each PID.



This is especially helpful when looking at PIDs which are using Statistical Multiplexing. As monitoring progresses the range bars grow whenever a PID drops to a new minimum or reaches a new maximum occupancy. They can be reset with the Refresh option from the pop up menu.

Current Proportion of the packets in the transport stream containing that PID value. The figure is based on the most recent 2 second sample of the transport stream contents.

Average Average PID occupancy, as measured from the start of the monitoring run or the last **Refresh** command.

Min Minimum value that the **Current** figure has taken since the start of the monitoring run or the last **Refresh** command.

Max Maximum value that the **Current** figure has taken since the start of the monitoring run or the last **Refresh** command.

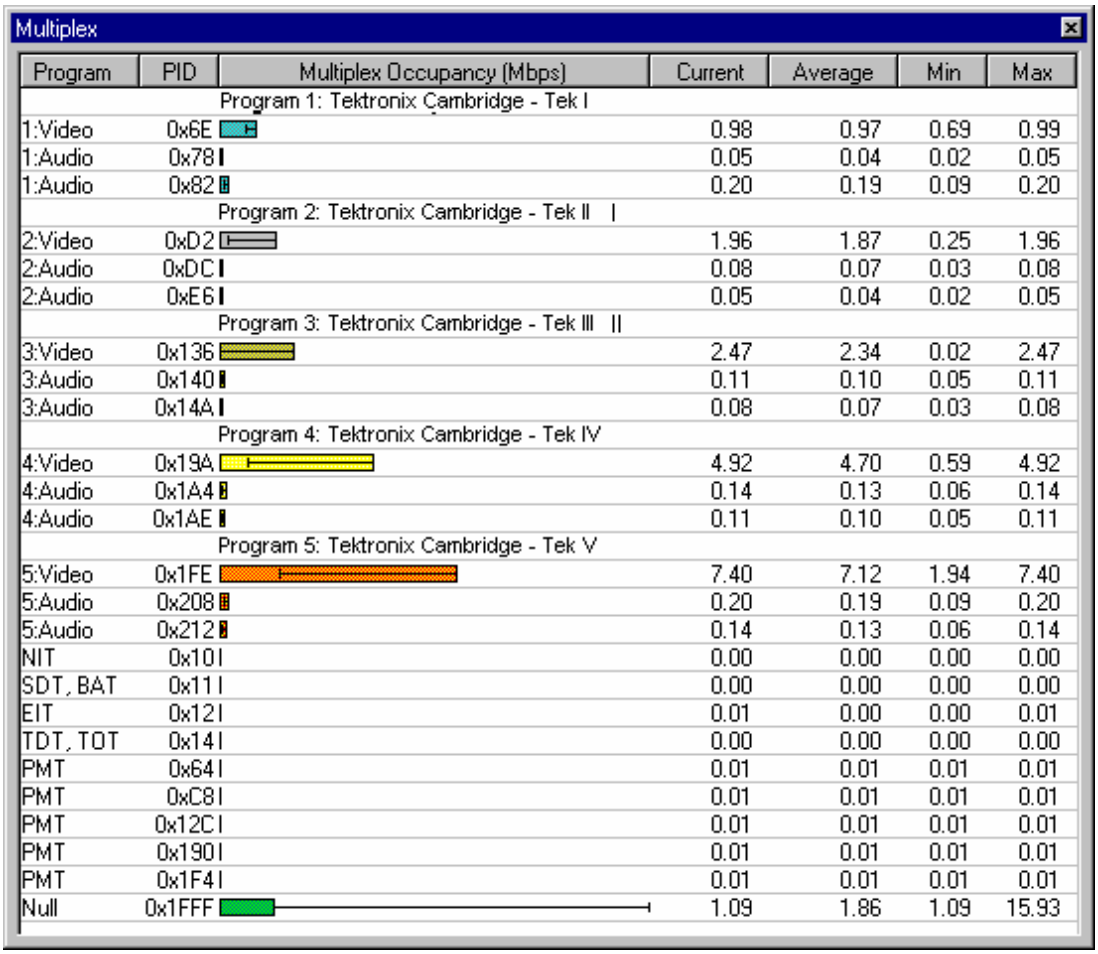
The statistics for the multiplex occupancy can be displayed as a percentage of the stream or given as an absolute bit rate. Select which measurement to use via the Pop Up menu described in the sub-section on Common Features. The units of measurement, (%) or (Mbps), are displayed in the **Multiplex Occupancy** column title.

Common Features

The Multiplex window provides the following facilities for configuring the display in all operating modes:

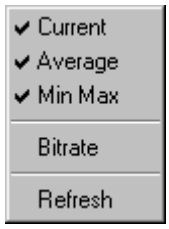
Hexadecimal Display of PID values

When the **Hexadecimal Display** option is enabled, from the **View** menu, the values of the PIDs are displayed in hexadecimal. For example:



Pop Up Menu

There is a pop up menu which provides display options and a reset command. Position the cursor anywhere in the window (not the column headings) and click the right mouse button to 'pop up' the menu.



(A check mark, ✓, indicates that the display option is currently enabled.)

Current Show or hide the **Current** column. (The check mark ✓ indicates that the column is currently displayed. No check mark ✓ would mean that the column is hidden.)

Average Show or hide the **Average** column.

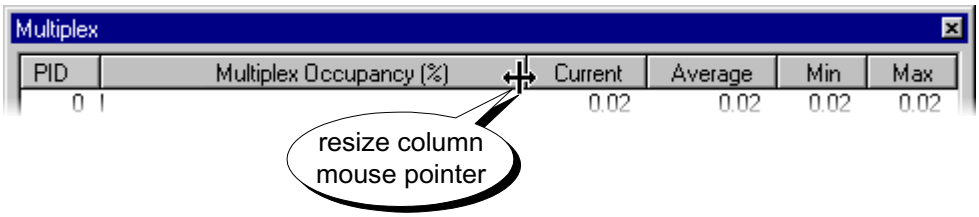
Min Max Show or hide the **Min** and **Max** columns - and the range bars in the **Multiplex Occupancy** histogram.

Bitrate Toggles between displaying the occupancy statistics as a percentage or bit rate. (A check mark, ✓, would indicate that the statistics are given as a bit rate. No check mark, ✓, means that the occupancy statistics are shown as a percentage.)

Refresh Resets the values the statistics are calculated to the start of run state and refreshes the display.

Resizing Columns

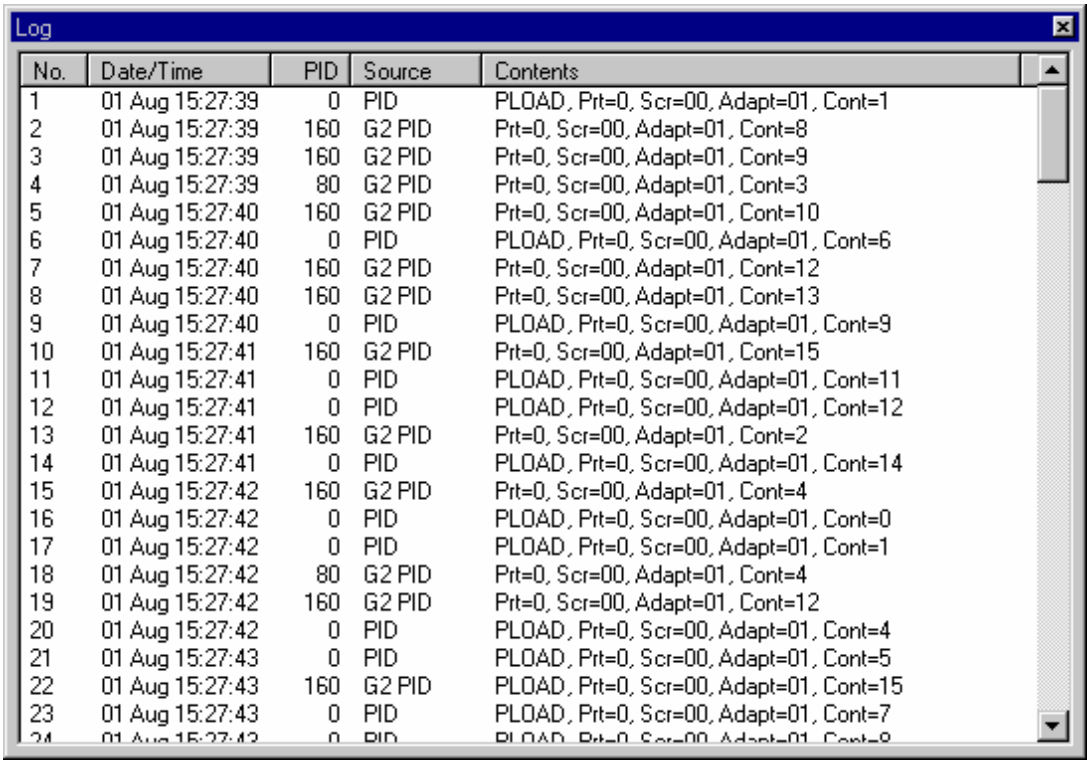
The width of each column can be adjusted manually. When the mouse pointer is moved close to the divider in the column title it changes to a column resize cursor.



To change the column width move the pointer over the column divider until it changes to the resize pointer. Then hold the left button down and drag the mouse in the required direction. When the column is at the desired width release the left mouse button.

Log Window

The Log reports the details of events associated with the Log Action in the Trigger Mode Settings dialog. It holds records of 2048 events, after which further event records are discarded. The log can be cleared manually to display fresh events as they are reported.



Each event record displays the following information:

Date/Time The MPEG Test System system date and time when the event was logged.

PID PID, in decimal or hexadecimal, of the packet which caused this event.

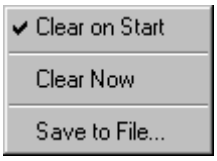
Source Source conditions which matched for that packet (the event is only logged if one of those conditions has a log action defined for it).

- **G1** Source condition specified in the **Global Event 1** option of the **Global Events** tab from the Settings dialog.
- **G2** Source condition specified in the **Global Event 2** option.
- **PID** Source condition specified in the **PID Events** tab in the Settings.

Contents Information extracted from the packet header. This consists of:

- priority
- scrambling control
- adaptation fields
- continuity count
- payload start indicator
- transport error indicator
- whether the synchronisation byte is valid or not.

There is a pop up menu which provides display options and a save to file command. Position the cursor anywhere in the window (not the column headings) and click the right mouse button to 'pop up' the menu.

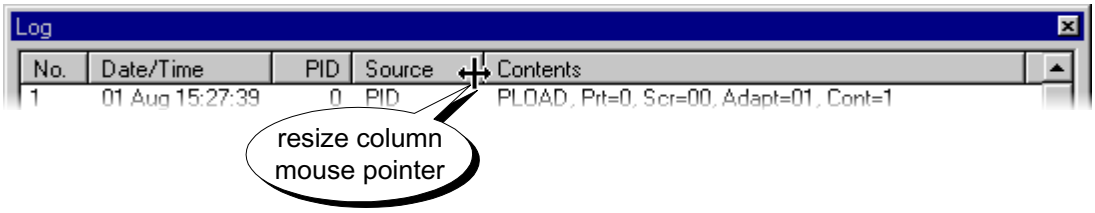


Clear on Start Clears or retains information from previous runs.. The check mark ✓ indicates that the log is cleared at the start of each run. No check mark ✓ would mean that information from previous runs is retained.

Clear Now Clears the Log of all records.

Save to File… Enables the text to be saved. Opens a standard file browser to allow a file to be specified.

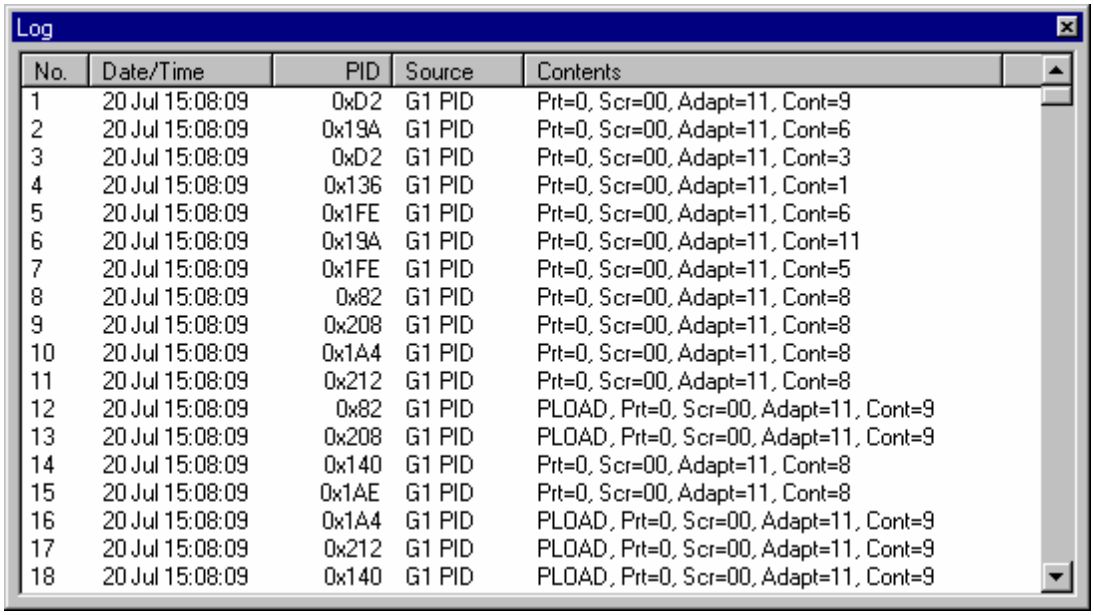
The width of each column can be adjusted manually. When the mouse pointer is moved close to the divider in the column title it changes to a column resize cursor.



To change the column width move the pointer over the column divider until it changes to the resize pointer. Then hold the left button down and drag the mouse in the required direction. When the column is at the desired width release the left mouse button.

Hexadecimal Display of PID values

When the **Hexadecimal Display** option is enabled, from the **View** menu, the values in the PID column are displayed in hexadecimal. For example:



Performing a Monitor/Record Run

A run can be as simple as monitoring the Multiplex of PID packets in the transport stream. At the other extreme:

- selected packets may be recorded prior to and after some event using pre-triggering
- occurrences of two sets of other events can be counted
- selected events can be reported in the Log
- an alarm signal can be sent to other equipment every time selected events are detected
- and the PID multiplex can still be displayed.

Here is a set of steps and suggestions to follow when using the Monitor Recorder.

Preparation

1. Check the current file set for Output by looking at the **Output** panel of the Main window. If the file contains valuable data select a different file, or create a new file.
2. Check which Operating Mode is selected using the **Mode** side-menu from the **Settings** menu, or by looking at the Toggle Mode toolbar button. Change the mode as required.
3. If the Monitor mode settings need altering:
   a. open the Settings dialog via the **Mode Settings…** option in the **Settings** menu.
   b. Select **MPEG2, DVB** or **ATSC** interpretation as required..
4. If the Trigger mode settings need altering:
   a. open the Settings dialog via the **Mode Settings…** option in the **Settings** menu.
   b. look for and disable any options in the **Global Events** and **PID Events** tabs which are not required. Remember to look at both **Global Event 1** and **Global Event 2** in the **Global Events** Tab.
   c. Select the required actions and options in the **Control** Tab
   d. Select events in the **Global Events** and **PID Events** Tabs.
   e. Associate the events with the actions at the bottom of each Tab.
5. Alternatively if suitable Settings have been placed in a file use the **Load Settings…** option in the **File** menu to re-load the settings.
6. The new settings can be saved to a file, if they may be used again and have not already been saved. Use the **Save Settings…** option under the **File** menu.

Starting the Run

7. Select the **Start** option from the **Run** menu or click on the Start button.

   While the program initializes the run, the LED indicator lamps in the main window remain off (grey). When initialisation is complete the Sync indicator glows red to show that the program is looking to acquire Sync.

   Once Sync is acquired the Sync Indicator changes to glow green.

Viewing Displays in Real Time

The Multiplex and Log displays may be opened and closed whenever required, before, during and after a run. The Multiplex display can be refreshed to flush old data without having to stop and start a new run. The Log display is only available under Trigger mode. The contents of the Log may be saved to disk and emptied whenever required.

If a Triggered Recording is Being made the Trigger indicator will glow orange once a trigger event has occurred.

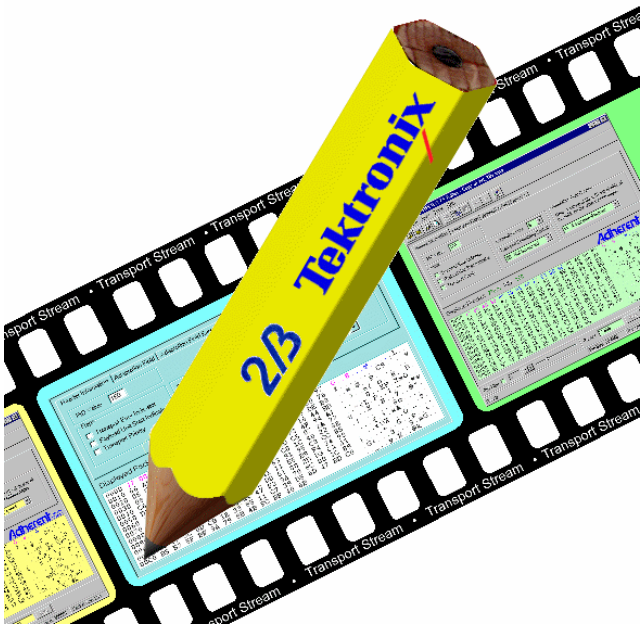
Stopping the Run

A Recording run will stop automatically when the output file is full. To stop a monitor run, event detection run or abandon a recording use the Stop command.

8. Select the **Stop** option from the **Run** menu or click on the stop button.
9. Save any information that may be required later, such as the current settings or the contents of the Log window.

Section 7

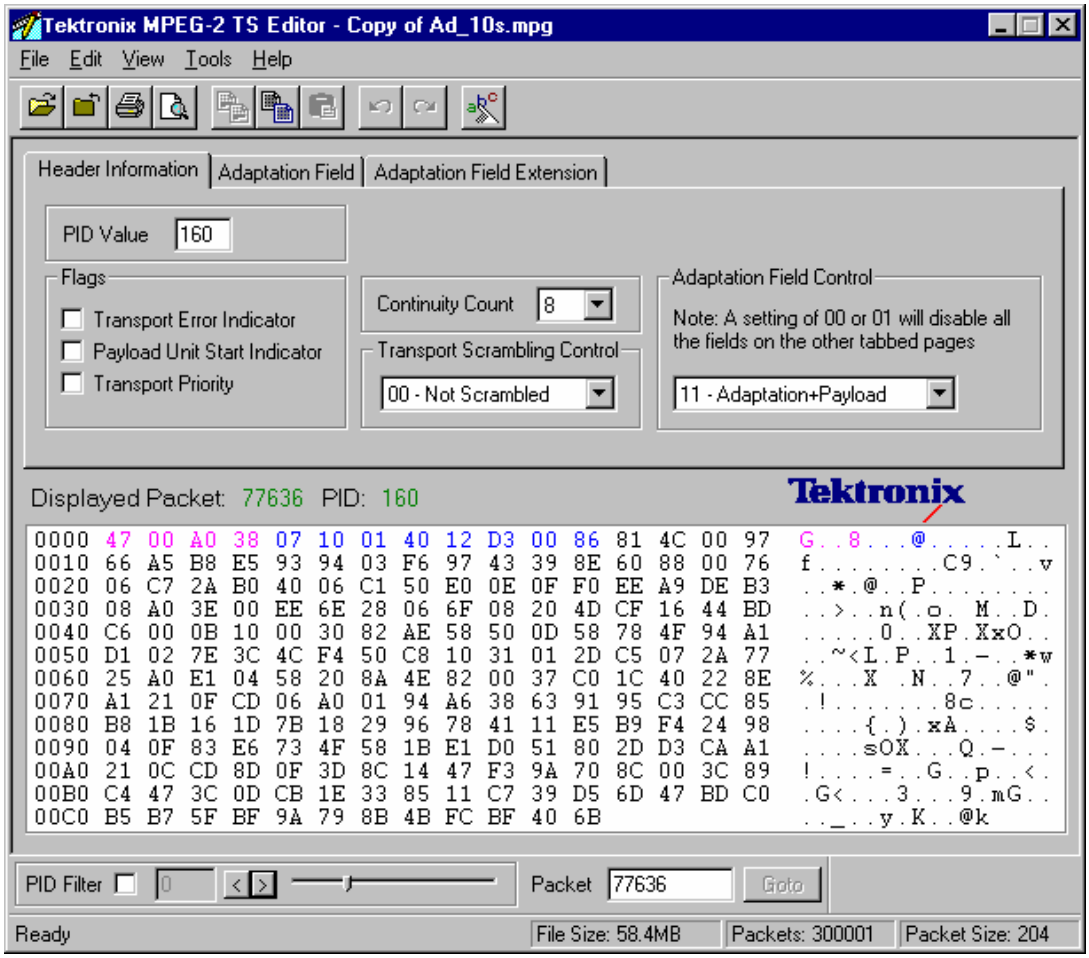
Transport Stream Editor



Introduction 3
Starting the Program 4
Initial Appearance 4
Options 5
Opening a file 7
Copying File Before Editing 8
Menus And Controls 10
Toolbar 10
Status Bar 11
Slider Bar 12
File Menu Options 14
Edit Menu Options 14
View Menu Options 15
Tools Menu Options 15
Help Menu Options 15
Hex Editor 16
Colour Coding 16
Selecting & Editing 17
Header Editor 20
Header Information Tab 20
Adaptation Field Tab 21
Adaptation Field Extension Tab 23
PID Remapping 24
PCR Recalculation 26
Jitter Functions 30

Introduction

The Transport Stream Editor may be used to edit the contents of transport stream packets contained in a file. It displays the complete contents of each packet in hexadecimal and provides an interpreted view of the packet header information.



Packet headers may be edited from both the header interpretation and hexadecimal displays. These are referred to as the Header Editor and the Hex Editor respectively. All changes made in one view are immediately shown in the other. The Header Editor is context sensitive, only allowing edits which "make sense" with the other fields in the header. It gives full syntax checking of all changes which are made.

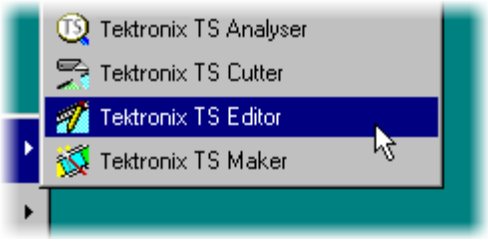
Payload, and any Reed Solomon, data is edited from the Hexadecimal Editor.

On the right of the Hex Editor pane the ASCII character is displayed. Unprintable characters are shown as a period (dot or full stop).

It is normal to edit a copy of a transport stream. Transport Stream Analyzer may be used to view the original whilst editing the copy.

Starting the Program

The program may be started by selecting the **Tektronix TS Editor** option from the **Start** -> **Programs** menu.

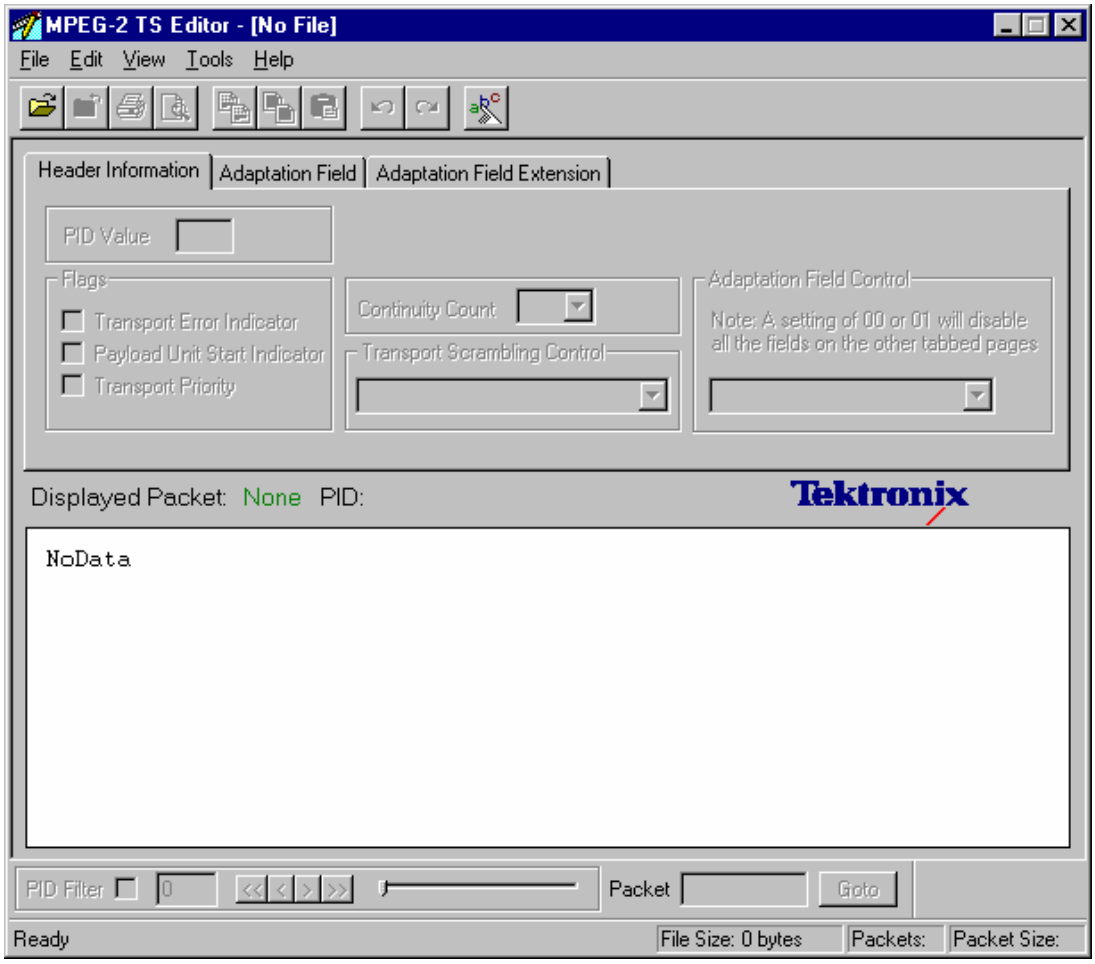


or

by double clicking on the **Tektronix TS Editor** Shortcut on the desktop.

Initial Appearance

Once the program has started and is ready for use it will open a Main Window which looks like this:

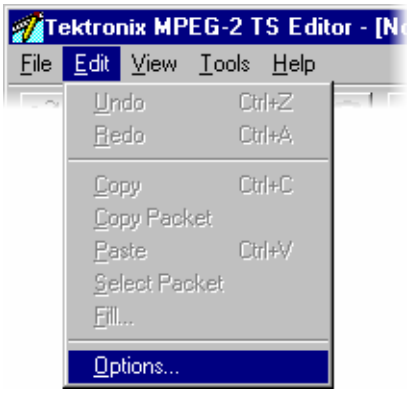


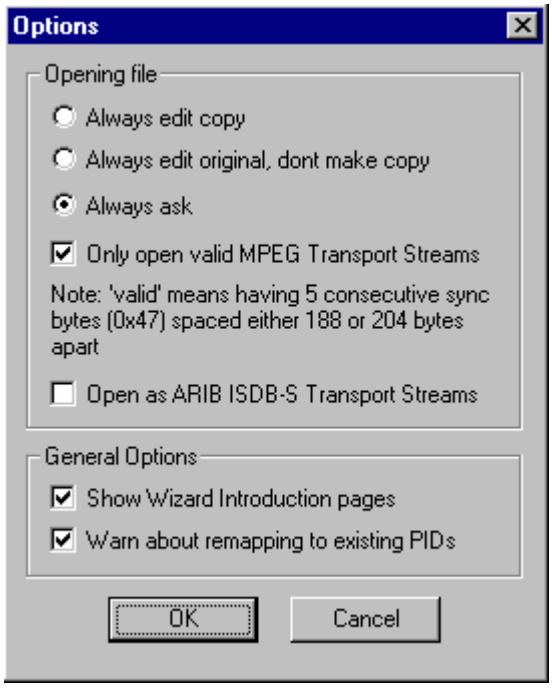
The Toolbar (row of buttons close to the top of the window) and the Status Bar at the bottom of the window may be hidden from view. They are always displayed when the program first starts.

Options

The Transport Stream Editor has a set of options relating to general use and opening files. It is a good idea to review the options before opening a file.

The settings may be changed at any time by selecting **Options...** from the **Edit** menu, which opens the Options dialogue.





Opening file

Specifies how the program will interpret the packet size of the stream. The options are mutually exclusive and are:

Always edit copy	When opening a file Editor always makes a copy, without asking.
Always edit original, dont make copy	Uses the original files without making a copy or asking for confirmation.
Always ask	Before opening a file for editing asks if it should edit the original or make a copy.
Only open valid MPEG Transport Stream files	Option to stop Editor opening files which do not have 5 or more consecutive sync bytes.
Open as ARIB ISDB-S Transport Streams	Option to open transport streams encoded as ARIB ISDB-S format (including TMCC information).

General Options

☑ **Show Wizard Introduction pages**	Causes any wizards invoked by Editor to display their Introduction pages.
☑ **Warn about remapping to existing PIDs**	Warns if an operation will remap a PID onto one which is already in use.

Opening a file

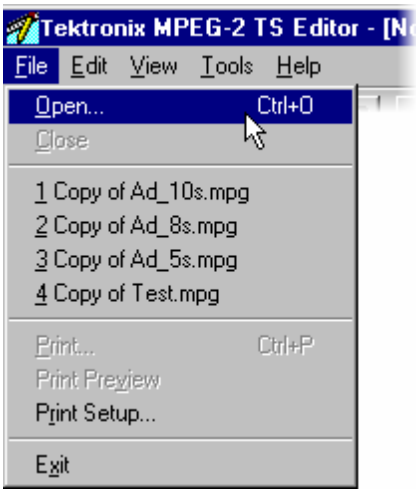
Any stream which is held in a file may be edited with the Transport Stream Editor.

Opening a file from the Menus and Toolbar

To edit a file select the **Open ...** option from the **File** menu. If the required file is in the list of recently edited files it may be selected from the list to save using the Open file dialogue.

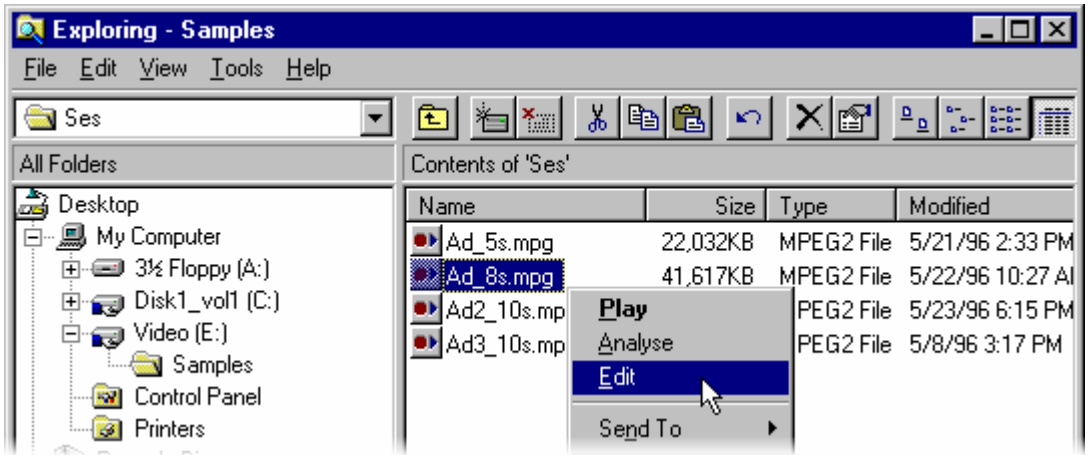
Alternatively use the **Ctrl+O** keyboard shortcut.

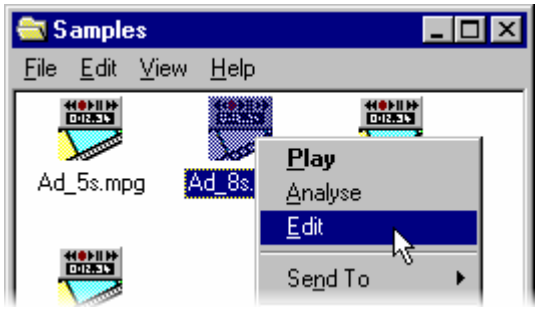
There is also a shortcut button available on the Toolbar for opening a file, which has the standard file open symbol:



Opening a file from Windows Explorer or a File Browser Window

The program can be started and a file opened (with the last set of program options) in a single operation from Windows Explorer or a File Browser Window.

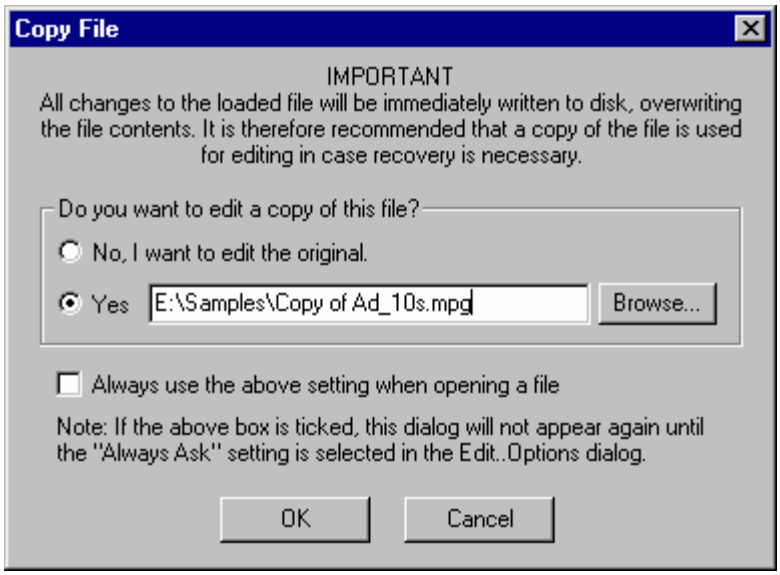




Place the pointer over the file name or icon, press the right mouse button to pop-up a menu and then select the **Edit** option

Copying File Before Editing

TS Editor writes all edits to the file immediately. To avoid accidental changes to prime data the application can make a copy of the file and edit that copy. By default, once a file has been selected for opening, a dialog is displayed asking whether to edit the original or make a copy.



For users who do not like to be presented with this dialog each time a file is opened the copy or edit original option can be set as the default.

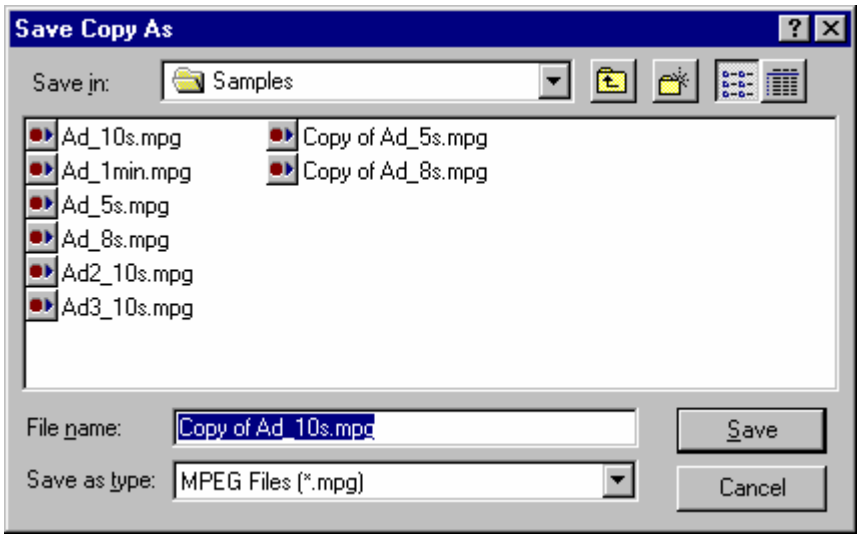
It is recommended that this dialog be left as the default option.

If someone else has used the MPEG Test System it is a good idea to look at the Options before opening a file.

To edit the original (useful when making edits to a file which is already a copy) select the **No, I want to edit the original** option, then select the **OK** button.

To make a copy select the **Yes** option, specify the copy file and then select **OK**. While the copy is being made the mouse pointer changes to the busy pointer, usually an hour glass.

When the Edit a copy option is selected the dialog suggests a suitable filename. This may be edited by selecting the filename text box and typing from the keyboard. To look for a different directory or filename select on the **Browse…** button. This will open a standard file browser window, like this:



Menus And Controls

Toolbar

The Toolbar provides a set of convenient shortcuts for the more frequently used menu options. The available commands are:

Opens a file. If a file is currently open it is closed when a new file is selected.

Closes the current file. There is no save option because all changes are written to file immediately.

Prints the current packet.

Opens a print preview of the current packet.

Copies the bytes which are currently selected in the Hexadecimal Editor from the packet to the clipboard. The bytes are copied using the hexadecimal representation. This button is disabled (greyed out) when nothing is selected which may be copied.

Copies the entire contents of the current packet to the clipboard.

Pastes any data, held in the TS Editor's hexadecimal representation, from the clipboard into the packet starting at the currently selected byte.

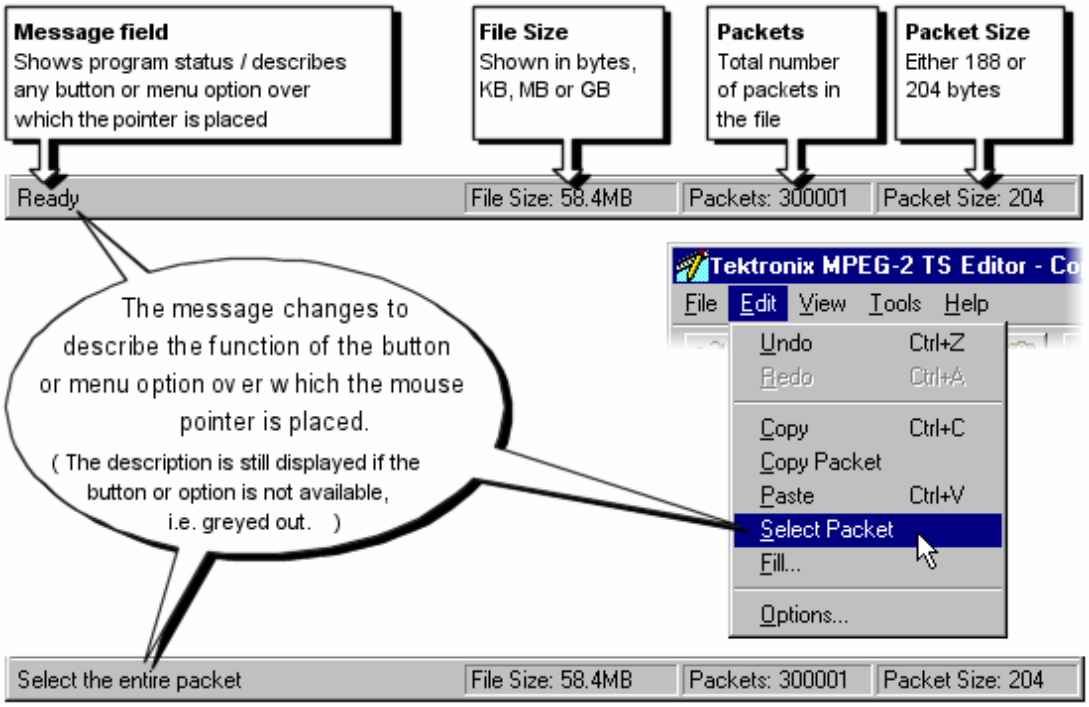
Undoes the last edit, restoring the previous value. Selecting Undo again undoes the previous change and so on.

Re-instates the previously undone change.

Opens the Options Dialog

Status Bar

The Status Bar may be hidden from view, but if visible is always at the bottom of the window. It displays the following information about the program and open file:

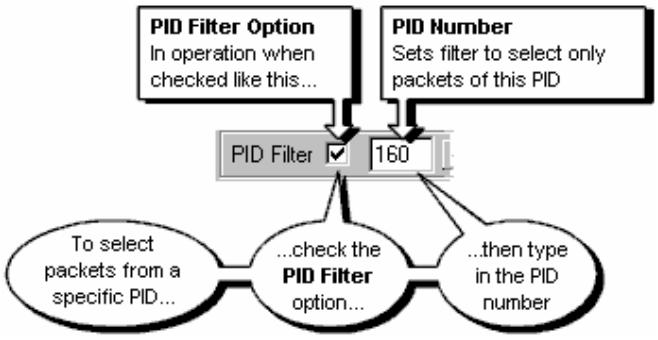


When no file is open the File Size, Packets and Packet Size fields are all set to zero or null:

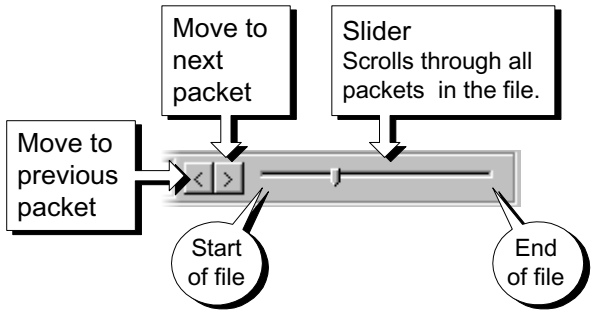
Slider Bar

The contents of any transport stream packet in the currently open file may be selected using the Slider bar. Packets are numbered according to their position in the file, the first packet being 0 (zero). The controls in the slider bar are:

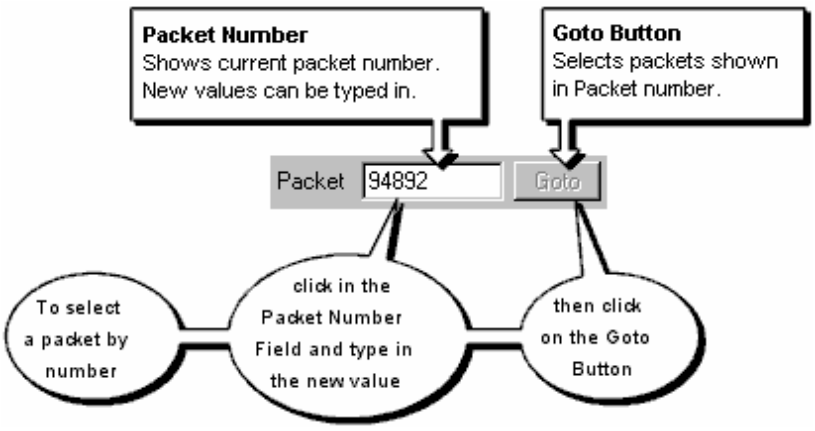
PID Filter



Slider

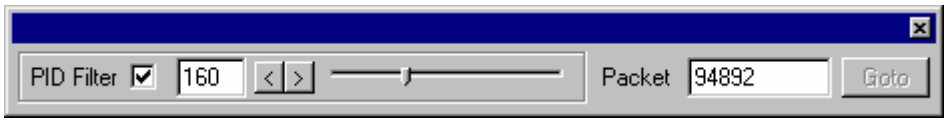


Packet number



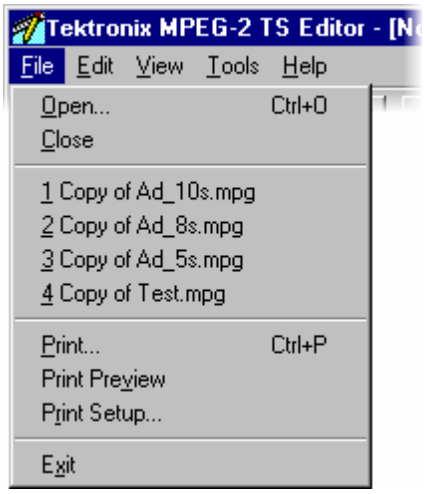
It is normal to edit a copy of a transport stream. Transport Stream Analyzer uses the same packet numbering as Editor. Hence the packet number can be used to find and view a packet in Analyzer then edit the copy of the same packet in Editor.

The Slider Bar can be dragged from the edge of the main window into a floating pallet. To do this place the mouse pointer on the background, inside the Slider Bar, hold down the left mouse button and drag away from the window border. The result is a self contained window which looks like this:



To replace the Slider Bar on the window border drag it over the border until the outline changes shape.

File Menu Options



Open — Opens a file for editing. If a file is currently open it is closed when a new file is selected.

Close — Closes the current file. There is no need for a save option because all changes are written to file immediately.

1 *<filename>*
2 *<filename>*
3 *<filename>*
4 *<filename>* — A list of the four most recently edited files. If the program has recently been installed the list may be empty or hold less than 4 files.

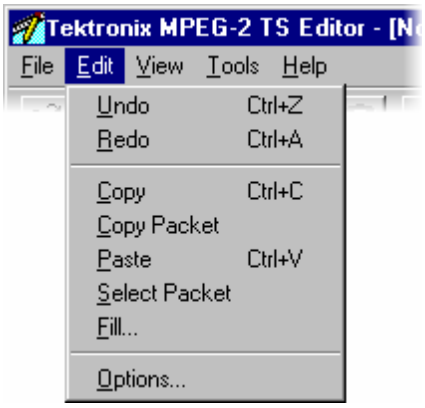
Print — Prints the current packet.

Print Preview — Opens a print preview of the current packet.

Print Setup — Selects printer and configuration.

Exit — Closes any file that is open and terminates execution of the program.

Edit Menu Options



Undo — Undoes the last edit, restoring the previous value. Selecting undo again undoes the previous change.

Redo — Re-instates the previously undone change.

Copy — Copies the bytes which are currently selected in the Hexadecimal Editor from the packet to the clipboard. The bytes are copied using the hex representation.

Copy Packet — Copies the entire contents of the current packet to the clipboard.

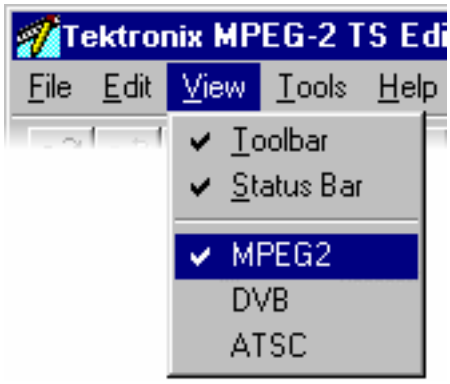
Paste — Pastes hexadecimal from the clipboard into the packet starting at the currently selected byte.

Select Packet — Selects the entire contents of the packet.

Fill — Prompts for and fills all selected bytes with a value.

Options … — Opens the options dialog.

View Menu Options



(a check mark ✓ next to an option indicates that it is currently selected.)

Toolbar Shows or hides the Toolbar, which provides a set of convenient shortcuts for the more frequently used menu options.

Status Bar Shows or hides the Status Bar.

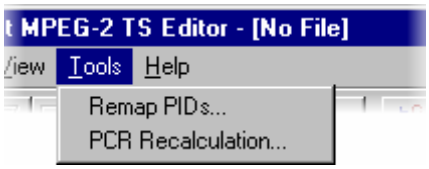
The following menu options select which standard is used to interpret the values held in the **Transport Scrambling Code** field. Only one standard can be selected at any time.

MPEG2 Selects the MPEG2 interpretation of the Transport Scrambling Code.

DVB Selects the DVB interpretation of the Transport Scrambling Code.

ATSC Selects the ATSC interpretation of the Transport Scrambling Code.

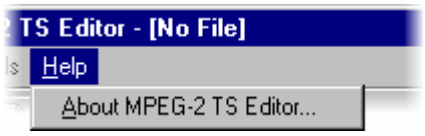
Tools Menu Options



Remap PIDs… Starts the tool to Remap packets from one or more PIDS to different PIDs.

PCR Recalculation … Invokes a Wizard to Recalculate the Program Clock References (PCR) carried in one or more PIDS.

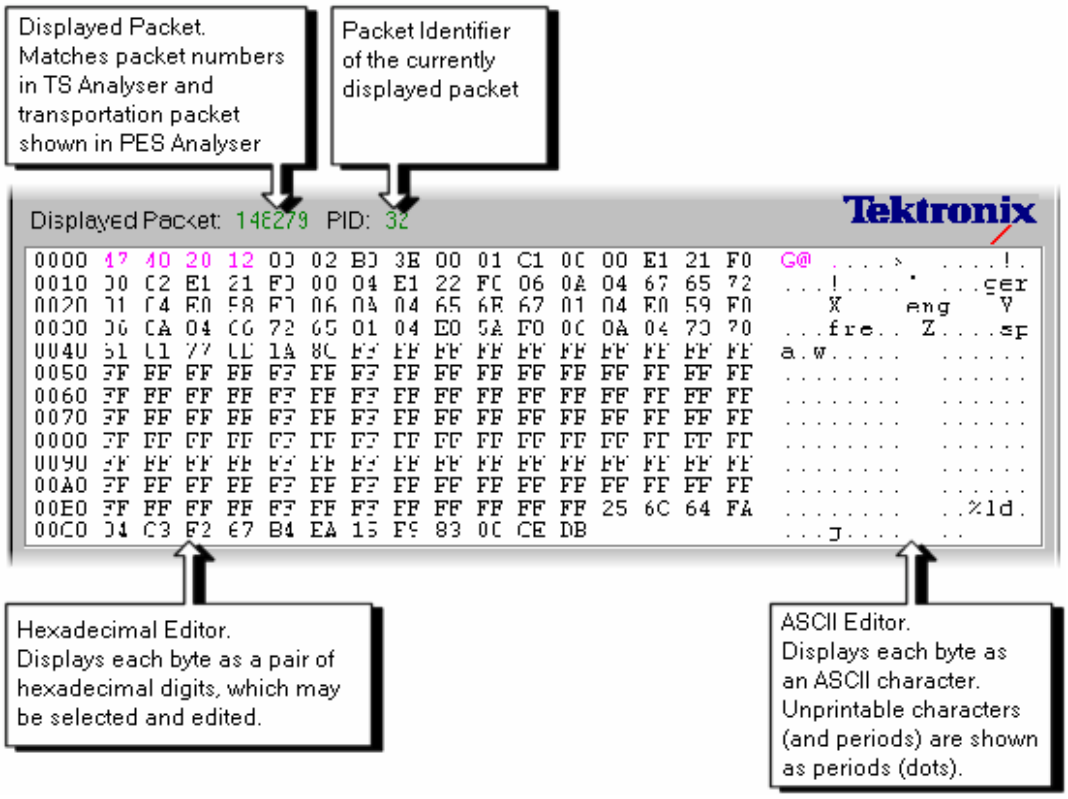
Help Menu Options



About ... Opens a dialogue which displays the program version number and license number.

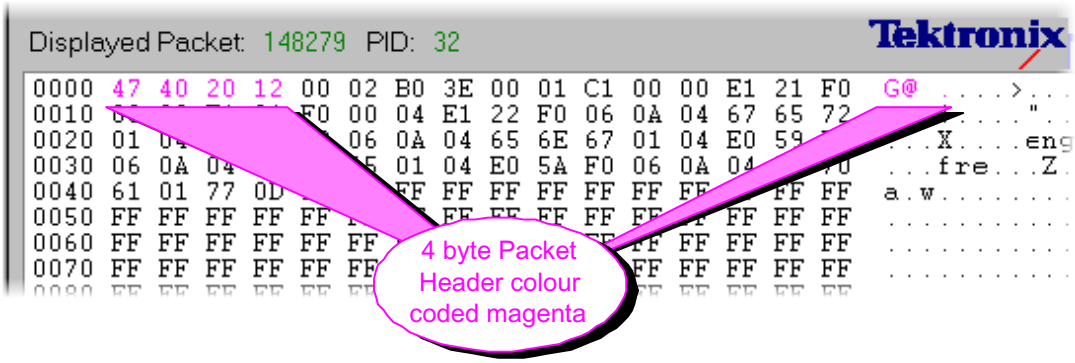
Hex Editor

The Hex Editor displays and provides editing facilities for the contents of the current packet in both hexadecimal representation and ASCII characters.

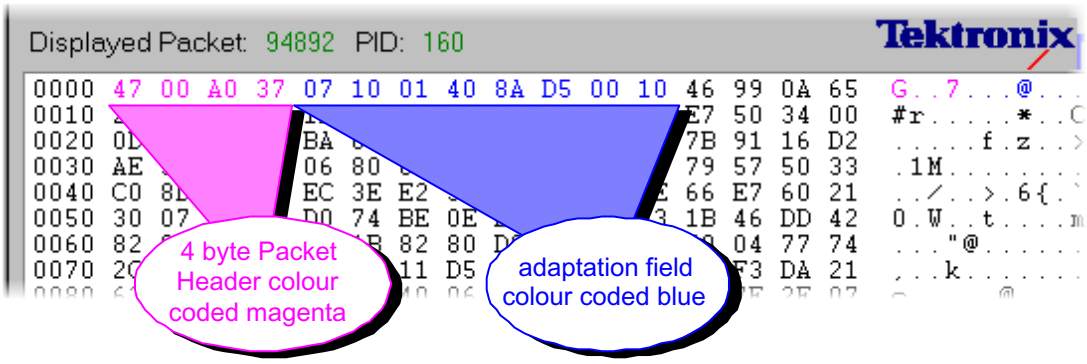


Colour Coding

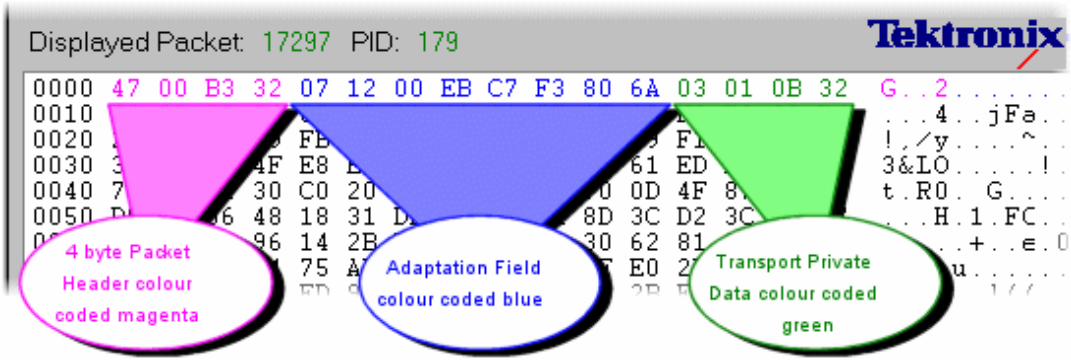
Colour coding is used to show the 'footprint' of various header fields, in both the hexadecimal and ASCII views. The packet payload and any Reed Solomon data is shown in black. The bytes of the packet header field are shown in magenta text.



When an adaptation field is present it is shown by blue coloured text:



If transport private data is present it is shown in green:



Note that it is possible to define a transport private data area which is not contained within the adaptation field area specified by the adaptation field length.

Selecting & Editing

One or more bytes can be selected using either the hexadecimal or ASCII view. Changes are made using options from the menus and by typing new values in the hexadecimal view.

When the mouse pointer is moved over either of the views in the Hex Editor it changes to the Text Select pointer.

Individual Bytes

To edit a byte or character, position the mouse pointer over the desired character in either the ASCII or hexadecimal view. Then click the left mouse button. A flashing inverse video cursor appears to the left of the character.

Alternatively double click on either view of the byte to select it for use with an option from the **Edit** menu operation.

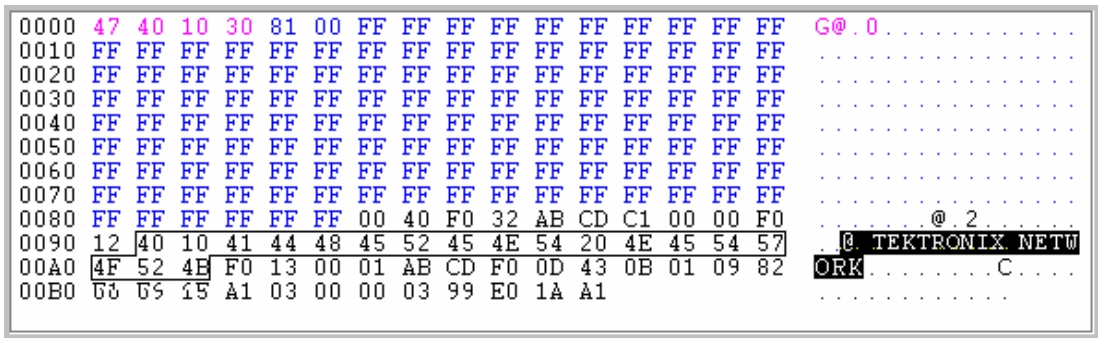
New values can be entered from the keyboard. As each character is typed the cursor moves on to the next. It can be repositioned with the mouse and by using the up, down, left and right cursor keys.

The cursor will not move beyond the end or back before the start of the packet. To select another packet use the Slider Bar.

Blocks of Bytes

A block of bytes may be selected for operations such as copying to the clipboard or filling with the same value.

With the mouse click on the first byte required and hold the left mouse button down. Then drag the mouse pointer to the last byte to be selected and release the left mouse button. Both the ASCII and Hex views can be used for selection. The selection is shown in inverse video in the view from which the it was made, and by an outline around the selection in the other view. For example, when made from the ASCII view a selection looks like this:

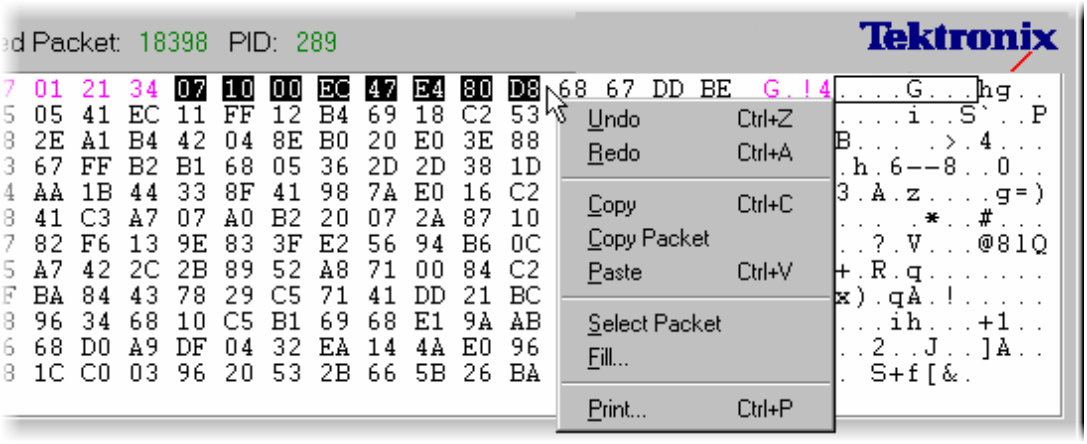


Once selected the block of bytes may be edited with the available options from the **Edit** and the Pop-Up menus. Clicking the mouse or pressing a cursor key clears the selection.

To select a block using the cursor keys: position the cursor on the first byte, then hold down the **Shift** key and move the cursor with the cursor keys. The selection is drawn between the initial and current cursor positions. Release the **Shift** key when the cursor has reached the last byte. Clicking the mouse or pressing a cursor key clears the selection.

Editing Commands

The **Edit** menu, Pop-Up menu and Toolbar buttons provide a variety of options for editing the packet contents. The Pop-Up menu is opened by clicking the right mouse button when the pointer is over the Hex Editor, for example:



Depending on what operations have recently been performed and on what is selected the menus and Toolbar will offer different commands. The complete set of menu options and associated buttons are:

Undo 

TS Editor keeps a list of recent changes. Each **Undo** command backs out the most recent change from the list. That change is moved to the Redo list in case it needs to be re-instated. As each change is undone the cursor moves to the appropriate field (in the Hex or Header Editors) and restores the previous value.

Redo 

Re-instates the most recently undone operation. When a new edit is made the Redo list is cleared.

Copy 

Copies the currently selected bytes to the clipboard. From there they may be pasted in to other packets or used by other applications.

Copy Packet 

Copies the entire contents of the current packet to the clipboard. From there it may be pasted in to other packets or used by other applications.

Paste 

Pastes packet contents held on the clipboard into the current packet, starting at the current cursor position.

Select Packet

Selects the entire packet. This is a quick alternative to selecting all the packets with the mouse or keyboard.

Fill…

Fills all the selected bytes with a hexadecimal value.

This option opens the Fill Byte dialog. Enter the fill value then select the OK button. The Cancel button abandons the operation leaving the bytes in their original state.

There are no Toolbar buttons for the Select Packet and Fill commands.

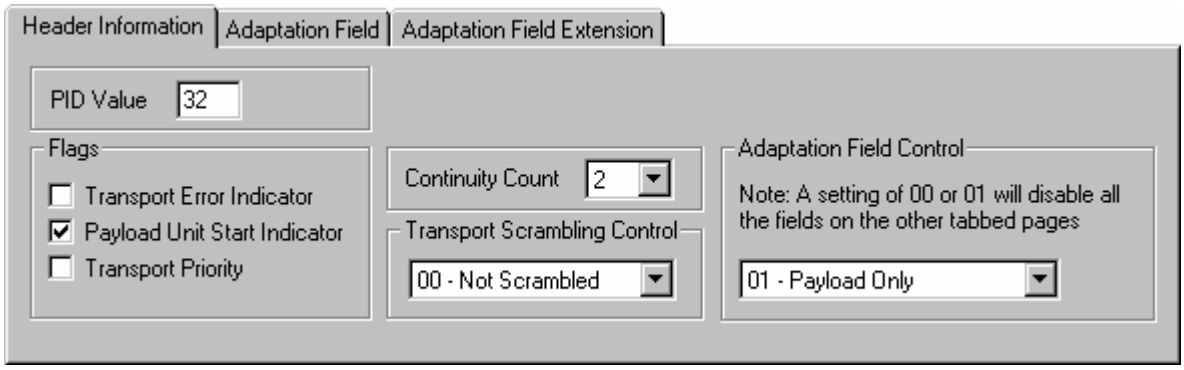
Header Editor

The Header Editor has three ‘tabs’. These show and allow editing of the basic header, adaptation field and the adaptation field extension contents. The Hex editor is immediately updated to show the new values when changes are made in the Header Editor.

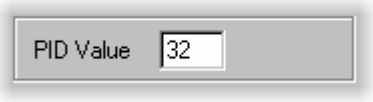
Binary flags are shown with check boxes whose state may be changed by clicking in the box with the mouse pointer. Multi-bit fields may be edited by typing in the new values or selecting a value from a drop down list.

It is important to remember that changing a flag or field often alters the structure of the header. The other flags and fields will be re-interpreted according to the data underlying their new position in the structure.

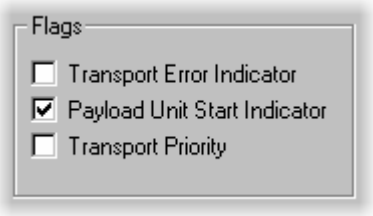
Header Information Tab



The Header Information Tab interprets the contents of the Packet Header (shown in magenta text in the Hex Editor) for ease of understanding and editing.



Displays, and allows editing of, the 13 bit PID as a decimal value. (The PID is packed into a pair of bytes with the Flags shown below.)

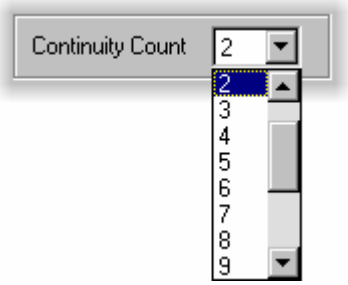


Displays the state of each binary flag in a check box:

☐ = 0 or false

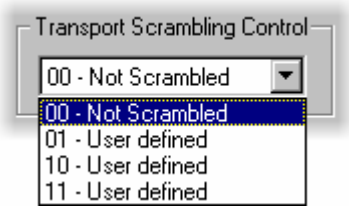
☑ = 1 or true

Click in the box to toggle the state of a flag.



Displays the value of the 4 bit Continuity Count field in decimal.

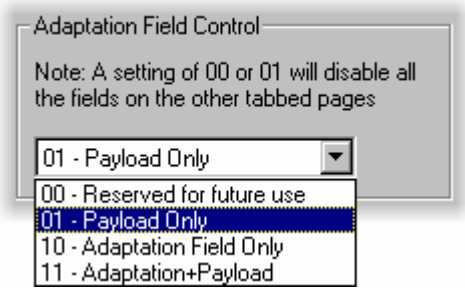
To avoid any typing errors the drop down list allows selection of a different value.



Displays the 2 bit Transport Scrambling Control field as a binary bit pattern, with a text description.

Use the drop down list to select a different value.

The text gives the interpretation for the bit pattern according to the standard which is currently selected: **MPEG2**, **DVB** or **ATSC**. Use the **View** menu to select the required option. The example on the left shows the **MPEG2** interpretation.

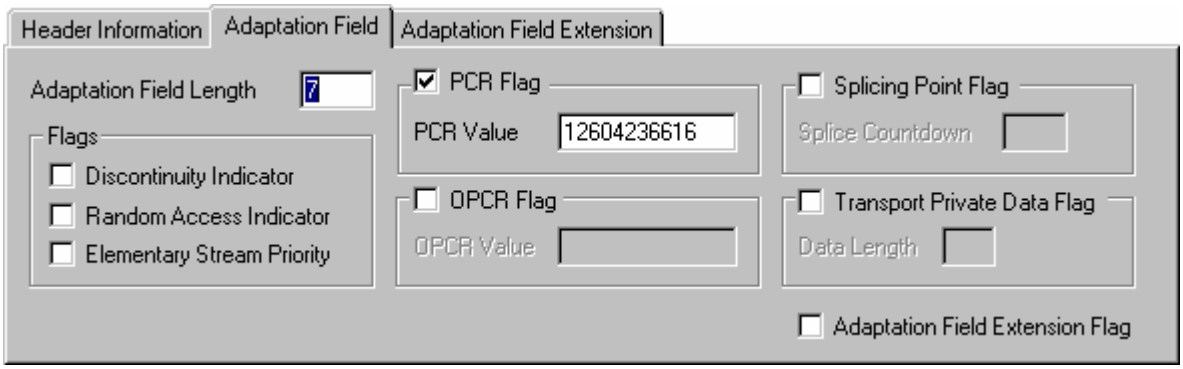


Displays the 2 bit Adaptation Field Control as a binary bit pattern, with a text description.

Use the drop down list to select a different value.

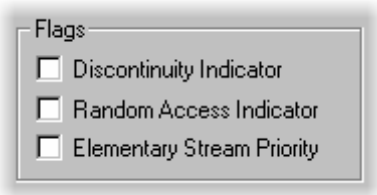
The Adaptation Field and Adaptation Field Extension Tabs will be empty (greyed out) when the **01 - Payload Only** or **00 -- Reserved** values are selected.

Adaptation Field Tab



The Adaptation Field Tab interprets the contents of the Adaptation field (shown in blue text in the Hex Editor) if one is present in the packet. To be able to edit an Adaptation Field the **Adaptation Field Control** value in the Header Information Tab must indicate that an adaptation field is present.

Shows the length of the Adaptation Field in bytes and allows it to be edited in decimal.

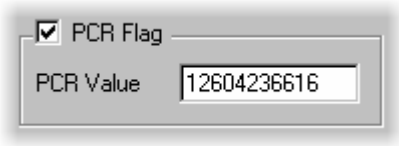


Displays the state of the binary flags in check boxes:

☐ = 0 or false

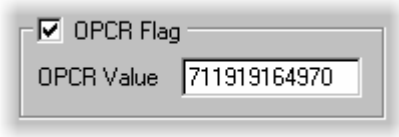
☑ = 1 or true

Click in the box to toggle the state of a flag.



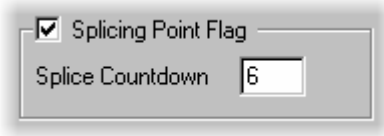
Displays the state of the binary PCR Flag in a check boxes: ☐ = 0 or false and ☑ = 1 or true.

When the flag is true the PCR Value is shown and may be edited in decimal.



Displays the state of the binary OPCR Flag in a check boxes: ☐ = 0 or false and ☑ = 1 or true.

When the flag is true the OPCR Value is shown and may be edited in decimal.



Displays the state of the Splicing Point Flag in a check boxes: ☐ = 0 or false and ☑ = 1 or true.

When the flag is true the Splice Countdown value is shown and may be edited in decimal.

Displays the state of the Transport Private Data Flag: ☐ = 0 or false and ☑ = 1 or true.

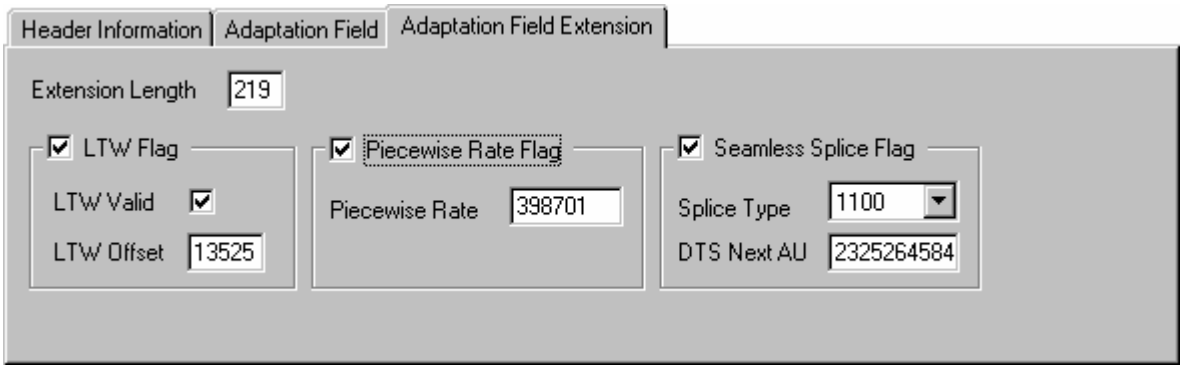
When the flag is true the Data Length is shown in bytes and may be edited in decimal.

Indicates the state of the binary Adaptation Field Extension flag.

☐ = 0, no Adaptation Field Extension.
The Adaptation Field Extension Tab may be viewed but all of the fields will be greyed out.

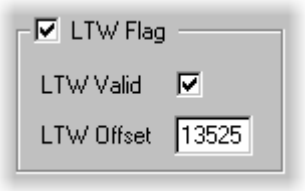
☑ = 1, Adaptation Field Extension present.
The Adaptation Field Extension Tab will show and enable editing of the information contained in the Adaptation Field Extension.

Adaptation Field Extension Tab



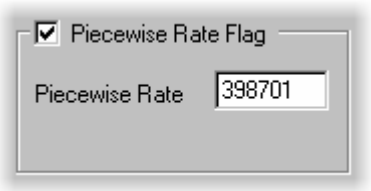
The Adaptation Field Extension Tab interprets the contents of the Adaptation Field Extension if one is present in the packet. To be able to edit an Adaptation Field Extension the Adaptation Field Extension flag must be set to 1 (i.e. the box must be checked) in the Adaptation Field Tab.

Shows the length of the Adaptation Field Extension in bytes and allows it to be edited in decimal.



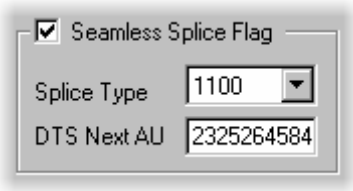
Displays the state of the LTW Flag:
☐ = 0 or false and ☑ = 1 or true.

When LTW is true the state of the LTW Valid flag and value of the LTW Offset are shown.
The Valid flag may be toggled and new Offsets can be typed in decimal.



Displays the state of the Piecewise Rate Flag:
☐ = 0 or false and ☑ = 1 or true.

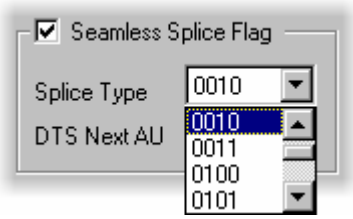
When the flag is true the Rate is shown and may be edited in decimal.



Displays the state of the Seamless Splice Flag:
☐ = 0 or false and ☑ = 1 or true.

When the DTS Next AU value is shown and may be edited in decimal.

The 4 bit Splice Type is shown as a bit pattern.



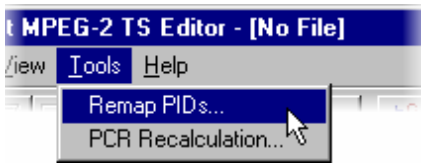
It has a drop down list containing all 16 possible bit patterns.

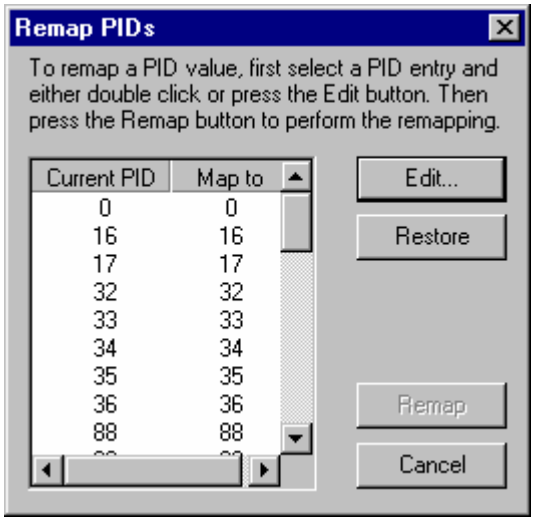
Use the list to select a different value.

PID Remapping

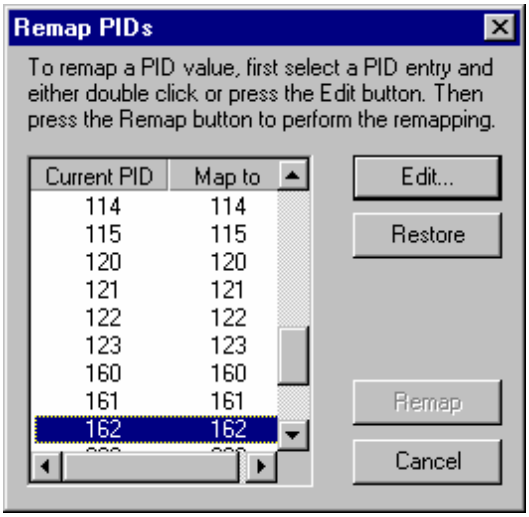
The packets of one or more PIDS may be remapped, i.e. moved to different PIDs. Only the PID in the packet headers is changed. Any packet payload contents such as SI and PSI tables are unaffected. Hence remapping can break the references from tables to PIDs, or be used as an investigation to correct broken references.

To remap packets from one or more PIDs select the **Remap PIDs…** option from the **Tools** menu.

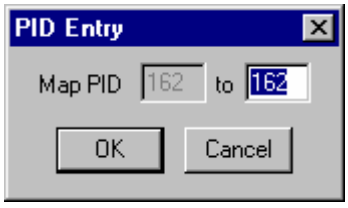




The program scans the file to build a list of PIDs, displaying the Hourglass mouse pointer while it is busy. It then opens the Remap PIDs dialog:

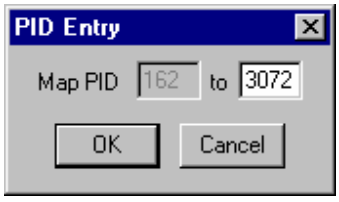


To specify a mapping from a current PID to a new PID select the current PID entry from the list, by clicking on it.



Now select the **Edit...** button, which opens the PID Entry dialog. (Alternatively double click on the required entry in the list.)

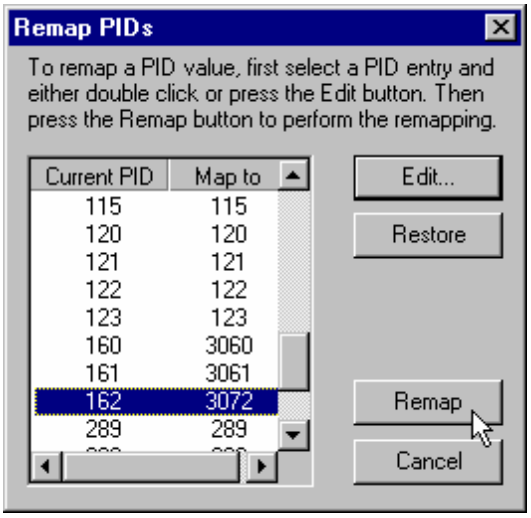
Type in the value for the new PID to map to and select **OK**.



Repeat this process for each PID that is to be remapped.

The **Restore** button will change the value of the selected **Map to** PID back to that of the **Current PID** without having to open the PID Entry dialog.

When all the mappings are specified select the **Remap** button. (The Remap button is not enabled unless one or more mappings has been specified.)



The hourglass mouse pointer is displayed while the program performs the remapping. On completion the dialog closes and control is returned to the main window.

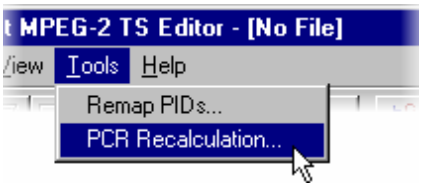
PCR Recalculation

The Program Clock References of one or all Programs may be changed. The rate may be changed and/or any one of six types of jitter added. Uses of PCR Recalculation include:

- Recalculating the rate at the correct value, without adding jitter, on a recording of a faulty stream may be used to remove suspected PCR problems. If the recalculated stream works correctly the problem is in the PCR.
- Creating test data with known deviations in rate for exercising other equipment.

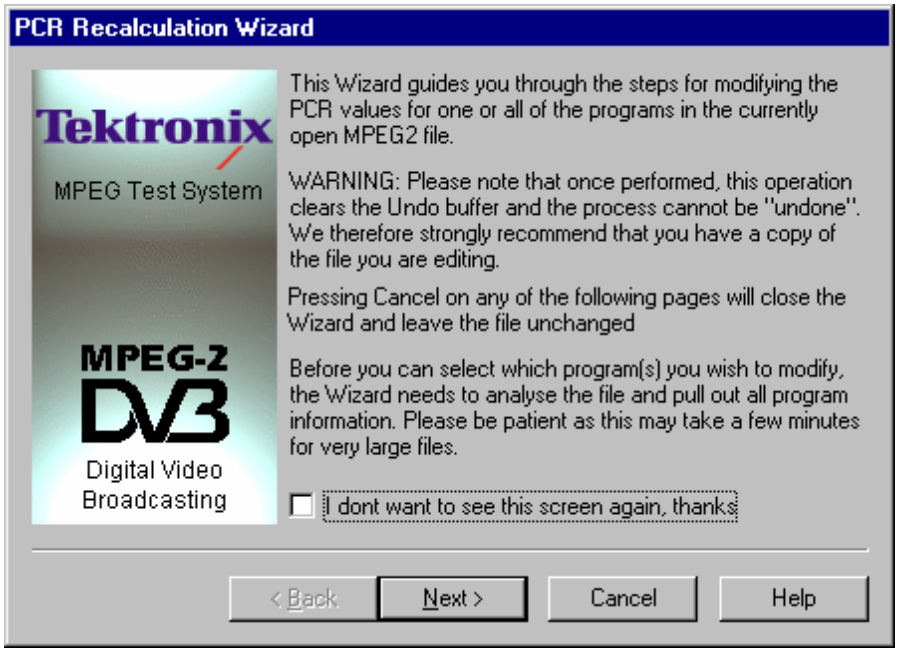
Do not perform PCR Recalculation on an original recording. This operation is not reversible so it is strongly recommended that a copy of the original file is used.

To modify the PCR select the **PCR Recalculation…** option from the **Tools** menu.



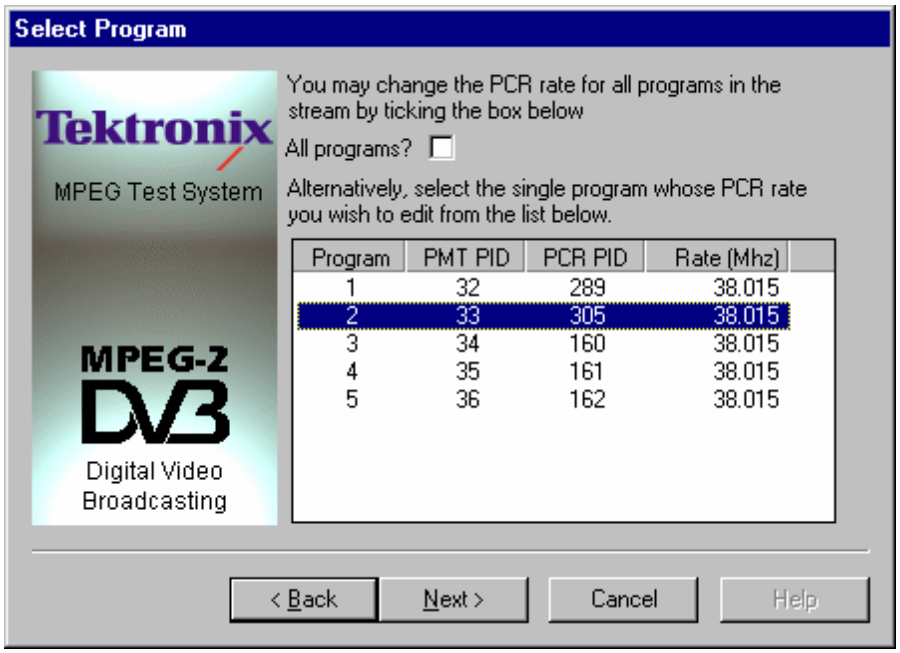
This is runs a wizard to analyze the program structure, guide the user through the available options and then recalculate the PCR values.. The wizard presents 3, 4 or 5 pages depending upon the options chosen:

By default the wizard will display this Introduction first.

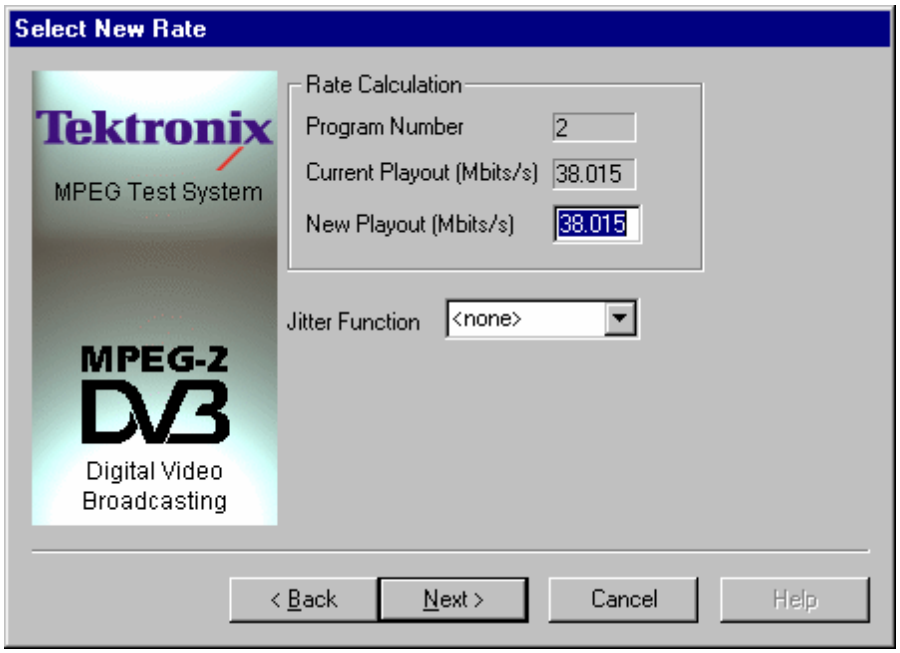


It may be disabled for future recalculations by selecting the check box option at the bottom of the introductory text. Selecting the Next button moves on to the Select Program page.

The wizard has to analyze the file to extract the relevant Program Information, which may take a while. When analysis is complete the Select Program page shows a list of the programs whose PCR values may be changed:

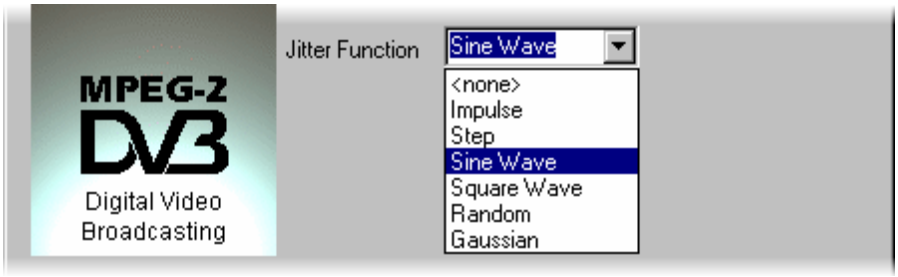


To recalculate the PCR rate for all the programs check the **All programs?** option. Otherwise select one of the programs from the list. Then select **Next** to move on to the Select New Rate page. The **Back** button moves back to the Introductory Page.



Keeping the rate as New Playout = Current Playout and selecting **Jitter Function** of **<none>**, will recalculate the PCR based on the current rate. This could be used, For example, to investigate a suspected problem with the PCR by playing the original and recalculated versions to see if there is a difference.

A new playout rate may be specified and/or a Jitter Function applied to the rate. There are seven Jitter Functions available including **<none>**. The available options are:

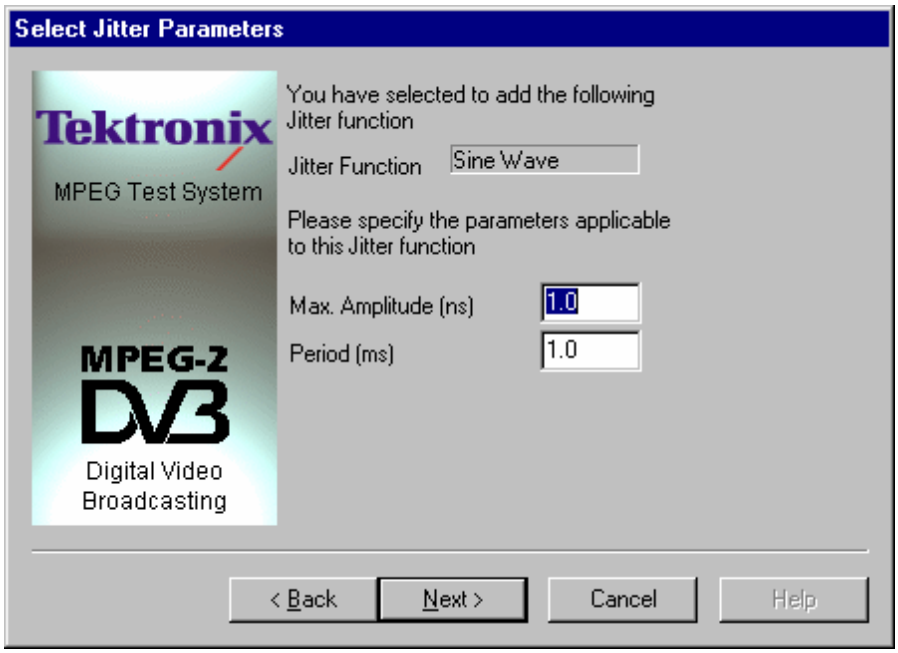


Each of the jitter functions is described in more detail at the end of this sub-section.

If a Jitter Function is required choose one of the six functions from the drop down list otherwise leave it set to **<none>**. Specify any change in the **New Playout** rate and select the **Next** button. Selecting **Back** returns to the Select program page.

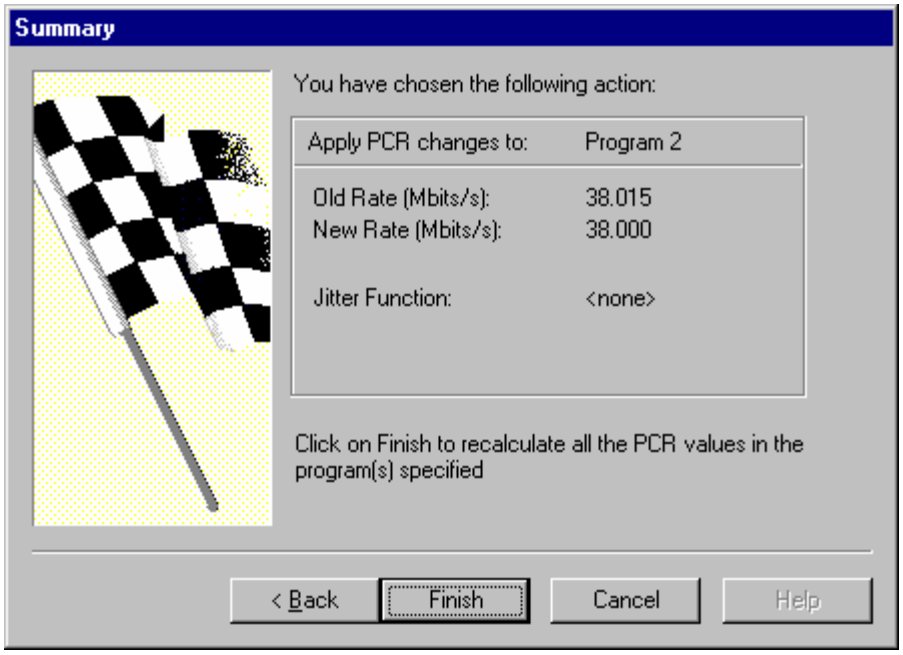
When no Jitter function, i.e. **<none>**, was selected the Select Jitter Parameters page will not appear. Go on to the Summary page, which shows a picture of a chequered flag.

With a Jitter Function selected the next page will be Select Jitter Parameters. This asks for additional information specific to the chosen Jitter Function. For example the **Sine Wave** function requires these parameters.



Specify the required parameters and select **Next** to move on to the Summary page. Use the **Back** button to return to the Select New rate page.

The Summary page displays a short list of the specified PCR rate changes,



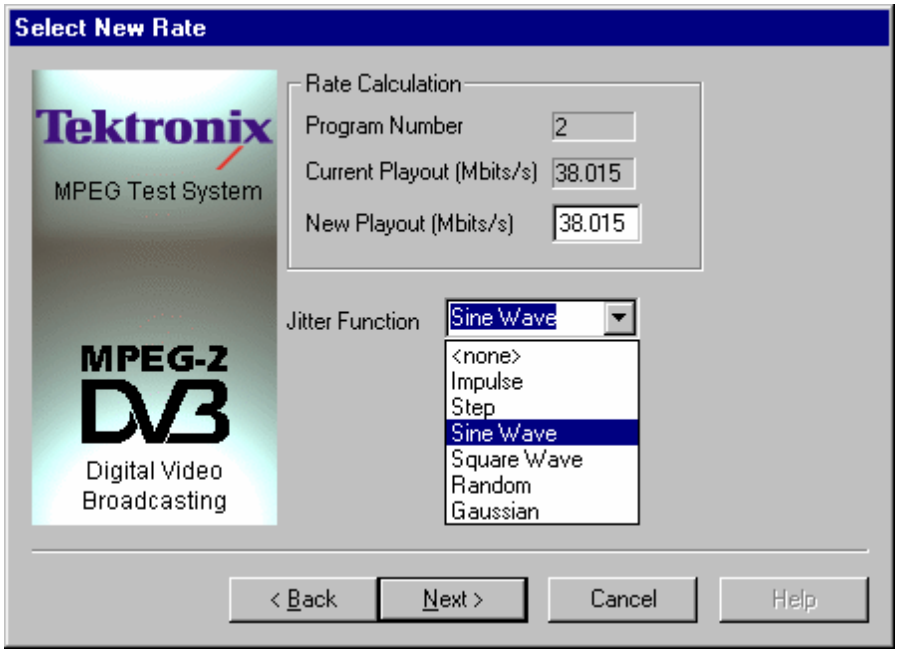
Select **Finish** to recalculate the PCR values. Remember once **Finish** has been selected there is no going back.

Use the **Back** button to return to the previous pages to make any changes.

The program may take a while to perform the recalculations. The Summary page will stay on screen and the Hourglass mouse pointer be displayed while the wizard is processing. When the summary page disappears the calculation is complete and the file may be closed or more edits carried out.

Jitter Functions

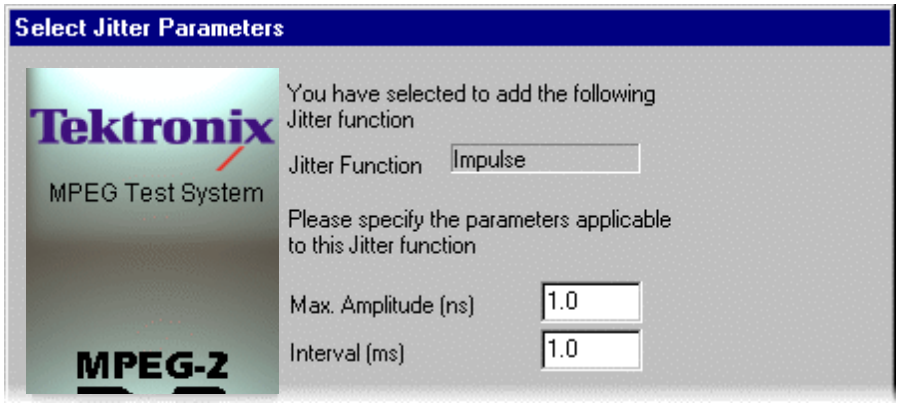
Select the required Jitter Function from the Select New rate page…



… then select **Next** to move on to the Select Jitter Parameters page to specify the parameters for the selected Jitter Function. The effect of and the parameters for each function are:

Impulse

The Impulse Jitter function adds a positive or negative value to a single PCR.

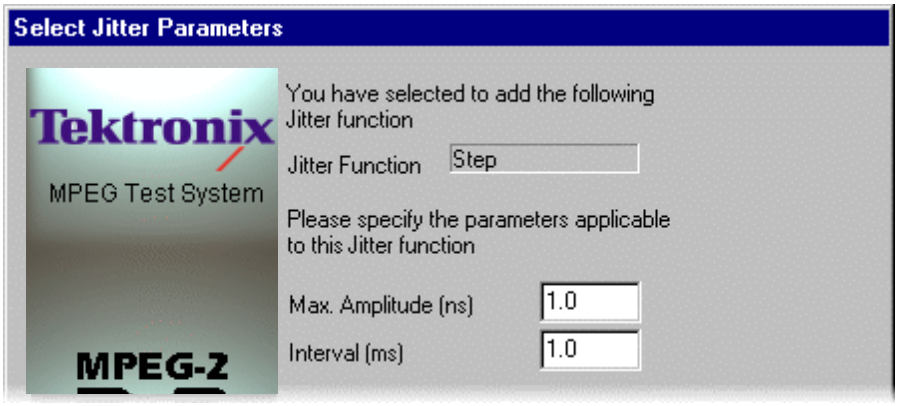


Max Amplitude specifies the size of the impulse in nano-seconds. Type a minus sign in front of the value for a negative impulse.

Interval specifies the time taken from the start of the file at which the Impulse is to be applied.

Step

The Step Jitter Function adds a positive or negative offset to the ideal PCR values after a specified time. The offset will be the same for all PCRs.

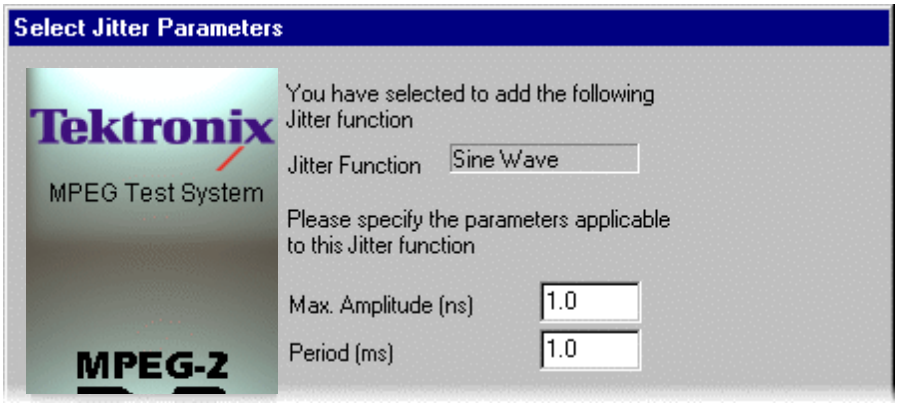


Max Amplitude specifies the size of the offset in nano-seconds. Place a minus sign in front of the value for a negative offset.

Interval specifies the time taken from the start of the file of the first PCR to which the offset is to be applied.

Sine Wave

An offset which varies according to a sine function is applied to the ideal PCR value for each PCR.

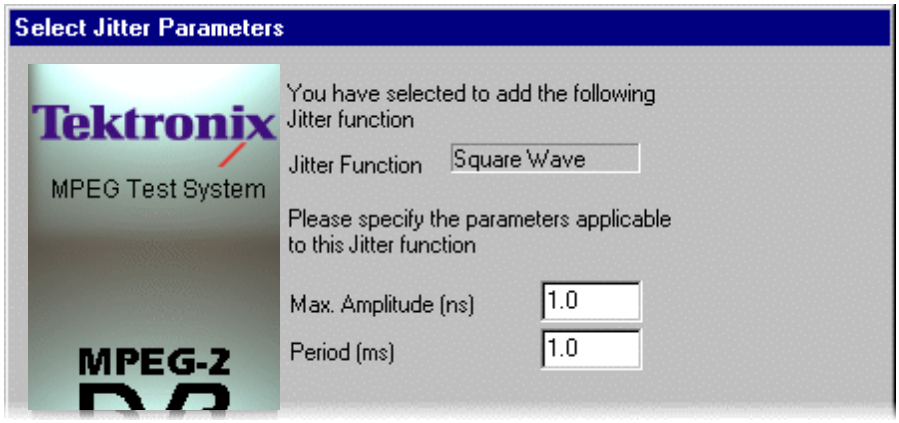


Max Amplitude specifies the amplitude of the sine wave in nano-seconds.

Period specifies the period of the sine wave in milli-seconds.

Square Wave

An offset which varies according to a square wave function is applied to the ideal PCR value for each PCR. The square wave has an equal mark/space ratio.

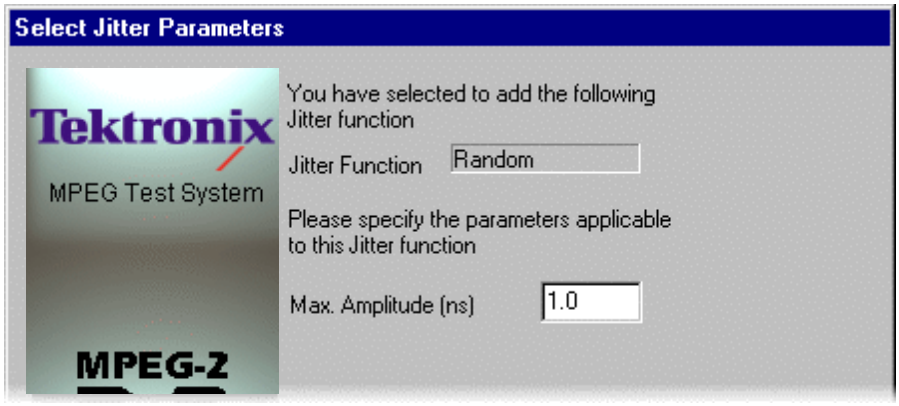


Max Amplitude specifies the amplitude of the square wave in nano-seconds.

Period specifies the period of the square wave in milli-seconds.

Random

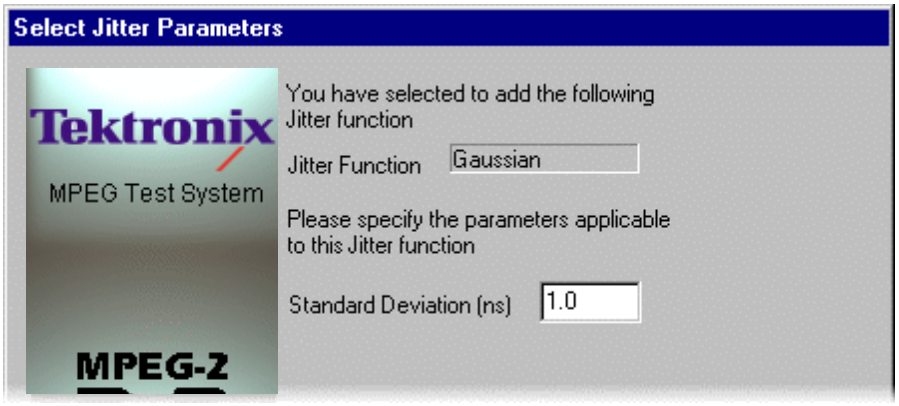
The PCR jitter applies offsets of a uniform random distribution to the ideal values of the PCRs. Each offset will be within the range of ± the specified amplitude.



Max Amplitude specifies the maximum amplitude of the jitter, relative to the ideal value, which may be added to any PCR. Only a positive value can be entered. The amplitude is always from **-Max. Amplitude** to **+Max. Amplitude** centred on the ideal PCR value.

Gaussian

The offsets are applied to the ideal PCR values following a Gaussian distribution according to the specified standard deviation.



Standard Deviation specifies the standard deviation to be used by the jitter function in deriving the offset for each PCR, relative to the ideal PCR value. Only a positive value can be entered for standard deviation.

Section 8

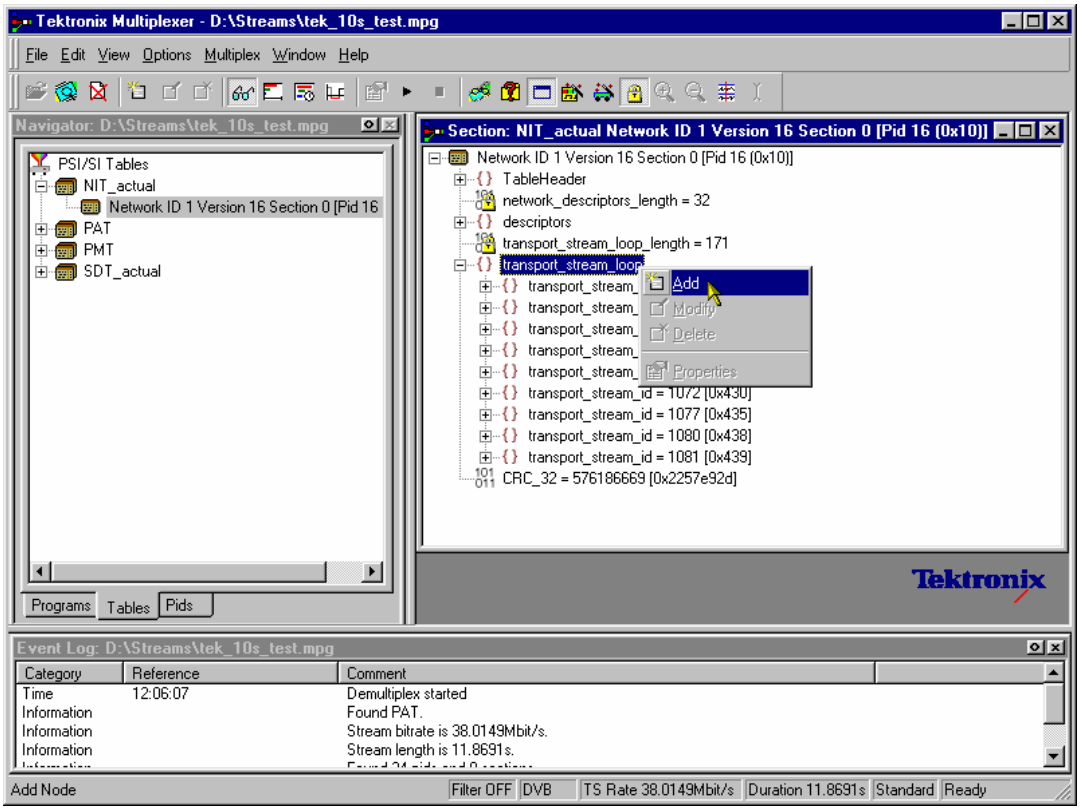
Multiplexer

Introduction 3
Starting the Program 5
Initial Appearance 5
Initial Menu Options 6
File Menu Options 6
View Menu Options 6
Scripts 7
Handling Scripts 8
Script Selection 9
Syntax Checking 9
Expert Mode 10
Script Management Buttons 10
Opening a Stream 11
Opening an MPEG Stream 11
Multiplex Configuration Files 12
Importing a file 12
Initial Stream Analysis 13
What To Do Next 13
User Interface 15
Menu Bar 16
File Menu Options 16
Edit Menu Options 17
View Menu Options 18
Options Menu 19
Multiplex Menu Options 19
Window Menu Options 20
Help Menu Options 20
Option Selection 21
Toolbar 22
Icons 23
Status Bar 24
Window Management 25
Dialogs 28
Cutting and Pasting Sections 29
Cutting a Section to the Clipboard 29
Copying a Section to the Clipboard 29
Pasting a Section from the Clipboard 29
Dragging and Dropping 29
Manipulation in Program View 30
Wizards 31
Transport Wizard 32
Creating a New Transport Stream 32
Program Wizard 35
Adding a Program to a Transport Stream 35
Views 42
Navigator Views 42
Section View 44
Syntax of a Section 45
Syntax of a Multiple String Structure 47
Expert and Standard Modes 49
Structure Diagram Manipulation 50
Event Log 51
Examine Transport Stream Window 52
Examine TS Section Copy 53
SI Filtering 54
Selecting a Table for Filtering 54

Saving/Loading SI Filter Settings 56
Component Views 57
Component Bitrate 57
Component Duration 58
Available Bit Rate 61
Common Features 62
Common Menu Options 64
Editing in the Navigator Views 65
Transport Stream 66
Opening an MPEG file 66
Opening a Multiplexer file 66
Change Transport Stream Bitrate and Duration 66
Programs 67
Adding a New Program 67
Copy/Move a Program 67
Table 68
Adding a New PSI/SI Table 68
Copying a PSI/SI Table 69
Deleting a PSI/SI Table 69
Exporting a Table 69
Import a Table 69
Section 70
Adding a New Section to a PSI/SI Table 70
Editing PSI/SI Table Properties 71
Deleting a Section 74
Exporting a Section 75
Importing a Section 75
ES PIDs 76
Adding an Unreferenced Elementary Stream 76
Adding Elementary Streams to the Program Structure 81
Exporting Elementary Streams 82
Exporting PES Packets 82
Modifying PES PID Details 82
Deleting a PES PID 82
DSM-CC 83
Adding an Unreferenced DSM-CC Section 83
Adding DSM-CC Sections to the Program Structure 84
Delete a DSM-CC Section 85
Export a DSM-CC Section 85
Editing in Section View 86
Editing Fields 86
Selecting a Field 86
Adding an Element to a Loop 87
Deleting an Element in a Loop 88
Modifying the Contents of a Field 88
Multiplexing Transport Streams 91
Start 91
Errors and Reporting 92
Stop 93
Exporting the Multiplex Configuration File ... 93
Export 93
Export As 93
Make Seamless 94
Enabling the Seamless option 94
Seamless Settings 94
Closing files 95
Reference 96
Abbreviations 96

Introduction

The Tektronix Multiplexer provides off-line multiplexing of ATSC, MPEG-2 and DVB Transport Streams.



Transport streams (TS), elementary streams (ES), packetised elementary streams (PES), Packet Identifiers (PID) – all can be selected, manipulated and recombined to form customised, synthesised transport streams.

The functionality provided includes:

- Wizards that facilitate the completion of common tasks, such as populating streams with Program Specific Information/ Service Information/ Program and System Information Protocol (PSI/SI/PSIP) and programs.
- Table contents are displayed in and edited from structure diagrams (tree diagrams).
- Transport Streams can be generated which:
    - conform strictly to the standards selected for interpretation or
    - have precisely engineered, known, non-conformances
- Two or more instances of Multiplexer may be running concurrently. This allows table information to be copied from one file to another.
- The source data for non-conformant streams can be saved in a raw format, which can be quickly re-loaded as the basis for generating more stream data.
- Conformance of edits to the standards is checked interactively and enforced by default. Checking and enforcement may be turned off when specifying non-conformances to be introduced into the new transport stream.

On opening, streams are analyzed and displayed according to the standard selected: MPEG, DVB, ATSC or ISDB. Scripts are used by the analysis process; this allows private PSI/SI tables and descriptors to be defined. Script generation is described in the *Custom SI Scripting* section, which forms part of this handbook.

The majority of examples given in this section of the User Manual are based on DVB SI. The user should remember that Multiplexer is equally at home with all major DTV standards, MPEG-2, DVB, ATSC and ISDB as well as the major extensions to those standards.

Program Specific Information (PSI), Service Information (SI) and Program and System Information Protocol (PSIP) are often referred to as simply SI in this chapter.

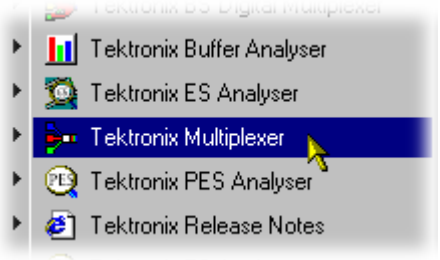
The Transport Stream Analyzer program should always be used for reliable analysis of transport streams containing DSM-CC or MPE addressable sections.

In the absence of TS Analyzer, it is acceptable to use Multiplexer for analysis, provided that the DSM-CC or MPE scripts are first applied using Expert mode in the Stream Interpretation dialog (see Scripts, page 7).

However, when multiplexing streams containing DSM-CC or MPE addressable sections, the related scripts must not be active.

Starting the Program

The program may be started by selecting the **Tektronix Multiplexer** option from the **Start** -> **Programs** menu.

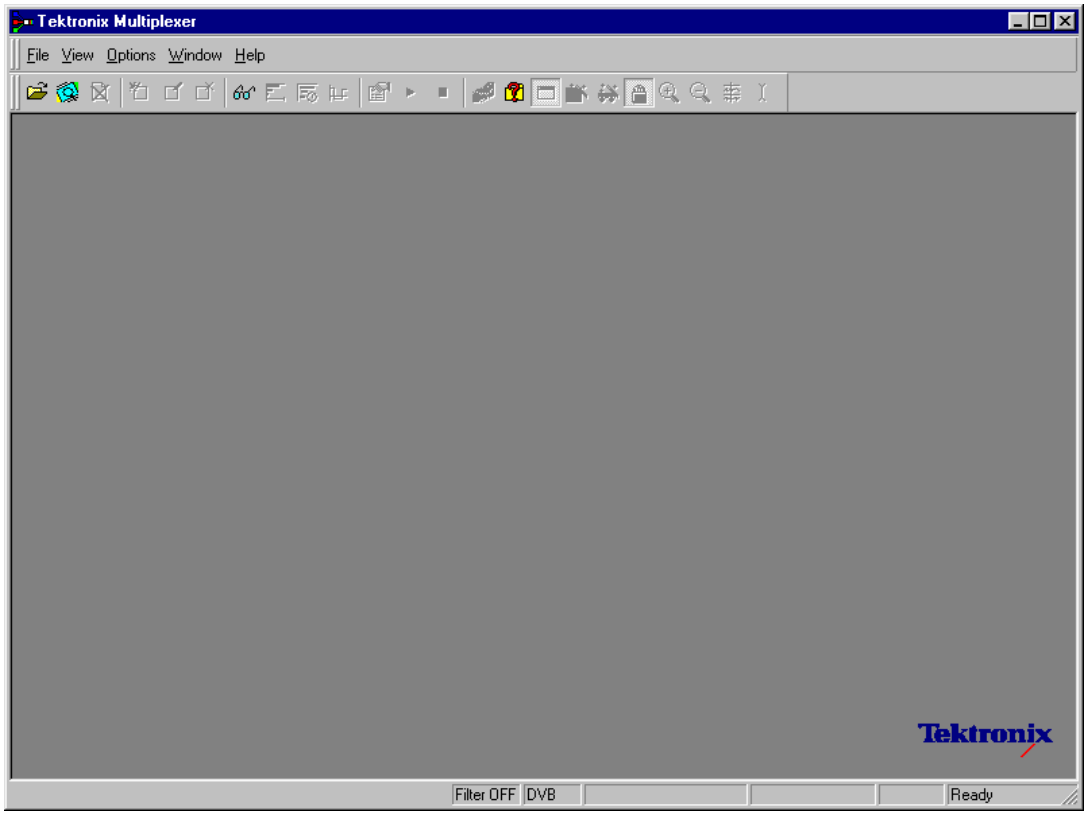


or

by double clicking on the **Tektronix Multiplexer** Shortcut on the desktop.

Initial Appearance

Once the program has started and is ready for use, it will open a Main Window that looks like this:

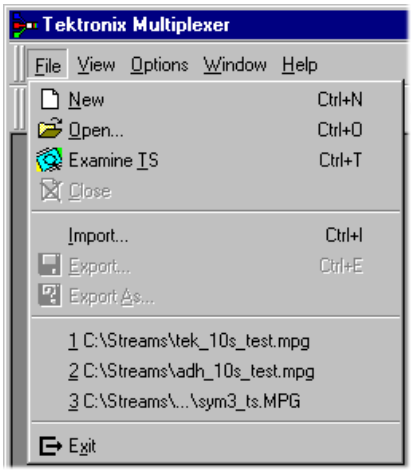


Use the View menu to select which standard will be used to interpret transport streams. Then open a transport stream file or import a multiplex configuration file.

Initial Menu Options

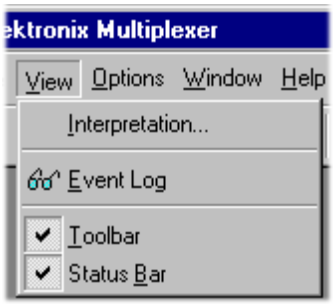
When the application is opened, users are presented with options only relevant to opening new or existing multiplex files. Options not relevant at this time are inactive (greyed out).

File Menu Options



New	Opens new multiplex configuration file.
Open...	Opens an MPEG file for use. The program opens the file selection dialogue allowing the user to choose the required file.
Examine TS	Opens the Examine TS window which allows a brief summary of the stream to be viewed before it is subjected to full analysis.
Close	(Currently disabled - see page 16).
Import...	Opens a previously saved multiplex configuration file.
Export...	(Currently disabled - see page 16).
Export As...	(Currently disabled - see page 16)
1 <filename> **2 <filename>** **3 <filename>** **4 <filename>**	A list of the four most recently used files. If the program has recently been installed the list may be empty or hold less than four files. Selecting a filename opens that file for use.
Exit	Finishes running the program.

View Menu Options



a check mark ✓ next to an option indicates that the object is currently visible.)

Interpretation...	Opens the Stream Interpretation dialog. This allows the scripts to be used in stream analysis to be selected.
Event Log	Opens the Event Log window.
Toolbar	Displays or hides the Toolbar.
Status Bar	Shows or hides the Status Bar.

Scripts

SI scripts are necessary to enable SI table and descriptor data to be analyzed successfully. Scripts are used to enable analysis of SI data dictated by the various international standards, e.g. MPEG-2, DVB, ATSC and ISDB.

Essential scripts are installed and enabled using the Stream Interpretation dialog. In the absence of any enabled scripts, only the PAT table will be analyzed, all other data will be presented as private data.

A listing of the currently available scripts is given in the *Custom SI Scripting* section of this manual. In addition, scripts may be customised to provided analysis and multiplexing of private data.

If a suitably configured script is selected and enabled before a stream is opened, custom data will be analyzed when the stream is opened. If the script is not selected or enabled the stream will not fail to be analyzed, but any custom data will be reported as either an error in the stream configuration or as an elementary stream PID.

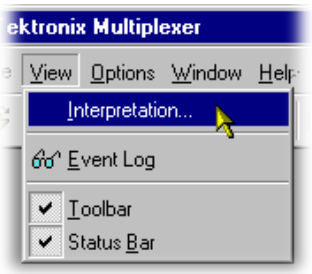
Scripts can only be selected and enabled when no files are open. The Stream Interpretation dialog is available when a file is open, but all activity is disabled.

Note that a script file will not be used for analysis until:

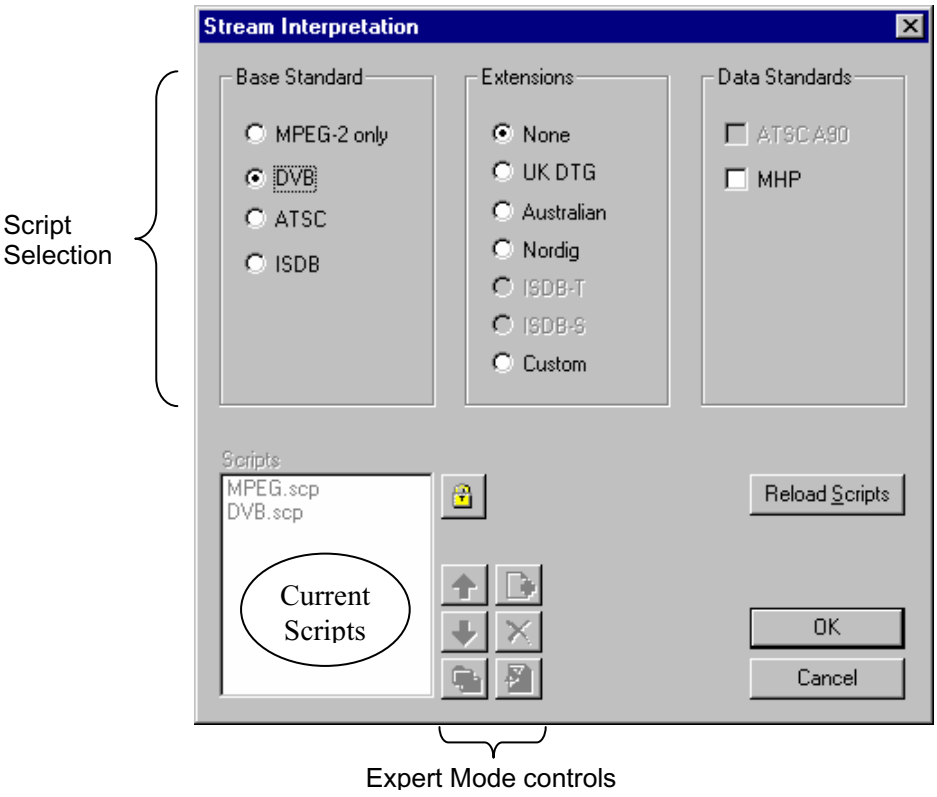
- it is present in the Scripts text-box in the current analysis mode.
- it is successfully enabled by closing the Stream Interpretation dialog using the OK button.

Handling Scripts

To open the Stream Interpretation dialog, with all files closed select the **Interpretation…** option from the **View** menu.



The Stream Interpretation dialog is displayed as shown below:



The top half of the dialog is concerned with selecting scripts. The text box (**Scripts**) lists the scripts currently selected. The area adjacent to the text box is dedicated to Expert mode controls.

Script Selection

The selection area of the Stream Interpretation dialog is best viewed and used from left to right.

The **Base Standard** section allows the MPEG, DVB or ATSC standard to be selected for analysis.

MPEG-2 only	Interprets and analyzes the packets in conformance to the MPEG-2 standards.
DVB	Interprets and analyzes the Transport Stream Packets according to the specifications of the DVB and MPEG-2 standards.
ATSC	Interprets and analyzes the Transport Stream Packets according to the specifications of the ATSC and MPEG-2 standards.
ISDB	Interprets and analyzes the Transport Stream Packets according to the specifications of the ISDB and MPEG-2 standards.

The standard selected will dictate the availability of the remaining options in the Extensions and Data Standards sections.

The **Extensions** section allows country-specific extensions to be added to the basic standard scripts. If **None** is selected, only the standard scripts are listed in the **Scripts** text-box. The remaining country-specific extensions add extra scripts to the current listing. As with the Base Standard, the choice of **Extensions** option will dictate the availability of the options in the **Data Standards** section. The **Custom** selection in the Extensions section allows users to include their own selection of scripts using Expert Mode.

The **Data Standards** section offers a choice of data-specific scripts.

Note that the scripts listed by default are those resident in the default installation directory (i.e. tektronix\scripts). Other directory locations can be specified in Expert Mode. All selections will be retained between sessions.

Syntax Checking

Scripts are syntactically analyzed when the OK button is selected. They are also checked when the application is opened. A fault in the syntax of a script will not necessarily prevent a stream from being analyzed, but it may result in incomplete analysis of the stream.

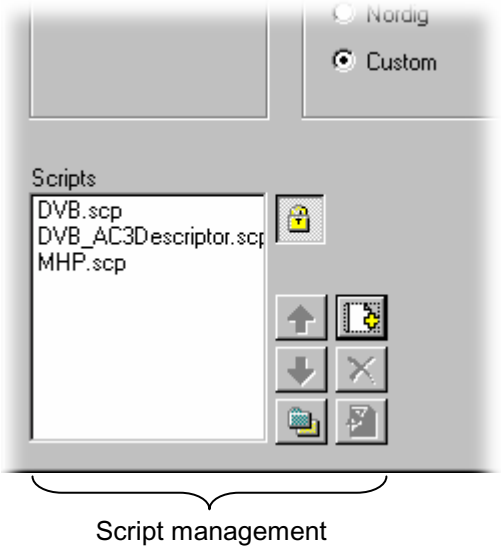
Scripts listed in the Scripts text-box will not be used for stream analysis until they have been successfully checked; that is, the application has been opened or the Stream Interpretation dialogue has been closed with no script-related error messages issued.

An intermediate check of scripts listed in the Scripts text-box can be made by selecting the **Reload Scripts** button. This performs the same action as the OK button but leaves the dialog open.

Syntactic errors will be indicated and reported in the Event Log (see page 51).

Expert Mode

Expert Mode allows the user to select and customise the scripts to be used in stream analysis and multiplexing. Note that when the expert mode is selected, the Custom extension option is automatically selected and that the management buttons are enabled. In Expert mode, all scripts become available to be added to the script list. The scripts will be checked and loaded, ready to be used for analysis, when the OK button is selected.



Script Management Buttons

The script management buttons act on the scripts currently listed in the **Scripts** text-box.


Script files are parsed in the order that they are listed; in some circumstances this may be important. To move a file in a list, highlight the file name and select the Up or Down arrow button as required. Each press of the button will move the file up or down one place in the list until it reaches the top or the bottom.

Add a script to the list: A standard Windows file selection dialog is opened. The default file extension is `.scp`. Select the required file. The selected script will be added to the bottom of the list. If necessary, it can be moved using the Up and Down buttons.

Scripts can be loaded from any directory.

Delete the highlighted script.

Change scripts' default directory: By default, all scripts are found in a default directory created during installation (i.e. tektronix\scripts). This button may be used to set a different default directory.

Note that all scripts supplied by Tektronix in the default installation are installed in a single directory; as long as this directory is designated as the default directory, they will work satisfactorily.

View highlighted script with the associated application; by default, script files are associated with the ScriptPad utility.

For a script file to be viewed successfully, the file extension (.scp) must be associated with a text editor in the MS Windows environment. The MPEG Test System installation program associates by default a script editing utility called ScriptPad; the user may use another text editor, e.g. MS Notepad, if preferred. ScriptPad is a simple script editor that can be installed with the MPEG Test System. Scripts can be viewed and edited as required (depending upon the file permissions).

Opening a Stream

Two options are available when opening a stream for multiplexing; that is, to open an existing stream or to open a previously prepared multiplex configuration file.

Three options are available when preparing a stream to be multiplexed:

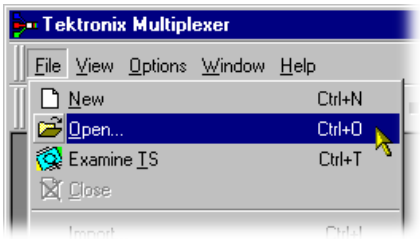
- Create a New null stream (using **File ➔ New**)
- Open an existing stream
- Import a Multiplexer configuration file

Opening an MPEG Stream

Any file holding a recorded or synthesised sample of a stream, which is conformant to the relevant standards, can be opened and used as a basis for a new multiplex. (Note that the **Examine TS** option (see page 52) can be used to preview stream.)

Some non-conformant streams can be opened, although, only the conformant parts can be edited usefully. Any tables that are carried in a conformant PID and have the correct syntax will appear in the output transport stream: as will any elementary streams (whether referenced by a table or not) which are in the input transport stream.

To open a file holding a transport stream, select the **Open...** option from the **File** menu. If the required file is in the list of recent files then it can be opened from the list to save using the open file dialogue.



… alternatively use the **Ctrl+O** keyboard shortcut.

… or drag the file from Windows Explorer and drop it into the Multiplexer window.

There is also a shortcut button available on the Toolbar for opening a file:

Multiplex Configuration Files

Any file holding a recorded or synthesised sample of a stream, which is conformant to the relevant standards, can be opened. Many non-conformant streams can be opened provided that the PAT, PMT and MGT tables correctly specify all the other tables and their PIDs.

Multiplexer is used for generating both conformant and non-conformant streams. Having generated a non-conformant stream, it may not be possible to successfully open it again in Multiplexer.

The specification for a new transport stream may be saved to a multiplex configuration file. This also saves time for opening large MPEG files, since the specification contains the results of the analysis from opening the original MPEG file.

The multiplex configuration file does not contain a copy of the transport stream, instead, it refers to the original MPEG file by the full path name. Deleting or moving the MPEG file will render the multiplex configuration file invalid and unusable.

Double-clicking on a *.muxml or *.mux file in Windows Explorer will open the file in a new instance of Multiplexer.

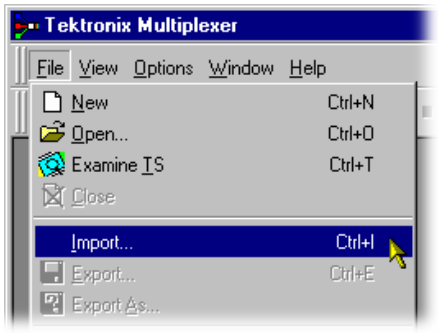
Importing a file

Importing opens a multiplex configuration file and the MPEG file on which it is based.

To open a previously exported multiplex configuration file, select the **Import...** option from the **File** menu. If the required file is in the list of recent files then it can be opened from the list to save using the Import file dialogue.

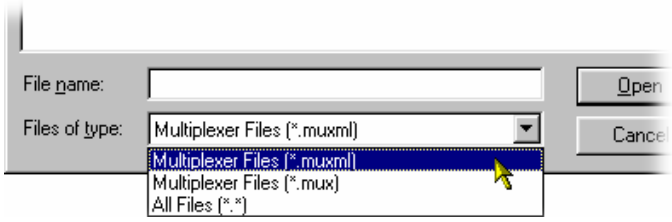
… alternatively use the **Ctrl+I** keyboard shortcut.

… or drag the file from Windows Explorer and drop it into the Multiplexer window.



Multiplexer reads the name and location of the MPEG file from the multiplex configuration file and then opens it automatically. The changes previously stored in the configuration file are applied to the display.

Note that the import dialog offers a choice of file types: *.muxml, *.mux and *.*.



Initial Stream Analysis

The Navigator Tables view window is opened as soon as a file is opened or imported. The program now starts to analyze the file with the loaded scripts to determine what tables are present.

As the file is analyzed, the Top Levels of the Transport Structure diagram are drawn in the Navigator window. The rightmost pane in the Status Bar at the bottom of the program window shows the progress of analysis:

Files that are imported require less processing since they were analyzed in the session from which they were exported.

What To Do Next

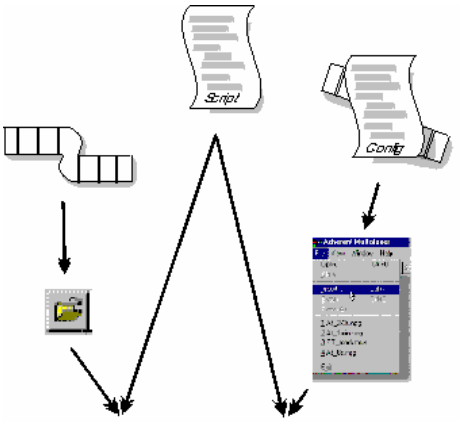
The file can now be manipulated to form a specification with which to synthesise a new transport stream. Tables, elementary streams and PIDs are viewed and selected via the Navigator views. The components of any table selected in the Navigator views are viewed and selected via the Section View window.

Tables, Programs and PIDs can be added and modified using the wizards provided or manually. A selection of menu options are provided to facilitate manipulation of the data.

The **Multiplex** menu has options for inhibiting and re-enabling enforcement of conformance to the selected standards.

Having manipulated the file, a transport stream can be synthesised to the new specification by the multiplex engine. The engine is started from the **Multiplex** menu or via a toolbar button. The source file is used as reference data by Multiplexer and the output written to a different file.

The illustration below gives an overview of the Multiplex process.



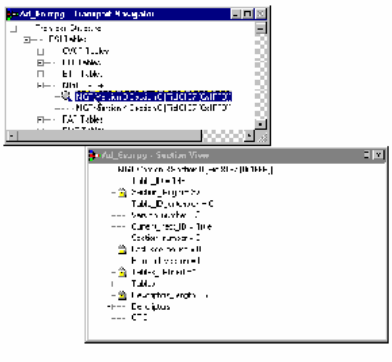
Open/Import

'Any file holding a recorded or synthesised sample of a stream, which is conformant to the relevant standards, can be opened.'

See **Opening an MPEG file**

'Importing opens a multiplex configuration file and the MPEG file on which it is based.'

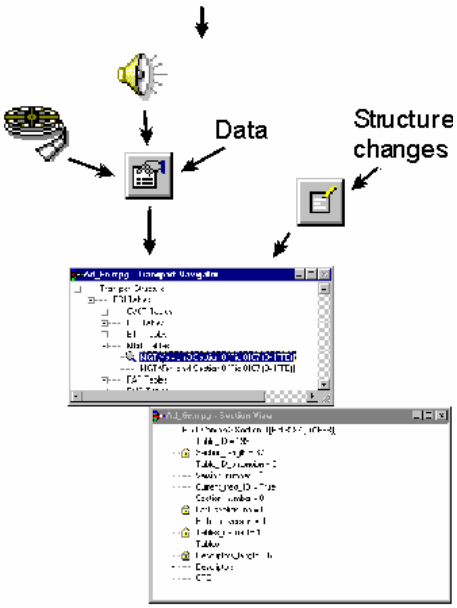
See **Importing a file**



Transport Structure Demultiplex

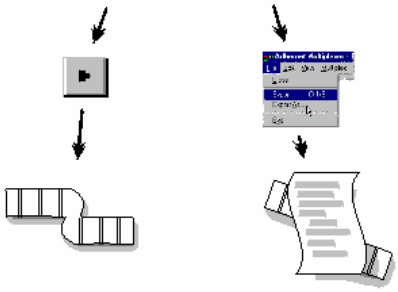
'As the file is analyzed the Top Levels of the Transport Structure diagram are drawn in the Transport Navigator.'

See **Initial Stream Analysis**



Transport Structure Modifications

'The file can now be manipulated to act as the specification to synthesise a new transport stream. The tables and elementary streams are viewed and selected either with the aid of Wizards or via the Navigator windows.



Output/Export

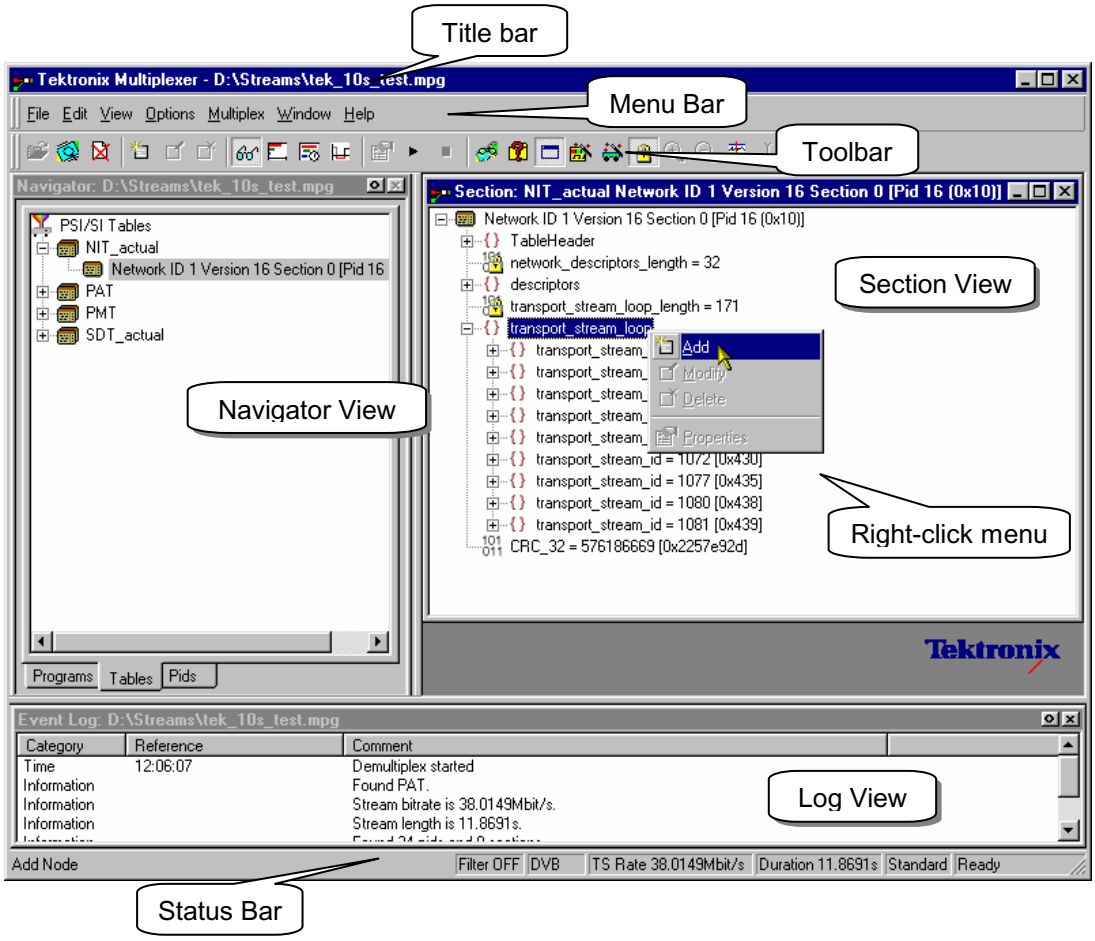
'The Multiplex Engine synthesises a new transport stream and writes it to an MPEG file.'

'To ensure that the specification for any synthesised stream can be re-used, it can be saved to a multiplex configuration file.'

See **Multiplexing Transport Streams**

User Interface

A typical layout of the user interface is shown below:

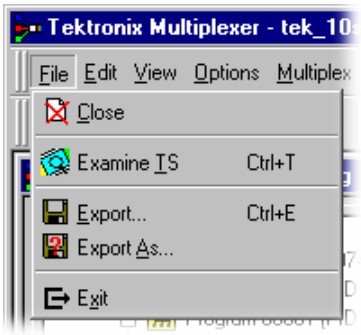


The Menu Bars and options, the Toolbar, the Status Bar and the icons employed are described below. The Navigator, Section and Event views displayed in the working area of the user interface are described later.

Menu Bar

Menu options are context-sensitive and will be enabled and disabled according to the current selection in the working area.

File Menu Options



Close Closes the current file. This option is available as soon as analysis starts. If the wrong file is being opened, or the wrong options are selected, selecting this option will abandon the analysis and close the file.

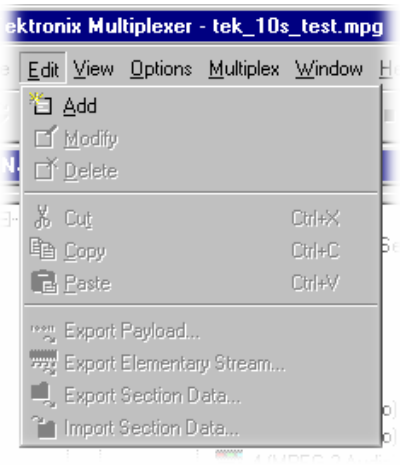
Examine TS Opens the Examine TS window which allows a brief summary of the stream to be viewed before it is subjected to full analysis.

Export... Exports the current multiplex specification in a form that can be imported even if it no longer generates a conformant transport stream. This options is disabled when no file is open.

Export As... Exports the current file, as above, and allows a different file name to be specified. This options is disabled when no file is open.

Exit Closes any file that is open and terminates execution the program.

Edit Menu Options



Add Adds a table/section/loop to the item currently selected in the Navigator or Section View.

Modify Edits the information in the field or item currently selected.

Delete Deletes the item currently selected.

Cut Cuts the current selection from the window to the clipboard

Copy Copies the contents of the current selection to the Clipboard.

Paste Pastes data from the clipboard to the part of the transport structure which holds that type of data.

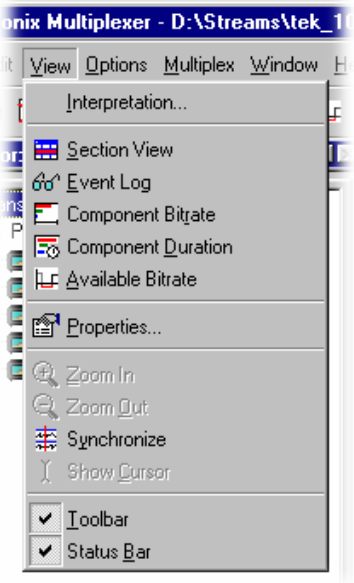
Export Payload…
Extracts and exports the payload of the source transport stream PID in the form of a simple data file.

Export Elementary Stream…
Removes the transport stream PID and PES headers and exports the remaining information in the form of a simple data file.

Export Section Data…
Extracts and exports section data. The file created can be imported as ES using Multiplexer's Add function or as SI using the **Import Section Data…** option (see following).

Import Section Data…
Imports SI data from a file and analyzes it. The section is added to the Navigator view.

View Menu Options



Interpretation… Displays a read-only dialog box for viewing scripts that have been selected for analysis (see also **Initial Menu Options**, page 6).

Section View Opens the window and displays the table section currently selected in the Navigator view.

Event Log Displays the list of events that are recorded in the Event Log.

Component Bitrate Displays a graphical comparison of the stream bitrates.

Component Duration Displays a graphical comparison of the stream component durations.

Available Bitrate Display a graphical view of the bit rate in the stream.

Properties… Opens a properties dialog for editing the item currently selected in the Transport Navigator window.

Zoom In Zoom in to the Available Bitrate and Component Duration views.

Zoom Out Zoom out from the Available Bitrate and Component Duration views.

Synchronize Synchronizes zoom level of the Available Bitrate and Component Duration views (Toggle action).

Show Cursor Shows or hides the cursor in the Available Bitrate and Component Duration views

---

Toolbar Displays or hides the Toolbar.

Status Bar Shows or hides the Status Bar.

Options Menu

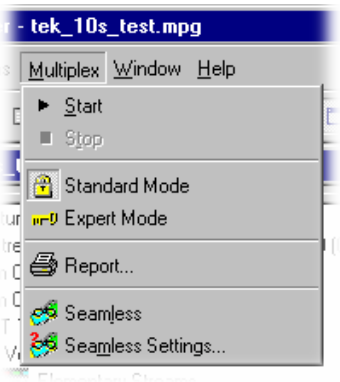
Display Filter Opens the SI Filter dialog.

Single Section View
Toggles between single and multiple section view. When disabled, multiple section views can be opened.

Program Wizard Invokes the Program wizard.

Transport Wizard Invokes the Transport wizard.

Multiplex Menu Options



Start Starts the Multiplex Engine, to synthesise a new transport stream file.

Stop Aborts multiplexing. The output file is closed and contains all of the data synthesised up to the point where the multiplex engine stopped. This option is available only while the Multiplex Engine is running.

Standard Mode Enforces conformance to the selected standards when editing some fields which can be generated automatically

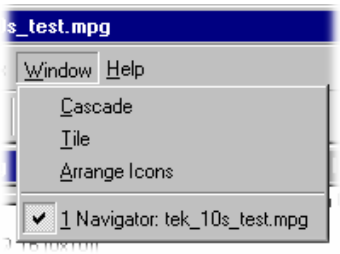
Expert Mode Inhibits the above conformance checking so that non-conformant files may be created.

Report… Provides the option of printing all or part of the transport structure to either a file or a printer.

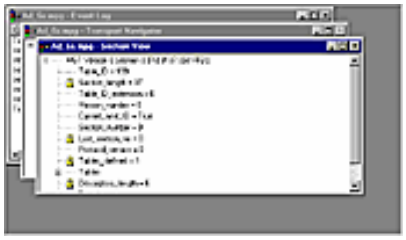
Seamless When enabled, the program specified in Seamless Settings… is processed and made seamless.

Seamless Settings… Opens a dialog in which the Make seamless parameters are specified.

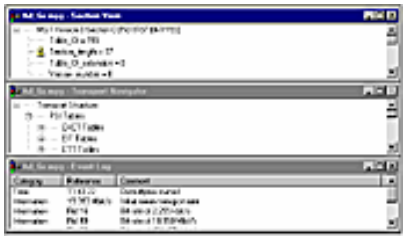
Window Menu Options



Cascade Re-arranges the Section views like this when **Options ➔ Single Section View** is disabled:



Tile Tiles the windows horizontally when **Options ➔ Single Section View** is disabled. For example, three windows would be tiled like this:



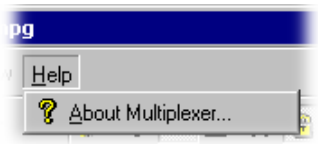
Arrange Icons Aligns icons of any minimised windows at the bottom of the program's main window.

---

1 *<window title>*
2 *<window title>*
3 ... etc.

Makes the named window active, putting it on top of any windows that had been hiding all or part of it.

Help Menu Options

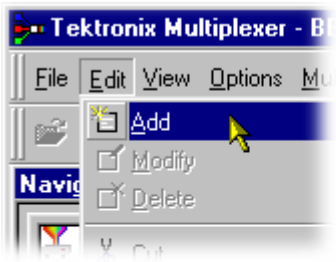


About Multiplexer…

Opens a dialogue that displays the program version number and license number.

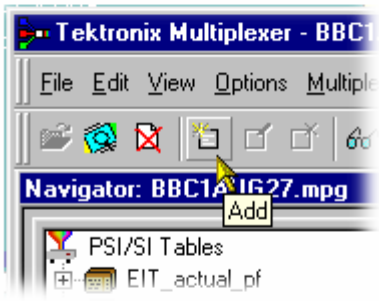
Option Selection

The Menu Bar contains the complete selection of options available in the Multiplexer. To assist the user, shortcuts to options are available via the toolbar and context-sensitive right-click menus.

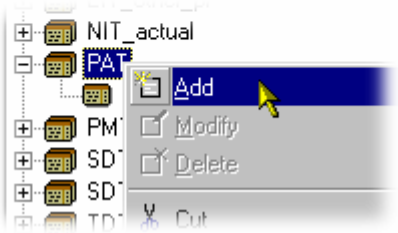


For example, the **Add** function is available from the following:

➔ Menu Bar



➔ Toobar



➔ Right-click menu

In this user guide to reduce duplication, the actions required to select an option are generally given in the following order of priority:

- Context-sensitive right-click menu
- Menu Bar option
- Toolbar button

Toolbar

Toolbars provide a set of convenient shortcuts for the more frequently used menu options. The buttons are context sensitive and are enabled or disabled dependent upon the currently highlighted view or the action being performed.

The Toolbar can be dragged off the edge of the main window into a floating pallet. To do this place the mouse pointer on the background inside the Toolbar, i.e. not on one of the buttons, hold the left button down and drag into the main window area. The result is a self-contained window that looks like this:

To replace the Toolbar on the window border drag it over the border until the outline changes shape. It can be placed on the top, bottom, left or right hand edges.

The Toolbar may be hidden from view - **View ➔ Toolbar**.

Icons

Icons are used throughout the Multiplexer user interface to assist the user to identify components and make visual links with toolbar shortcuts and menu options.

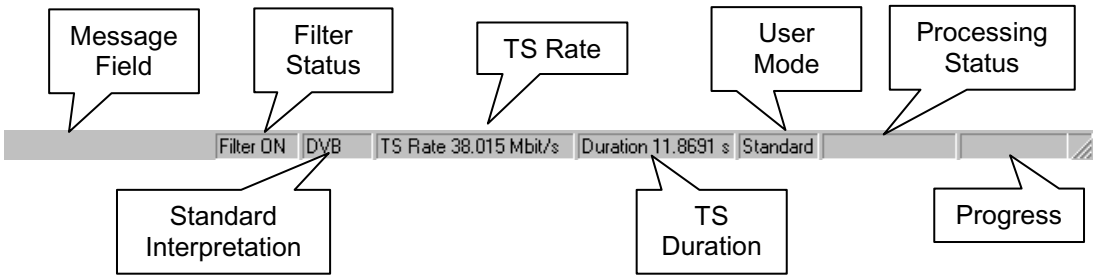
The following table lists all the icons used; detailed descriptions of the functions will be found elsewhere.

	About Multiplexer		Export Payload
	Add		Export Section Data
	Audio stream		Import Section Data
	Bit field		Modify
	Close		New
	Container/Loop		Open
	Copy		Paste
	Current selection		Program
	Cut		Program Group
	Delete		Program Wizard
	Display Filter dialog		Properties
	Examine Transport Stream		Report
	Exit		Seamless
	Expert mode		Seamless Settings
	Export		Section
	Export As		Section timing
	Export Elementary Stream		Section View

	Single window		Unknown
	Standard mode		Video stream
	Start		View Event Log
	Stop		View Component Duration
	Table		View Component Bitrate
	Transport Stream icon		View Available Bit Rate
	Transport Wizard		

Status Bar

The Status Bar may be hidden from view, but when displayed it is always at the bottom of the main window. For example:



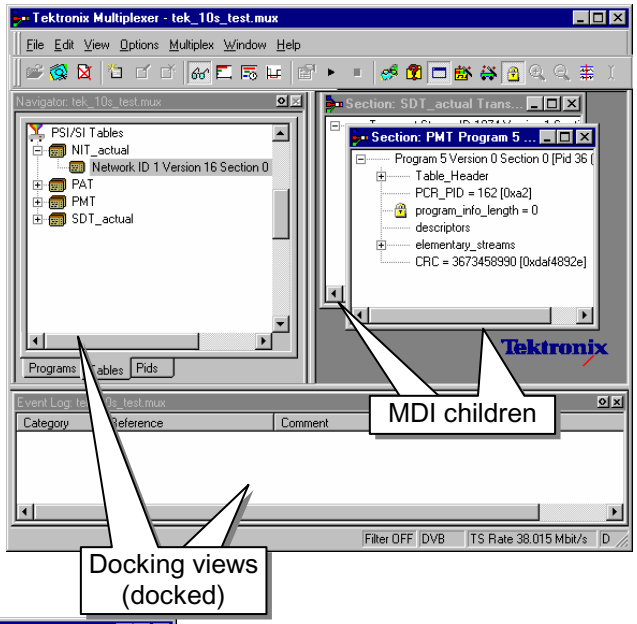
From left to right, the following information is displayed on the Status Bar:

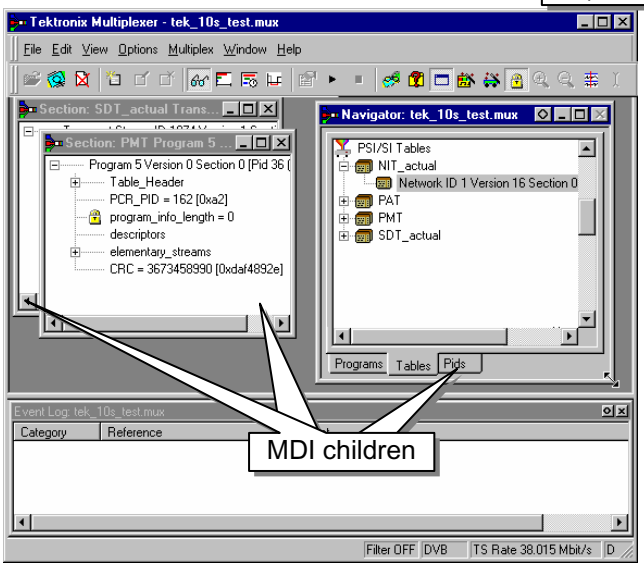
Message Field	Provides a description of any button or menu option over which the cursor pointer is placed. Other non-critical messages may also be shown.
Filter Status	Indicates the status (On /Off) of the SI Filter.
Standard Interpretation	Indicates the standard selected with which to process the file; MPEG-2, ATSC or DVB.
TS Rate & Duration	Shows the transport stream rate and the duration at that rate. A default rate is displayed during initial analysis.
User Mode	Shows User mode selected; Expert or Standard. Standard mode prevents changes to certain fields. Expert mode enables editing.
Processing Status	Indicates the progress (%) during initial analysis and multiplexing.
Processing Progress	Indicates the progress during initial analysis and multiplexing.

Window Management

The windows or views displayed in the application can be one of two types: docking and MDI (multiple document interface) child.

Docking windows can dock to the application's main frame…

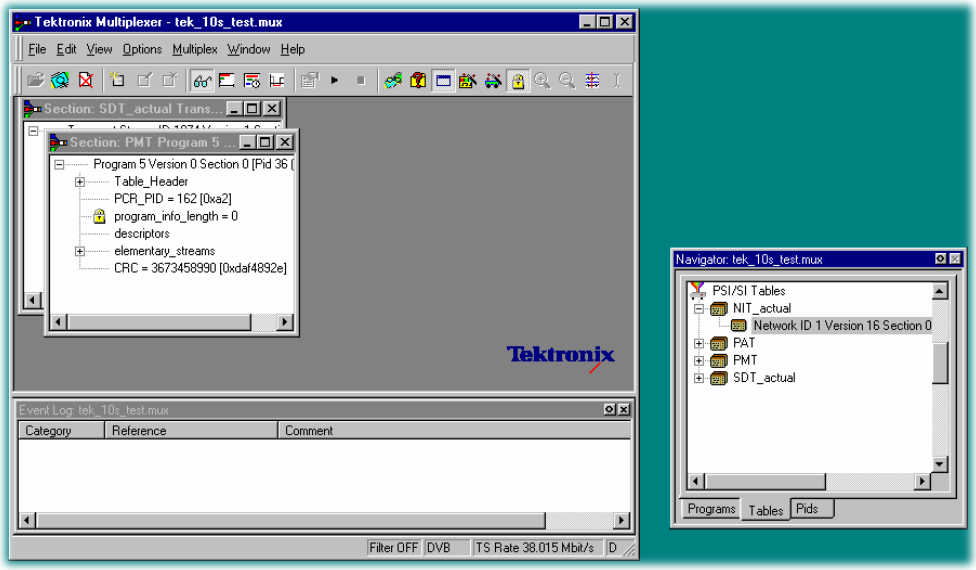




…or float as MDI children…

(MDI children can be arranged using the generic **Cascade** and **Tile** options available from the **Window** menu.)

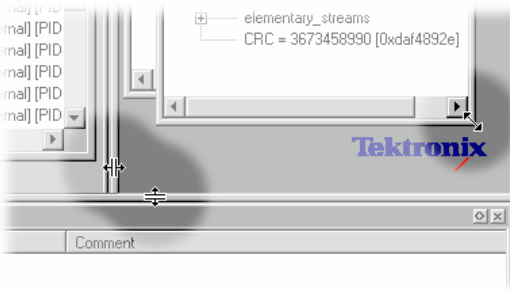
…or float in a frame outside the application window.



Windows can be moved by left-clicking the title bar and while holding the mouse-button, dragging the window to the required location.

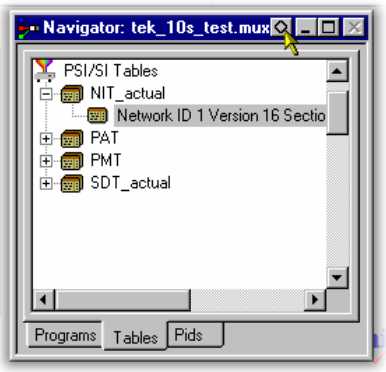
A docking window will adopt a docking position when it is dragged to the application's edge. MDI children do not attempt to dock with the edges of the workspace. Floating windows will attempt to dock as they pass over the application boundary, but can be dropped outside the application.

Resize docked windows using the splitter bars positioned along the window's edge. When a view is floating as an MDI child or outside the main frame, it can be resized in the conventional Windows manner.

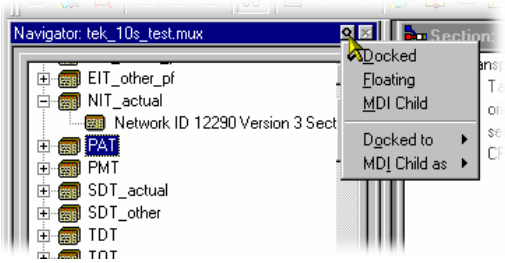


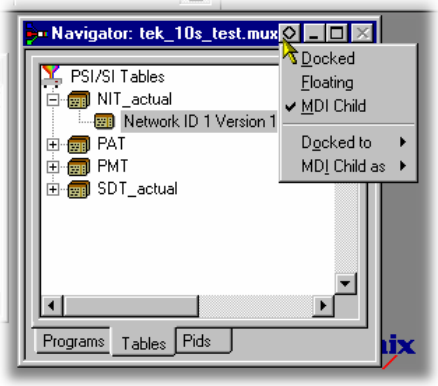
Docking Controls

Left-clicking the docking control ( ) will toggle the window between the Docked and MDI child status.



Control of the docking / MDI features is exercised via the docking control right-click menu:



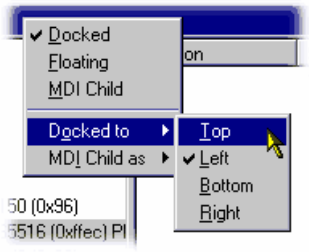


(The checkmark ✔ indicates the current selection.)

Docked

When docked, a window will be automatically placed against one of the four sides of the application workspace.

For example, selecting **Docked to ➔ Top** thus:



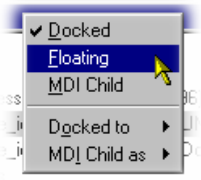
will dock the selected window at the top of the workspace:

If multiple windows are docked at the same edge, they will stack in selection order.

Floating

Designating a window as floating allows it to be moved around on the monitor desktop independently of the applicaction interface

For example, selecting **Floating** thus:

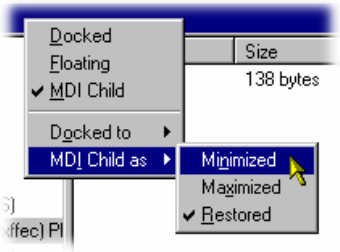


will allow the window to be moved anywhere on the desktop:

MDI Child

Designating a window as an MDI Child allows it to be moved anywhere within the application workspace.

The MDI Child sub-menu allows the window to be designated as **Restored**, **Minimized** or **Maximized**.



Dialogs

Where dialogs are displayed, their operation follows standard Windows' practice. The following buttons may be used:

OK accept all changes and close the dialog.

Cancel abandon all changes made since the dialog was opened and since the Apply button was used. Close the dialog.

Apply accept all changes made since the dialog was opened. Keep the dialog open. This allows intermediate changes to be applied.

Cutting and Pasting Sections

A section of a table can be cut, copied and pasted using the windows clipboard. Only one section can be held on the clipboard at a time. Alternatively, a section of a table can be dragged and dropped using the mouse.

Cutting a Section to the Clipboard

A section may be deleted from a table, and placed on the windows clipboard. It can be pasted to a different file or back into the current file. Highlight the section in the Navigator Tables or PIDs view, then select the **Cut** option from the **Edit** menus, or use the **Ctrl+X** keyboard shortcut.

Copying a Section to the Clipboard

A section may be copied to the windows clipboard. From the clipboard it can be pasted to a different file or back into the current file.

Highlight the required section in the Navigator Tables or PIDs view and then select the **Copy** option from the **Edit** menu, or use the **Ctrl+C** keyboard shortcut.

Pasting a Section from the Clipboard

More than one instance of Multiplexer can run concurrently on a machine. A section may be pasted from the clipboard into any open transport stream file. The contents of the clipboard are not affected by the paste operation, so the section can be pasted to many files and more than once to the same file.

Activate the Navigator Tables or PIDs view of the required transport stream file (i.e. in an instance of Multiplexer). Then select the **Paste** option from the **Edit** menu, or use the **Ctrl+V** keyboard shortcut.

The section/version is always appended to the end of the list under the appropriate table. Program/version numbers are automatically created. If the table is not present in the multiplex configuration it will be created automatically.

Dragging and Dropping

A concept familiar to windows users is 'drag and drop' in which files can be highlighted by clicking on them with the mouse and then dragged and dropped to a new location, either in the same application or across applications.

In Multiplexer probably the main use of the drag and drop feature will be when building new multiplexes or modifying existing ones.

Elements can be dragged within Multiplexer, or from the Multiplexer Browser, Windows Explorer or other instances of Multiplexer.

Program references and numbering will be automatically added and/or updated when a new program is dropped onto the navigator Programs view.

Note that only the MPEG aspects of the transport structure are updated. Tables specific to DVB and ATSC are not updated.

Manipulation in Program View

- When using Navigator Program view, a program can be copied or dragged. The program can be dropped only on the transport stream node of the Program view.
- Only the standard MPEG elements are copied, namely the PAT entry, the PMT section and the elementary streams. Standard dependent information is not copied, e.g. DVB SDT.
- Where a conflict occurs with the target, new values will be allocated. i.e. Program Number and PID numbers.
- Elementary streams can also be dragged and dropped between Program Views. They can only be dropped onto the elementary stream root node.
- An elementary stream may have a stream type, a component tag and descriptors associated with it; this information is retained during a drag and drop in the program view. The program view displays this information when the properties dialog is activated.

Wizards

In the Navigator Programs view, wizards provide the user with a step-by-step approach to building streams to be multiplexed by offering defaults for PSI/SI and the opportunity to include user-selected programs. The standard previously selected in the Interpretation dialog will dictate the PSI/SI components offered.

There are two major wizards; the Transport Wizard and the Program Wizard. Other minor wizards may be invoked by these major wizards or they may be invoked in their own right to facilitate specific tasks, such as adding EIT information. When configuring a new multiplex, the Transport Wizard is invoked, followed by the Program Wizard; although, on completion of the Transport phase, an opportunity to exit the wizard process is offered before the Program Wizard is invoked. For some detailed operations, only the appropriate wizard may be invoked.

At their most basic level, wizards invoke, in a logical order, the property dialogs that are available when building a stream manually.

The following paragraphs provided a step-by-step description of the wizards; individual dialogs are described in more detail in the sections of this user guide which describe the manual addition of PSI/SI and programs.

Wizard Controls

The following control buttons are provided on the wizard dialogs where relevant:

Next Retain changes made using this dialog and move to next dialog.

Back Discard changes made using this dialog and return to the previous dialog.

Cancel Exit the wizard and discard all changes.

Finish Exit the wizard and implement all changes.

Transport Wizard

The Transport wizard allows the user to easily create a basic stream populated with the PSI/SI necessary to hold program information. It may also be invoked when PSI/SI is to be added to an existing stream.

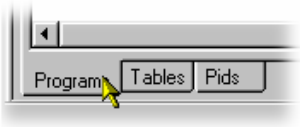
Creating a New Transport Stream

If, when the Transport Wizard is used to populate a new stream, the defaults in the various dialogs are retained and the resulting stream will conform to the standard selected.

The following steps show the screens used in the creation of a DVB stream.

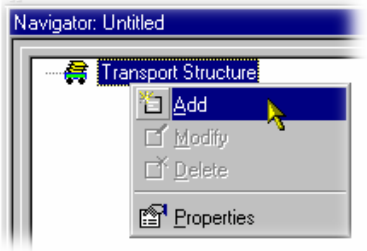
a) Open a new file; **File ➔ New**.

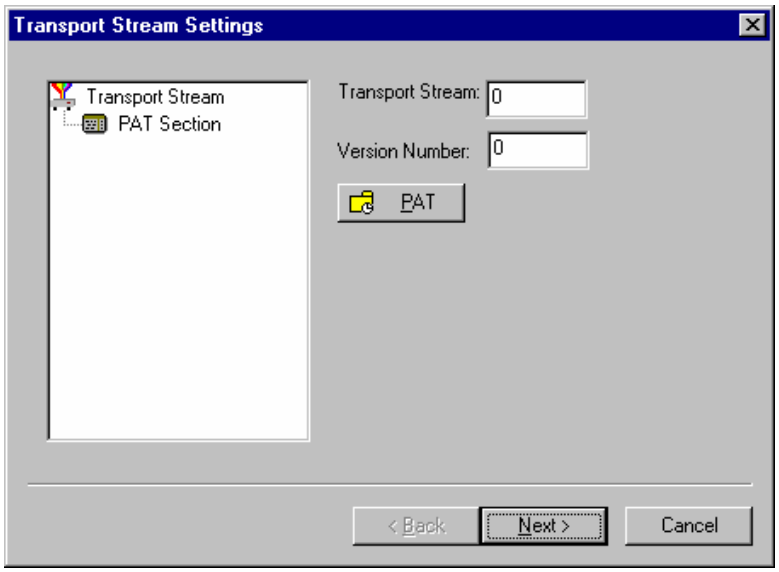
b) Select the Program tab in the Navigator view.



c) Select and highlight the Transport Structure element; at this stage in the creation of a new stream, this will be the only element visible in the Program Navigator view.

d) Select **Add** from the right-click menu.



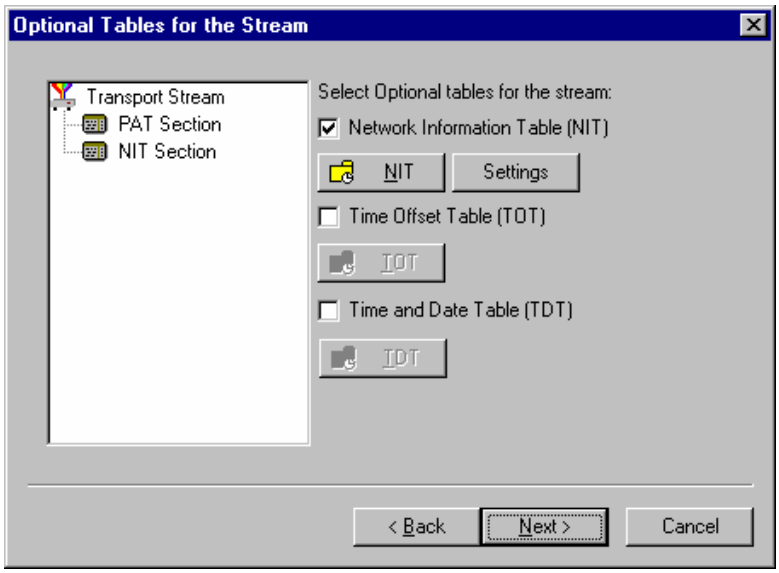


This **Transport Stream Settings** dialog allows the user to set up the transport stream identity (part of the PAT section) and version. Adjustments can also be made to the PAT timing, if required, by selecting the PAT button.

PAT timing - see Editing PSI/SI Table Properties, page 71.

e) Select **Next** to move to the **Optional Tables** dialog.

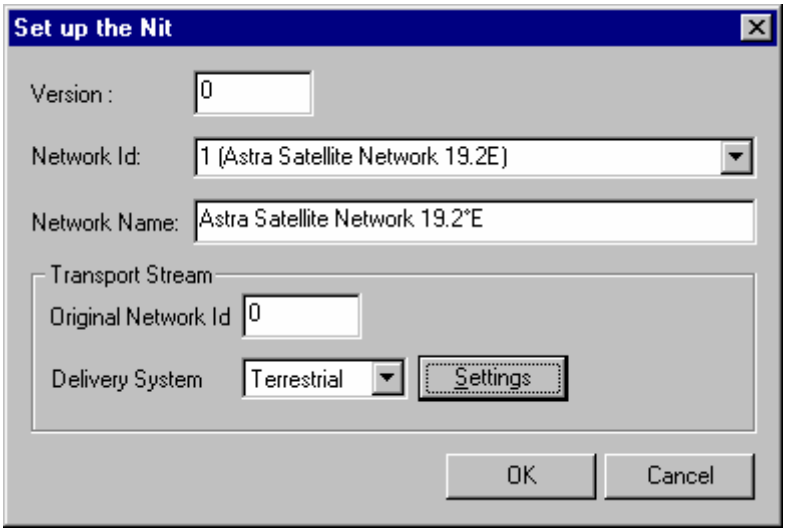
f) This dialog allows the user to include, and if required, configure basic PSI/SI information



As the checkbox next to each table is enabled, the table name is added to the graphical representation on the left. The associated buttons are also enabled to allow timing or other aspects of the table to be modified.

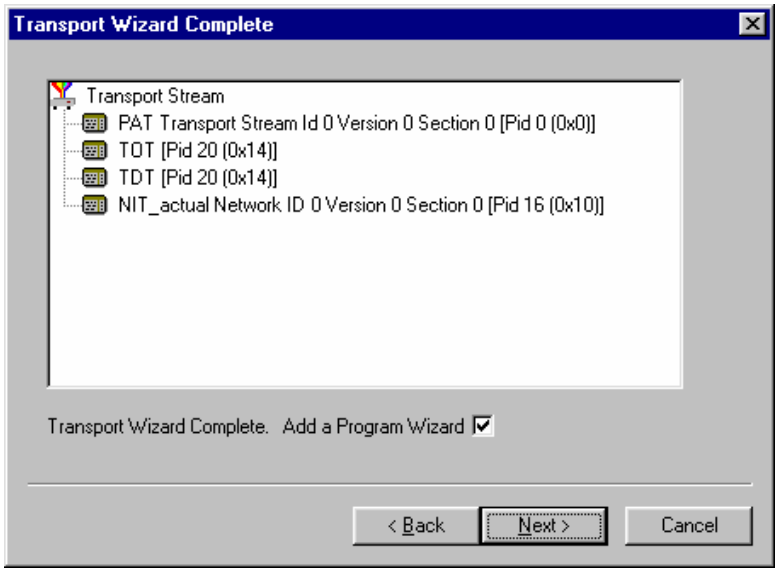
NIT, **TOT** and **TDT** Timing - see Editing PSI/SI Table Properties, page 71.

NIT Settings



In setting up the **NIT**, enter or select the values required and select the **OK** button. Note that if a **Delivery System**, other than **Undefined**, is selected, a further settings dialog becomes available specific to the Delivery System chosen.

g) Select **Next** to move to the **Transport Wizard Complete** dialog.



This dialog allows the user to review the changes made by the wizard before confirming the process.

The wizard process can be cancelled, thereby losing all changes, by selecting the **Cancel** button.

At this stage in the creation of a new multiplex, it would be natural to add programs, hence the **Add Program Wizard** checkbox is enabled and selecting **Next** would open that wizard. However, if the user does not wish to add programs at this stage or wants to add them by some other means available in the Multiplexer application, the **Add a Program Wizard** checkbox should be disabled. In this case, the **Next** legend will change to **Finish**, which allows the user to exit the wizard and implement all changes.

When the Transport Wizard has closed, note that the Navigator views are updated with the new PSI/SI.

Program Wizard

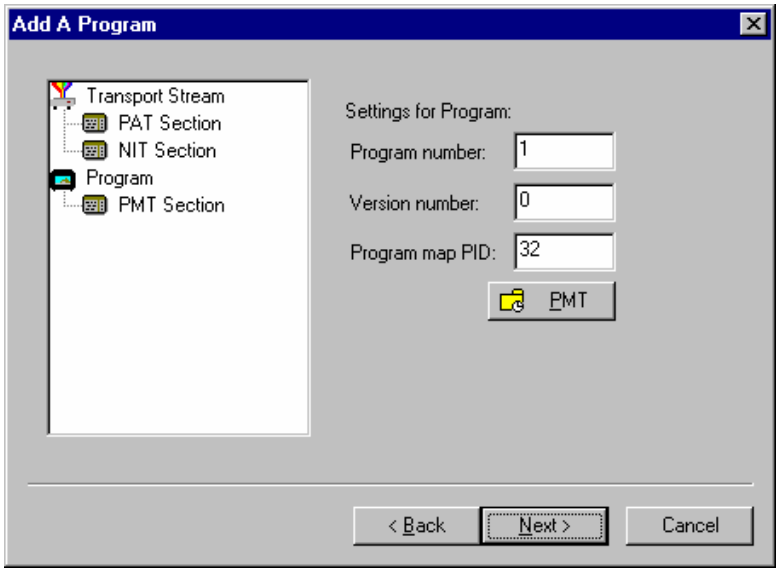
The Program Wizard allows the user to add programs as required to a stream already populated with basic PSI/SI. Each use of the Program Wizard allows the addition of one program. Adding more programs requires the wizard to be re-invoked each time.

If a new stream is being created, the Transport Wizard offers an opportunity to open the Program Wizard. Alternatively, in the Navigator Programs view, highlight the Programs node and select **Add** from the right-click menu.

Adding a Program to a Transport Stream

If, when the Program Wizard is used to add programs to a steam, the defaults in the various dialogs are retained, the resulting stream will conform to the DVB standard.

a) On opening the Program Wizard, either as a continuation of creating a new stream or by attempting to add a new program, a dialog similar to that shown below is displayed:



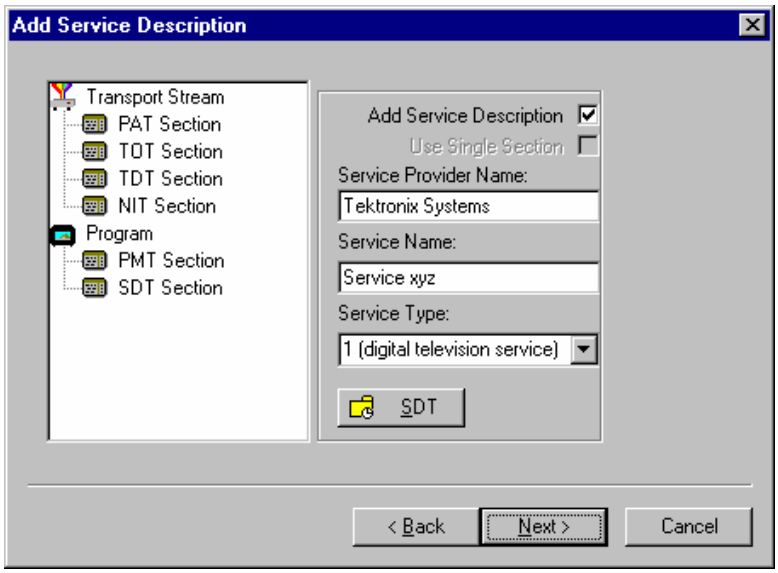
The values placed automatically in the three fields displayed will be the next in the sequence of programs. (In the example screenshot, the stream contains no prior programs, hence this is program number 1. PID 32 is used because that is the first free PID after the reserved PSI/SI PIDs.)

PMT Timing - see Editing PSI/SI Table Properties, page 71.

b) Select **Next** to move to the **Add Service Description** dialog.

Service Description Dialog

The Service Description dialog allows the user to identify the Service and Provider to be associated with a program.



c) By default, the **Add Service Description** checkbox is clear. When it is enabled, a **Service Provider Name** and a **Service Name** must be entered and a Service Type selected from the drop-down list. If no details are provided, the section will still be created but the relevant descriptors will be empty.

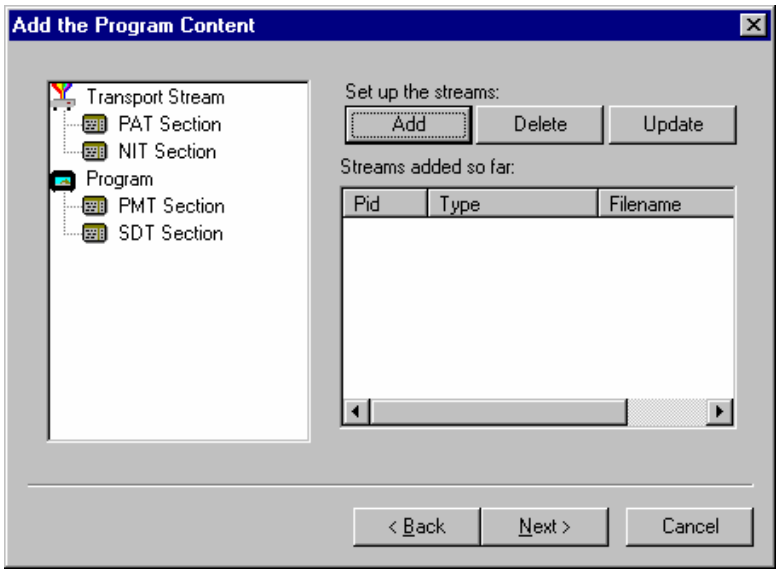
Enabling the Use Single Section checkbox will cause the SDT descriptors to be added to the existing SDT section. If the stream contains no SDT section, the checkbox is disabled.

SDT timing - see Editing PSI/SI Table Properties, page 71.

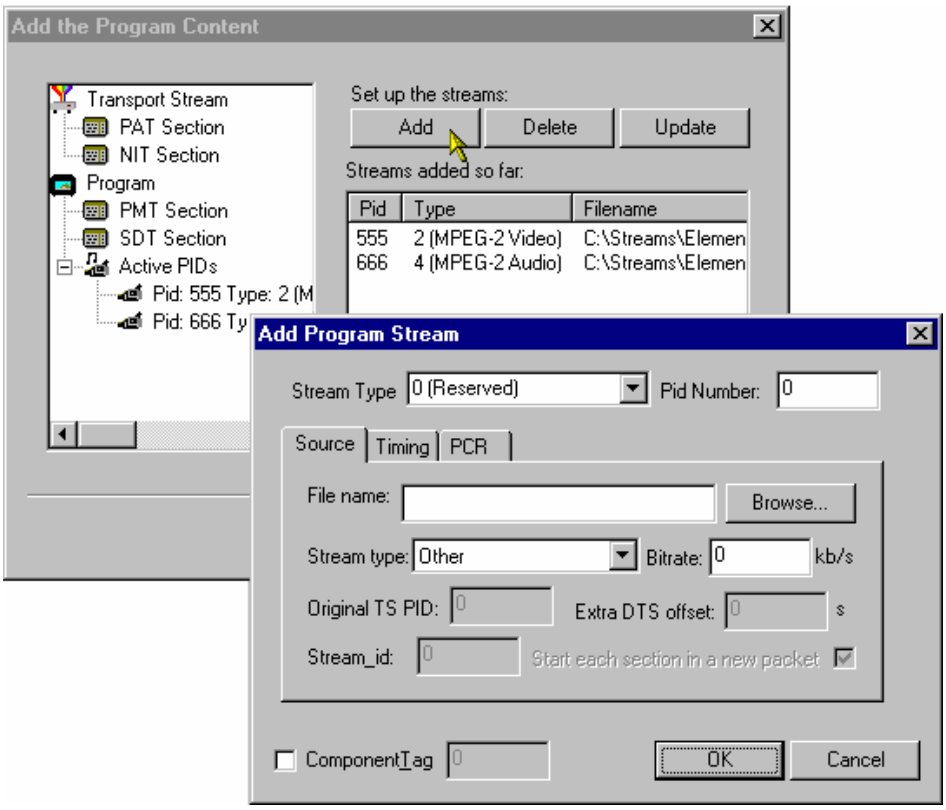
d) Select **Next** to move to the **Program Content** dialog.

Program Content Dialog

This dialog allows the user to compile a list of elementary streams to be associated with the program in the final multiplex.



i) Select **Add** to display the **Add Program Stream** dialog.

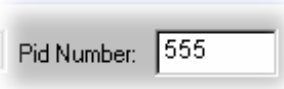


This dialog allows the user to identify elementary streams to be included in the new multiplex. The user must specify the PID, Stream Type of the new stream; a Component Tag can also be allocated.

If the Component Tag is enabled, it can be referenced by other tables e.g. Event Information Table.

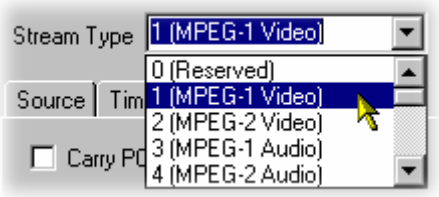
The dialog comprises three tabbed pages that specify the source of the stream, it's timing within the multiplex and whether it should be carrying a PCR PID.

ii) Allocate a PID Number in which the elementary stream is to be carried.



iii) Select a Stream Type from the drop-down list (see page 77).

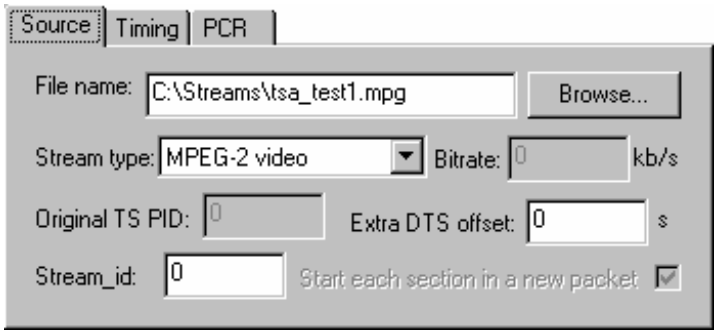
This will be the Stream Type allocated to the stream in the new multiplex.



iv) Enable the Component Tag checkbox, if required. Enter a Component Tag number (0 - 255) in the enabled field.

Source Tab

The **Source** tab of the **Add Program** dialog is used to select and specify elementary streams to be included in the new multiplex.



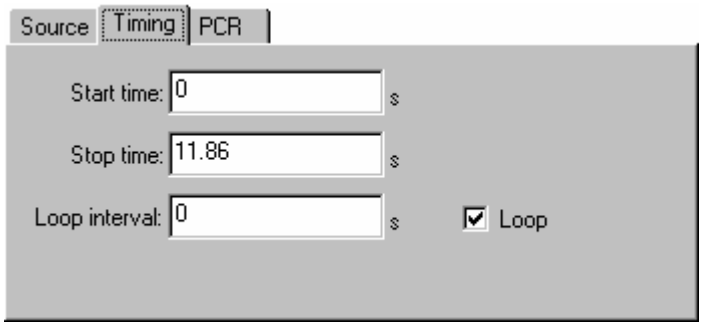
v) Enter an elementary stream **File Name**. It can be entered directly or the **Browse** button can be used to open a standard Windows file selection dialog.

vi) Select the **Stream Type** of the selected stream from the drop-down list.

The remaining fields on this tab, will be enabled or disabled depending on the Stream Type selected (see page 77). Complete the enabled fields as necessary.

Timing Tab

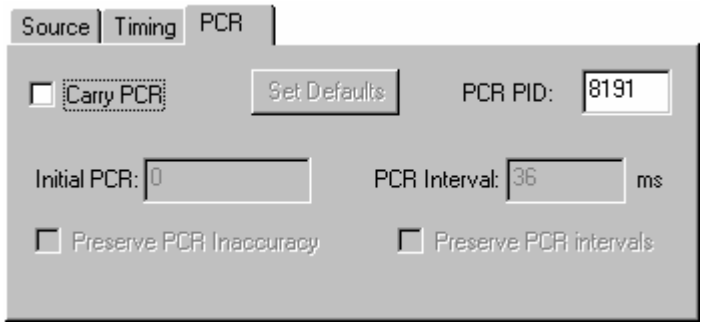
The **Timing** tab of the **Add Program** dialog is used to specify for what portion of the new multiplex the selected stream will be used.



vii) Complete the fields as required. The default settings assume that the stream is to be carried throughout the new multiplex; looping if necessary (see page 79).

PCR Tab

The **PCR** tab of the **Add Program** dialog is used to specify whether PCR information should be carried with the selected elementary stream or in a separate associated PID.



viii) If the PCR is to be held in an associated PID, disable the **Carry PCR** checkbox and enter a **PCR PID** number.

ix) If the PCR is to be carried with the stream, enable the **Carry PCR** checkbox and complete the remaining fields as required.

x) Select the **OK** button to complete the addition of an elementary stream to the listing in the Program Wizard.

Set Defaults returns the settings to their initial values.

More streams can be added using the **Add** button.

Listed streams can be deleted using the **Delete** button.

Details of listed streams can be modified using the **Update** button.

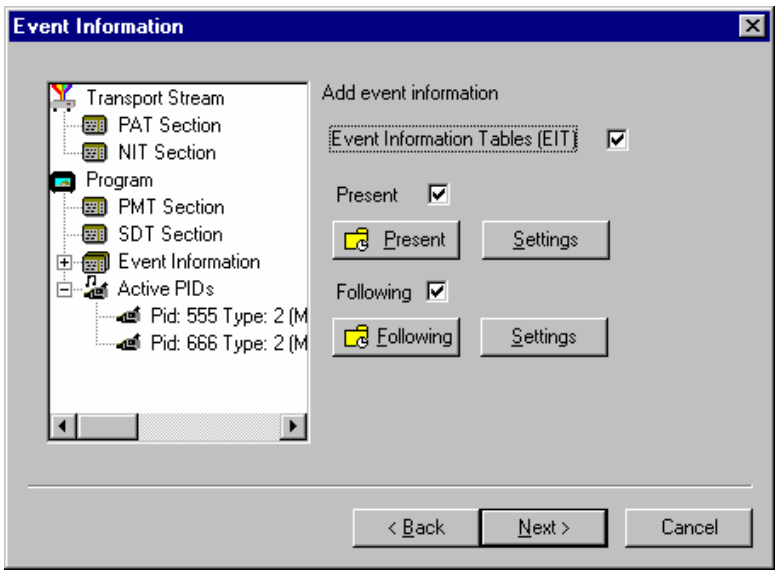
That completes the addition of one or more program streams.

e) Select **Next** to move to the **Event Information** dialog.

For more details of the fields on these tabs - refer to Adding an Unreferenced Elementary Stream, page 76.

Event Information Dialog

The Event Information dialog allows the user to add Present and Following event information.



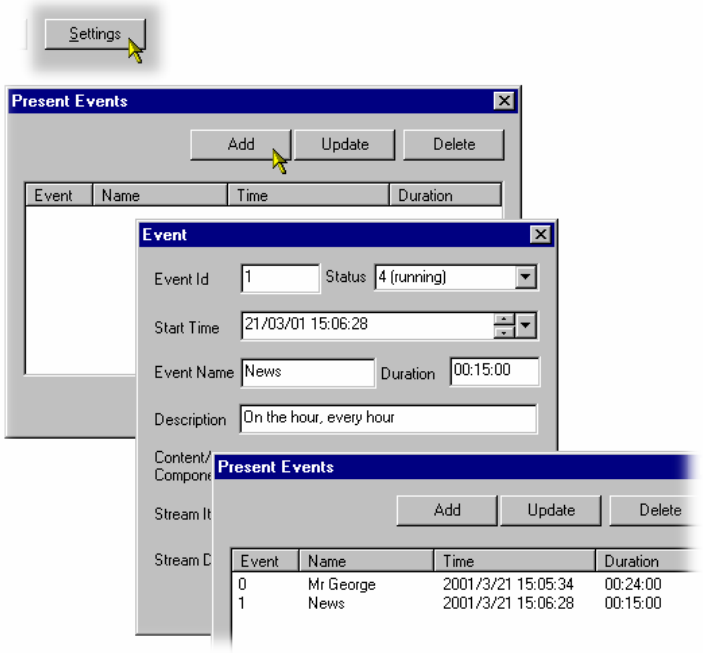
f) If the Event Information Table is to be included in the multiplex, enable the Event Information Table checkbox.

g) Enable the Present and following checkboxes as required.

Present/Following timing - see Editing PSI/SI Table Properties, page 71.

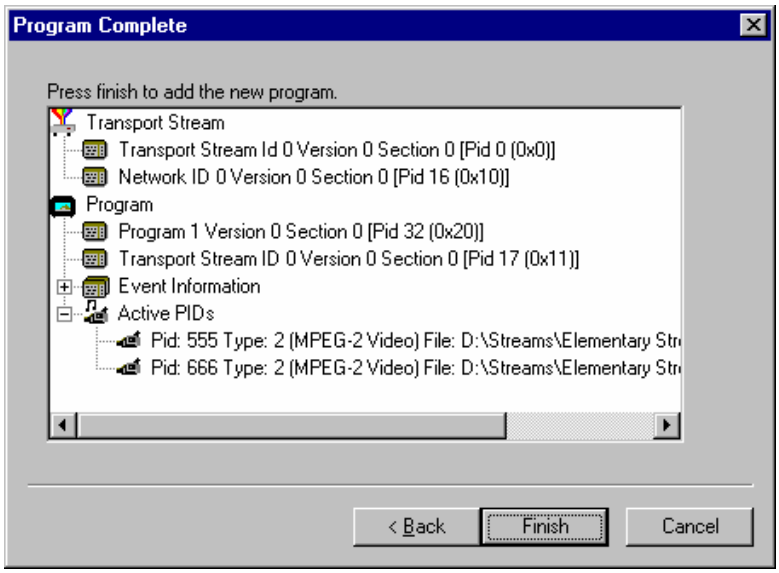
h) Use the Settings buttons to open the Present/Following Events dialogs and add and specify events as required.

i) Select **Next** to move to the **Program Complete** dialog.



Program Complete Dialog

The Program Complete dialog provides the user with a summary of the created Transport Structure.



j) To confirm and implement the Transport Structure, select the **Finish** button.

Note that the proposed structure is created in the Navigator views.

That completes the procedure of adding a program to a transport stream using the Program Wizard.

Views

Multiplexer comprises a number of views which are displayed in the working area of the user interface. All of the views can be manipulated using conventional Windows techniques. The Navigator and Error Log views can be docked against the edges of the UI or floated independently of the Multiplexer window. The Section view can be manipulated within the Multiplexer window, including tiling and cascading where multiple Section views are displayed.

Each view available displays a different aspect or level of detail of stream analysis and manipulation.

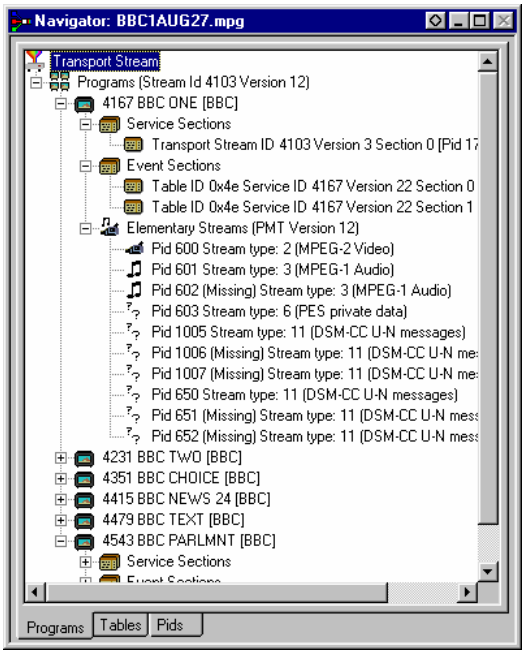
Navigator Views

The Navigator view comprises three sub-views or tabs: **Programs**, **Tables** and **PIDs**.

Programs View

The Navigator Programs view extracts and displays system information relevant to programs. Information that is not directly related to programs (e.g. NIT), or has not been incorporated into a program, i.e. elementary streams not listed in a PMT, will be omitted from the Program view; it is still available for viewing in the Navigator Tables and PIDs views.

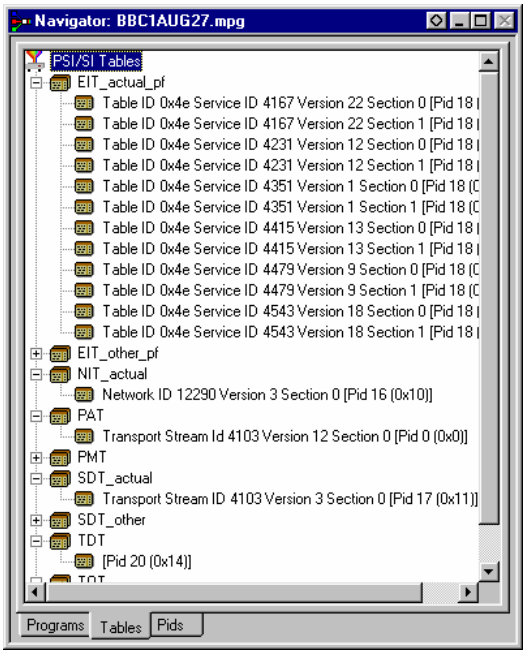
It is recommended that manipulation of programs and elementary streams should take place from within this view.



Tables View

The Tables view displays high level structure of the Program and System Information Protocol (PSIP), Service Information (SI) and Program Specific Information (PSI) Tables. More detailed payload information can be examined and edited, for a selected section of a table, using the Section View.

Any PSI/SI information that the program cannot confidently analyze, will be shown in the **PIDs** view.

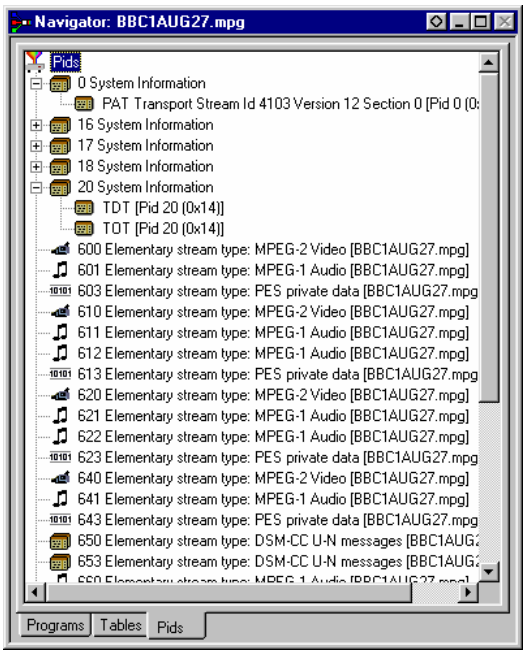


PIDs View

The PIDs view displays the PIDs contained in the stream. The PIDs are displayed in ascending numerical order.

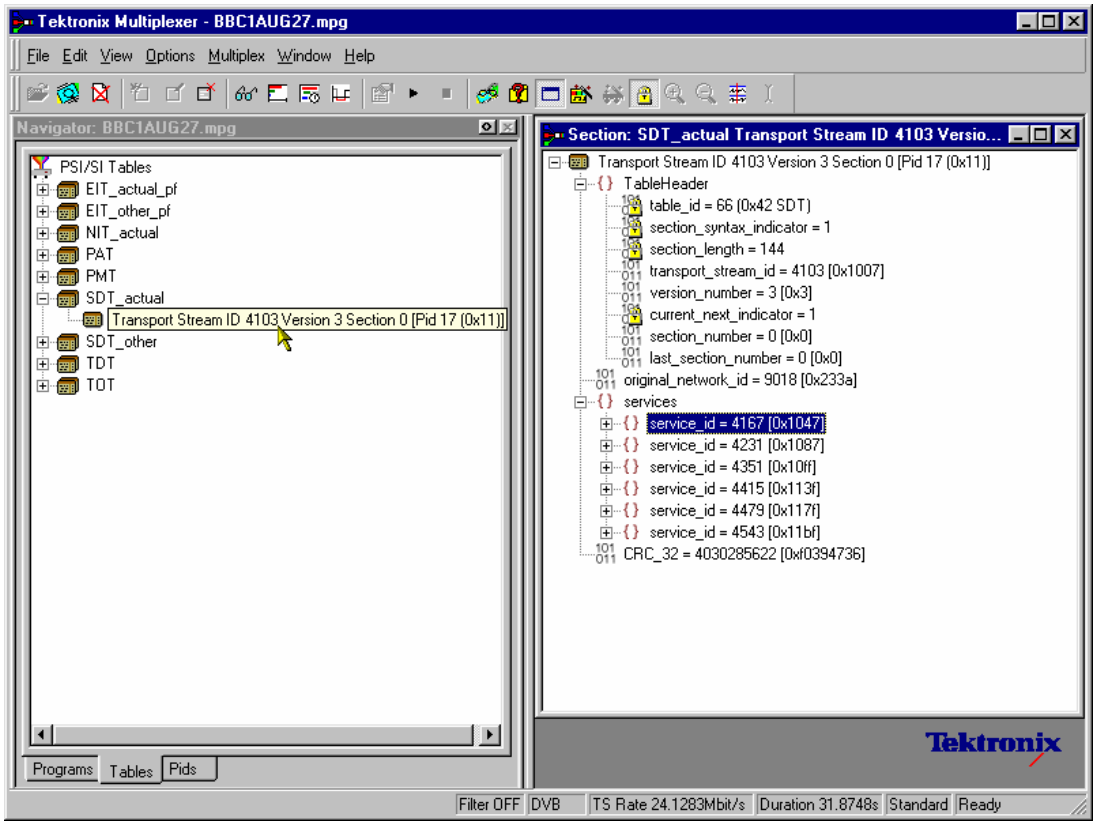
PSI/SI table types are identified in the section nodes of **System Information** nodes

Elementary stream PIDs are identified by source and type where possible.



Section View

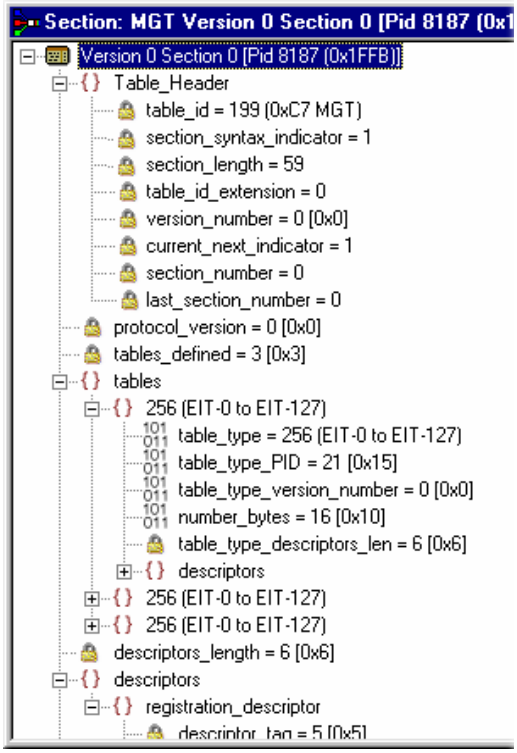
The Section View displays the contents of the section currently selected in either of the Navigator views.



The Section view is dynamic in that it will be instantly refreshed if a new section is highlighted in the Navigator view. If no section is selected, the Section view will be blank.

The lock icon - - adjacent to certain elements of the table in the Section view indicates those items that have restricted access due to the mode of user operation, Expert or Standard.

Syntax of a Section



The adjacent diagram shows a screenshot of a section from a Master Guide Table (MGT). The syntax specified for an MGT in the *ATSC standard A65* is:

```
master_guide_table_section () {
        table_id
        section_syntax_indicator
        private_indicator
        zero
        section_length
        table_id_extension
        reserved
        version_number
        current_next_indicator
        section_number
        last_section_number
        protocol_version
        tables_defined
        for (i=0;i<tables_defined;i++) {
                table_type
                reserved
                table_type_PID
                reserved
                table_type_version_number
                number_bytes
                reserved
                table_type_descriptors_length
                for (k=0;k<N;k++)
                        descriptor()
        }
        reserved
        descriptor tag
        descriptors_length
        for (I = 0;I< N;I++)
                descriptor()
        CRC_32
}
```

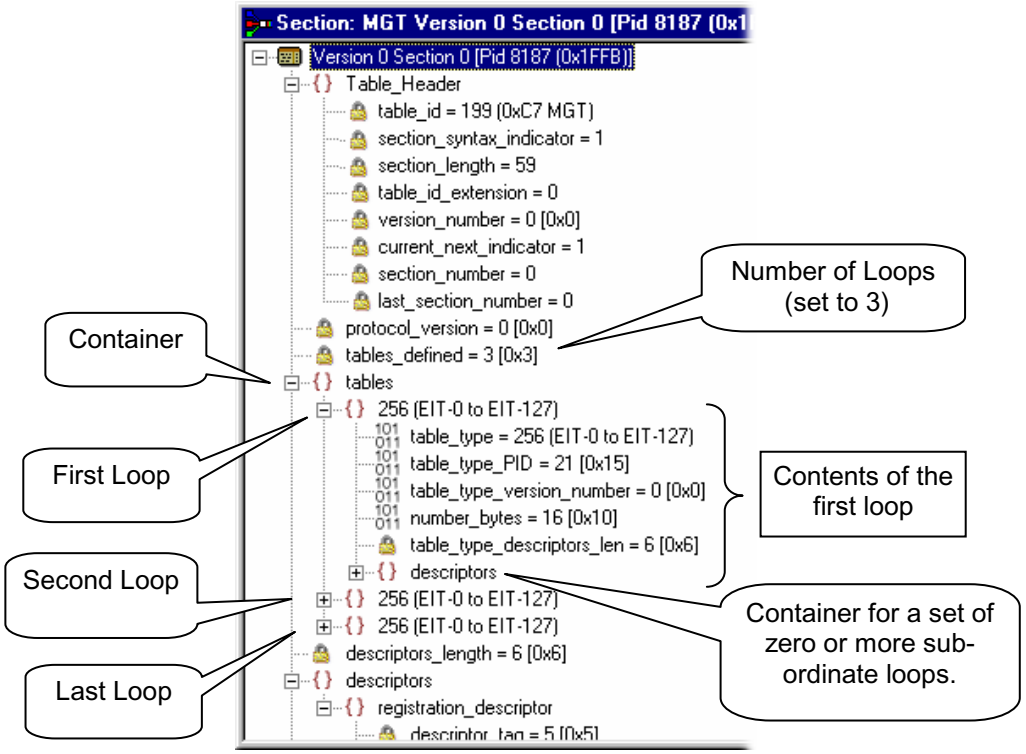
The terms used in this manual to describe the components, represented by nodes, in the structure diagram are:

Container is a term used to describe a node in the structure diagram which may contain zero, one or more loops. It is analogous to the **for (i=0;i<loops_defined;i++)** statement used to describe the syntax of a table in the ATSC standards. The container is always preceded by a field which specifies the number of loops it contains.

Loop describes a data structure composed of a specified set of fields and sub-ordinate loops. The structure diagram shows each loop as a node with the fields and sub-ordinate loops as children. Each loop node in the section view represents one iteration of the loop body (the contents of the curly braces **{ }**) in the syntax specified by the ATSC standards.

Field Fields are referred to in the standards documents as both data items and fields. They are the smallest pieces of information that make up a table.

For example, taking an MGT that defines three tables, the Section View represents the syntax and contents of the **Tables** container like this:



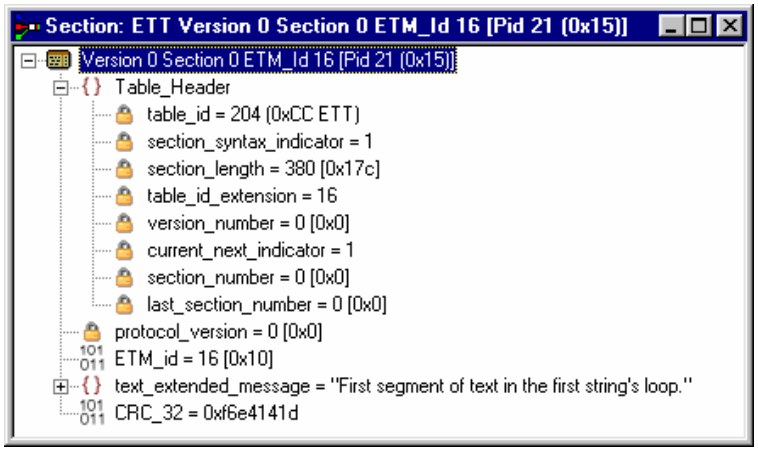
The loop for the first table, **EIT-0** has been expanded to show the fields and sub-ordinate loops which it contains.

Syntax of a Multiple String Structure

The *ATSC standard A65* defines a data structure called the Multiple String Structure. An instance of this structure may contain zero or more strings and each string may contain zero or more segments. The syntax specified for a Multiple String Structure in *A65* is:

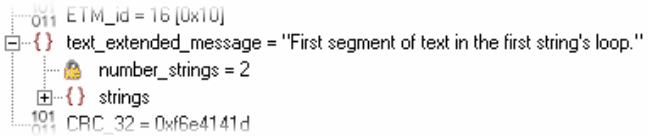
```
multiple_string_structure () {
    number_strings
    for (i= 0;i< number_strings;i++) {
        ISO_639_language_code
        number_segments
        for (j=0;j<number_segments;j++) {
                        compression_type
                        mode
                        number_bytes
                        for (k= 0;k<number_bytes;k++)
                           compressed_string_byte [k]
        }
    }
}
```

Using the notation of container, loop and field nodes, Section View represents the Multiple String Structure in the same way as any other data structure. For example: an Extended Text Table (ETT) carries its **extended_text_message** in a Multiple String Structure. The default view of a section of an ETT in the Section View looks like this:

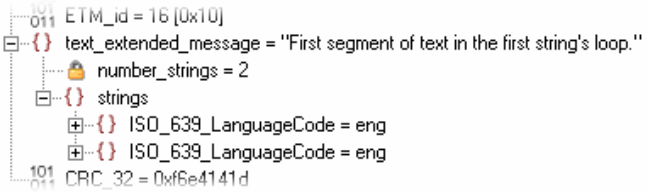


Section view displays a node for the **extended_text_message** with as much as possible of the first segment from the first string.

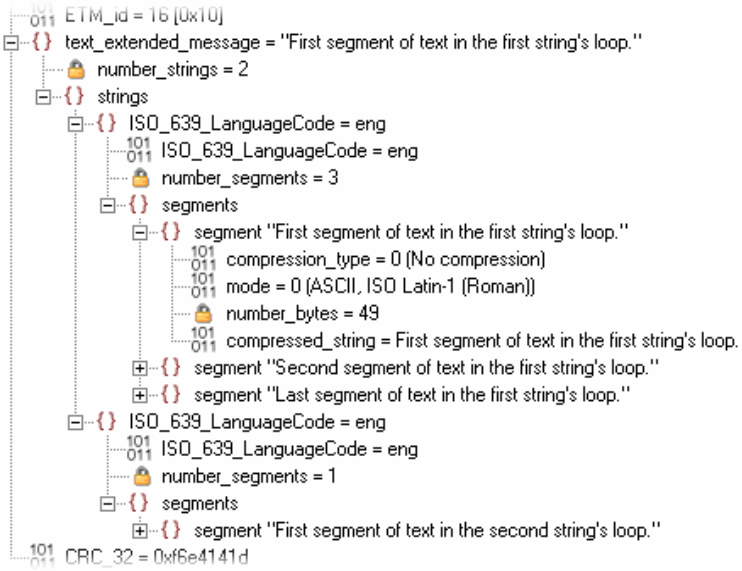
Expanding the node reveals a **number_strings** field which specifies the number of strings and a container which holds them (`strings`):



The `number_strings` field shows that there are two strings in this example. Expanding the **strings** container shows the loop for each string. From this it can be seen that both strings are in English.



Expanding each of the strings reveals the number of segments (`number_segments`) which make up each string and a segments container. Similarly, expanding the segments container reveals segments.



The contents of each segment loop define what compression and character set are used followed by the actual text. The text is held in the `compressed_string` field.

Expert and Standard Modes

The Multiplexer has two modes of operation for conformance checking when editing table contents. These are selected from the Multiplex menu. The checks that affect the Navigator are:

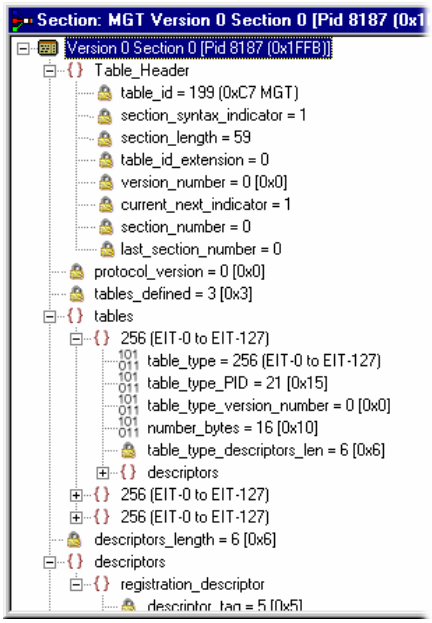
Standard Mode Prevents changing the PID of a table whose PID number is specified in the standard, e.g. PID 0x0 carries the PAT.

Expert Mode A warning is displayed and confirmation requested before changing the PID of a table whose PID number is specified in the standard.

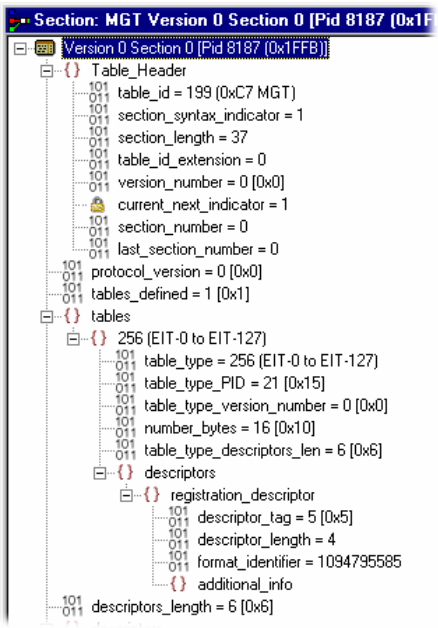
The adjacent icon being shown as depressed indicates a selected menu option.

The mode is also reflected on the Status Bar:

In the Section View a padlock symbol is displayed adjacent to all of the fields that cannot be edited in the current mode. For example, the screenshots below show the same tables in Standard and Expert mode.



Standard Mode



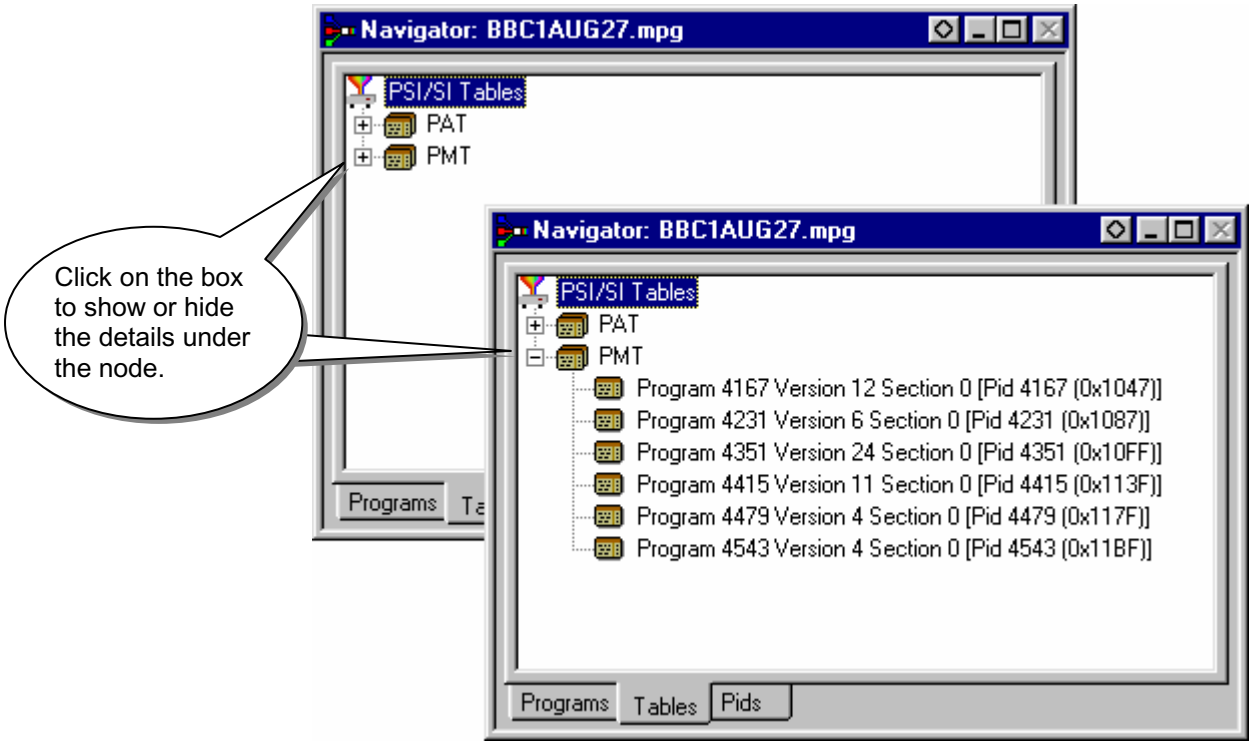
Expert Mode

Note that the `current_next_indicator` in both Standard and Expert mode cannot be edited. This is because the field is affected solely by the Section Properties concerned with Version Timing (see Version Timing, page 72).

The mode selected is also reflected in the Wizards used to facilitate creation of multiplexes. Elements that are restricted in the tables in Standard mode will also be restricted in the relevant wizard. Similarly, elements that are enabled in Expert mode will be enabled in the associated Wizard.

Structure Diagram Manipulation

A tree diagram, with the 'root node' or highest level component at the top represents the Transport Structure. A square box indicates components that contain more information beneath them in the structure.



Clicking on the box does not select that node. It only shows or hides the next level of detail under that node.

If the node has a minus sign ⊟ in the box the level of detail below it is currently displayed. The lower level(s) may be hidden by clicking the mouse pointer on the box.

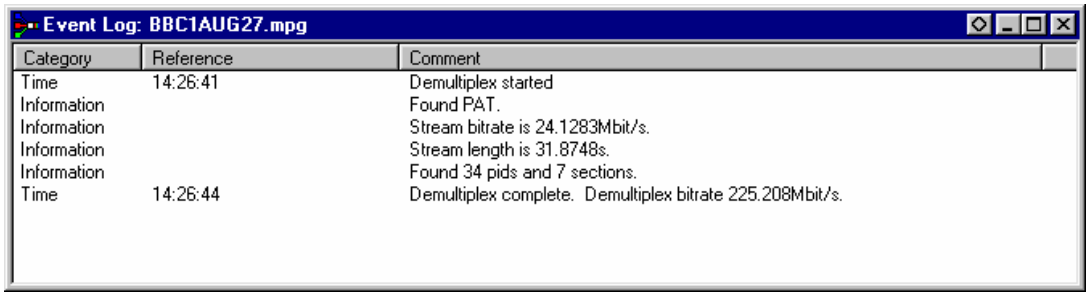
If the box contains a plus sign, ⊞, there is another level contained by the node which is currently hidden. Click the mouse pointer on the box to display the next level of information under the node.

Components that are connected to a branch of the tree without a square box are leaf nodes; the accompanying icon indicates the node type. They display the lowest and finest level of detail available in this diagram. These are either a Section of a Table or a PID.

Fields in the Section view which may not be edited directly are indicated by a padlock symbol, 🔒. This protection may be switched off by selecting **Expert Mode** from the **Multiplex** menu. It can be re-enabled by selecting **Standard Mode**.

Event Log

Messages about significant events are written to the Event Log from the time a file is first opened. The Event Log may be opened for viewing at any time during or after the initial analysis. When the initial analysis is done, the mean transport rate, bit rate for each PES PID and a **Demultiplex completed** message are written in the Event Log.



The start and end times for generating a new transport stream are shown by the **Multiplexer started** and **Multiplexer completed** messages.

Note that when demultiplexing and multiplexing streams, the bitrate at which the demultiplex or the multiplex is performed is given. This is in addtion to the stream bitrate derived from the stream itself.

When synthesising a new transport stream any errors or warnings about the new stream are written to the Event Log between the start and completed messages:

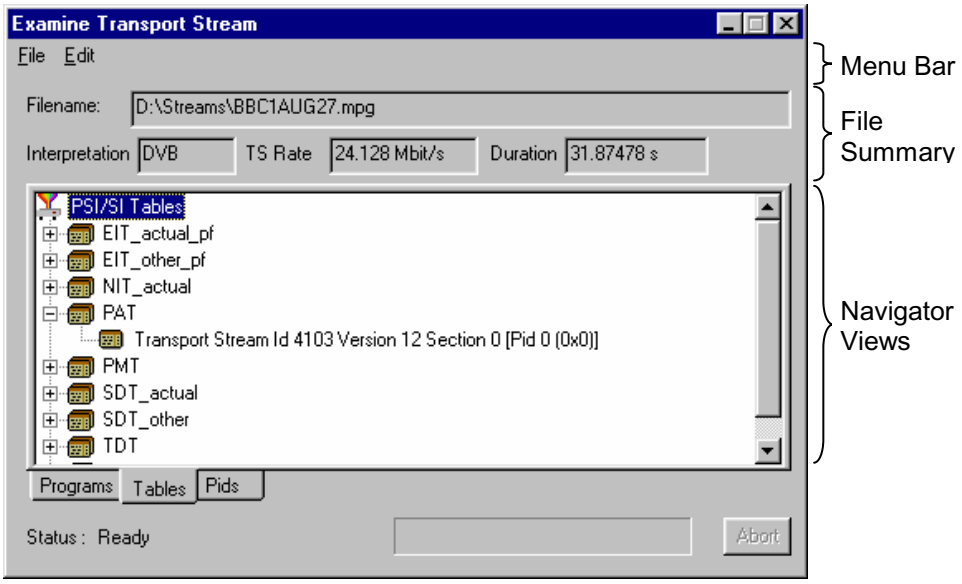
The **Category** column indicates the type of event. The subject or time of the event is shown in the **Reference** column and the details are given in the **Comment** column.

The complete text may be copied onto the windows clipboard, using the **Copy** option from the right-click menu. The text can also be cleared with the **Clear** command. Both commands are also available from the **Edit** menu.

Examine Transport Stream Window

The Examine Transport Stream (Examine TS) window (**File ➔ Examine TS**) performs two main functions within the Multiplexer:

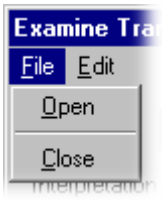
- It allows the user to take an overview of a transport stream before subjecting it to full analysis.
- It allows tables and programmes to be dragged and dropped from the examined stream to the file currently open in Multiplexer.



Menu Bar

The Examine TS window menu bar comprises only two items: **File** and **Edit**.

File Menu



Open… Analyzes and opens the selected file in the Examine TS window. Closes the current file.

Exit Closes the Examine TS window.

Edit Menu

Copy Copies the currently highlighted section to the clipboard.

File Summary

These fields provide a brief summary of the analyzed file.

Filename: The filename of the examined stream.

Interpretation: The interpretation applied to the stream. This is the same as that selected in the Multiplexer application via the View menu: MPEG-2, DVB, ATSC or ISDB.

TS Rate: The transport stream bitrate derived from the stream.

Duration: The duration of the transport stream.

Status: The status of the stream analysis.

Navigator Views

The Examine TS Navigator views correspond to the Navigator views in the main application; that is Programs, Tables and PIDs; the information that they show is exactly the same as that that would be shown after a full analysis. The PSI/SI tables are expanded and collapsed in the same manner. The Section view is not available in the Examine TS window.

Examine TS Section Copy

While examining transport streams, it is possible to copy sections to the main multiplex using the standard Windows techniques: copy and paste or by dragging and dropping them with the aid of the mouse.

For example, to import a section visible in the Examine TS window into the new multiplex configuration:

a) Select the Navigator Tables view.

b) Highlight the section to be copied in the Examine TS window.

c) Either:

i) Select **Edit ➔ Copy**.
(Note that this menu option is only enabled when sections are highlighted.)

ii) With the Navigator Tables view active, select **Edit ➔ Paste**.

or

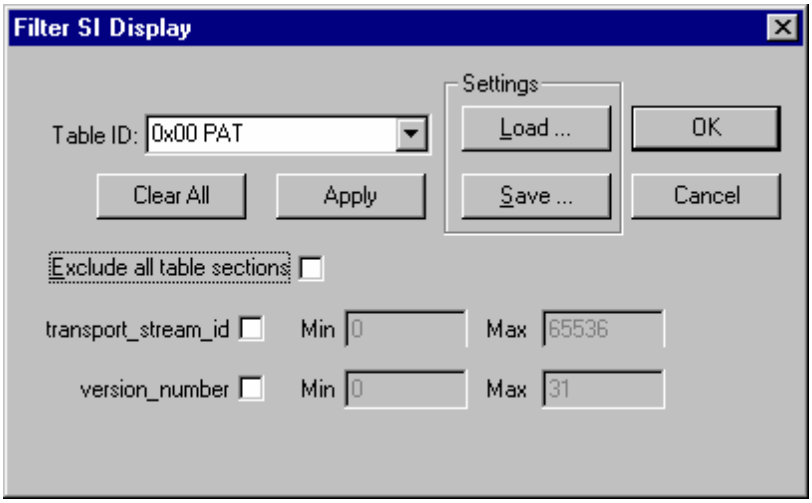
iii) Using the mouse, place the cursor over the highlighted section, press and hold the left button on the mouse and drag the section onto the Navigator Tables view. Release the mouse button.

d) Note that the copied section is placed in the PSI/SI structure at the correct location. If any conflict arises concerning similar PID numbers, a new version is created.

SI Filtering

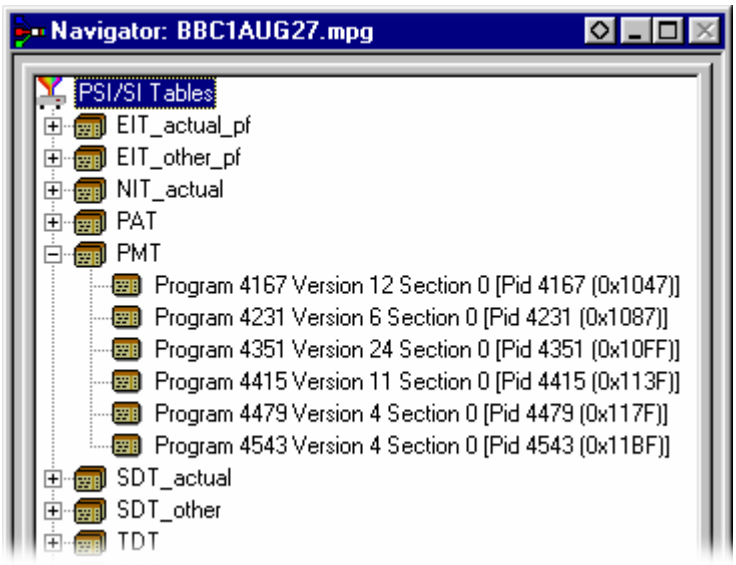
Table elements can be excluded from the Navigator Tables view using the Display Filter available via **Options ➔ Display Filter…**.

The following dialog is displayed:

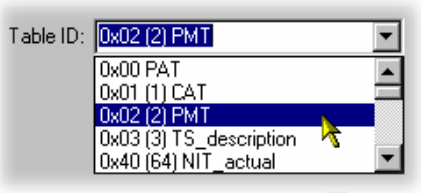


Selecting a Table for Filtering

Example: Prior to filtering, the stream tree may be as shown below:



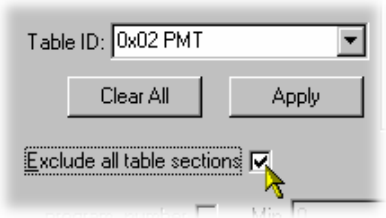
In the **Filter SI Display** dialog, table identities are listed in the **Table Id:** drop-down menu.

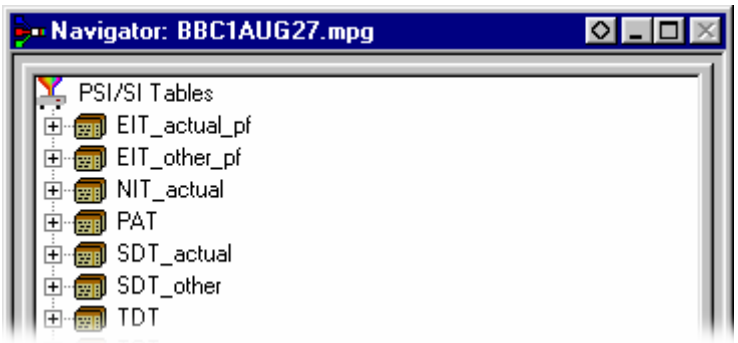


All sections of a table can be *excluded* by enabling the **Exclude all table sections** checkbox.

To preview the result of filtering, select the **Apply** button.

Note that all reference to the PMT tables is removed - as shown below:



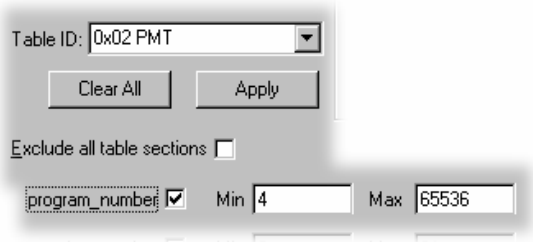


To exclude a range of sections, enable the section by selecting from the drop-down list and enter the range required.

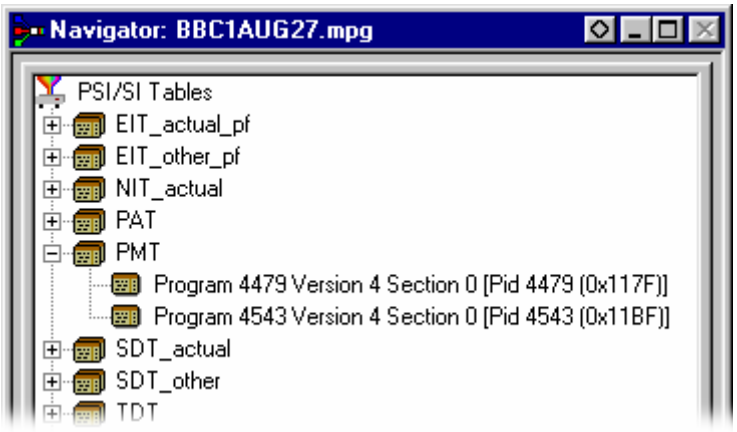
Note that section names shown in the dialog change according to the table selected.

To preview the result of filtering, select the **Apply** button.

For example, the settings shown opposite will result in the display shown below:



Minimum and maximum values may be entered in either decimal (12345) or hexadecimal (0xA12B) format.



The parameters for each table must be set individually. Overall settings can be applied individually by selecting the **Apply** button when a setting is made or as a whole by making all of the settings and selecting the **OK** button.

To preview the result of filtering, select the **Apply** button. All settings can be cleared by selecting the **Clear All** button.

Note that filter settings remain in force for as long as the current multiplex is active. The settings are lost when the Multiplexer is closed unless they have been previously saved.

Saving/Loading SI Filter Settings

The filter settings made in the Display Filter dialog can be saved and subsequently re-applied to the same stream or other streams.

To save the current filter settings, select the **Save** button and enter a name (and location) in the **Save As** dialog. To retrieve or load filter settings, select the **Load** button and identify the filter file in the **Open** dialog. The file extension `*.fil` is used.

Component Views

The Component views provide a graphical view of the bitrate and duration of the components of a stream. The management of the views has a number of common features; these are described in the Common Features, page 62.

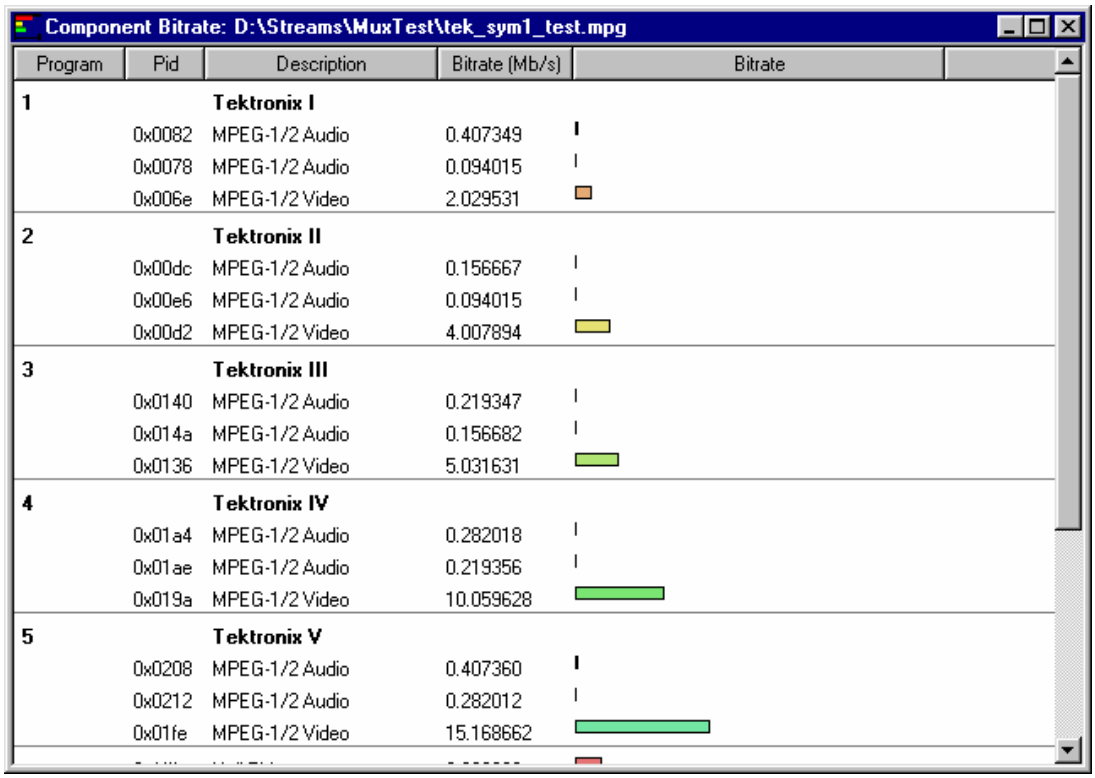
Component Bitrate

The Component Bitrate view provides a graphical comparison of the stream components.

Open the Component Bitrate view either by selecting
View ➔ Component Bitrate from the Menu Bar…

or the toolbar button.

Each component includes the following information: Program name, PID, Description and the Bitrate in numerical and graphical form. Where appropriate, the Service ID and the Service Name is displayed (extracted from the SDT).

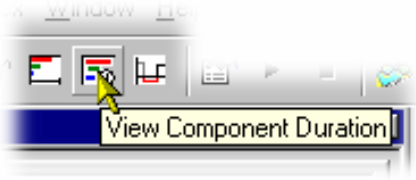


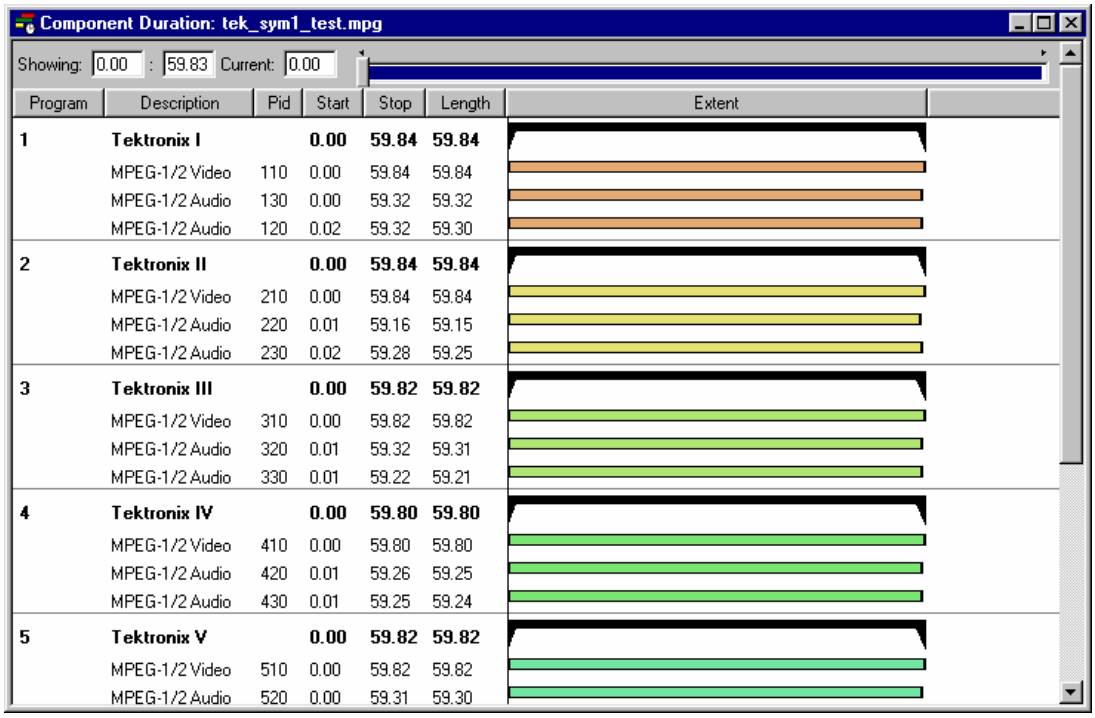
Component Duration

The Component Duration view provides a graphical view of the timing and duration of each program/component within the current stream. Adjustments can be made to the duration of each component.

Open the Component Bitrate view either by selecting **View ➔ Component Duration** from the Menu Bar…

or the toolbar button.

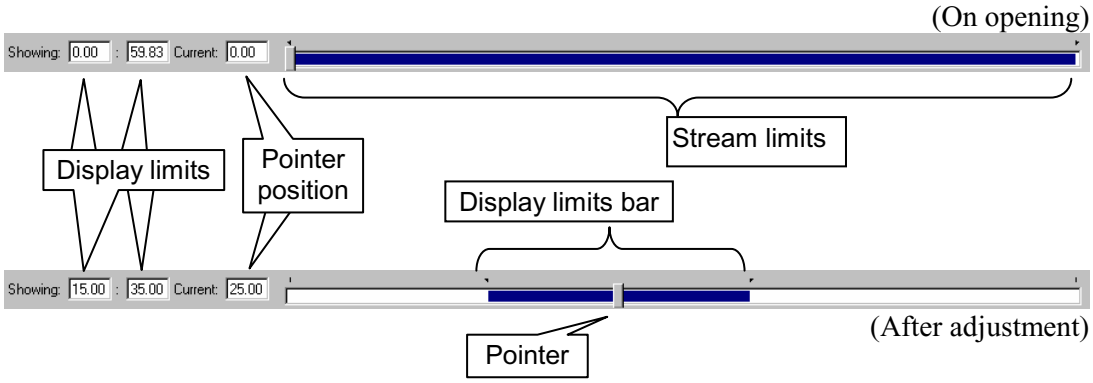




The following data is displayed for each component of the stream: Program, Description, PID, Start and Stop time (in numerical and graphical form), Length and Bitrate. (The timing and bitrate elements of this information are also available in the **Program Stream Properties** dialog, see Program Content Dialog, page 37.)

Scaling Bar

The Scaling bar, which is displayed at the top of the Component Duration view, allows the user to select the portion of the transport stream that should be displayed in the body of the view.



The *Stream limits* bar represents the full extent of the stream. The *Display limits bar* (dark portion) indicates the portion of the stream that is currently displayed in the body of the view.

The *Display limits* fields indicate the extents of the *Display limits bar* and the current *Pointer* position.

The Pointer can be dragged to a new position on the Stream limits bar. The Display limits bar will centre on the Pointer.

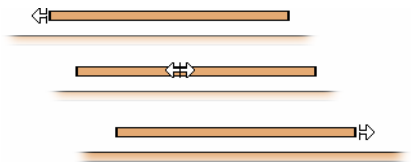
Clicking to the right or left of the Pointer will cause it to move to the left or right respectively.

Duration Control

The duration of each element in the stream is given by the Start and Stop values and the shown graphically by the associated bar. The components are colour coded according to which program group they belong to.

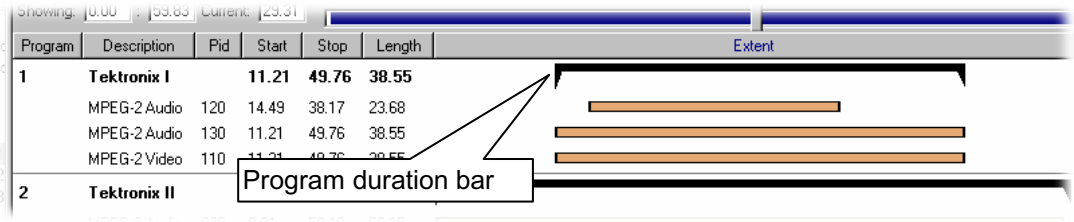
The Start, Stop and Length values can be changed by clicking on the appropriate field and entering the required value. The associated bar will reflect the change.

The Start, Stop and Length values can also be changed graphically by manipulating the bar. The cursor shape indicates what action can be taken.



The changes are reflected in the associated field values.

Components can be changed individually. In addition, whole Program groups can be changed by manipulating the Program duration bar, but only when the view is sorted by Program:



A vertical dotted line indicates the upper limit of the multiplexed stream.

In the Transport Stream Properties dialog box (**View ➔ Properties…** with the Transport Stream node highlighted in the Navigator **Programs** view), the user can determine how and if the stream duration is updated. The options available will be:

- Select **Fixed** to ensure that the stream duration can only be updated in the Stream Properties dialog box.
- Select **Set to the greatest component stop time** to ensure that the stream duration is set to the greatest stop time recorded in the SI/PSI/PSIP tables.

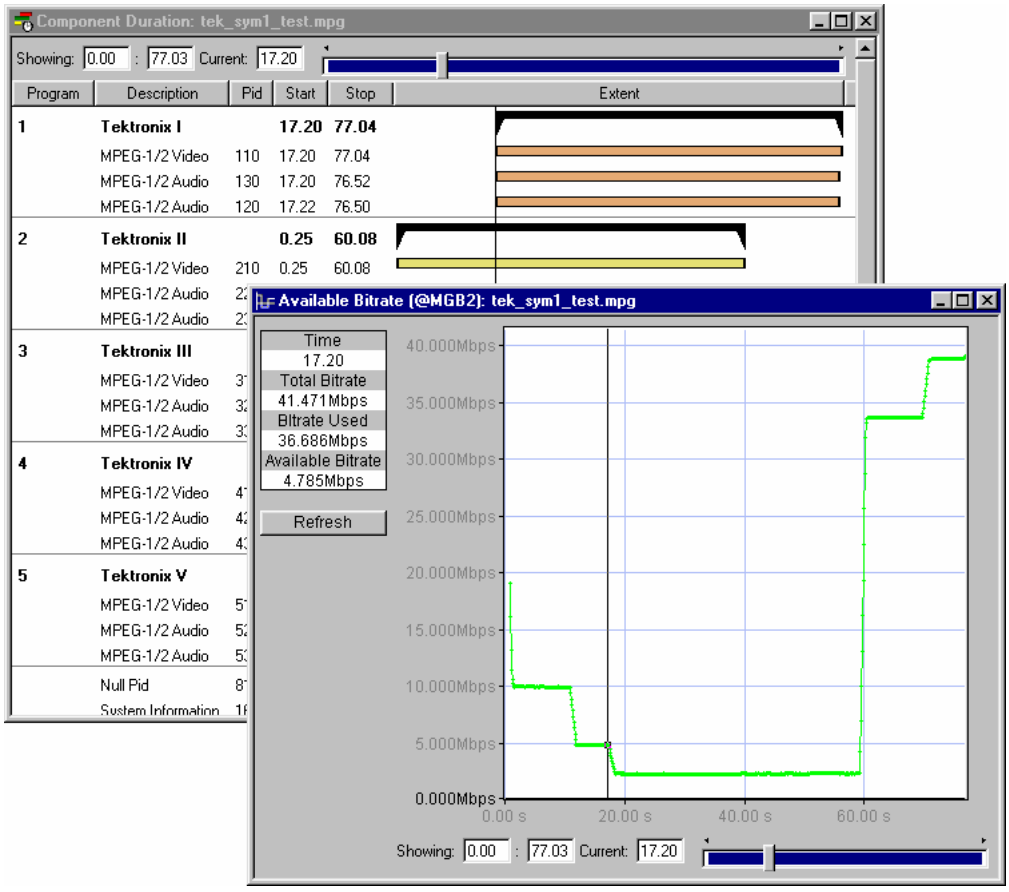
Component start and stop times changed in the Component Duration view are automatically updated in the SI/PSI tables.

Available Bit Rate

The Available Bitrate view displays in graphical form the available bit rate for the duration of the multiplex.
The bit rate is calculated using the MGB2 measure (Ref: ETSI TR 101 290).

Open the Component Bitrate view either by selecting **View ➔ Available Bitrate** from the Menu Bar…

or the toolbar button.



If the bit rate falls below zero, the points will be highlighted in red. When editing a multiplex, the user can add components which cause the bit rate to fall below zero and no warnings will be displayed. However, if a transport stream is then generated, errors will be logged and displayed in the Log view.

Use **Refresh** to redraw the graph.

Clicking anywhere within the graph will place a vertical cursor at that point; the position and bit rate are displayed in the **Time** and **Available Bitrate** fields.

The zoom level and cursor placement of the Available Bitrate and the Component Duration views can be synchronized by selecting **View ➔ Synchronize**.

Common Features

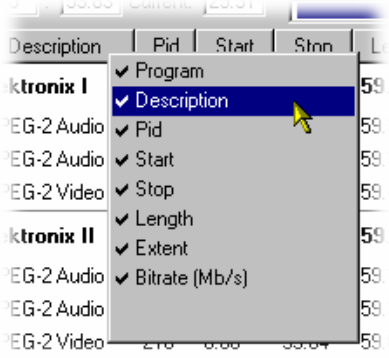
Columns in the Component views can be sorted and rearranged to suit the preferences of the user. Column management in the two Component views is similar.

Field Selection

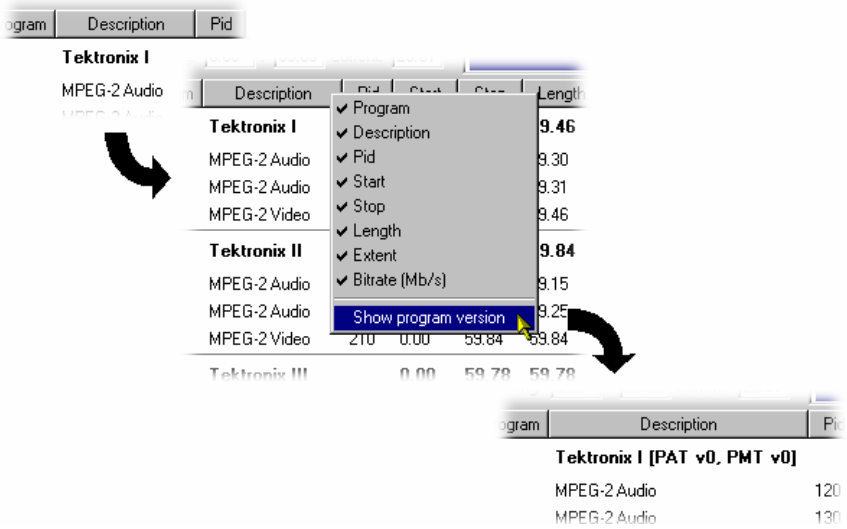
The fields to be displayed in each Component view can be selected by the user. The Header bar indicates which fields are currently displayed.

By right-clicking on the Header bar, a menu is displayed:

The user can select which fields are to be displayed. A check-mark next to a field name indicates that the field display is currently enabled.



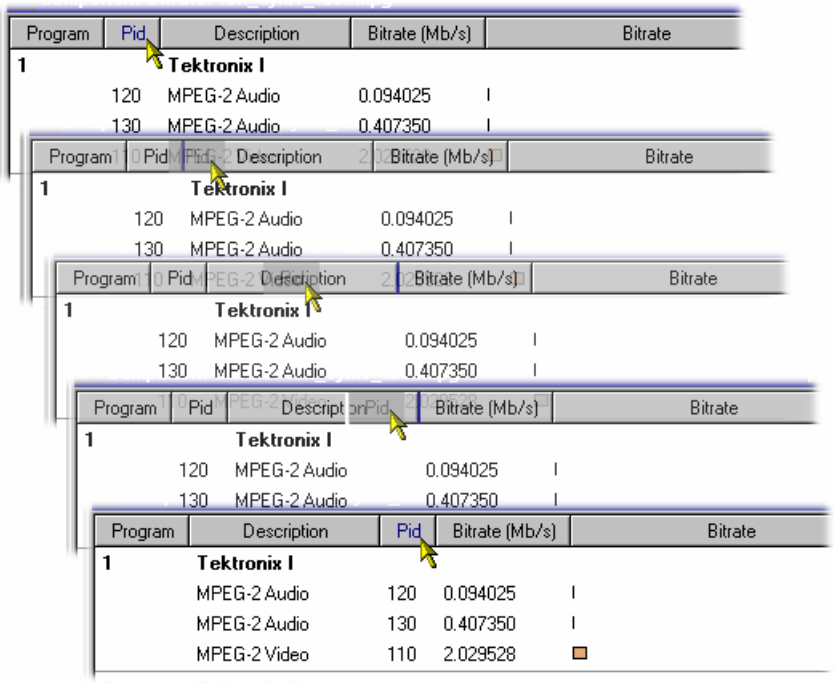
The version number of the PAT and PMT can be displayed in the Description column by enabling the **Show program version** option in the right-click menu from the Description column header.



Similarly, the PID numbers can be displayed in hexadecimal, by selecting **Display in hexadecimal** from the PID column right-click menu.

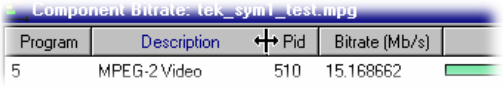
Column Repositioning

Columns can be repositioned as required. Click and drag the column to the required position.



Column Width

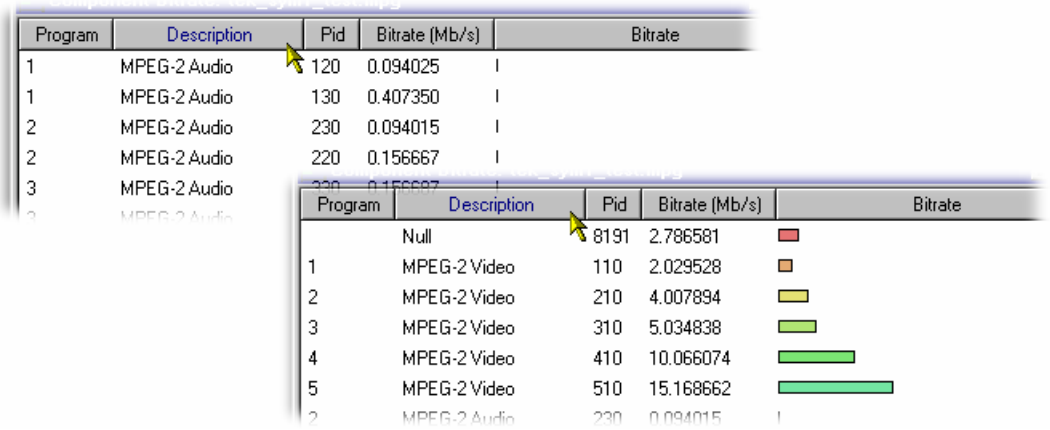
Columns can be resized as required. Place the cursor over the dividing line between two columns; it will change to the resizing cursor (↔). Click and drag the column to the required width. The change will be made to the column to the left of the cursor.



Double-clicking the column divider will automatically resize the column to the left to the optimum size required to view the content.

Column Sort

Columns can be sorted in ascending or descending order. Click the cursor on the heading to sort the column. Clicking again will sort the column in reverse order.



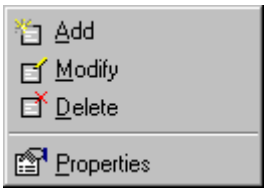
Similarly, the columns can be grouped in Program order, by clicking the **Program** header.

Common Menu Options

The specifications for components of the various views can be manipulated by options from the Edit menu, View Menu and Toolbar.

There is also a right-click menu that provides the Add, Modify, Delete, Import, Export and Properties options. Place the mouse pointer over the component to change and click the right mouse button to 'pop up' the menu.

A typical right-click menu is shown here:



The menu options are context sensitive and will be enabled or disabled according to the current selection in the view.

The following options are available from the various right-click menus:

Add Adds a component to the item currently selected.

Modify Opens the properties dialog.

Delete Deletes the currently selected component.

Properties Opens a properties dialog for editing the item currently selected.

Export Payload… Extracts and exports the payload of the source transport stream in the form of a simple data file.

Export Elementary Stream… Removes the transport stream and PES headers and exports the remaining information in the form of a simple data file.

Export Section Data… Extracts and exports section data. The file created can be imported as ES using Multiplexer's Add function or as SI using the Import Section Data… option (see following).

Import Section Data… Imports SI data form a file and analyzes it. The section is added to the Navigator view.

Editing in the Navigator Views

Multiplexer provides a variety of ways of building and modifying transport streams for multiplexing. In addition to the Menu Bar options and Toolbar shortcuts built into the Multiplexer, many of the operations can be carried out using familiar drag and drop Windows techniques.

In the following descriptions, the alternative methods for carrying out a task are given at the head of the section, but only one method is described for each action. Other methods for the same action often invoke the same dialog boxes and sequence of follow-on actions.

Drag and Drop

To drag a file, click on its name and hold down the left-hand button of the mouse while dragging the file to the required location. The cursor will change according to the background that it is dragged over:

(with Ctrl key held) when dropped, the file will be copied.

when dropped, the file will be moved (cut and pasted).

when dropped, no action will be taken.

Note that as the file is dragged over elements in the Navigator, 'receptive' elements (elements where the file can be meaningfully dropped) will be highlighted

Transport Stream

Opening an MPEG file

(See Opening a Stream, page 11)

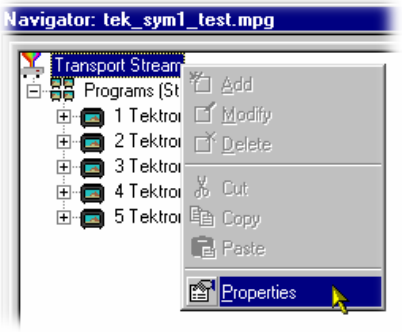
Opening a Multiplexer file

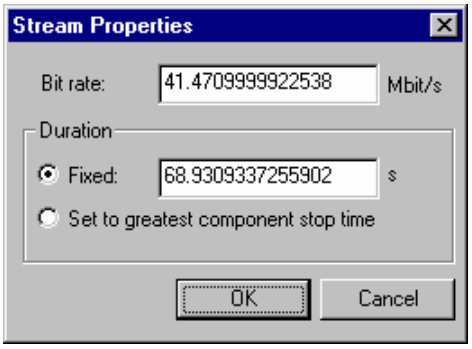
(See Opening a Stream, page 11)

Change Transport Stream Bitrate and Duration

To specify a new bitrate or duration for the transport stream select and highlight the **Transport Structure** component in the Navigator view.

From the right-click menu, select Properties. The dialog shown below will be displayed.





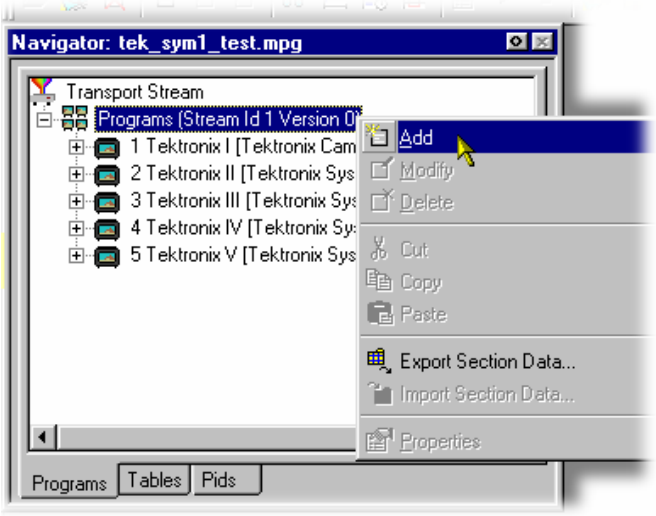
Edit the **Bit rate** and the **Duration** as required, then click on the **OK** button.

Programs

The introduction of the Navigator Programs view has provided a more program-centered means of manipulating SI/PSI. Whole programs can be added to the multiplex and the application will update the associated tables, including the PAT and PMT.

Note that the nodes of the tree structure in the Navigator Programs view are context sensitive. When dragging and dropping files from either the Examine TS window or from another instance of Multiplexer, a node will only be highlighted as the cursor passes over it when the operation proposed is legal. Note also that there may be a very short delay before the node is highlighted whilst the legality of the operation is checked.

Adding a New Program



With the Transport Stream ID field highlighted in the Navigator Programs view, selecting this option either from the right-click menu (PAT highlighted in Navigator Programs view) or the Menu Bar (Edit ➔ Add) will invoke the Program Wizard (see page 35).

(In the Navigator Programs view, the PAT is represented by the Transport Stream ID field.)

Copy/Move a Program

Methods available:

- Drag and drop (copy only) from the Examine TS window (Programs view) to the Navigator Programs view
- Drag and drop (copy/move) from another instance of Multiplexer to the Navigator Programs view

In the Navigator Programs view, programs can only be dropped onto the PAT node.

Table

Adding a New PSI/SI Table

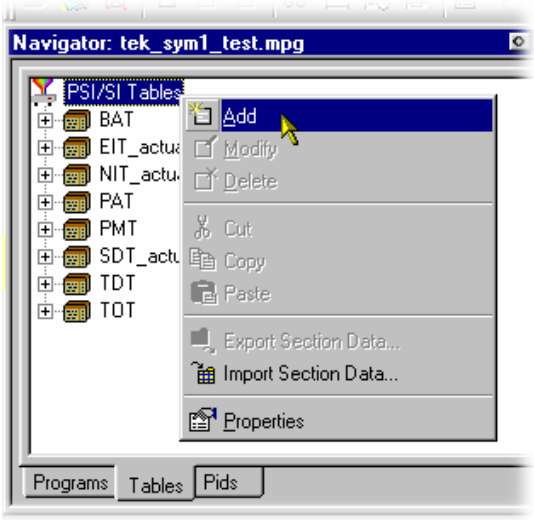
Methods available:

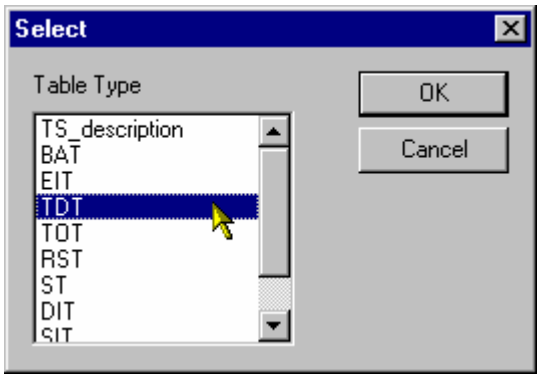
- Highlight the **PSI/SI Tables** level in the Navigator Tables view and select **Add** from the right-click menu.
- Drag and drop (copy only) from the Examine TS window (Tables view) to the Navigator Tables view
- Drag and drop (copy/move) from another instance of Multiplexer to the Navigator Tables view

Any Table which is defined in the selected standards, and not already present, may be added the transport stream. To add a table to the transport stream, click on **PSI/SI Tables** in the Navigator Tables view:

a) Highlight the **PSI/SI Tables** level and select **Add** from the right-click menu.

This will open the **Select** dialog. The dialog displays a list of the table types that are not already present in the stream.





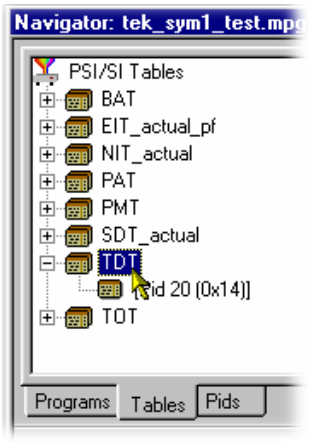
b) Highlight the required table type, then select the **OK** button.

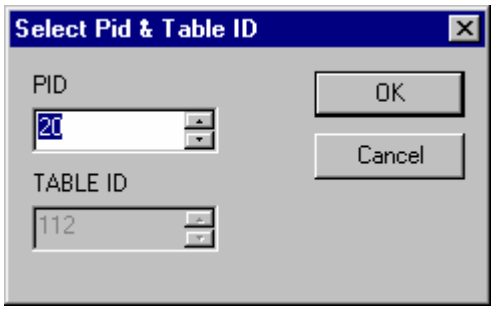
Pressing **Cancel** will abandon the Add operation without adding a new table.

Only the table types not currently specified for the stream are listed. If the table type required is not listed, press the **Cancel** button to close the dialog without affecting the specification for the stream.

The **Select PID & Table ID** dialog is displayed only if a PID and/or Table ID need to be identified. Otherwise the selected Table type is automatically created.

A single section is automatically added to the newly created table type.





Copying a PSI/SI Table

Methods available:

- Drag and drop (copy only) from the Examine TS window (Tables view) to the Navigator Tables view
- Drag and drop (copy/move) from another instance of Multiplexer to the Navigator Tables view

Tables can be copied (or moved) from existing multiplexes, using either of the available methods.

If a similar table type is already present in the multiplex, the contents of the copied table will be integrated with it.

Deleting a PSI/SI Table

A table is automatically removed when the last section is deleted (see page 74).

Exporting a Table

(see Exporting a Section, page 75.)

Import a Table

(see Importing a Section, page 75)

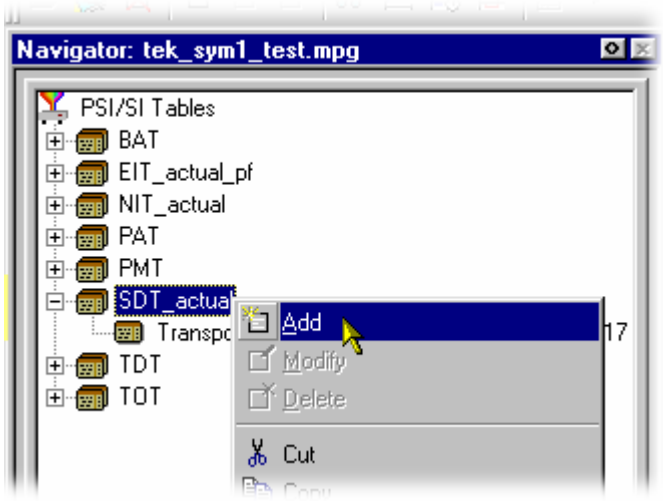
Section

Adding a New Section to a PSI/SI Table

Methods available:

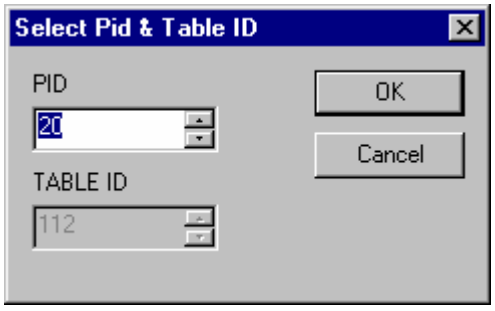
- Highlight the parent table level in the Navigator Tables view and select **Add** from the right-click menu.
- Drag and drop (copy only) from the Examine TS window (Tables view) to the Navigator Tables view.
- Drag and drop (copy/move) from another instance of Multiplexer to the Navigator Tables view.

To add a section to a table select the parent table in the Navigator Tables view. For example to add a section to the SDT, select **SDT Tables**:



Then select **Add** from the right-click menu.

The **Select PID & Table ID** dialog is displayed only if a PID and/or Table ID need to be identified. Otherwise the selected section is automatically created.



Select the required PID and Table ID (where enabled) and press **OK**.

Pressing **Cancel** will abandon the Add operation without adding a new section.

The version/section of a table is created with a new version or section number. The rules used by Multiplexer for numbering are:

- For tables that the selected standard dictates should always have a section number of 0, the version number is increased by one. The new version number is based on the version currently in the table with the most recent number. The **version_number** is a 5-bit field, so if the new version would be 32, it is reset back to 0.

  $$\textbf{version\_number}_{NEW} = (\textbf{version\_number}_{RECENT} + 1) \text{ modulo } 32$$

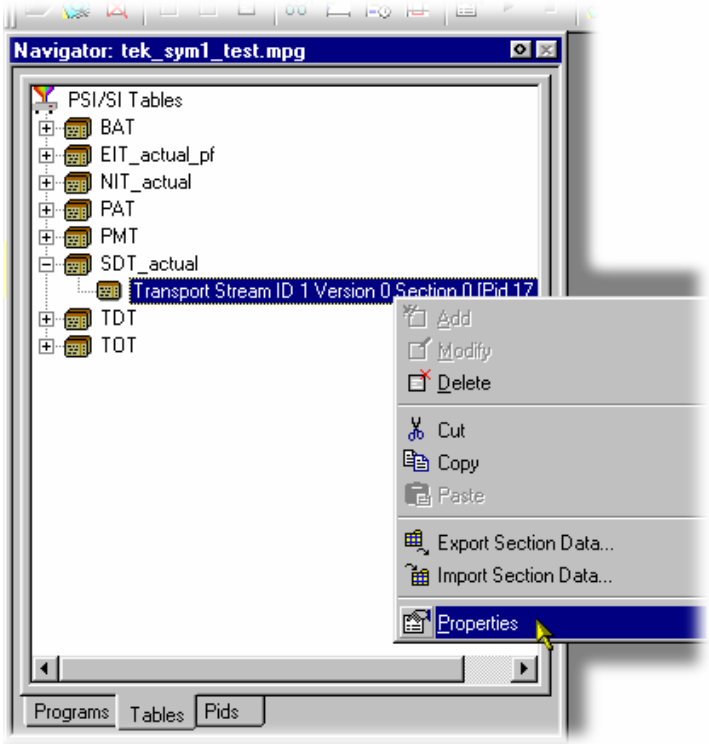
- When the standards permit more than one section:
  - the section and version numbers are based on the version/section with the most recent version number.
  - the section number is increased by one.
  - the most recent version number is applied to the new section.

When copying a section, the Multiplexer will resolve any numbering conflicts by creating new versions of duplicated tables.

When adding SDT entries an option is provided to put all channels into a single section or in multiple sections.

Editing PSI/SI Table Properties

Table and Section Properties are edited by selecting and highlighting one of the versions/section within the transport structure and selecting the **Properties** option from the right-click menu.



This opens a dialog with four tabs, one for each property. Depending on the type of table, properties may be applied to a specific version or section of the table. Multiplexer only allows operations that make sense in the context of the selected table type.

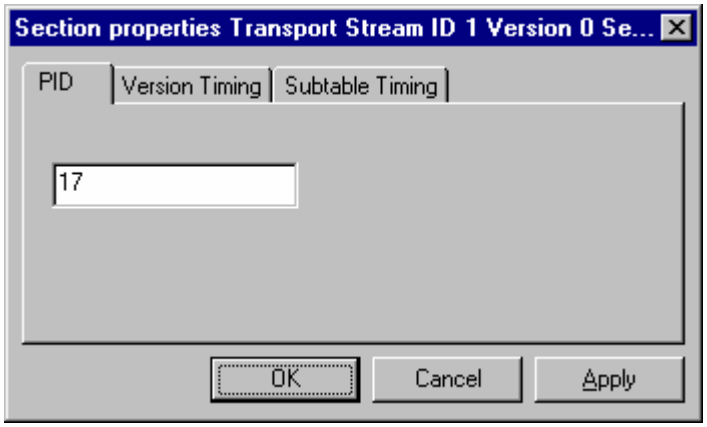
The properties that may be edited from the Navigator Tables view are:

PID Number

The PID tab is displayed by default when the Section Properties dialog is opened.

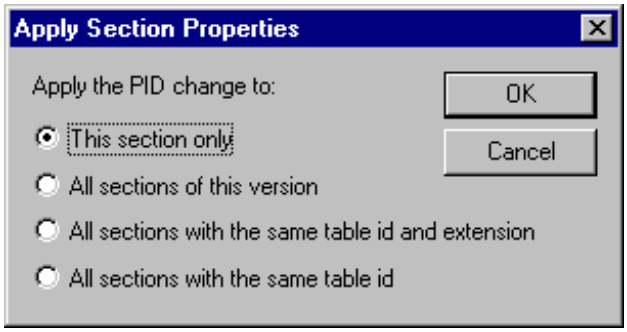
Edit the value and select **OK** to change the PID number.

Edit the value and select **Apply** to make the changes and update the other properties (tabs) without having to close this dialog.



Multiplexer checks the new PID number against the selected standards and warns of any non-conformance issues. If a conflict is found a warning message is displayed, with the option to continue. Multiplexer also checks for conflicts with other PIDs. If the new PID number conflicts with an existing PID, an error message is displayed and the change is rejected; in this case, either choose a different PID number for the table or edit the number of the PID that is currently the owner.

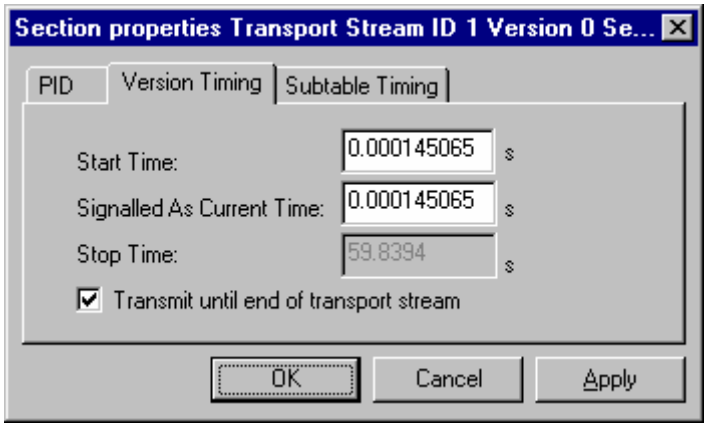
If no conflict is found, another dialog is opened to define the scope of the changes:



Select the required scope and click on **OK**. Selecting **Cancel** will abandon the change.

Version Timing

The Version timing tab shows the time when the version will become current, the start and end times. New values may be specified for any of these times.



Start Time: specifies the time at which sections of this version will start to appear in the transport stream.

Signalled As Current Time: controls the time when the sections with this version will have the **current_next_field** set to 1.

By default when these sections start to appear in the transport stream, the **current_next_field** of the section set to 0. To specify a version that is always current set the **Start Time** and **Signalled As Current Time** fields to the same value.

Transmit until end of transport stream: enables the section to be repeated until the end of the transport stream. If the checkbox is disabled, the **Stop Time** becomes active.

Stop Time: specifies the time after which no sections of this version will appear in the transport stream.

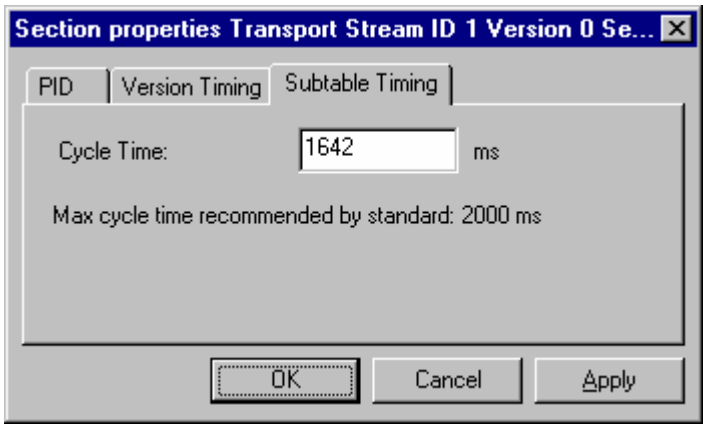
All of the times are in seconds, taken from the start of the transport stream file.

Edit the values and select **OK** to change the timings. Edit the values and select **Apply** to make the changes and update the other properties (tabs) without having to close this dialog.

Subtable Timing

Service information is usually constrained to appear at regular intervals in the transport stream. This is usually implemented as a maximum time between appearances of all the sections of a subtable (where a table is defined by the table_id, table_id_extension and version_number on the same PID).

Use the Subtable Timing tab to specify the desired and the maximum acceptable period between instances of the subtable. When an MPEG file has been opened this shows the mean time between instances of the subtable in the transport stream.



Cycle Time: Displays the mean time between instances of the subtable specified for synthesising a new MPEG file. The value may be edited to specify a different cycle time.

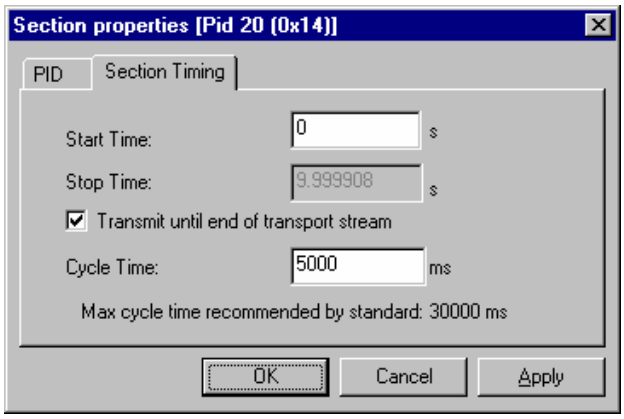
Beneath the **Cycle Time**, the dialog displays subtable specific information from the currently selected standard.

Edit the values and select **OK** to change the Cycle Times. Select **Apply** to make the changes and update the other properties (tabs) without having to close this dialog.

When synthesising a new transport stream, the multiplex engine tries to insert the subtable at the frequency specified by the **Cycle Time**. An error message is written to the event log whenever a subtable cannot be multiplexed into the stream within the period specified by the maximum cycle time.

Section Timing

Where a table can contain only a single section (for example, TOT and TDT), a section timing tab mis displayed in the Properties dialog.



Start Time: Specifies the time at which the first appearance of this section will occur.

Stop Time: When enabled, specifies the time at which the last appearance of this section will occur.

Transmit until end… When enabled, specifies that the section should be transmitted until the end of the stream.

Cycle Time: Specifies the interval at which the section should be transmitted.

Max cycle time… gives the cycle time recommended by the current standard.

Edit the values and select OK to change the timings. Select Apply to make the changes and update the other properties (tabs) without having to close this dialog.

An error message is written to the event log when a table cannot be multiplexed in accordance with the timings set.

Deleting a Section

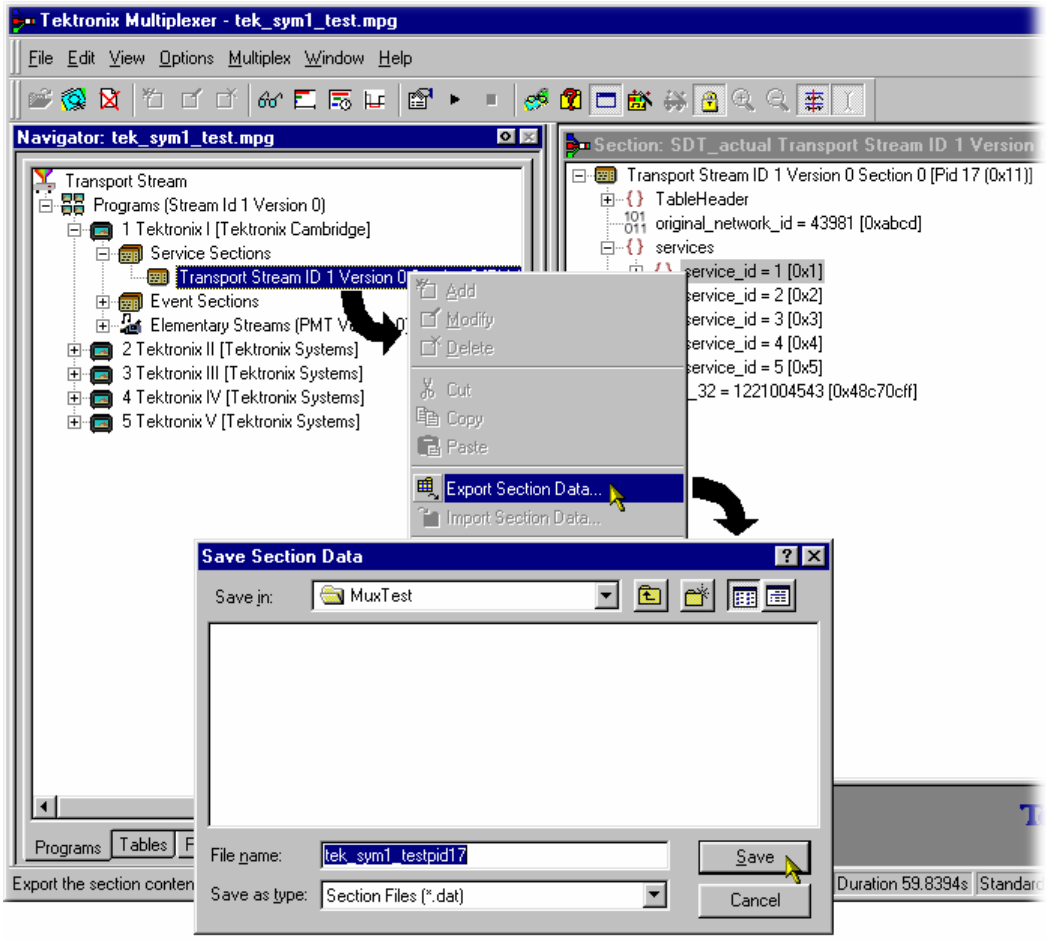
A section can be deleted from a table by highlighting it in the Navigator Tables view and selecting **Delete** from the right-click menu. To delete more than one section, select and delete each one in turn. When the last section is deleted from a table, the table is automatically deleted from the structure.

Exporting a Section

Section data can be exported in the form of a binary file. In the Navigator Tables view, highlighting a Table node (e.g. PMT Tables), allows all sections of the table to be exported. Similarly, highlighting a single section entry (e.g. Program 123) allows only that section to be exported.

Highlight the required section or Table node in the Navigator Tables view. From the right-click menu, select **Export Section Data…**. Name the file to be created and choose a location. Select **Save** to confirm the action.

Individual sections can also be exported using the Navigator Programs view. Highlight the required section to be exported. From the right-click menu, select **Export Section Data…**. Name the file to be created and choose a location. Select **Save** to confirm the action. Note that not all tables are shown in the Navigator Programs view, e.g. TOT.



Importing a Section

In the Navigator Tables view, highlight the **PSI/SI Table** node. From the right-click menu, select **Import Section Data…**. In the **PID** tab of the **Import Section Data** dialog, identify the PID that is to carry the information. Similarly, in the **Source** tab, identify the file that holds the section data to be imported. Select **OK** to confirm the selection. During the import action, the content of the file is examined to determine where the section(s) should be placed.

ES PIDs

ES PIDs which carry additional Elementary Streams can be multiplexed into the synthesised transport stream. The following actions are required when defining an elementary stream to be added:

- Allocate a PID number
- Define the source of the elementary stream to be added
- Define the timing to be applied to the new stream
- Define the PCR placement

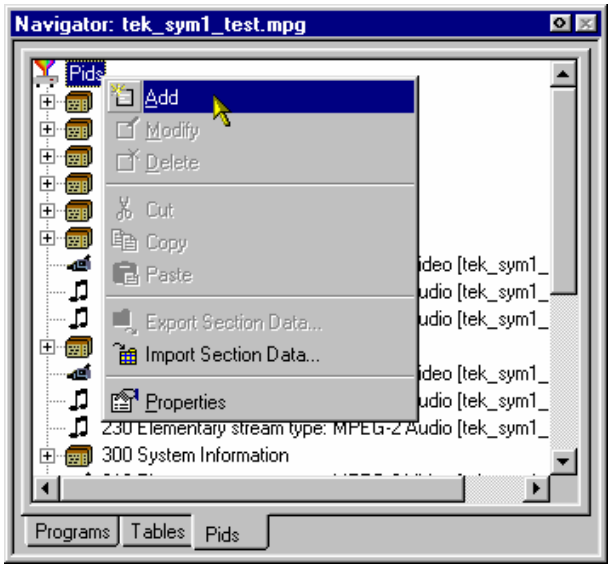
Adding an Unreferenced Elementary Stream

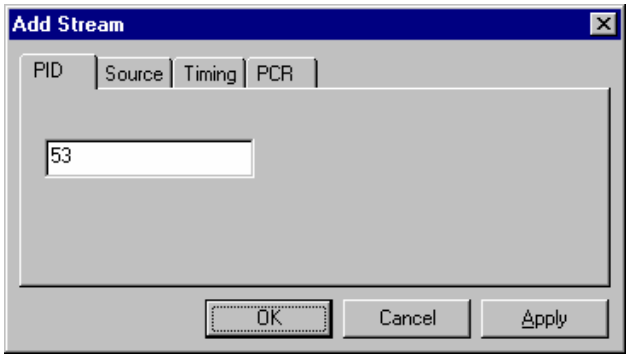
Methods available:

- Highlight the **ES PIDs** in the Navigator Tables view and select **Add** from the right-click menu.
- Drag and drop (copy only) from the Examine TS window (Tables view) to the Navigator Tables view.
- Drag and drop (copy/move) from another instance of Multiplexer to the Navigator Tables view.

To add a new stream, highlight **ES PIDs** in the Navigator Tables view and select Add from the right-click menu:

This will open the Add Stream dialog; the **PID** tab will be displayed by default.



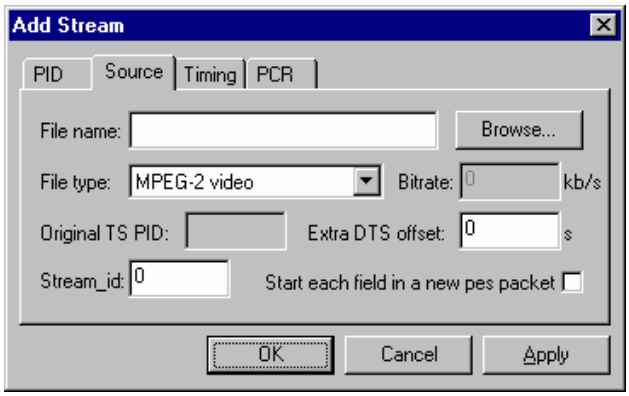


Enter the PID number. A new value may be entered using either decimal or hexadecimal notation. Values are assumed to be decimal unless prefixed with **0x**. The dialog is not case sensitive and values may include zeros after the prefix and before any significant digits.

When all details (in all tabs) are satisfactory, select **OK** to accept all changes and close the dialog.

Defining the PID Source

On the **Add Stream** dialog select the **Source** tab; this will allow the PID source to be selected and defined.



File name: Enter the file name of the stream to be multiplexed. If the filename is unknown, select **Browse** to open a standard file browser dialog and locate the file required.

The names of files being copied to the multiplex will be automatically filled in.

Stream type: Select the type of stream to be multiplexed from the drop-down list box.

The following **Stream Types** are available:

MPEG-1 video	ES or PES
MPEG-2 video	ES or PES
MPEG-2 audio	ES or PES
MPEG-2 AAC audio	ES or PES (ADTS format only)
AC-3 audio	ES or PES

(ES – Elementary Stream; PES – Packetised Elementary Stream)

Transport Packets A single PID stream. The **Bitrate** value will require setting. The **Original TS PID** will require setting.

Section The content of the file will be Sections. The sections will be in binary form. The file will consist of one, or many sections appended one after the other.

When multiplexed, the sections will be encoded on the given PID as SI. If the resulting multiplex is subsequently opened in the Multiplexer, the sections will be interpreted as SI and displayed under the SI Tables node in the tree.

A file generated using the **Edit ➔ Export Section Data** menu option can be used here.

The **Bitrate** value will require setting.

Other Any binary or ASCII file which is to be packetised into the transport stream at the specified bitrate. The **Bitrate** value will require setting.

The remaining fields are interactive and will only be enabled when a value is required.

Bitrate: When first defining a source, the bitrate is unknown and **0kbit/s** is displayed. If the Transport Packet Stream or an '**Other**' **Stream Type** is selected, the field is enabled and a value (in kbit/s) can be entered.

Original TS PID For streams other than transport streams, this field will be blank and disabled.

Extra DTS offset: When multiplexing ES or PES streams, the Multiplexer will derive an offset between the PCR and the decoded timestamp (DTS) of the first access unit (video picture / audio frame). The user can override this offset and make it larger (positive + number) or smaller (negative – number). Changing this value may cause the resultant stream to be non-conformant with respect to the T-STD of the MPEG-2 standard. Enter the **DTS offset** in seconds required.

Stream_id Only enabled for elementary stream types. This number specifies the value of the stream_id field in the PES packet header.

Only needs to be set for DVB stream. Stream identity in the PES header.

Start each field in a new pes packet

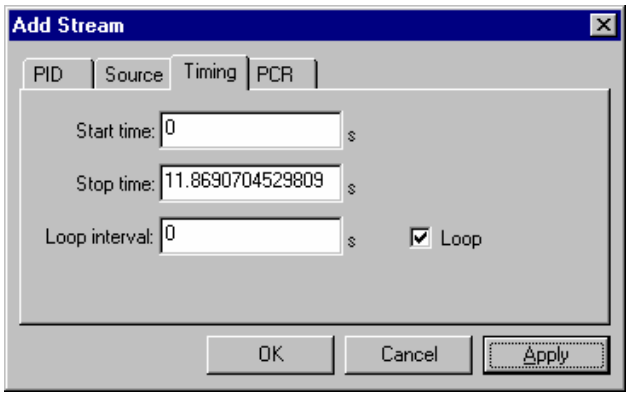
(Only enabled when **File Type: MPEG-2 Video** is selected)
When disabled, both field pictures making up a coded frame are put in a single PES packet. Otherwise each field picture is put into a separate PES packet. This setting has no effect upon frame pictures.

Start each section in a new packet

(Only enabled when **File Type: Section** is selected)
When disabled, SI data is placed in the packet payloads in the most efficient manner. The start of a section will immediately follow the end of the previous section; no stuffing bytes will be used.
When enabled, each section will begin in a new packet and stuffing bytes will be used to pad out any payloads that are not full.

Defining the Stream Timing

On the **Add Stream** dialog select the **Timing** tab; this will allow timing parameters for the selected source stream to be defined.



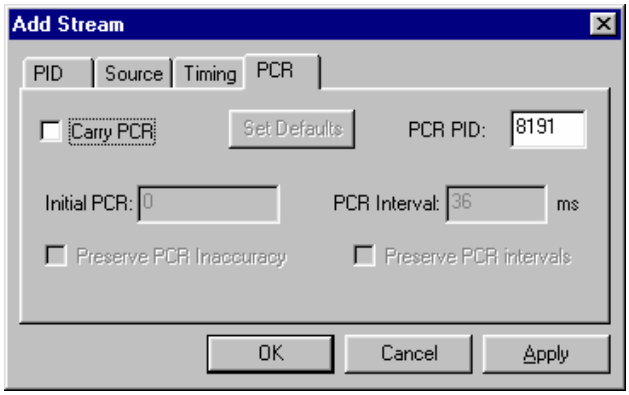
Start/Stop Time: Enter the times that the selected source stream is to start and stop within the host transport stream. Note that the overall duration of the host transport stream is defined via the Transport Stream Properties dialog.

Loop: Select this checkbox to loop the selected source stream for the duration of the synthesis. A **Loop Interval** may be set which introduces a delay between each repeat of the source stream; if zero is entered, the source stream will loop continuously. The Loop checkbox will always be disabled for transport stream types. The Multiplexer cannot loop transport streams.

Select **OK** to accept all changes and close the dialog.

Defining the PCR Placement

On the **Add Stream** dialog select the **PCR** tab; this will allow PCR placement to be defined.



PCR for Elementary Streams

(Includes **File Type: Transport Packets**)
PCRs are placed in the packets at the specified interval, starting with the specified initial value

PCR for Remultiplexed PIDs

(**File Type: Transport Stream**)
If the **Carry PCR** checkbox is not enabled, any PCRs in the packets will be removed.
If the **Carry PCR** checkbox is enabled, PCRs will be sent as follows: If **Preserve PCR Innacuracy** is set, the PCRs from the original transport stream will be used, otherwise the initial PCR value can be specified.
If the **Preserve PCR Intervals** checkbox is enabled, PCRs will be sent in those packets that originally contained them, otherwise PCRs are inserted into packets at the specified intervals.

Adding Elementary Streams to the Program Structure

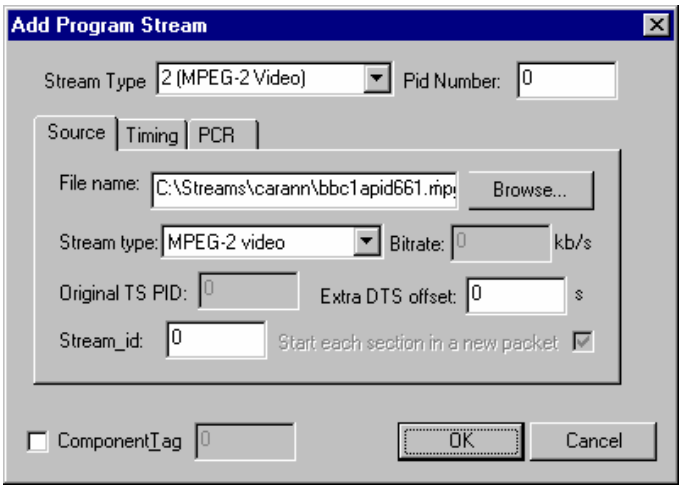
Methods available:

- Highlight an **Elementary Stream** in the Navigator Programs view and select **Add** from the right-click menu.
- Drag and drop (copy only) from the Examine TS window (Programs view) to the Navigator Programs view.
- Drag and drop (copy/move) from another instance of Multiplexer to the Navigator Programs view.

Elementary stream data can be added via the Navigator Programs view.

a.) In the Navigator Programs view, highlight an **Elementary Streams** node to which the elementary stream is to be added.

b.) From the right-click menu, select **Add**. The **Add Program Stream** dialog is displayed.



The dialog tabs allows the input elementary stream to be selected and specified. The main dialog fields Stream Type and Pid Number dictate the PID that will carry the stream and the stream type entry that will be made in the PMT.

c.) The functionality of the tabbed dialogs is described in the following pages:

Source	see Defining the PID Source, page 77,
Timing	see Defining the Stream Timing, page 79,
PCR	see Defining the PCR Placement, page 80.

d.) Enable the Component Tag checkbox, if required. Enter a Component Tag number (0 - 255) in the enabled field. If the Component Tag is enabled, it can be referenced by other tables e.g. Event Information Table.

Exporting Elementary Streams

The Export Elementary Stream option allows the non-packetized elementary stream data to be extracted from an elementary stream and saved to a binary file; note that this data will not include the transport packet or the PES packet headers.

In the Navigator Programs view, highlight the elementary stream whose payload is to be exported. Select the **Export Elementary Stream…** option from the right-click menu. Name the file to be created and choose a location. Select **Save** to confirm the action.

Exporting PES Packets

The Export Payload option allows the PES packets to be extracted from an elementary stream and saved to a binary file; note that this data will not include the transport packet headers.

In the Navigator Programs view, highlight the elementary stream whose payload is to be exported. Select the **Export Payload…** option from the right-click menu. Name the file to be created and choose a location. Select **Save** to confirm the action.

Modifying PES PID Details

To modify any of the **ES PID** parameters, highlight the required PID in the Navigator Tables view and select **Properties** from the right-click menu. The **Stream Properties** dialog and its tabs are identical to the **Add Stream** dialog – refer to Adding an Unreferenced Elementary Stream, page 76. Locate the parameter to be amended and when changed, select the **OK** button.

ES PID parameters can also be modified via the Navigator Programs view. Highlight an Elementary Stream in the Programs view and select **Properties** from the right-click menu. The dialog thus displayed (**Program Stream Properties**) is similar to the **Add Program Stream** dialog shown on the previous page (page 81).

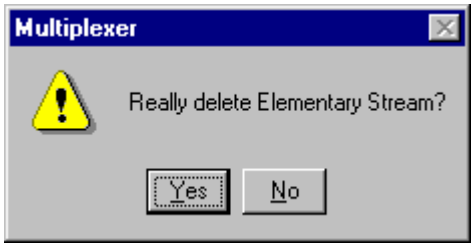
Deleting a PES PID

An elementary stream can be removed from the multiplex by deleting the PID. To delete a PID, highlight the required PID and select **Delete** from the right-click menu.

Then select the **Delete** option from the **Edit** or Pop-Up menus. Alternatively click on the delete button from the toolbar.

Multiplexer asks for confirmation before removing the PID from the multiplex.

Select **Yes** to delete the stream or **No** to abandon the operation and leave the stream unchanged.



DSM-CC

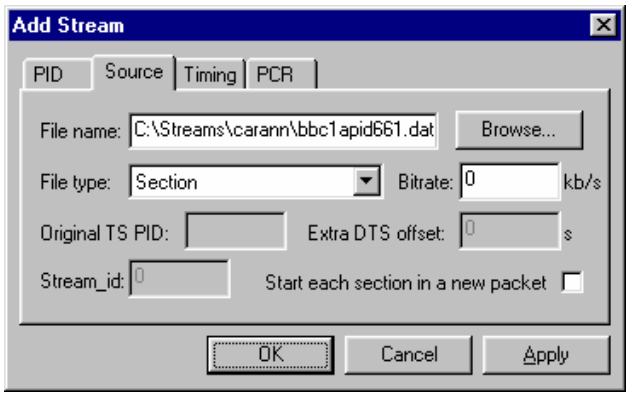
Adding an Unreferenced DSM-CC Section

Methods available:

- Highlight the **ES PIDs** node in the Navigator Tables view and select **Add** from the right-click menu.
- Drag and drop (copy only) from the Examine TS window (Tables view) to the Navigator Tables view.
- Drag and drop (copy/move) from another instance of Multiplexer to the Navigator Tables view.

Adding an unreferenced DSM-CC section is similar to adding an unreferenced elementary stream (see page 76), with the following modifications:

In the Source tab of the Add Stream dialog, select **Transport Packets / Sections** as the **File type** and set the bit rate.



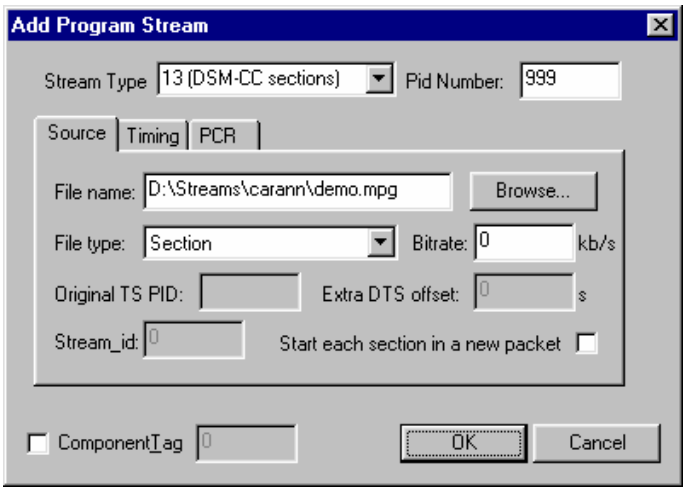
Adding DSM-CC Sections to the Program Structure

Methods available:

- Highlight an **Elementary Stream** in the Navigator Programs view and select **Add** from the right-click menu.
- Drag and drop (copy only) from the Examine TS window (Programs view) to the Navigator Programs view.
- Drag and drop (copy/move) from another instance of Multiplexer to the Navigator Programs view.

Adding a DSM-CC section to the program structure is similar to adding an elementary stream to the program structure (see page 81), with the following modifications:

The main dialog fields Stream Type and Pid Number dictate the PID that will carry the stream and the stream type entry that will be made in the PMT. The Stream Type should be set to one of the DSM-CC entries.



In the Source tab of the Add Program Stream dialog, identify the **File name** to be added. Select **Transport Packets / Sections** as the **Stream type** and set the bit rate.

The DSM-CC section will be added.

Delete a DSM-CC Section

A DSM-CC section can be deleted from a table by highlighting it in the Navigator view and selecting **Delete** from the right-click menu. To delete more than one section, select and delete each one in turn.

Export a DSM-CC Section

DSM-CC data can be exported in the form of a binary file.

Highlight the required DSM-CC section in the Navigator Tables view. From the right-click menu, select **Export Section Data…**. Name the file to be created and choose a location. Select **Save** to confirm the action.

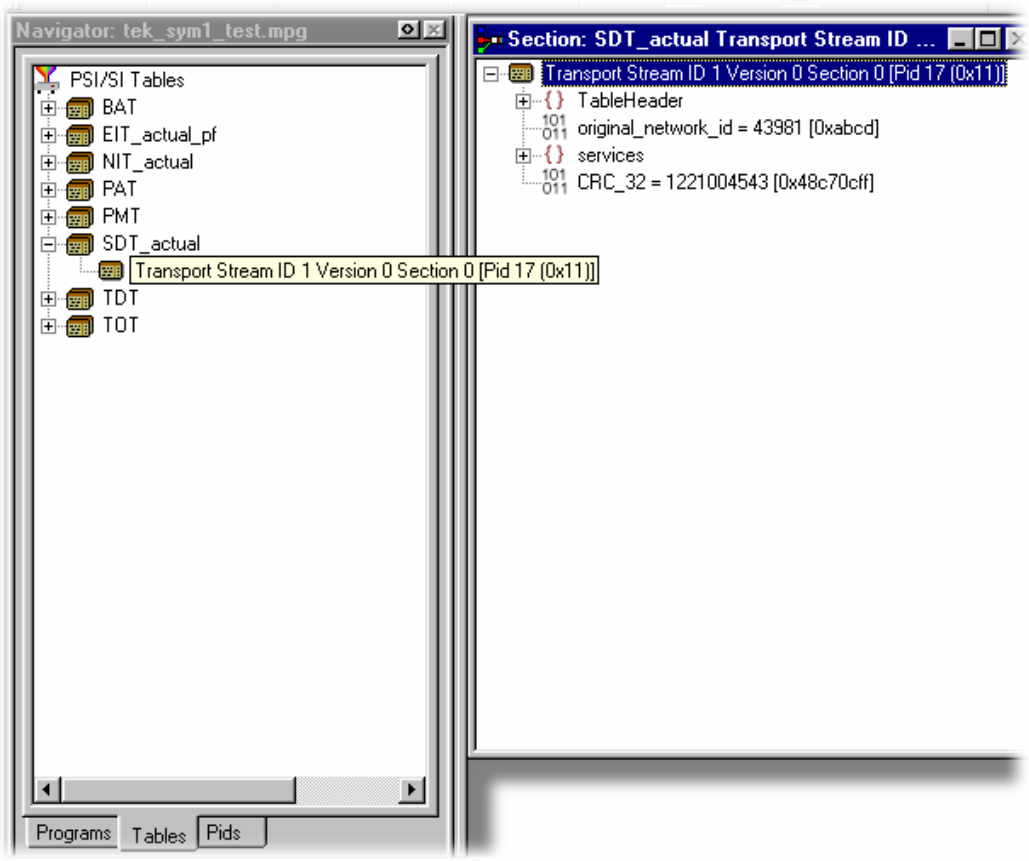
Individual DSM-CC sections can also be exported using the Navigator Programs view. Under any Elementary Streams node, highlight the DSM-CC section to be exported. From the right-click menu, select **Export Section Data…**. Name the file to be created and choose a location. Select **Save** to confirm the action.

Editing in Section View

Use the Section View window to modify the contents of a version/section. This includes **version**, **section** and table specific data that the Navigator Tables view displays. If the Section View window it is not already open, highlight the **Section View** option from the **View** menu.

If a section/version is selected in the Navigator Tables view, the contents are automatically displayed in the Section View; otherwise the Section View window is blank.

To open a table version/section in Section View select the component in the Navigator Tables view. The Section View is updated immediately to show the selected section/version.



Editing Fields

To add, change or delete a field, , element or loop in a section/version the parent table must be selected in the Navigator Tables view. Highlight the appropriate line in the Section view and select the required option from the right-click menu.

Selecting a Field

To select a field or container place the mouse pointer over it and click the left button.

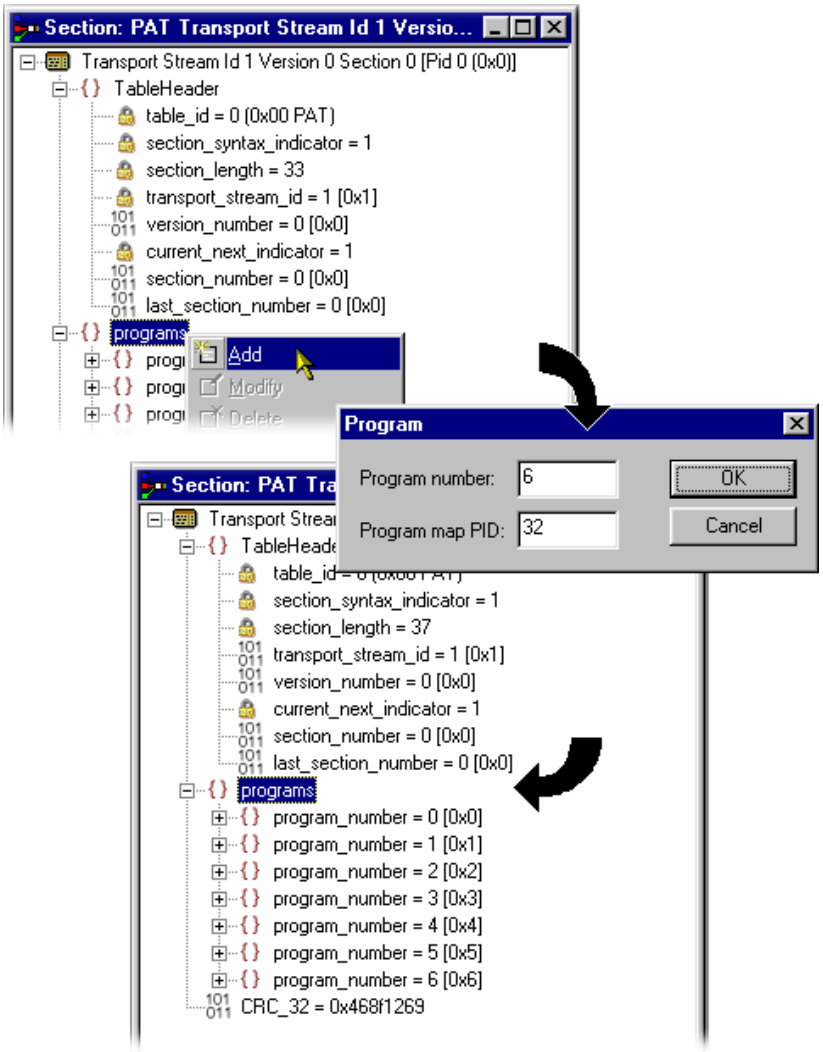
The magnifying glass symbol, , indicates the selected component.

If **Standard Mode** is selected the magnifying glass selection cannot be placed on a field which is locked. To select and edit locked fields, first select the **Expert Mode** option from the **Multiplex** menu.

Adding an Element to a Loop

To add an element to a loop, select the parent loop that will contain it, select **Add** from the right-click menu.

For example to add a program to a PAT, highlight the **Programs** container and select **Add** from the right-click menu:



In this example, a dialog is displayed in which the Program Number and Program Map PID can be accepted or re-specified. Other table loops may not display any dialog, but immediately create a new element with default contents. An entry is displayed for the new element, with its details collapsed, at the end of the list of elements in the loop. In addition, the section length field is automatically recalculated and amended. For the example above of adding an element to the **Programs** loop in a PAT, the new entry is **program_number = 6 (0x6)**.

Note that the example above was taken with Standard mode selected. In Standard mode, all recalculation is done automatically. In Expert mode, a program element will be added, but the program number and PID must be manually adjusted. Similarly, the section length will need to be calculated and amended manually (see also Expert and Standard Modes, page 49).

Deleting an Element in a Loop

To delete a loop element, in the Section view, highlight the element and select **Delete** from the right-click menu.

The element is deleted and the Section View window updated to reflect the changes.

Modifying the Contents of a Field

To edit the contents of a field, highlight the field and select **Modify** from the right-click menu. This will open an appropriate dialog for modifying the type of data held by the field.

The following paragraphs describe the different types of data that may be modified.

Enumerated Value

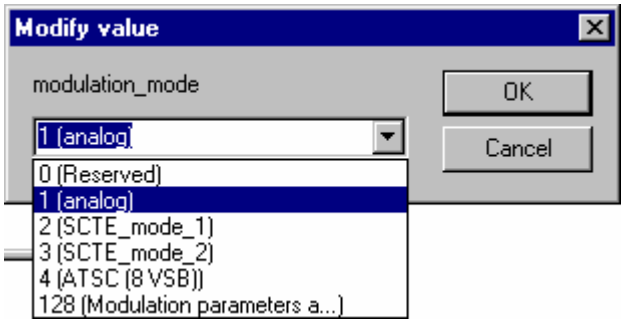
The **Modify value** dialog displays the name of the field and the current value. The value is shown as a number followed by the interpretation of the governing standards.

In this screenshot the field being edited is a **modulation_mode** and the current text is **1 (analog)**.

Type in the number, without any text, for the required value. When the changes are accepted Multiplexer will display the interpretation in the Section View window.

Alternatively, click on the down arrow to select the value from the drop down list.

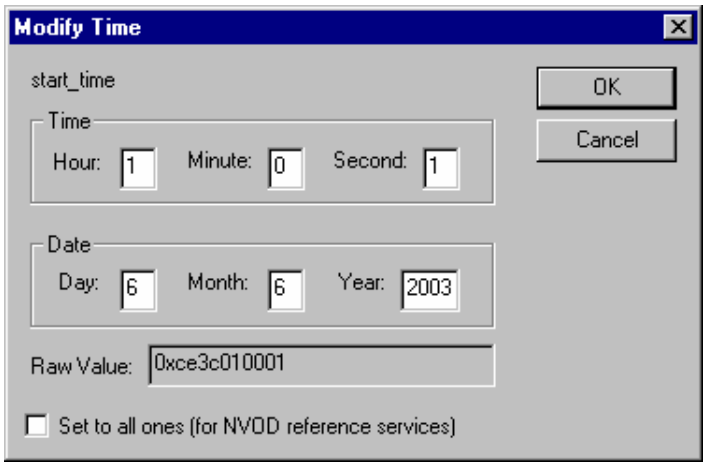
This displays a list of the defined values and their interpretation. The list will vary depending upon the field being edited.



Enter the required value and select **OK** to continue. Multiplexer may open a simple context-sensitive dialog offering advice and/or asking for more information or confirmation. An error message is displayed if the number was typed in requires more bits than are allocated to the field.

Date & Time

The **Modify Time** dialog displays the name of the field. It displays the time in both interpreted and raw formats; only the interpreted mode can be edited.

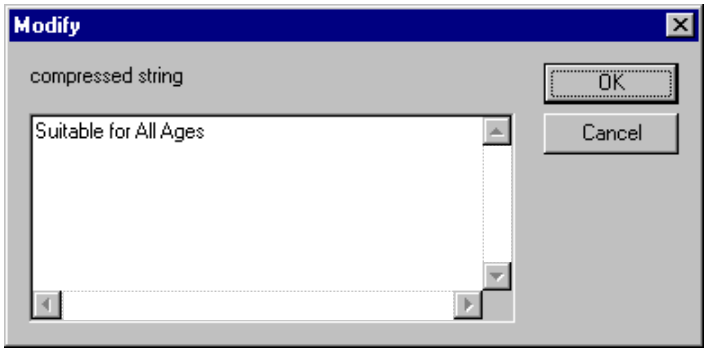


Edit the numbers in any of the fields as required. All fields are updated as each digit is added, changed or deleted. Select **OK** to commit the changes or **Cancel** to abandon editing and keep the original time.

The **Set to all ones…** checkbox, when enabled, sets the 40 bit date field to 0xFFFFFFFFF. This may be required when setting the start_date for an event in a Near Video on Demand (NVOD) reference service.

Compressed String

The **Modify** dialog displays the name of the field, which is always **compressed string**, and the contents of the selected string segment. Text can be entered, deleted, selected, copied to and pasted from the windows clipboard.



Edit the text and select **OK** to continue. Select **Cancel** to abandon the edits and leave the original segment unchanged. Multiplexer will check that the new string length will not make the total section length exceed the maximum specified by the standards.

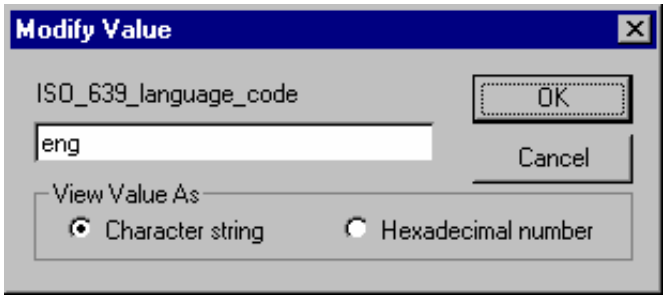
If it does an error message will be displayed:

Select **OK** to return to the **Modify** dialog and shorten the string.

Text

The **Modify Text** dialog displays the name of the field and the current text on a single line. Text can be entered, deleted, copied to and pasted from the windows clipboard.

In this screenshot, the field being edited is an **ISO_639_language_code** and the current text is **eng**.



View Value As allows the user to choose between viewing the text as an ASCII character string or a hexadecimal sequence.

Most text strings have a maximum length, specified by the governing standards, which this dialog will enforce. Edit the text and select **OK** to continue. Select **Cancel** to abandon the edits and leave the original text unchanged.

Numeric

The **Modify** dialog displays the name of the field and the current value in decimal. Edit the existing value or type in a new value.

In this screenshot, the field being edited is a **version_number** and the current value is **0xc**.

A new value may be entered using either decimal or hexadecimal notation. Values are assumed to be decimal unless prefixed with **0x**. The dialog is not case sensitive and values may include zeros after the prefix and before any significant digits, for example:

Edit or replace the existing value then select **OK** to continue. Select Cancel to abandon any changes made in the field.

Multiplexer will check the new value against the governing standards and for conflicts with other fields. It may open a simple context-sensitive dialog offering advice and/or asking for more information or confirmation. For example: when changing a **version_number** a dialog is opened to determine the scope of the change.

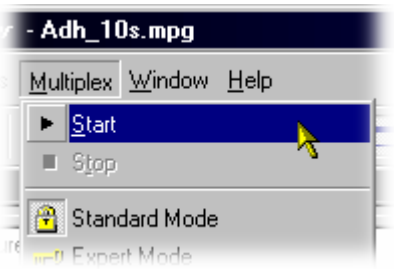
Multiplexing Transport Streams

The Multiplex Engine in the Multiplexer synthesises a new transport stream and writes it to an MPEG file. The contents of the new stream are multiplexed according to the specification currently held in memory, which is shown in the Navigator and Section views.

The tables displayed in the Navigator are synthesised from the current specification. Elementary streams and other data are acquired from the original MPEG file and other stream files and re-multiplexed according to the specification.

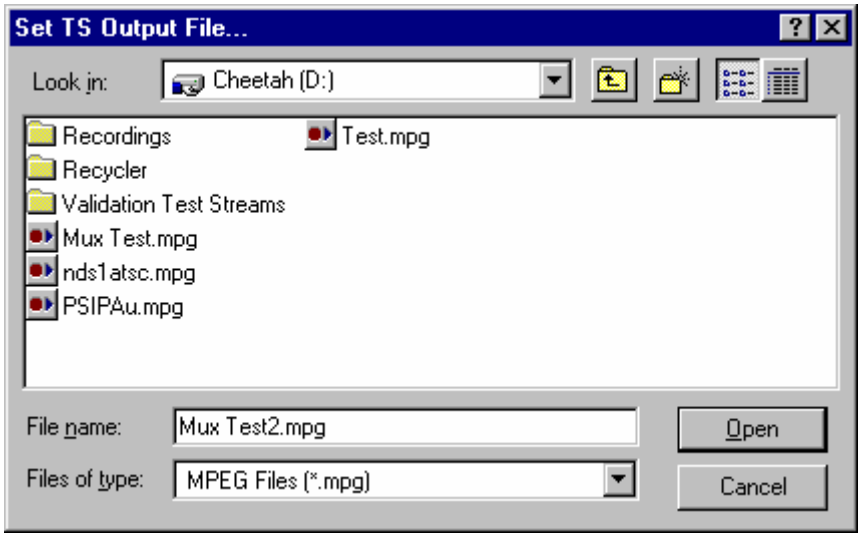
Start

To start the Multiplex Engine select the **Start** option from the **Multiplex** menu.



Alternatively select the start button on the Toolbar:

Multiplexer opens a standard file-browser dialog to specify the file name and path for the synthesised transport stream.



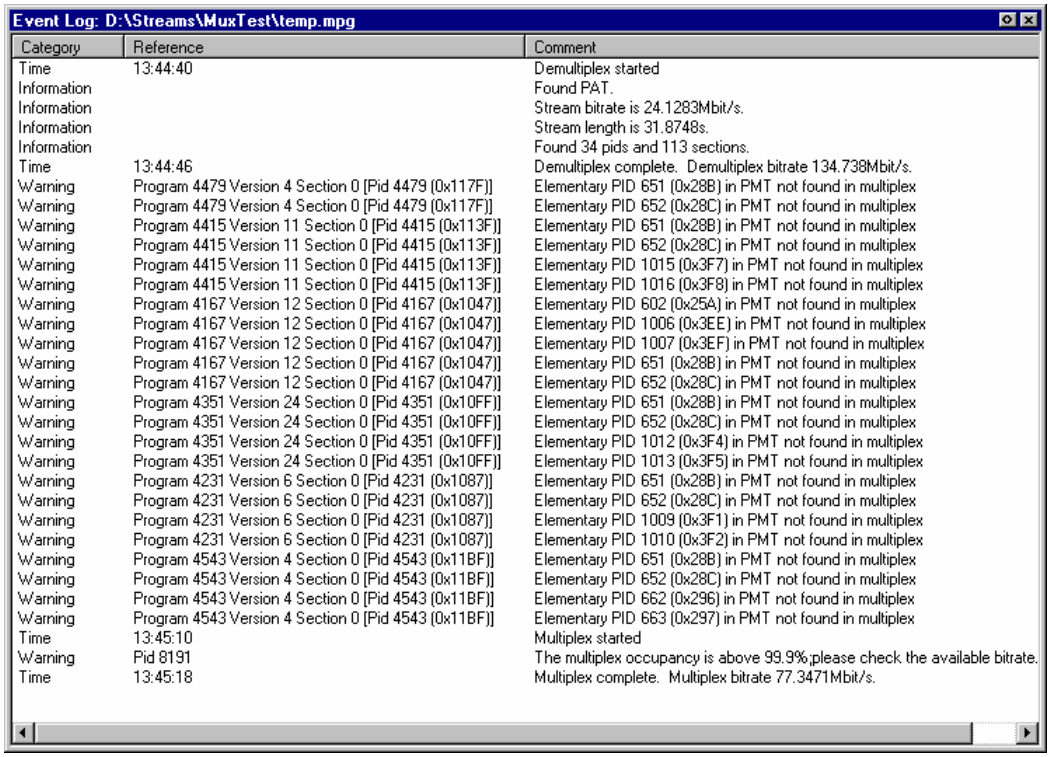
A new file may be created or an existing file can be selected to be overwritten. The program will seek confirmation before writing over an existing file.

The Multiplexer automatically creates 188 byte packets in the transport stream output file, regardless of the source material size.

Errors and Reporting

The right hand pane of the status bar indicates progress as the Multiplex Engine synthesises the new transport stream.

Any errors are recorded in the Event Log, which can be opened at any time before, after and during processing. Here is an example where a table can not be multiplexed into the new stream at the specified rate:



Event Log: D:\Streams\MuxTest\temp.mpg

Category	Reference	Comment
Time	13:44:40	Demultiplex started
Information		Found PAT.
Information		Stream bitrate is 24.1283Mbit/s.
Information		Stream length is 31.8748s.
Information		Found 34 pids and 113 sections.
Time	13:44:46	Demultiplex complete. Demultiplex bitrate 134.738Mbit/s.
Warning	Program 4479 Version 4 Section 0 [Pid 4479 (0x117F)]	Elementary PID 651 (0x28B) in PMT not found in multiplex
Warning	Program 4479 Version 4 Section 0 [Pid 4479 (0x117F)]	Elementary PID 652 (0x28C) in PMT not found in multiplex
Warning	Program 4415 Version 11 Section 0 [Pid 4415 (0x113F)]	Elementary PID 651 (0x28B) in PMT not found in multiplex
Warning	Program 4415 Version 11 Section 0 [Pid 4415 (0x113F)]	Elementary PID 652 (0x28C) in PMT not found in multiplex
Warning	Program 4415 Version 11 Section 0 [Pid 4415 (0x113F)]	Elementary PID 1015 (0x3F7) in PMT not found in multiplex
Warning	Program 4415 Version 11 Section 0 [Pid 4415 (0x113F)]	Elementary PID 1016 (0x3F8) in PMT not found in multiplex
Warning	Program 4167 Version 12 Section 0 [Pid 4167 (0x1047)]	Elementary PID 602 (0x25A) in PMT not found in multiplex
Warning	Program 4167 Version 12 Section 0 [Pid 4167 (0x1047)]	Elementary PID 1006 (0x3EE) in PMT not found in multiplex
Warning	Program 4167 Version 12 Section 0 [Pid 4167 (0x1047)]	Elementary PID 1007 (0x3EF) in PMT not found in multiplex
Warning	Program 4167 Version 12 Section 0 [Pid 4167 (0x1047)]	Elementary PID 651 (0x28B) in PMT not found in multiplex
Warning	Program 4167 Version 12 Section 0 [Pid 4167 (0x1047)]	Elementary PID 652 (0x28C) in PMT not found in multiplex
Warning	Program 4351 Version 24 Section 0 [Pid 4351 (0x10FF)]	Elementary PID 651 (0x28B) in PMT not found in multiplex
Warning	Program 4351 Version 24 Section 0 [Pid 4351 (0x10FF)]	Elementary PID 652 (0x28C) in PMT not found in multiplex
Warning	Program 4351 Version 24 Section 0 [Pid 4351 (0x10FF)]	Elementary PID 1012 (0x3F4) in PMT not found in multiplex
Warning	Program 4351 Version 24 Section 0 [Pid 4351 (0x10FF)]	Elementary PID 1013 (0x3F5) in PMT not found in multiplex
Warning	Program 4231 Version 6 Section 0 [Pid 4231 (0x1087)]	Elementary PID 651 (0x28B) in PMT not found in multiplex
Warning	Program 4231 Version 6 Section 0 [Pid 4231 (0x1087)]	Elementary PID 652 (0x28C) in PMT not found in multiplex
Warning	Program 4231 Version 6 Section 0 [Pid 4231 (0x1087)]	Elementary PID 1009 (0x3F1) in PMT not found in multiplex
Warning	Program 4231 Version 6 Section 0 [Pid 4231 (0x1087)]	Elementary PID 1010 (0x3F2) in PMT not found in multiplex
Warning	Program 4543 Version 4 Section 0 [Pid 4543 (0x11BF)]	Elementary PID 651 (0x28B) in PMT not found in multiplex
Warning	Program 4543 Version 4 Section 0 [Pid 4543 (0x11BF)]	Elementary PID 652 (0x28C) in PMT not found in multiplex
Warning	Program 4543 Version 4 Section 0 [Pid 4543 (0x11BF)]	Elementary PID 662 (0x296) in PMT not found in multiplex
Warning	Program 4543 Version 4 Section 0 [Pid 4543 (0x11BF)]	Elementary PID 663 (0x297) in PMT not found in multiplex
Time	13:45:10	Multiplex started
Warning	Pid 8191	The multiplex occupancy is above 99.9%;please check the available bitrate.
Time	13:45:18	Multiplex complete. Multiplex bitrate 77.3471Mbit/s.

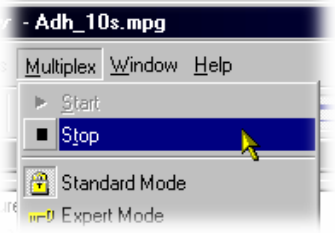
Each table has a specification for nominal and maximum interval, in milliseconds, between instances of the table. These can be edited via the Navigator. The multiplex engine will try to multiplex the table into the synthesised transport stream at the nominal repetition rate. Errors are reported whenever packets for any PID cannot be encoded at their specified minimum rate.

The complete text may be copied onto the windows clipboard, using the **Copy** option from the right-click menu. The text can also be cleared with the **Clear** command. Both commands are also available from the **Edit** menu.

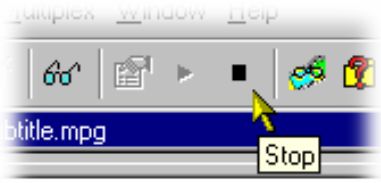
Stop

The Multiplex Engine can be stopped at any time while it is running. This will abandon processing and close the file. The file will contain all of the packets synthesised up to the time the engine was stopped.

To stop the Multiplex Engine select the **Stop** option from the **Multiplex** menu.



Alternatively select the stop button on the Toolbar:



Exporting the Multiplex Configuration File

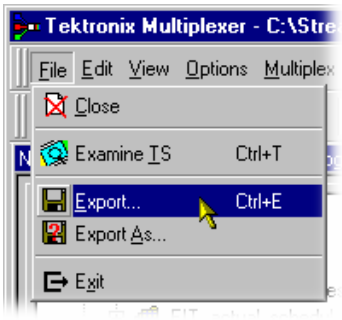
Multiplexer is used for generating both conformant and non-conformant streams. Use the **Export** and **Export As** options to save copies of the specification for non-conformant streams in a multiplex configuration file. This file does not include a copy of the transport stream, instead, it refers to the original MPEG file by name and location.

The multiplex configuration file can be re-opened using the **Import** option (see page 12).

Export

Select the **Export…** option from the **File** menu to save any changes to the current multiplex configuration file.

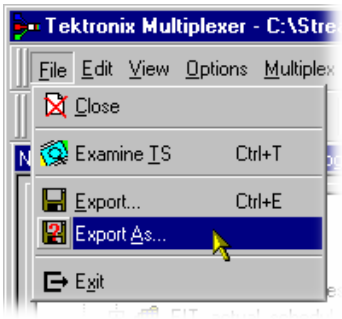
Alternatively, use the **Ctrl+E** keyboard shortcut.



If a multiplex configuration file has not been opened **Export…** opens a standard file browser dialog to specify the file. This is the same as selecting the **Export As…** option.

Export As

The **Export As…** option from the **File** menu exports a file with a user specified name.



Multiplexer opens a standard file browser dialog to select an existing file or specify a new file:

If creating a new file specify the name of the exported file and select where it will be saved. By default files are be created with **.muxml** as the file extension.

Make Seamless

When looping a transport stream to simulate continuous playout, errors can be generated at the loop point caused by discontinuities in timing information. The Seamless option provides the opportunity of creating seamless MPEG-2 files.

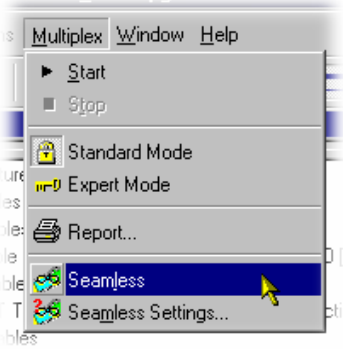
The option can be set up and enabled so that all multiplex operations result in seamless output – or none.

Enabling the Seamless option

Toggle the Seamless option by selecting **Multiplex ➔ Seamless**.

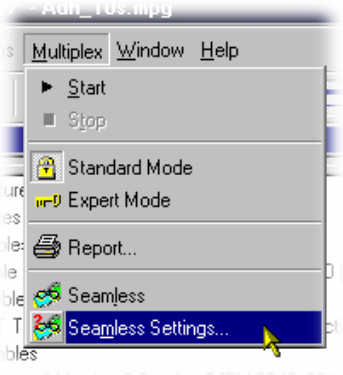
or

by selecting the toolbar button 

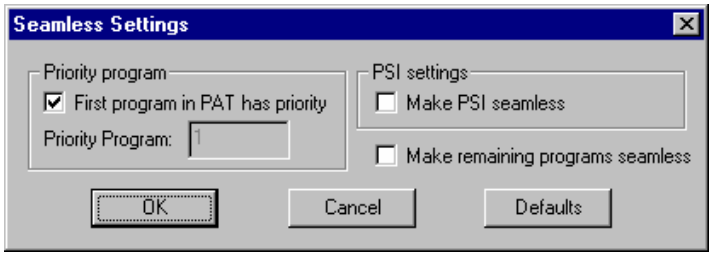


Seamless Settings

Open the Seamless Settings dialog by selecting **Multiplex ➔ Seamless Settings…**



The dialog shown below is displayed:



Priority program

First program in PAT has priority If this setting is enabled the first program specified in the PAT will be given priority in the make seamless process.

If the setting is disabled, the priority program can be specified in the **Priority Program**. The number can be deduced by inspecting the results of the transport stream analysis.

PSI settings

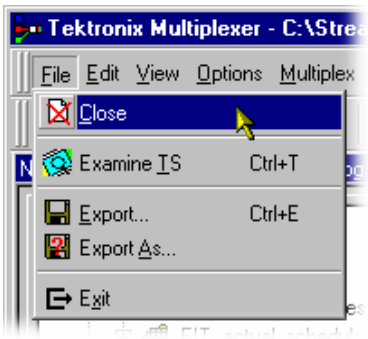
Make PSI seamless If enabled, the service information contained in the transport stream is processed to make it seamless.

If the setting is disabled, the PSI/SI is not processed but simply copied to the output transport stream.

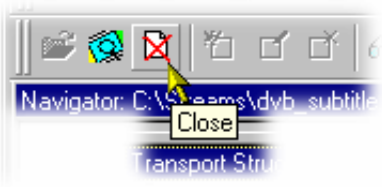
Make remaining programs seamless If enabled, the remaining programs are made seamless but are constrained by limits defined by the priority program. This may lead to these remaining programs having a gap at the beginning and end of the file.

Closing files

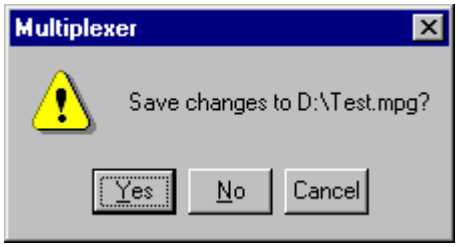
To close the files select the **Close** option from the **File** menu. This will close both the MPEG file and any multiplex configuration file that is open.



There is also a shortcut button available on the Toolbar for closing a file, which has a standard file close symbol:



If a multiplex configuration file has been edited, and the changes not exported, the program will ask if the file should be saved.



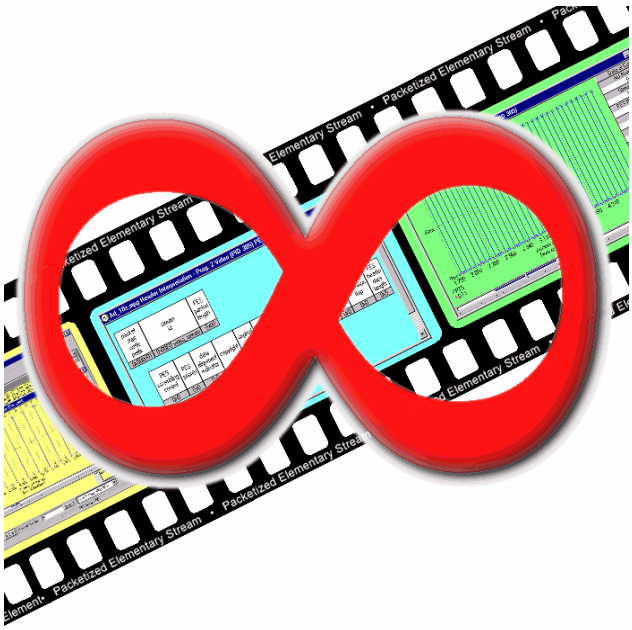
Select **Yes** to export the file, **No** to close the file without saving or **Cancel** to undo the close command and keep the file open.

Reference

Abbreviations

Abbreviation	Expansion
AIT	Application Information Table
ASCII	American Standard Code for Information Interchange
ATSC	Advanced Television Systems Committee
CAT	Conditional Access Table (MPEG)
CDT	Carrier Definition Table
CVCT	Cable Virtual Channel Table (ATSC)
DSM-CC	Digital Storage Media - Command and Control
EIT	Event Information Table (DVB/ATSC)
ES	Elementary Stream
ETT	Extended Text Table (ATSC)
MGT	Master Guide Table (ATSC)
MMT	Modulation Mode Table
NIT	Network Information Table (DVB)
PAT	Program Association Table (MPEG)
PES	Packetized Elementary Stream
PID	Packet IDentifier
PIT	Program Information Table (ATSC)
PMT	Program Map Table (MPEG)
PSI	Program Specific Information (MPEG)
PSIP	Program and System Information Protocol (ATSC)
RAID	Redundant Array of Independent Disks
RRT	Regional Ratings Table (ATSC)
RST	Running Status Table (DVB)
SDT	Service Description Table (DVB)
SI	Service Information (DVB)
SIT	Satellite Information Table
STT	System Time Table (ATSC)
TDT	Time and Date Table (DVB)
TDT	Transponder Data Table (ATSC)
TNT	Transponder Name Table
TOT	Time Offset Table (DVB)
TS	Transport Stream
TSTD	Transport Streams Description Table
T-STD	Transport Stream System Target Decoder
TVCT	Terrestrial Virtual Channel Table (ATSC)
UTC	Universal Co-ordinated Time
VCT	Virtual Channel Table (ATSC)
XML	Extensible Markup Language

Section 9



Make Seamless Wizard

Introduction 3
Using the Make Seamless Wizard 4
Starting the Wizard 4
Selecting an Input File 5
Select a Program to Make Seamless 8
Selecting a Multiplex Output File 10

Introduction

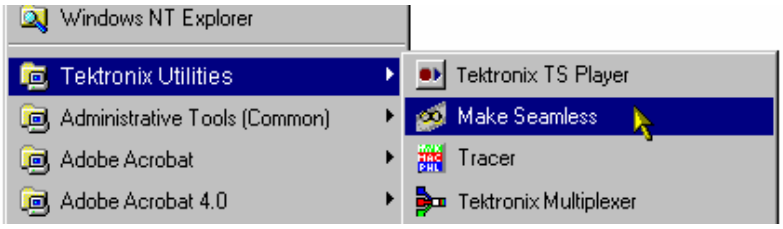
This Wizard guides the user through the process of creating an MPEG-2 file for use by Stream Player in continuously looped operation.

The Wizard is largely self-explanatory relying as it does on intuition and text based instructions. The notes in this section of the user guide provide a slightly more detailed explanation of the Wizard and the necessary user responses.

Using the Make Seamless Wizard

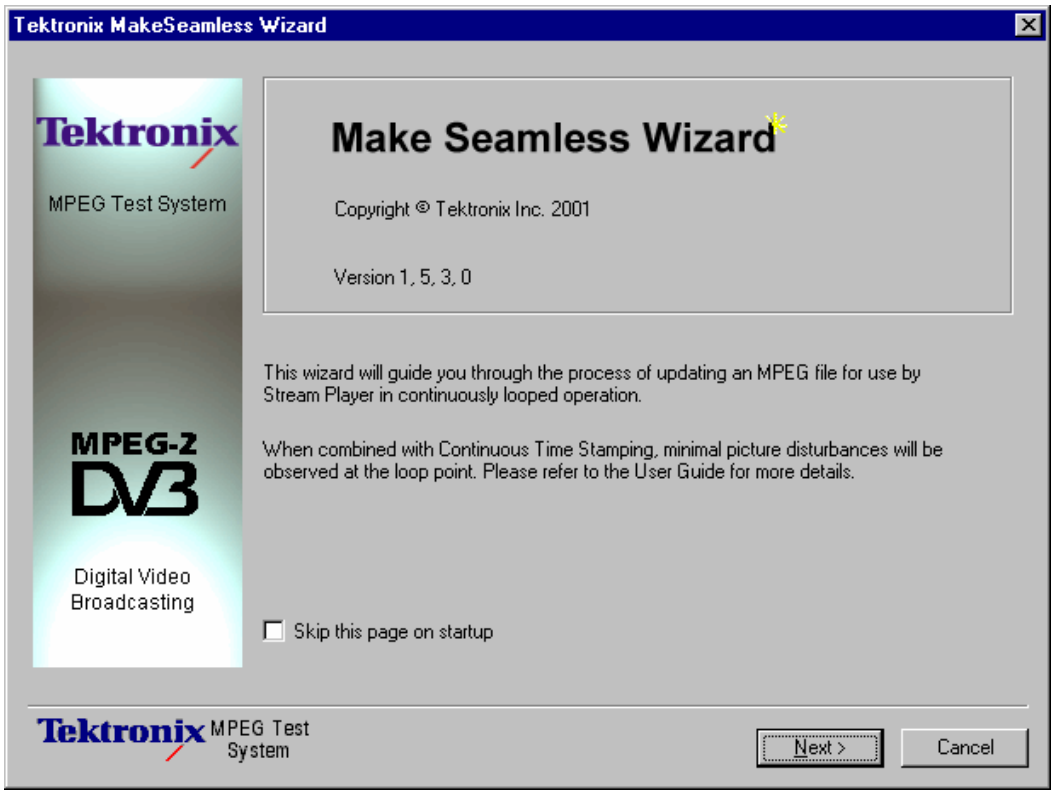
Starting the Wizard

The wizard may be started by selecting the **Make Seamless** option from the **Adherent Utilities** sub-menu of the **Start** ➔ **Programs** menu (left). Alternatively, double-click on the **Make Seamless** shortcut on the desktop (right).



or

The opening window is displayed:



This first page gives a short explanation of the Wizard's activities and offers the opportunity to skip the page in future.

Select **Next** to move to the next screen and specify the input file.

Progress & Information Log

The Progress & Information log displays messages during the operation of the wizard. Three types of message can be displayed:

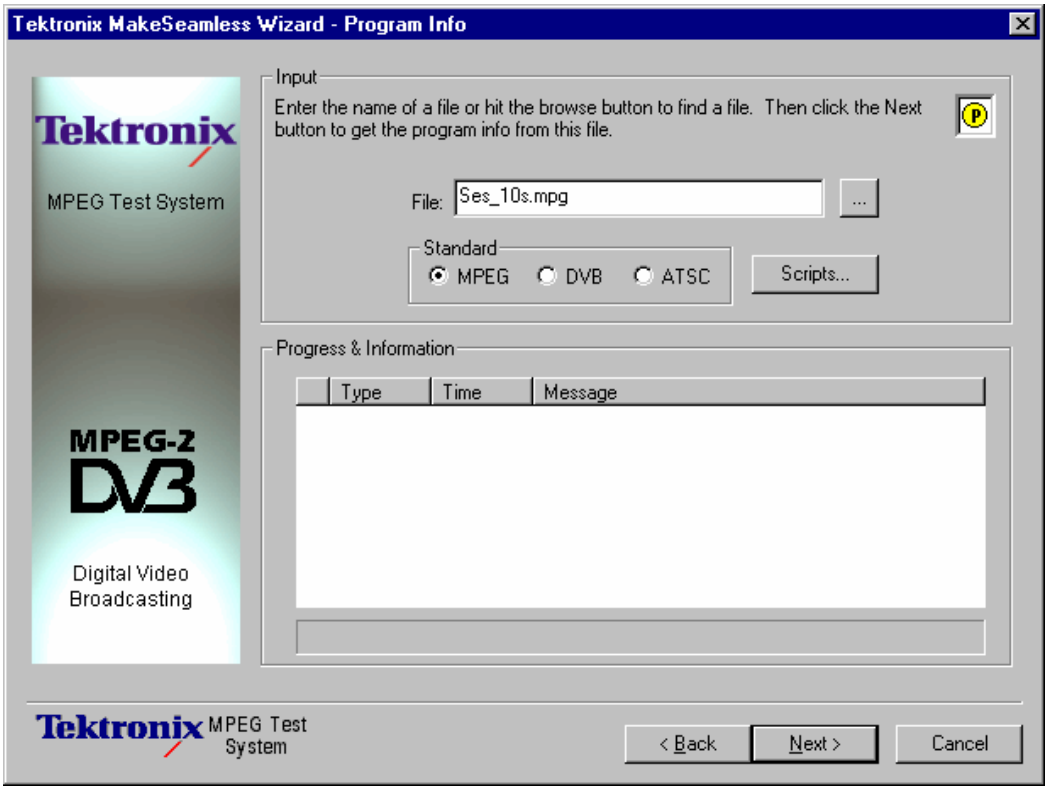
INFO	General processing information.
WARNING	Messages which may mean that the output stream will contain errors.
ERROR	Messages indicating catastrophic information which will cause the wizard to disable the Next button and prevent further progress.

An icon is displayed in the top right-hand corner of the window and as a prefix to any messages displayed in the Progress & Information log. The icons are used to indicate the current processing phase of the Make Seamless Wizard:

Program (P) Analysis (A) Multiplex (M)

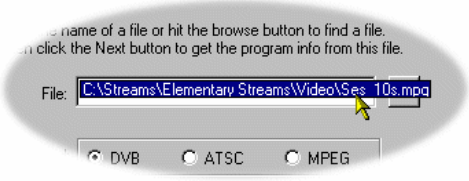
Selecting an Input File

The first action is to identify the input or source transport stream.



Enter the filename in the **File:** field. The browse button (**...**) can be used to open a standard Windows Open dialog and locate files.

Note that only the filename will be shown, but that by resting the cursor over the filename, the full path is shown for a short time.



SI Scripts

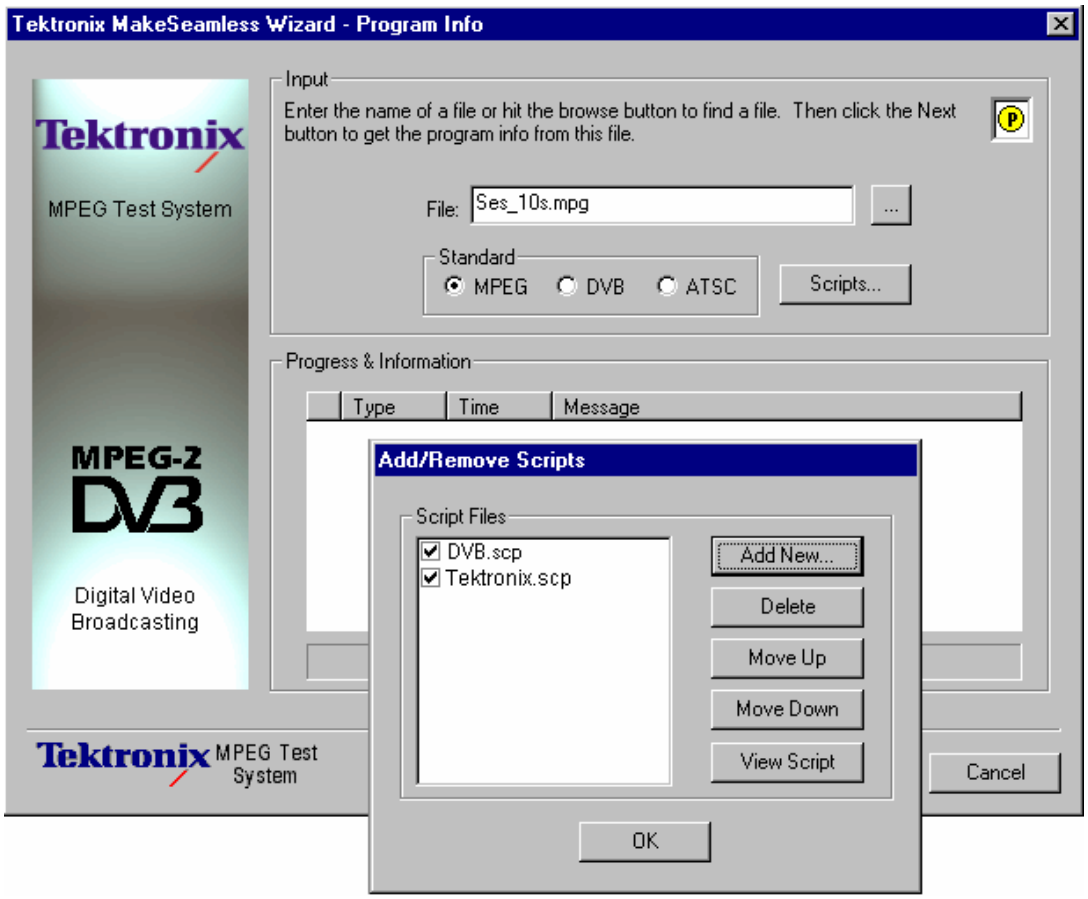
Customised SI scripts are available to the Make Seamless Wizard to enable custom SI table and descriptor data to be processed successfully. Basic processing of the Standards does not require additional scripts.

If a suitably configured script is selected and enabled before a stream is analyzed, custom data will be analyzed when the stream is opened. If the script is not selected or enabled the stream will not fail to be analyzed, but any custom data will either be ignored or reported as an error in the stream configuration.

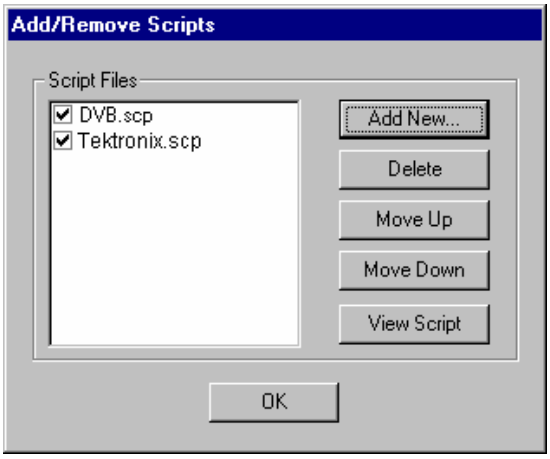
(The underlying principles of scripting are described in the *Custom SI Scripting* section of this user manual.)

Handling Script files

To handle SI Scripts, select the general **Standard** required by enabling the appropriate radio button and select the **Scripts…** button.



The Script Add/Remove dialog is displayed as shown below:



The Script dialog displays the scripts currently associated with each standard and allows them to be added, removed, viewed and manipulated.

There is, in effect, one Script File list associated with each mode; script files can be listed in one or more Script file lists. Script files are designated as MPEG, DVB or ATSC when they are added to the Script File list. Each mode will display only those script files associated with that mode. Further script files can be added as required using the **Add New…** button.

Note that a script file will not be used for analysis until:

- It is added to the Script File list in the appropriate mode.
- It is enabled; that is it displays a check mark '✓' in the Script File list.

Adding a Script file

1. In the Script dialog, select the **Mode** to which the script is to be added; e.g. DVB.
2. Select the **Add New…** button. A standard Windows file selection dialog is opened. The default file extension is .scp. Select the required file.

Note that the selected script file is now listed in the script file list and is enabled; it will be used for any analysis.

Enabling a Script file

A check mark ✓ adjacent to the required script file indicates that it is enabled; that is, it is available for analysis. The check mark has a toggle action; simply place the mouse pointer over the check mark box and click the left-hand button.

Moving a Script file

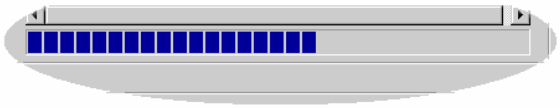
Script files are applied to analysis in the order that they are listed; in some circumstances this may be important. To move a file in a list, highlight the file name and select the **Move Up** or **Move Down** button as required. Each press of the button will move the file up or down one place in the list until it reaches the top or the bottom.

Viewing a Script file

Script files can be viewed and edited in a text editor (provided that the scp extension has been associated correctly in Windows Explorer). To edit a script, highlight the script name and select **View**. This will open the script in Notepad or its equivalent. The required edits can then be made and the script saved.

When the filename is satisfactory and any scripting actions have been performed, select **Next** to analyze the file.

Progress is indicated by the progress bar and the appearance of messages in the Progress & Information log.

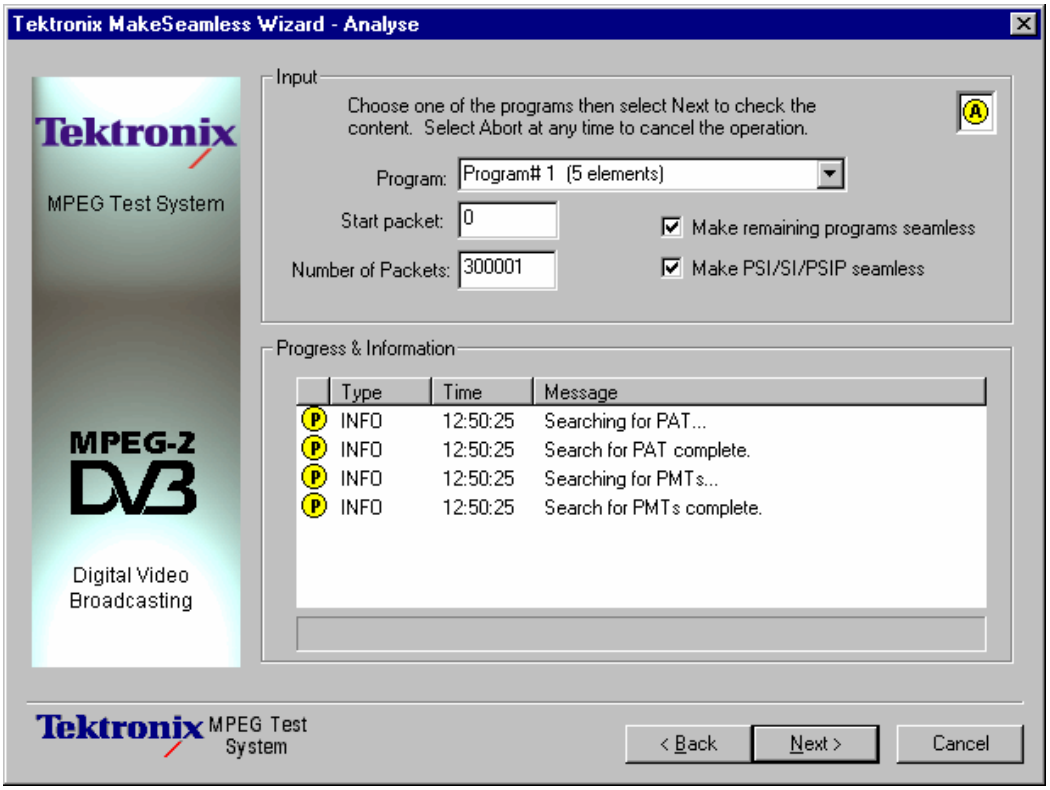


Select a Program to Make Seamless

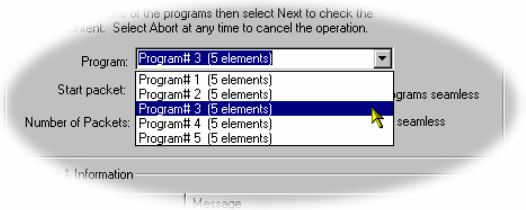
During the input file's analysis the selected transport stream is analyzed to determine it's program content. If analysis is unsuccessful in determining program content, the stream will not be opened and an appropriate message will be displayed in the Progress & Information log.

Each program found is displayed in the drop-down list (**Program:**) accompanied by an indication of the number of program elements (video, audio, etc.).

At this stage a priority program must be selected in order for it to be analyzed and tested for suitability for the 'make seamless' treatment.



Program: Highlight the program required from the drop-down list.



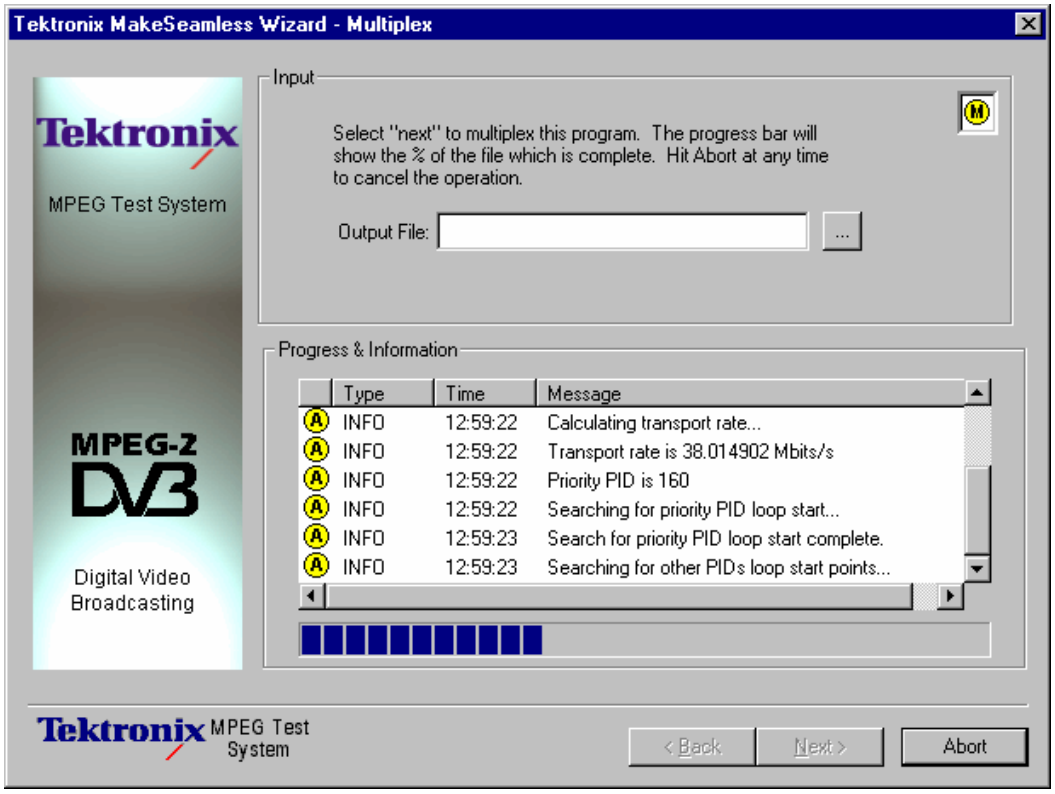
Start packet: This value determines from where the primary program is to be analyzed. Indicates the offset from the original transport stream start point to start looking for a loop start point.

Number of Packets: Initially this value is set to the total number of packets in the transport stream. It indicates the maximum number of packets (up to the end of the stream) from the **Start packet** point that may be included in the loop.

Make remaining programs seamless If enabled, the remaining programs are made seamless but are constrained by limits defined by the priority program. This may lead to these remaining programs having a gap at the beginning and end of the file.

Make PSI/SI/PSIP seamless The service information contained in the transport stream is processed to make it seamless.

If this checkbox is not enabled, the SI is not processed but simply copied to the output transport stream.

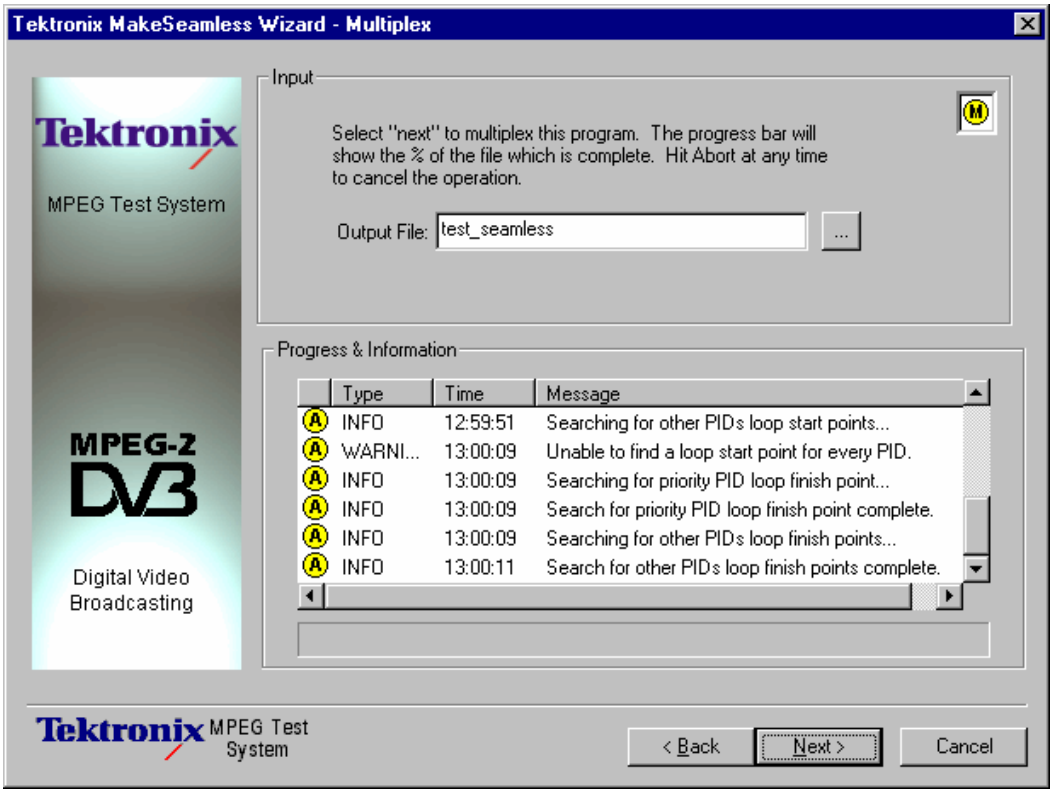


Select **Next**. Once again the progress bar will indicate progress. While the stream is being analyzed, selecting the **Abort** button will stop the process and allow the program to be reselected (Note that the **Abort** button, which replaces the **Cancel** button, is only displayed during processing).

When the file has been analyzed, a number of messages will have been posted in the Progress & Information log.

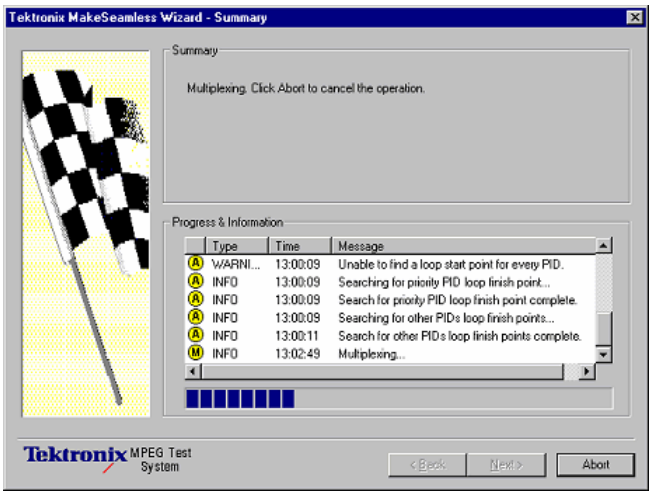
Selecting a Multiplex Output File

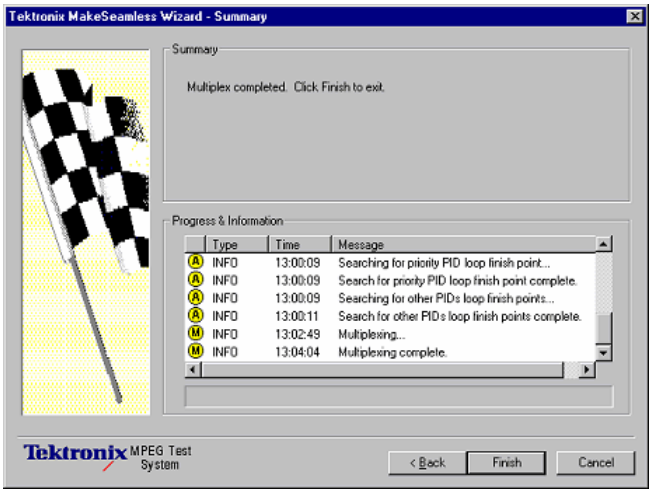
When a file has been analyzed and found suitable for making seamless, an output file must be named.



A new filename can be typed or an existing file selected using the Browse button (**...**), in which case confirmation of the replacement will be required. Select **Next** to create the multiplexed output file.

The screen shown below is displayed upon completion of the process.

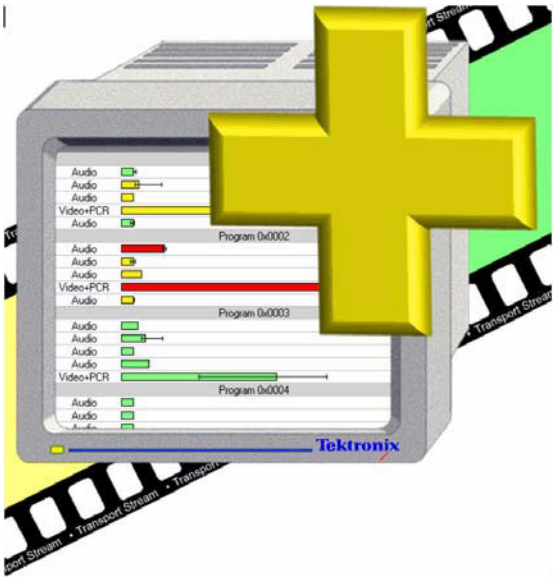




The output file will contain a program which when played out and looped with the Continuous Time Stamping option enabled will demonstrate minimal picture disturbances at the loop point.

Section 10

Stream Monitor Plus

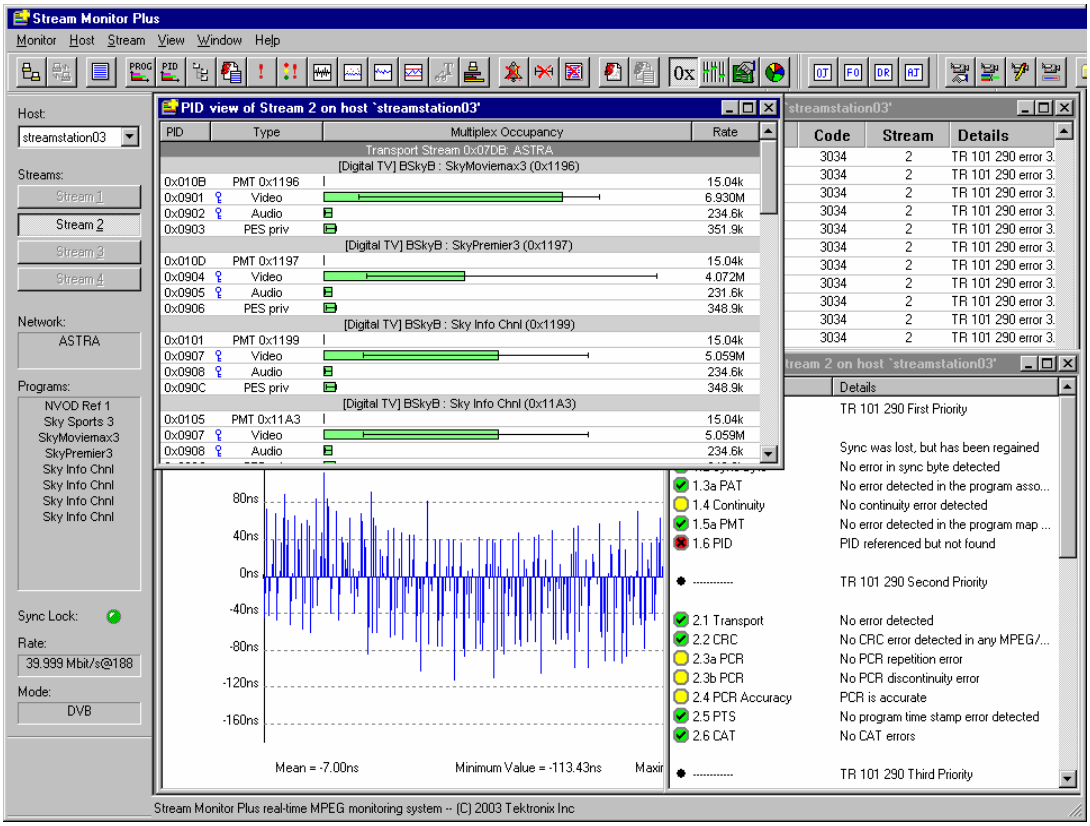


Description of Features 3
Starting the Program 5
Initial Appearance 5
Initial Menu Options 6
Installing a Custom SI Script 7
Connecting to a Host 8
Menus And Controls 10
Streams Bar 10
Toolbar 11
Jitter Analysis Bar 12
Record Bar 13
Status Bar 13
Menus and Options 14
Errors, Events and Indicators 19
Custom SI Scripting 20
Handling Scripts and Modules 21
Script Selection 22
Expert Mode 23
Viewing Host and Stream Logs 24
Host Log 25
Stream Log 26
Error Classification 27
Logs and the Error Views 31
Navigation 31
Setting Highlights 32
Log View Filter 33
Save Log 34
Stream Configuration 35
Monitoring Streams 37
Program and PID Views 37
Structure View 46
Error View 50
Error LEDs 54
PCR Statistics Graphs 55
TS Fullness Graph 65
TMCC Information 66
MPE Sessions 66
MIP Sessions 67
Pie Chart 68
Recording Streams 69
Record Wizard 70
Filter Editor 71
Trigger Editor 74
Streamfile Manager 85
Recorder Configuration 90
Record Master Controls 93
Monitoring Hosts 95
Version Information 95
Disconnecting from a Host 95
References 96

Description of Features

The Stream Monitor Plus application enables DVB, ATSC and ARIB-SI Transport Streams to be recorded to hard disk, monitored for errors and non-compliance to the DVB, ATSC and ARIB-SI standards.

The user interface looks like this:



The server software is invisible to the user when running. It is started automatically by the connection of a client User Interface.

Stream Monitor Plus provides facilities to:

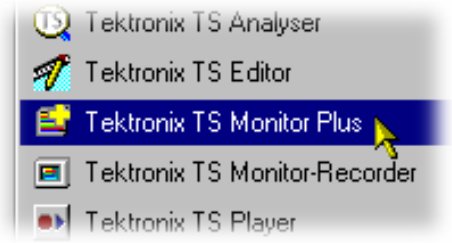
- Concurrently monitor one or more transport streams, in real time. The monitor functions include:
    - Conformance checking against the DVB standards using the Priority 1, 2 and 3 measurements defined in TR 101 290.
    - Conformance checking against the ATSC standards.
    - Error Logging and ‘at a glance’ displays of conformance test results.
    - Options to configure test parameters.
    - Decoding and display of SI/PSI table data.
    - Displaying minimum, maximum and current occupancy of each PID and program within each transport stream.

- Options to specify range limits tests for the occupancy of individual Programs and PIDs.
- Graphs showing recent PCR Accuracy, Arrival Interval and Instantaneous Transport Rates, PCR Overall Jitter (PCR-OJ), PCR Frequency Offset (PCR-FO), PCR Drift Rate (PCR-DR) and PCR Arrival Time Jitter (PCR-AJ).
- A graph of capacity usage in the transport stream.

- Record transport streams to files on disk for subsequent analysis, processing and playout. The recording functionality includes:
  - Choice of manual or automatic triggering of recording.
  - A user definable amount of transport stream data may be captured prior to the recording trigger event.
  - One or more conformance and range limit test results can be selected to trigger automatic recording.
  - Recording can be triggered when selected fields in transport stream packet headers contain a user-specified value.
  - Multiple recording sessions can be set up enabling automatic capture of data for successive trigger events.

Starting the Program

The program may be started by selecting the **Tektronix TS Monitor Plus** option from the Start -> Programs menu.

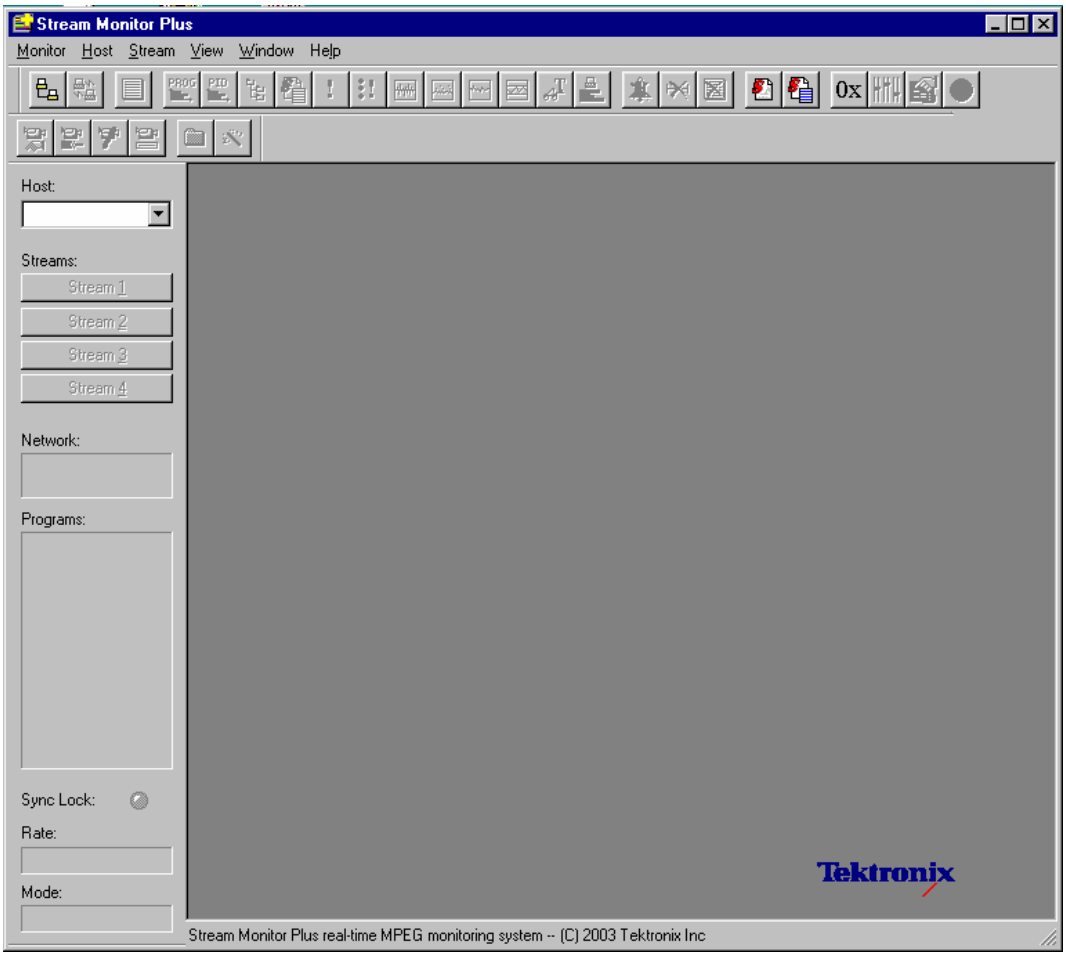


or

by double clicking on the **Tektronix TS Monitor Plus** Shortcut on the desktop.

Initial Appearance

Once the program has started and is ready for use it will open a Main Window. When the program starts the main window looks something like this:



The three toolbars (two at the top of the screen and one to the left of the screen in the example) may be hidden from view, moved to a separate window, either side or the bottom of the main window.

From the top of this example the toolbars are:

- Toolbar - for connecting to hosts and monitoring streams
- Record Bar - to configure and manage recording sessions
- Streams Bar - (shown on the left) for selecting hosts and streams

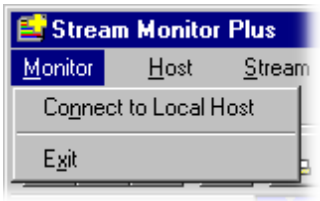
The Status line at the very bottom of the window may be hidden from view. It displays messages and brief explanations of menu options.

Stream Monitor Plus saves the window size, position and visibility of the toolbars when it is closed. This window and toolbars are laid out using those properties next time it is run.

Initial Menu Options

Users are presented with different menus and options, depending on whether or not a host is connected to for monitoring/recording; unavailable options may also be greyed out. The File Menu options available when the program has just been started, or after a file is closed, are:

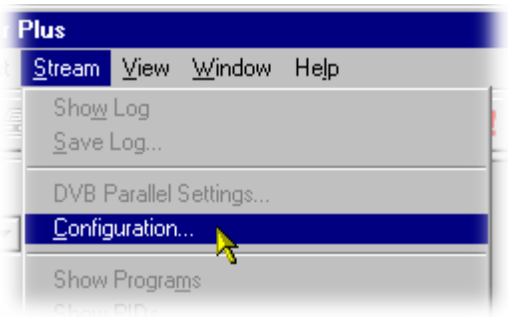
File Menu Options



Connect to Local Host Opens a connection for monitoring and recording Transport Streams on the MPEG Test System running this program.

Exit Finishes running the program.

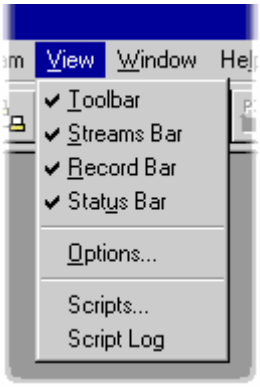
Stream Menu Options



Configuration… Allows the Stream Mode (DVB, ATSC or MPEG) to be selected before connecting to a host.

View Menu Options

Before a host is connected, scripts can be added/modified.



Scripts… Opens the **Add/Remove Scripts** dialog.

Script Log Opens the **Script Log** window.

The remaining options are described in Note: The Stream **Mode** selection in the **Stream Configuration** dialog (page 9) and the **Base Standard** selected in the **Stream Interpretation** dialog (page 22) ***must*** be the same for the correct scripts to be applied to the stream.

Menus And Controls, page 9.

Installing a Custom SI Script

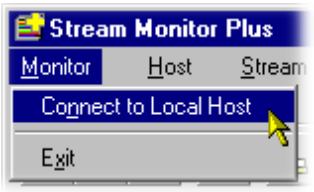
Before connecting to a host (see following section), it is necessary to ensure that the necessary Custom SI Scripts are in place. This activity is described in Custom SI Scripting, page 20 et seq.

Connecting to a Host

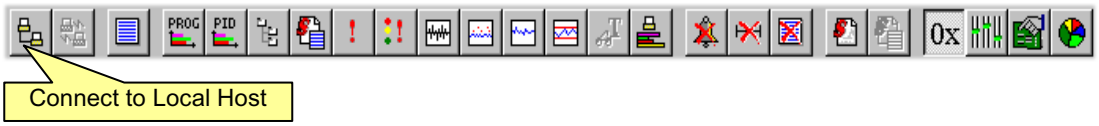
Up to four transport streams can be monitored. At present MPEG Test Systems only support one or two MIC adapters, and hence, one or two transport streams.

Connecting to the Local Host

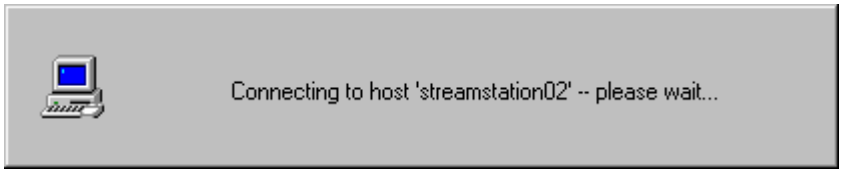
To connect to the local host select the **Connect to Local Host** option from the **Monitor** menu.



Or alternatively click on the Connect to Local Host button on the toolbar:



Making the connection takes a few moments, during which this dialog is displayed:



The dialog is replaced once connection is established with another. This displays the hostname of the local machine, e.g. **STREAMSTATION02**:

Select **OK** to continue.

Stream Monitor Plus will display a message if an error occurs or the connection is not made within a reasonable time.

Duplex Operation

With two MPEG Interface Cards (MICs) fitted to the MPEG Test System and the duplex dongle option enabled, MPEG Test System can be operated in duplex mode. For example, whilst the Player is playing out a stream, Stream Monitor Plus can be monitoring a separate stream or, if the Player output is looped back to the input of the other MIC card, the output of the Player can be monitored by Stream Monitor Plus.

Because of the way Stream Monitor Plus handles resources, it should be the last application opened if duplex operation is to be successful.

Monitoring of the Hosts

Once a connection is established the client starts to receive, and make available for display, information from the server. The Streams Bar automatically displays information for Stream 1, for example:

Stream Mode Configuration

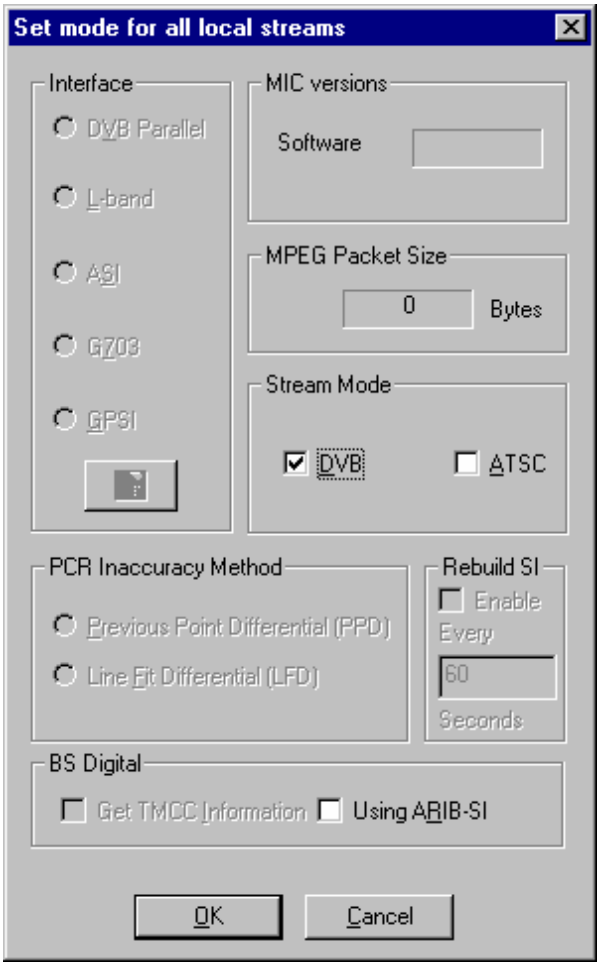
Before a connection is made, it is advisable to set the Stream Mode in the Configuration dialog. Analysis will start as soon as Stream Monitor Plus is connected; setting the Stream Mode should pre-empt any problems that arise in trying to analyze the wrong standard.

With no connection made, select **Streams ➔ Configuration…**.

Select the **Stream Mode** required and press the **OK** button.

Stream Monitor Plus is both DVB and ATSC compliant. Select the **Stream Mode** standard required. Selecting neither will ensure that only the basic MPEG conformance tests are performed. If ARIB-SI is expected then enable the **Using ARIB-SI** checkbox.

The SI refresh rate (**Rebuild SI**) is described later (see page 36); for setting up, the option is disabled.



Note: The **Stream Mode** selection in the **Stream Configuration** dialog (page 9) and the **Base Standard** selected in the **Stream Interpretation** dialog (page 22) ***must*** be the same for the correct scripts to be applied to the stream.

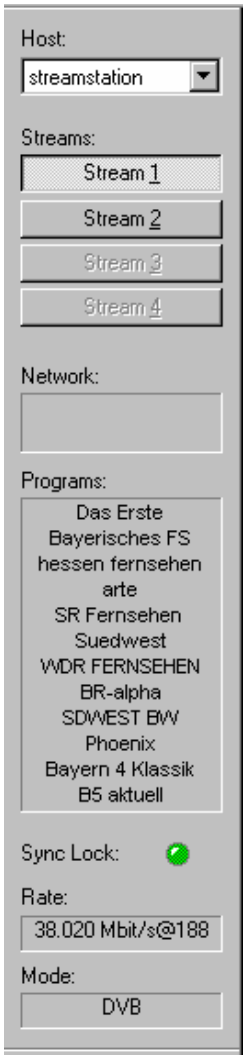
Menus And Controls

When the host is connected the program presents a different set of menus and options. They change as soon as the connection is established.

Streams Bar

Most **Host**, **Recording** and **Stream** menu options operate on the currently selected host and stream. The Stream Bar is used to select the current host and stream. It also displays information about the content and state of the current stream.

The Streams Bar may be oriented horizontally as shown above or vertically as shown to the right. From the left of the horizontal Streams Bar and the top of the vertical example the controls are:



Host — Indicates the current host, i.e. the network name.

Streams — Stream Monitor Plus can monitor up to four streams per host connection. The Streams control provides a button for each possible stream from the current host. A button is enabled for each stream which is available from that host.

Network — Displays the network name of the selected stream, if it can be identified.

Programs — Displays the name of each program which can be identified from the selected stream. The name is acquired from the Service Description Table (SDT) or Virtual Channel Table (VCT).

Sync Lock — Shows whether the Interface on the host machine has locked to the signal. The indicator shows red when sync is lost and green when it is acquired.

Rate — Displays the mean transport stream rate.

Mode — Displays the selected stream mode (ATSC/DVB/ MPEG/DVB-ATSC).

To change the orientation select the **Options** option from the **View** menu. Select or deselect the **Streams Bar Horizontal** option, click on **OK**, then exit and re-start Stream Monitor Plus.

The Streams Bar can be dragged from the edge of the main window into a horizontal or vertical floating pallet. To do this click on the background inside the Streams Bar and drag into the main window area. The result is a self-contained window, for example:

To replace the Streams Bar on the window border drag it over the border until the outline changes shape.

Toolbar

The Toolbar provides a set of convenient shortcuts for frequently used menu options. The available commands are:


Opens a connection to the server on the machine running this program.


(Disabled)


Opens the Add/Remove Scripts dialog.


Opens the Script Log.

The following are shortcuts for options from the **Stream** menu. They are all applied to the stream which is currently selected in the Streams Bar. If no stream is selected these buttons are disabled (greyed out). If a button is selected for which the associated window is already open, the window will be made active and brought to the 'front' of the displayed windows. The available commands are:


Opens a Stream Log window. This is a shortcut for the **Show Log** option.


Opens a Program View window. This is a shortcut for the **Show Programs** option.


Opens a PID View window. This is a shortcut for the **Show PIDs** option.


Opens a Structure View window. This is a shortcut for the **Show Structure** option.


Opens the Script Log window. This is a shortcut for the **Show Script Log** option


Opens an Error View window. This is a shortcut for the **Show Errors** option.


Opens an Error View LEDs window. This is a shortcut for **Show Error LEDs**.


Displays a graph of the PCR Inaccuracy for a program. Before opening the graph a dialog is displayed to select a program from the stream. This is a shortcut for the **Show PCR Accuracy** menu option.


Displays a graph of the PCR Arrival Interval for a program. Before opening the graph a dialog is displayed to select a program from the stream. This is a shortcut for the **Show PCR Arrival** menu option.


Displays a graph of the PCR Instantaneous Transport Rate for a program. Before opening the graph a dialog is displayed to select a program from the stream. This is a shortcut for the **Show Instantaneous Transport Rate** menu option.


Displays a graph indicating how much spare capacity the transport stream contains. This is a shortcut for the **Show Fullness** menu option.


Displays an information window showing the TMCC information for an ISDB-S stream. This is a shortcut for the **Show TMCC Information…** menu option.


Displays the MPE Sessions window. This is a shortcut for the **Show MPE Sessions** menu option.


Resets all Events for the current stream. This is a shortcut for the **Reset Events** option.


Resets all minimum and maximum shown by range bars in the PID and Program views. This is a shortcut for **Reset Min/Max Ranges** option.

Toggles between hex and decimal format in many views and dialogs. When the button is active the hex format is displayed. This is a shortcut for Hex display on the **View** ⇒ **Options** dialog. The selection persists across Stream Monitor Plus sessions.


Resets TR 101 290 and ATSC Test Settings (Repetition Rates) to default.


After confirmation, clears the Host error log (even if not displayed).


Opens the interface card configuration dialog.
(Refer to the Installation section of this User Guide for the Interface card information.)


Displays the Multiplex Statistics (Pie Chart) view.

To change the toolbar to a floating pallet, click the background inside the Streams bar and drag into the main window areas. The resulting window looks like this:"

To replace the Toolbar on the window border drag it over the border until the outline changes shape. It can be placed on the top, bottom, left or right hand edges.

Jitter Analysis Bar

Opens the Overall Jitter (PCR-OJ) view.

Opens the Frequency Offset (PCR-FO) view.

Opens the Drift Rate Measurement (PCR-DR) view.

Opens Arrival Time Jitter (PCR-AJ) view.

Like the Toolbar, the Jitter Analysis Bar can be dragged off the edge of the main window into a floating pallet, for example:

To replace the Jitter Analysis Bar on the window border drag it over the border until the outline changes shape. It can be placed on the top, bottom, left or right hand edges.

Record Bar

The following commands are shortcuts for options on the **Recording** side-menu of the **Host** menu. They are all applied to the host which is currently selected in the Streams Bar. If no host is selected these buttons are disabled (greyed out).

Brings up the Recorder Configuration dialog to select the percentage of the file to be saved prior to the trigger event and which stream to trigger from. This is a shortcut for the **Configuration** option.

Opens the Recording Filter Editor dialog to select which PIDs to record. This is a shortcut for the **Edit Filter** option.

Invokes the Trigger Editor dialog to set up the conditions to trigger recording a file. This is a shortcut for the **Edit Trigger** option.

Opens the Record Master Controls dialog. This is a shortcut for the **Master Controls…** option.

Opens the Streamfile Manager dialog to create, delete, queue for recording, deselect for recording and rewind files. This is a shortcut for the **Streamfile Manager…** menu option.

Invokes the Record Wizard which provides guidance through the process of setting up a recording session. This is a shortcut for the **Wizard…** option.

Like the Toolbar, the Record Bar can be dragged off the edge of the main window into a floating pallet, for example:

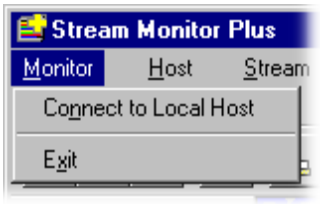
To replace the Record Bar on the window border drag it over the border until the outline changes shape. It can be placed on the top, bottom, left or right hand edges.

Status Bar

The Status Bar may be hidden from view, but if visible is always at the bottom of the main window. It displays a brief description of any menu option or toolbar button under the mouse pointer. The example show above gives a description of the **Record Bar** option from the **View** menu.

Menus and Options

Monitor Menu Options

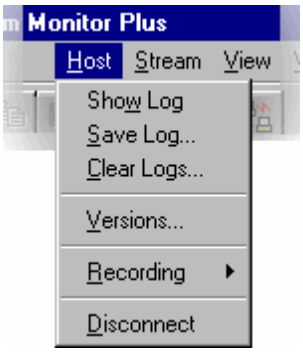


Connect to Local Host
Opens a connection to the server on the machine running this program.

Exit Finishes running the program.

Host Menu Options

All **Host** menu options operate on the host which is currently selected in the Streams Bar.



Show Log… Opens a new window showing the host log.

Save Log… Saves the contents of the host log to disk.

Clear log… After confirmation, clears the Host error log (even if not displayed).

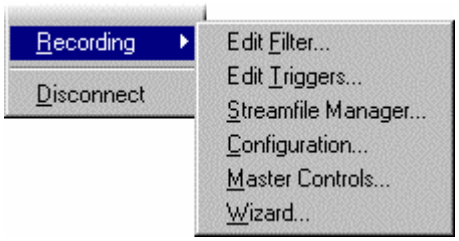
Versions… Displays version information for the software of the active host.

Recording Pops up a side menu for the selecting Recording options.

Disconnect Disconnects the client from the host. The program asks for confirmation before executing this command

Host Recording - Side Menu

All **Recording** side menu options operate on the host which is currently selected in the Streams Bar.



Edit Filter… Opens the Filter Editor dialog to select which PIDs to record.

Edit Triggers… Invokes the Trigger Editor dialog to set up the conditions to trigger recording a file.

Streamfile Manager… Opens the Streamfile Manager dialog to create, delete, queue for recording, deselect for recording and rewind files.

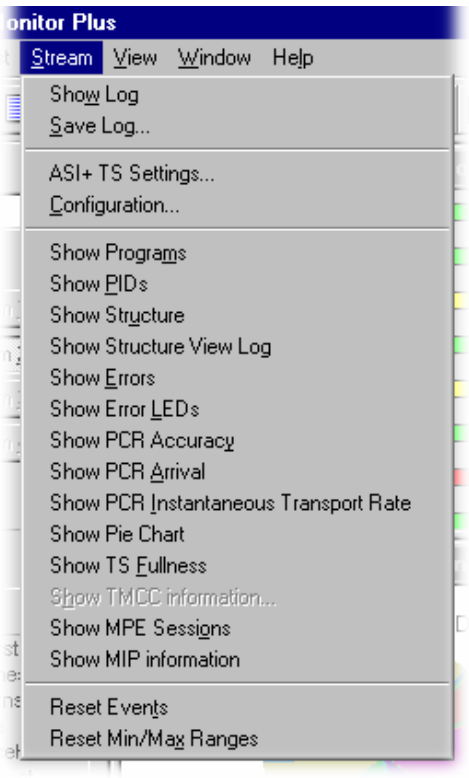
Configuration… Brings up the Recorder Configuration dialog to select the percentage of the file to be saved prior to the trigger event and which stream to trigger from.

Master Controls… Opens the Record Master Controls dialog which allows manual triggering and pausing of recording. It displays trigger status and progress.

Wizard… Invokes the Record Wizard which provides guidance through the process of setting up a recording session.

Stream Menu Options

All **Stream** menu options operate on the stream which is selected in the Streams Bar.



Show Log Opens a new window showing the Stream Log.

Save Log… Saves the Stream Log to disk.

(Interface Card) **Settings…** Opens the interface card settings dialog.

Configuration… Shows the configuration of the interface which is receiving the current stream. Allows the configuration to be changed or a different interface to be selected.

Show Programs Opens a Program View showing the relative occupancy and data rate for each Program in the stream.

Show PIDs Opens a window showing the occupancy and data rate of each PID in the stream.

Show Structure Displays the PSI/SI Tables carried by the stream.

Show Structure View Log Displays the Script Log.

Show Errors Displays an Error View window which shows details of the state for each conformance test.

Show Error LEDs Displays the state of each conformance test via a panel of virtual three colour LEDs.

Show PCR Accuracy Opens a graph of PCR Inaccuracy for a program. A dialog prompts for selection of the program from those carried by the stream.

Show PCR Arrival Opens a graph showing the PCR Arrival Interval for a program. A dialog prompts for selection of the program from those carried by the stream.

Show Instantaneous Transport Rate Opens a graph showing the PCR Instantaneous Transport

Stream Menu Options cont'd…

Rate for a program. A dialog prompts for selection of the program from those carried by the stream.

Show Pie Chart Opens the Pie Chart view.

Show TS Fullness Opens a graph showing the used capacity in the transport stream. That is the number of packets of the null PID.

Show TMCC Information Opens the TMCC Information window.

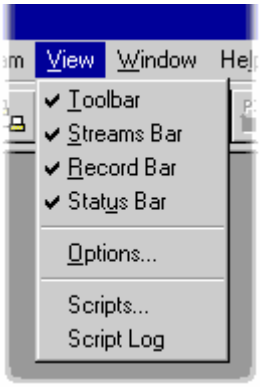
Show MPE Sessions Opens the MPE Sessions window.

Show MIP Information Opens the MIP Information window.

Reset Events Resets all Events for the current stream.

Reset Min/Max Ranges Resets all minima and maxima shown by range bars in the PID and Program views.

View Menu Options



(a check mark ✓ next to an option indicates that the toolbar is currently visible.)

Toolbar Shows or hides the Toolbar.

Streams Bar Shows or hides the Streams Bar.

Record Bar Shows or hides the Record Bar.

Status Bar Shows or hides the Status Bar.

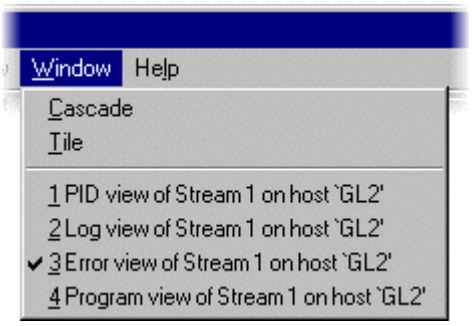
Options… Opens a dialog for selecting program options such as the size of icons in the error view and orientation of the streams bar.

Scripts… Opens the **Add/Remove Scripts** dialog.

Script Log Opens the **Script Log** window. This shows errors generated when parsing the script.

(The **Script Log…** option is only available when a host is *not* connected.)

Window Menu Options

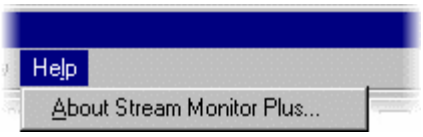


Cascade Re-arranges the windows like this:

Tile Tiles the windows horizontally. For example 3 windows will be arranged like this:

1 ***<window title>*** Makes the named window
2 ***<window title>*** active, putting it on top of any
3 ... etc. windows which had been hiding all or part of it.

Help Menu Options



About ... Opens a dialogue that displays the Program Version Number and the License Number.

Errors, Events and Indicators

Throughout the application, a consistent colour scheme is used for test result indicators, including in the Error and Error LED views, and for the bars of the PID and Program histograms.

The following colours apply:

Green	Test passed.
Red	Test is currently in error.
Yellow	Test has failed but has returned to a state in which it passes.

Errors with duration

Some kinds of errors have a well-defined beginning and end (for example, in this case of '2.1 Transport Error', the first and last packets in a sequence of consecutive packets with the transport_error flag set). Such errors initiate two events: the first is the transition into error, which causes the test indicator to go red, an entry to be made in the log, and, when required, a recording to be triggered. The second is the transition out of error, which causes another entry to be made in the log (this time with the word 'end' in it), and the test indicator to go yellow.

Note that potentially there may be a long time between these two events; in some cases (e.g. Unreferenced PID) the log may fill before the end event is seen.

Instantaneous Errors

Some kinds of errors, (e.g. 1.4 Continuity Error), are instantaneous; that is, they have no duration. Once such an error is detected, it is already over. Therefore instantaneous errors cause only one event, and one entry into the log; indicators for instantaneous errors are never Red, but go straight from Green to Yellow.

Resetting Errors

By selecting the Reset Events command any Yellow indicators are reset to Green. Red indicators are unaffected.

Custom SI Scripting

Customised SI scripts are available to Stream Monitor Plus to enable custom SI table and descriptor data to be analyzed successfully.

- User can define private tables
- User can override standard *tables*, i.e. display them according to the format specified in the script file.
- User can override *descriptors* which appear in the standard (hard-coded) tables. Each descriptor so defined will be displayed according to the format in the script. Other parts of the table will not be affected. (Note that if a scripted *table* is used then each descriptor which appears in the table *must* be defined in the script otherwise an error will be raised.)

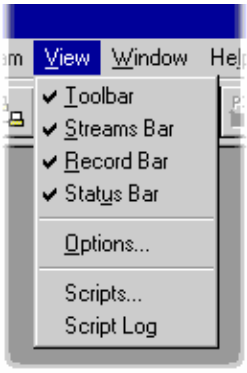
If suitably configured scripts are selected and enabled before a stream is analyzed, custom data will be analyzed when the host is connected. If scripts are not selected or enabled the host stream will not fail to be analyzed, but any custom data will either be ignored or reported as an error in the stream configuration.

Scripts can only be selected and enabled when no host is connected. The option is not available when a host is connected.

Note that a script file will not be used for analysis until:

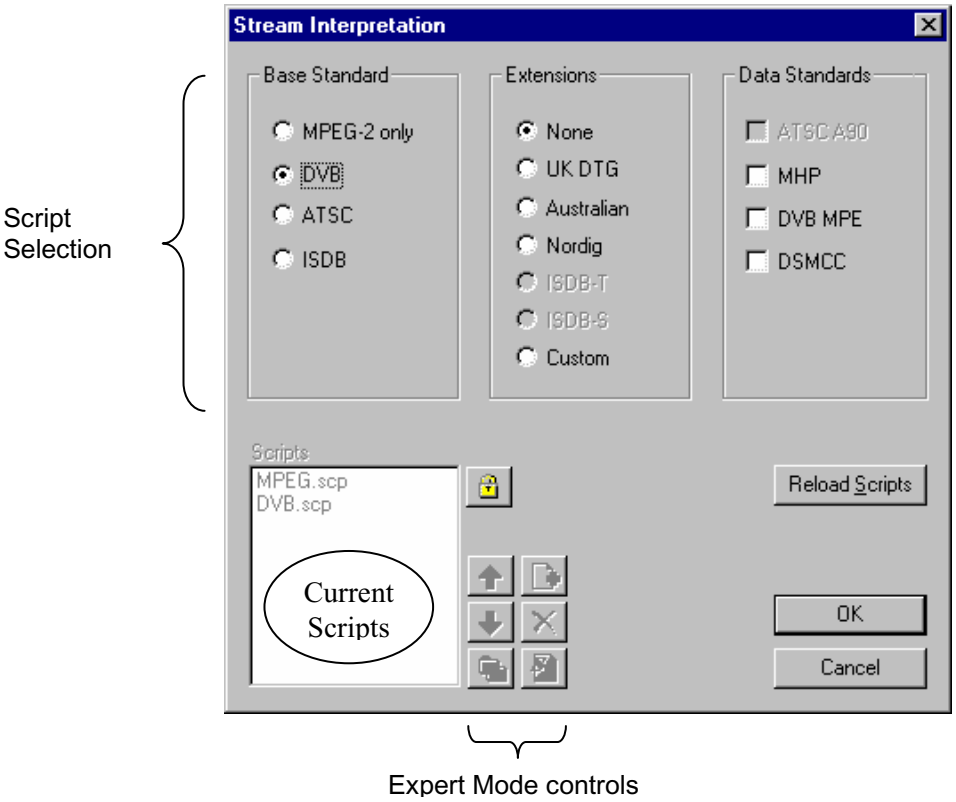
- it is present in the Scripts text-box in the current analysis mode.
- it is successfully enabled by closing the Stream Interpretation dialog using the OK button.

Handling Scripts and Modules



To open the script file dialog, with all files closed select the **Scripts…** option from the **View** menu.

The Script Add/Remove dialog is displayed as shown below:



The top half of the dialog is concerned with selecting scripts and modules. The text box (Scripts) shows the scripts currently selected. To the right of the text box are the Expert mode controls.

Script Selection

The selection area of the Stream Interpretation dialog is best viewed and used from left to right.

The **Base Standard** section allows the MPEG, DVB, ATSC or ISDB standard to be selected for analysis.

MPEG-2 only	Interprets and analyzes the packets in conformance to the MPEG-2 standards.
DVB	Interprets and analyzes the Transport Stream Packets according to the specifications of the DVB and MPEG-2 standards.
ATSC	Interprets and analyzes the Transport Stream Packets according to the specifications of the ATSC and MPEG-2 standards.
ISDB	Interprets and analyzes the Transport Stream Packets according to the ARIB and MPEG-2 standards.

Note: The **Stream Mode** selection in the **Stream Configuration** dialog (page 9) and the **Base Standard** selected in the **Stream Interpretation** dialog (page 22) ***must*** be the same for the correct scripts to be applied to the stream.

The standard selected will dictate the availability of the remaining options in the Extensions and Data Standard sections.

The **Extensions** section allows country-specific extensions to be added to the basic standard scripts. If **None** is selected, only the standard scripts are listed in the **Scripts** text-box. The remaining country-specific extensions add extra scripts to the current listing. As with the Base Standard, the choice of **Extensions** option will dictate the availability of the options in the **Data Standards** section. The **Custom** selection allows users to include their own selection of scripts using Expert Mode.

The **Data Standards** section offers a choice of data-specific scripts.

Note that the scripts listed by default are those resident in the default installation directory (i.e. tektronix\testsystem\scripts). Other directory locations can be specified in Expert Mode. All selections will be retained between Stream Monitor Plus sessions.

Syntax Checking

Scripts are syntactically analyzed when the OK button is selected. They are also checked when the application is opened. A fault in the syntax of a script will not necessarily prevent a stream from being analyzed, but it may result in incomplete analysis of the stream.

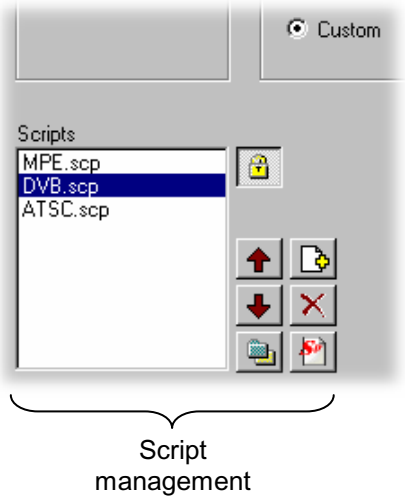
Scripts listed in the Scripts text-box will not be used for stream analysis until they have been successfully checked; that is, the application has been opened or the Stream Interpretation dialogue has been closed with no script-related error messages issued.

An intermediate check of scripts listed in the Scripts text-box can be made by selecting the **Reload Scripts** button. This performs the same action as the OK button but leaves the dialog open.

Syntactic errors will be indicated and reported in the Message Log.

Expert Mode

Expert Mode allows the user to select and customise the scripts to be used in stream analysis. Note that when the expert mode is selected, the Custom extension option is automatically selected and that the management buttons are enabled. In Expert mode, all scripts become available to be added to the script list. The scripts will be checked and loaded, ready to be used for analysis, when the OK button is selected.



Script Management Buttons

The script management buttons act on the scripts currently listed in the **Scripts** text-box.


Script files are parsed in the order that they are listed; in some circumstances this may be important. To move a file in a list, highlight the file name and select the Up or Down arrow button as required. Each press of the button will move the file up or down one place in the list until it reaches the top or the bottom.

Add a script to the list: A standard Windows file selection dialog is opened. The default file extension is `.scp`. Select the required file. The selected script will be added to the bottom of the list. If necessary, it can be moved using the Up and Down buttons.

Scripts can be loaded from any directory.

Delete the highlighted script.

Change scripts' default directory: By default, all scripts are found in a default directory created during installation (i.e. tektronix\scripts). This button may be used to set a different default directory.

Note that all scripts supplied by Tektronix in the default installation are installed in a single directory; as long as this directory is designated as the default directory, they will work satisfactorily.

View highlighted script with the associated application; by default, script files are associated with the ScriptPad utility.

For a script file to be viewed successfully, the file extension (.scp) must be associated with a text editor in the MS Windows environment. The MPEG Test System installation program associates by default a script editing utility called ScriptPad; the user may use another text editor, e.g. MS Notepad, if preferred. ScriptPad is a simple script editor that can be installed with the MPEG Test System. Scripts can be viewed and edited as required (depending upon the file permissions).

Viewing Host and Stream Logs

Stream Monitor Plus maintains a log of errors for the host to which it is connected. This log may also be viewed per stream. Several Log Views may be open, at the same time, displaying the logs for different streams. For a host with only one MPEG Interface Card the Host and Stream Log Views will be the same.

The log is implemented as a buffer with a maximum capacity of 64K entries. When a host fills its buffer the oldest entries are dropped, to make space for new entries, as the new entries arrive.

Certain errors, such as PCR inaccuracy and Program paradigm, are prone to generating errors at a very high rate. This can overload the log views and make meaningful interpretation of *all* errors difficult.

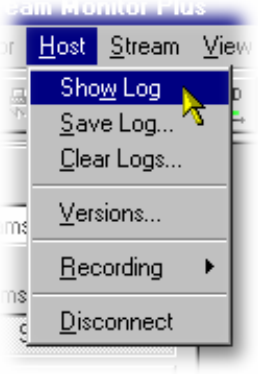
For this purpose, when large number of a single errors occur, a single error event is logged with the number of occurrences of that error indicated in square brackets.

Also, when very large numbers of multiple errors occur in a short time (0.5s), the message 'Too many errors' is logged.

Host Log

The host log displays information for all streams being received by the host.

To view the Host Log, for the host selected in the Streams Bar, select the **Show Log** option from the **Host** menu.



This opens a window which looks like this:

Log view of host `streamstation'

Date	Code	Stream	Details
20 Mar 2002,11:08:45	3121	1	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:45	3121	1	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:45	3121	1	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E [+6]
20 Mar 2002,11:08:45	3121	1	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:45	3121	1	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:45	3121	1	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:46	3121	1	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E [+6]
20 Mar 2002,11:08:46	3121	1	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:46	3121	1	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:46	3121	1	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:46	3121	1	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E [+3]
20 Mar 2002,11:08:46	3121	1	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:46	3121	1	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:46	3121	1	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:47	3121	1	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E [+5]
20 Mar 2002,11:08:47	3121	1	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:47	3121	1	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:47	3121	1	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:47	3121	1	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E [+4]
20 Mar 2002,11:08:47	3121	1	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:47	3121	1	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:08:47	3121	1	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E

The title bar of the window gives the name, or IP address, of the host whose log is being displayed.

From left to right the columns in the Host log are:

Date Gives the date and time of the entry.

Code Shows an identifier code for the error type which can be used for specifying a highlight colour (See Setting Highlights, page 32).

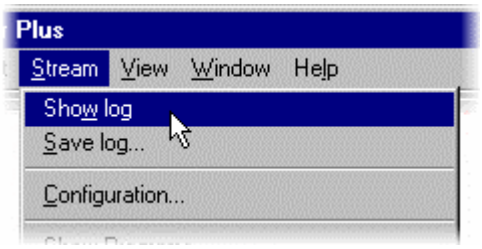
Stream Indicates which stream the error was detected in.

Details Displays a textual description of the error.

Stream Log

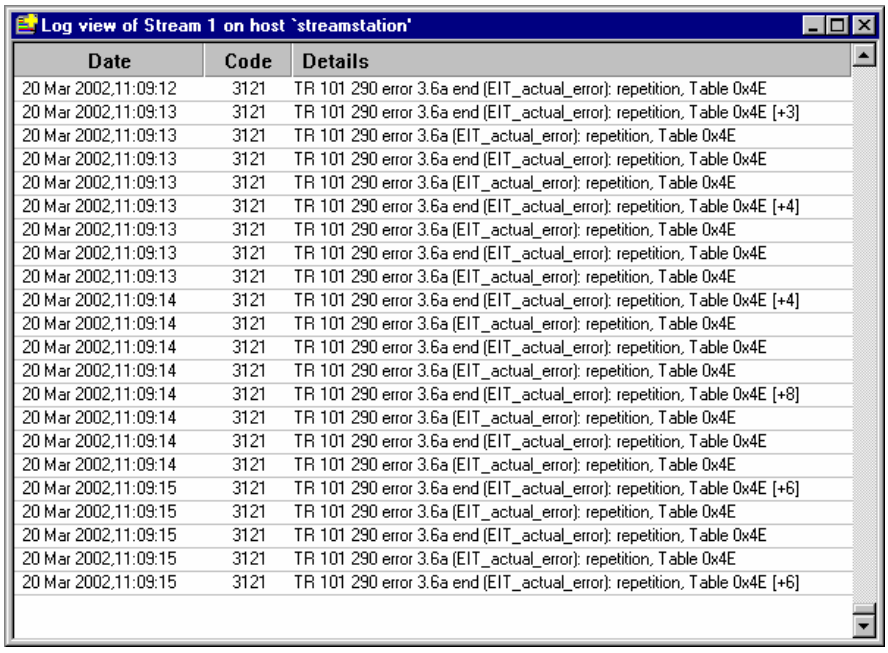
The stream log displays information for a single selected stream on the selected host.

To open the Stream Log, for the stream selected in the streams bar, select the **Show Log** option from the **Streams** menu:



Alternatively click on the Stream Log button from the Toolbar:

This opens a window which looks like this:



Date	Code	Details
20 Mar 2002,11:09:12	3121	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:13	3121	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E [+3]
20 Mar 2002,11:09:13	3121	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:13	3121	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:13	3121	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:13	3121	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E [+4]
20 Mar 2002,11:09:13	3121	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:13	3121	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:13	3121	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:14	3121	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E [+4]
20 Mar 2002,11:09:14	3121	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:14	3121	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:14	3121	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:14	3121	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E [+8]
20 Mar 2002,11:09:14	3121	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:14	3121	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:14	3121	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:15	3121	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E [+6]
20 Mar 2002,11:09:15	3121	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:15	3121	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:15	3121	TR 101 290 error 3.6a (EIT_actual_error): repetition, Table 0x4E
20 Mar 2002,11:09:15	3121	TR 101 290 error 3.6a end (EIT_actual_error): repetition, Table 0x4E [+6]

The title bar of the window identifies the stream and host whose log is being displayed. The information displayed in the window are similar to the Host Log except that there is no **Stream** column.

From left to right the columns in the Stream log are:

Date Gives the date and time of the entry.

Code Shows an identifier code for the error type which can be used for specifying a highlight colour.

Details Displays a textual description of the error.

The scroll bar indicates where the displayed entries are in the buffer.

The log is limited to 64kbytes of data by purging the oldest entries as new entries arrive.

Error Classification

Stream Monitor Plus implements the tests defined in the ETSI Technical Report *Measurement Guidelines for DVB systems (TR 101 290)*. All of the first, second and third priority tests described in Section 5 of TR 101 290 are implemented, with the exception of 3.3 (Buffer_error), 3.9 (Empty_buffer_error) and 3.10 (Data_delay_error). In addition, a number of tests have been constructed from guidelines specified in ATSC standard A/65 and two further tests, A.1 (PID occupancy) and A.2 (Program occupancy), have been defined by Tektronix.

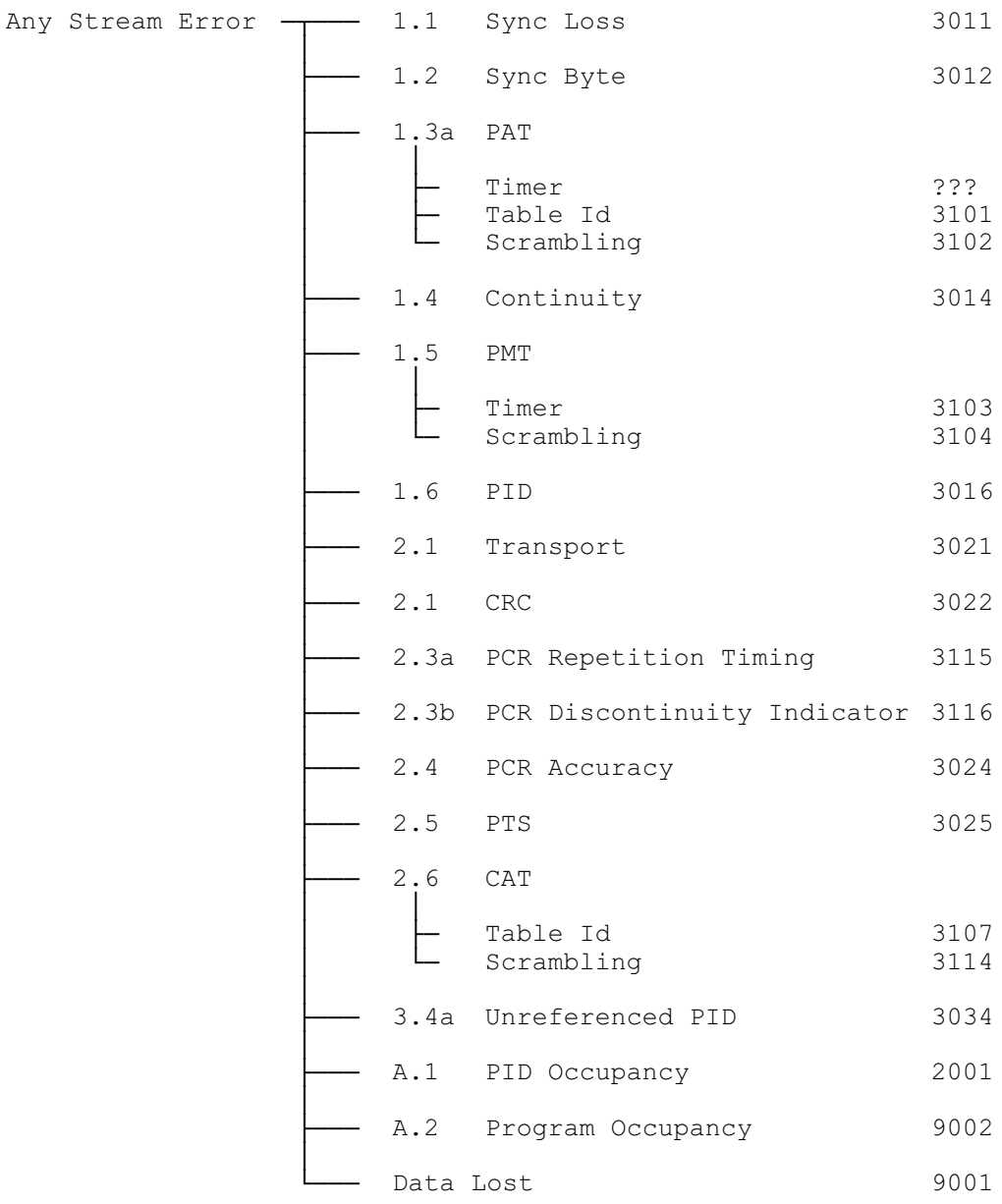
Stream Monitor Plus is able to analyze MPEG-2, DVB, ATSC, and DVB/ATSC-harmonised streams. The tests performed will depend on the mode defined for the stream. In MPEG-2 mode, all the tests from Priorities One and Two of TR 101 290, and also 3.4, A.1, and A.2, are performed.

In DVB mode, all the tests from Priorities One, two and Three are performed (with the exceptions referred to above) plus SFN tests. In ATSC mode, the following additional tests are performed: MGT, VCT, RRT and EIT repetition. If both DVB and ATSC are selected, both sets of additional tests are performed.

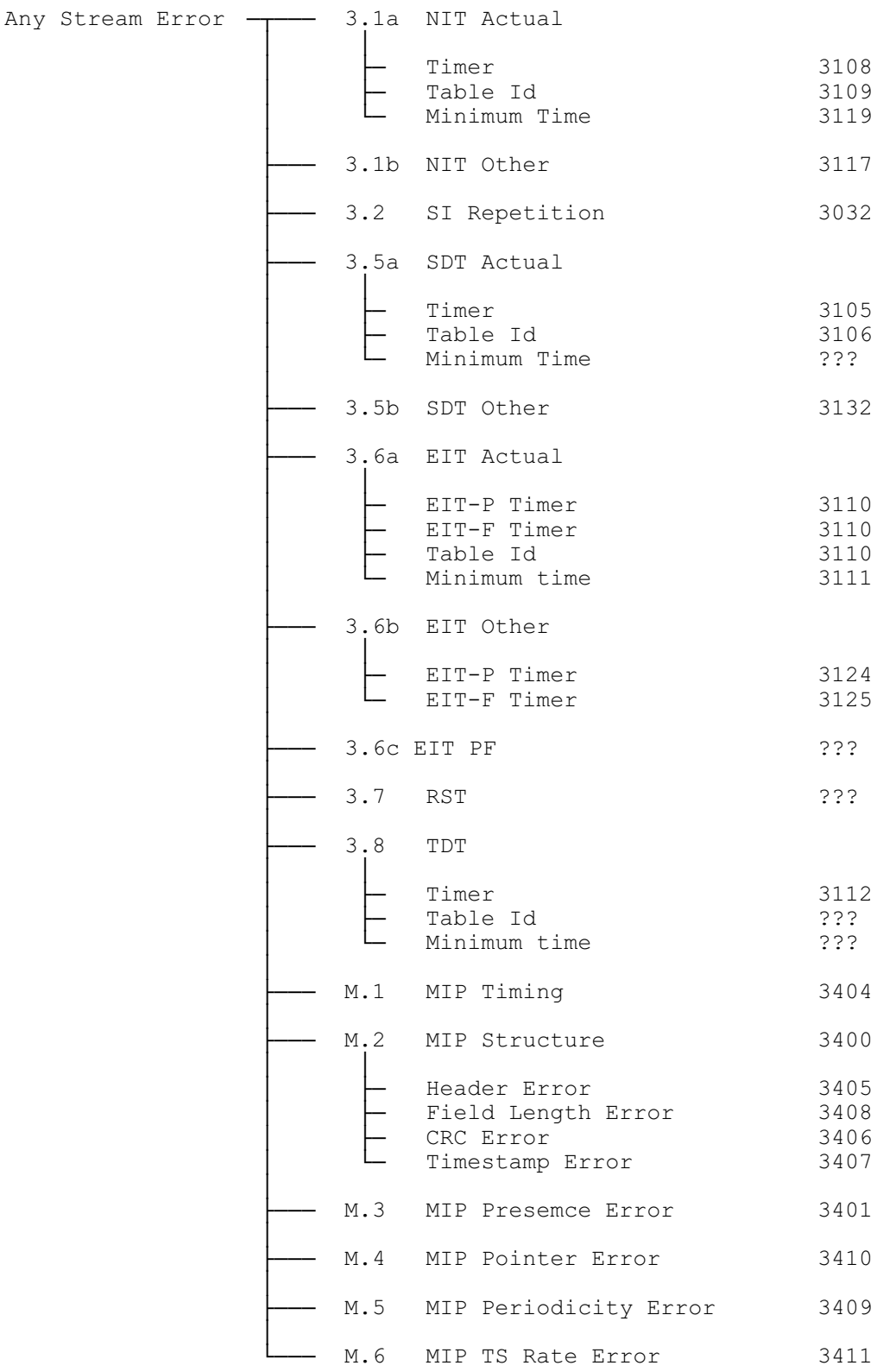
The diagrams below shows the test tree or ‘event hierarchy’. The TR 101 290 standard defines that certain tests are in fact composed of multiple sub-tests. For example, 2.6 CAT_error comprises tests for table ID and scrambling control. This composition of tests gives rise to the hierarchy shown.

Note that only the leaf events (those with no sub-tests) appear in the log view, as they are more specific and thus more informative than the branch events, whose status can be inferred anyway. Triggered recording may be performed off either leaf events or branch events, so for example, you can choose to trigger off 2.6 CAT, or from just one of the constituent sub-tests; for instance, table_id or scrambling.

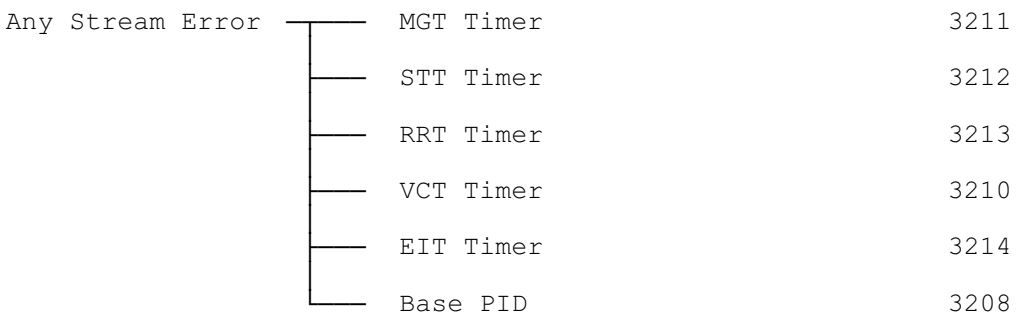
The numbers used to describe each test were assigned by Tektronix, and are used for identification of errors in the log view, and also in the saved log files which may be opened in Microsoft Excel or other data-processing applications.


Any Stream Error
1.1 Sync Loss 3011
1.2 Sync Byte 3012
1.3a PAT
Timer ???
Table Id 3101
Scrambling 3102
1.4 Continuity 3014
1.5 PMT
Timer 3103
Scrambling 3104
1.6 PID 3016
2.1 Transport 3021
2.1 CRC 3022
2.3a PCR Repetition Timing 3115
2.3b PCR Discontinuity Indicator 3116
2.4 PCR Accuracy 3024
2.5 PTS 3025
2.6 CAT
Table Id 3107
Scrambling 3114
3.4a Unreferenced PID 3034
A.1 PID Occupancy 2001
A.2 Program Occupancy 9002
Data Lost 9001

MPEG Errors


Any Stream Error
3.1a NIT Actual
Timer 3108
Table Id 3109
Minimum Time 3119
3.1b NIT Other 3117
3.2 SI Repetition 3032
3.5a SDT Actual
Timer 3105
Table Id 3106
Minimum Time ???
3.5b SDT Other 3132
3.6a EIT Actual
EIT-P Timer 3110
EIT-F Timer 3110
Table Id 3110
Minimum time 3111
3.6b EIT Other
EIT-P Timer 3124
EIT-F Timer 3125
3.6c EIT PF ???
3.7 RST ???
3.8 TDT
Timer 3112
Table Id ???
Minimum time ???
M.1 MIP Timing 3404
M.2 MIP Structure 3400
Header Error 3405
Field Length Error 3408
CRC Error 3406
Timestamp Error 3407
M.3 MIP Presemce Error 3401
M.4 MIP Pointer Error 3410
M.5 MIP Periodicity Error 3409
M.6 MIP TS Rate Error 3411

DVB Errors



ATSC Errors

DATA_LOST (9001)

Occasionally, when the system is under very high load, it may be noticed that the special error DATA_LOST (9001) is recorded in the log. This indicates that the software is unable to cope with the operations currently being asked of it and has dropped one or more packets. If this should arise during recording, the recorded file will contain a discontinuity. It may also cause spurious PCR inaccuracy measurements.

The Data Lost message may arise in the following situations:

- The incoming stream bitrate is too high.
- There is a very large amount of SI information in the incoming stream.
- The PCR inaccuracy measurements are overloading the CPU, usually because of a very large number of PCR PIDs.
- The Record filter is being adjusted. This is quite normal while the hardware adjusts its filter settings.

If acceptable, the following may reduce the error frequency:

- Stop the PCR inaccuracy computations by disabling the 2.4 PCR Inaccuracy detection.
- Clear the Record filter and ‘de-queue’ any files.
- Finally and as an extreme measure, consider changing the stream mode to MPEG-2. This will prevent the reconstruction of many tables which may cause overloading.

Logs and the Error Views

The Error View and Error LEDs windows display a higher level overview of errors than the Log Views. For example, test 1.3a PAT is the combined result of three separate tests. These are described in the Error View Test explanation dialog as:

> **The Program Association Table (PAT), which only appears in PID 0x0000 packets, tells the decoder what programs are in the TS and points to the Program Map Tables (PMT) which in turn point to the component video, audio and data streams that make up the program (Figure 4).**
>
> **If the PAT is missing then the decoder can do nothing, no program is decodeable.**
>
> **Nothing other than a PAT should be contained in a PID 0x0000.**

Failures of these tests will be recorded as separate events and types of error in the Host and Stream Log View windows.

Navigation

The scroll bar and a set of keyboard commands are used to scroll through the entries displayed in a log view. By default, log views are continuously updated to show the most recent entries.

Using the scroll bar or pressing any key other than **End** stops the update to keep the display on a set of entries. When the displayed set of entries are dropped to make space for new entries the view updates to show the next oldest entries.

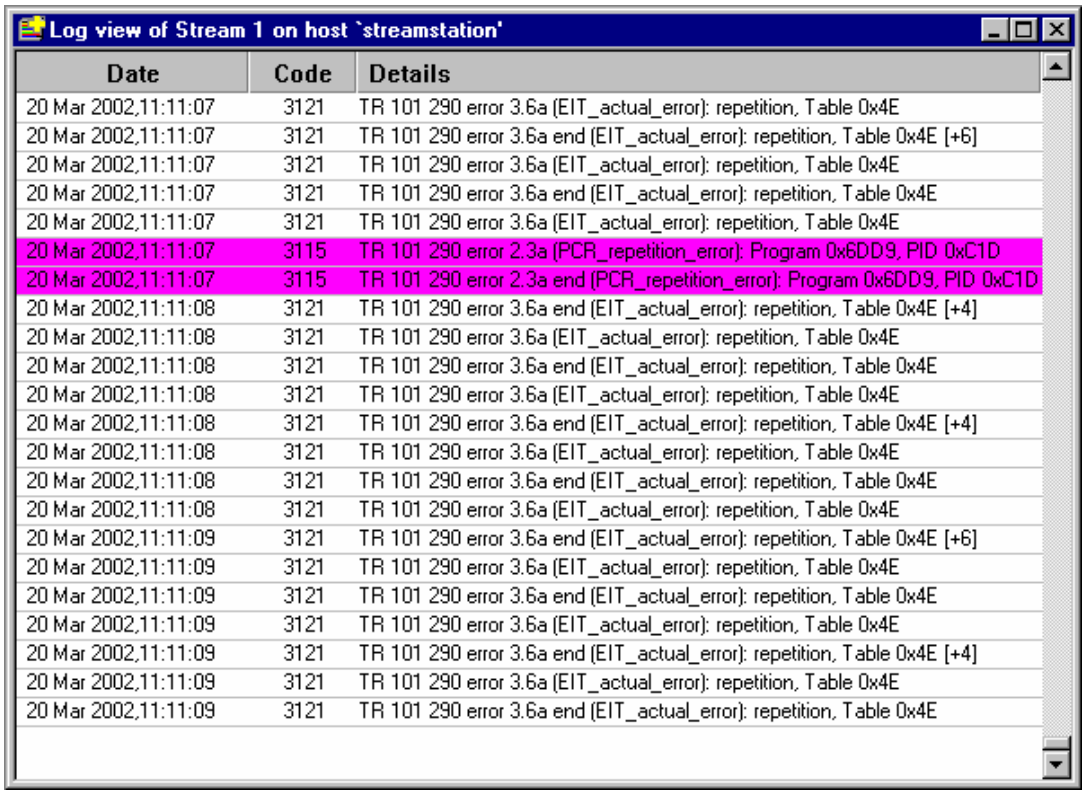
The scroll bar indicates where the displayed entries are in the buffer.

The available key commands are:

Up Arrow	Scrolls the display back in time by one line.
Page Up	Scrolls the display back in time by a window. The line which was displayed at the top of the window will move down to be the last.
Page Down	Scrolls the display forward in time by one line.
Down Arrow	Scrolls the display forward in time by a window. The line which was displayed at the bottom of the window will move up to be the first.
Home	Displays the oldest entries in the log.
End	Sets the view to continuously update to display the most recent entries.
Any other key except **End**.	Pauses updating to show the same entries.

Setting Highlights

Up to six different error or event types can be highlighted, each in a different colour. Here is an example:



To configure the highlighting place the mouse pointer anywhere inside the log view window and click the right mouse button. Then select the **Edit Highlights** option from the Pop-Up menu. Alternatively double click anywhere on the window contents.

This will open the Log Highlighting dialog. The settings used to highlight the previous example are shown on the right:

To highlight a type of error, select it from the list then click on a swatch (coloured square) to set the desired highlight colour.

A highlight setting is cleared by selecting **<no highlight>** from the list then clicking on the swatch to be cleared.

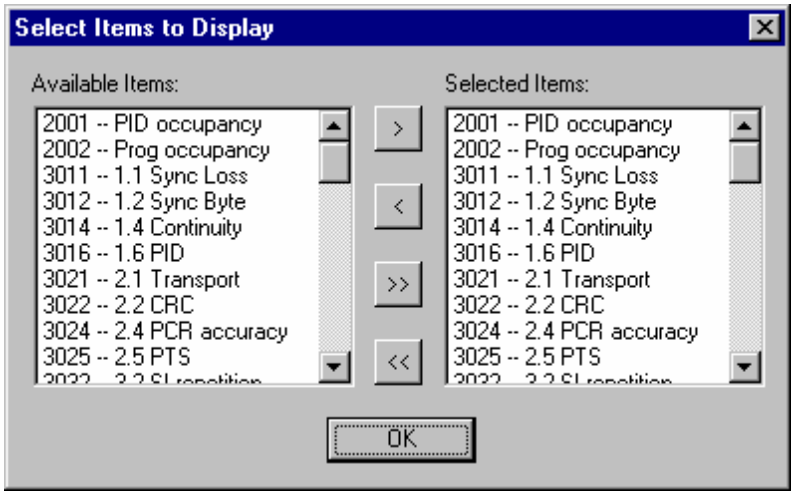
Only one type of error can be associated with each colour. This allows a maximum of six error types to be highlighted at any time.

For an explanation of the error codes, refer to Error Classification, page 27.

Select **OK** to implement the new settings. The settings chosen will be retained (until changed) and used whenever Stream Monitor Plus is opened.

Log View Filter

The Log View can be filtered to show a subset of the logged messages. To configure the filter place the mouse pointer anywhere inside the Log View window and click the right mouse button. Then select **Set Filter…** from the right-click menu options. The following dialog is displayed:



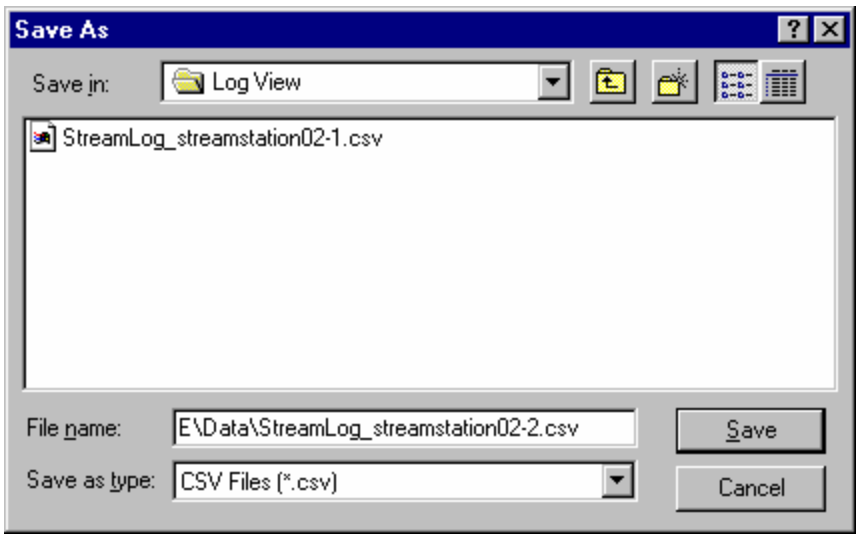
The left-hand pane shows all the available logged messages, the right-hand pane shows the currently selected messages to be display (both are the same initially). The four buttons in the centre of the dialog allow for adding items to the **Selected Items:** pane (multiple selections allowed), removing items, adding all items and removing all items. [1]

Select OK to implement the filter; only messages of the type listed in the **Selected Items:** pane will be displayed in the Log View. When a subset of messages is being displayed, the Log View title bar will display the legend **Filter On** to indicate that not all available messages are being displayed.

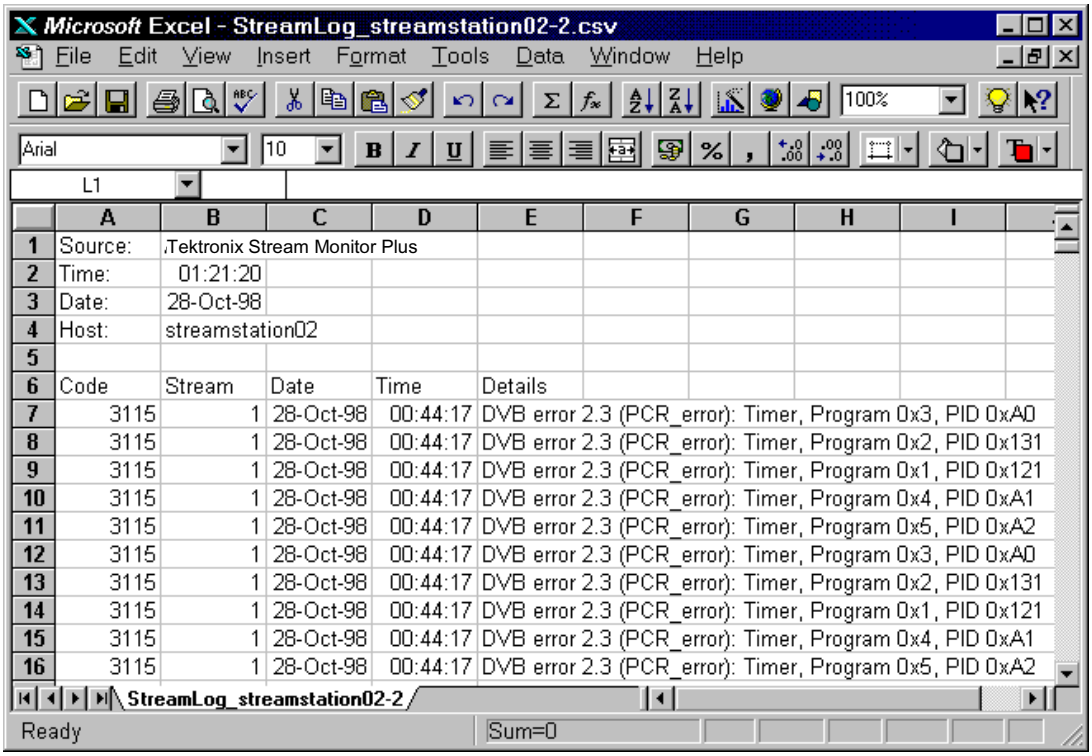
[1] If an item is already added it is ignored if an attempt is made to add it again.

Save Log

The contents of the host or stream log, for the currently selected host and stream, may be saved to file, in CSV (comma separated value) format. To save the host log select the **Save log…** option from the **Host** menu. Similarly to save the Stream Log select the **Save log…** option from the **Stream** menu. Both of these open a standard **Save As** dialog, for example:



The CSV format allows spreadsheet and database programs to import the information. For example several log files could be opened for comparison and further analysis using a spreadsheet program like Microsoft Excel:

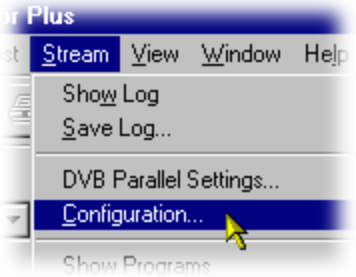


	A	B	C	D	E	F	G	H	I
1	Source:	Tektronix Stream Monitor Plus							
2	Time:	01:21:20							
3	Date:	28-Oct-98							
4	Host:	streamstation02							
5									
6	Code	Stream	Date	Time	Details				
7	3115	1	28-Oct-98	00:44:17	DVB error 2.3 (PCR_error): Timer, Program 0x3, PID 0xA0				
8	3115	1	28-Oct-98	00:44:17	DVB error 2.3 (PCR_error): Timer, Program 0x2, PID 0x131				
9	3115	1	28-Oct-98	00:44:17	DVB error 2.3 (PCR_error): Timer, Program 0x1, PID 0x121				
10	3115	1	28-Oct-98	00:44:17	DVB error 2.3 (PCR_error): Timer, Program 0x4, PID 0xA1				
11	3115	1	28-Oct-98	00:44:17	DVB error 2.3 (PCR_error): Timer, Program 0x5, PID 0xA2				
12	3115	1	28-Oct-98	00:44:17	DVB error 2.3 (PCR_error): Timer, Program 0x3, PID 0xA0				
13	3115	1	28-Oct-98	00:44:17	DVB error 2.3 (PCR_error): Timer, Program 0x2, PID 0x131				
14	3115	1	28-Oct-98	00:44:17	DVB error 2.3 (PCR_error): Timer, Program 0x1, PID 0x121				
15	3115	1	28-Oct-98	00:44:17	DVB error 2.3 (PCR_error): Timer, Program 0x4, PID 0xA1				
16	3115	1	28-Oct-98	00:44:17	DVB error 2.3 (PCR_error): Timer, Program 0x5, PID 0xA2				

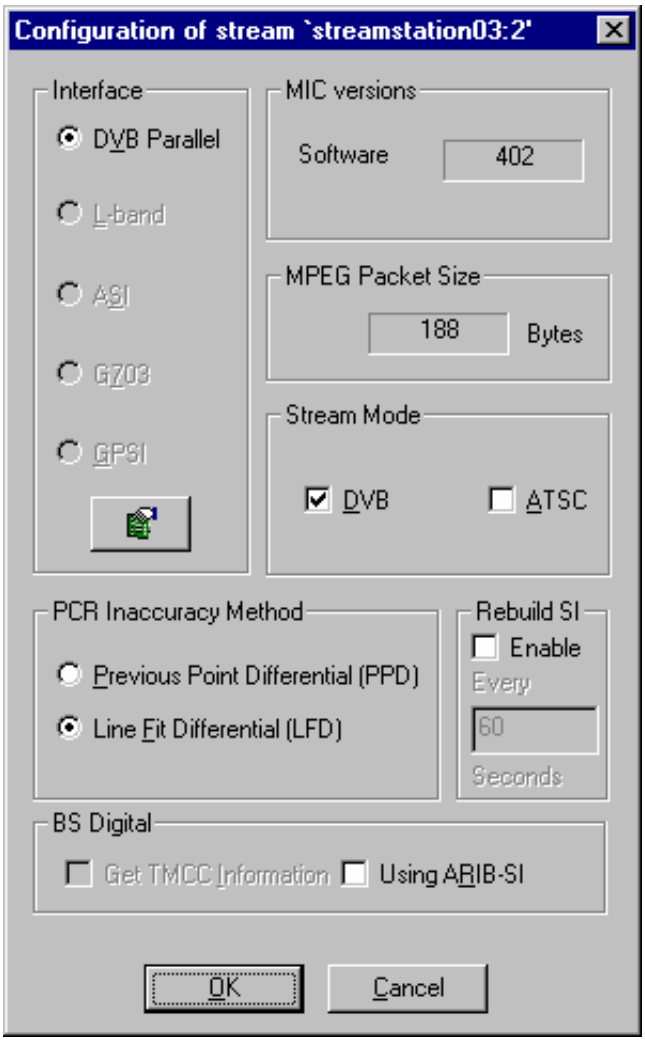
Stream Configuration

When an additional interface adapter is fitted to an MPEG Interface Card, Stream Monitor Plus can select which of the two interfaces to use.

To display or change the interface, select the required host and stream on the Streams Bar. Then select the **Configuration…** option from the **Stream** menu.



This opens a dialog showing which interfaces are available and which one is selected:



The dialog also displays version information for the MPEG Interface Card (MIC) and the packet size of the transport stream being fed to the interface.

Note that the packet size is that reported by the MIC card; this may not be the transport stream format.

Stream Monitor Plus is both DVB and ATSC compliant. Select the **Stream Mode** standard required. Selecting neither will ensure that only the basic MPEG conformance tests are performed.

The PCR Accuracy Method panel allows one of two methods of PCR accuracy measurement to be selected (see below).

The above example only has a MIC, hence only the **DVB Parallel** option is available. It will always be selected.

When an additional interface adapter is fitted one other interface option will also be available, in which case, either the **DVB Parallel** interface or the additional interface will be selected.

Select whichever interface is required and then click on the **OK** button. Select **Cancel** to close the dialog and discard all changes.

PCR Inaccuracy Measurement Method

Two methods of PCR Accuracy measurement are available on Stream Monitor Plus: Previous Point Differential (PPD) and Line Fit Differential (LFD).

Briefly, using the PPD method, an average PCR gradient is calculated using the first and last PCRs in the file. This gradient is then used to extrapolate the value of the *next* PCR from the current PCR; an error is reported if the actual PCR value differs from the extrapolated value.

Conversely, using the LFD method, although the gradient is calculated in the same way, the next PCR is not extrapolated from the actual position of the previous PCR, but from the expected position of the previous PCR.

A more detailed description of these measurement methods can be found in the Technical Notes which are included in electronic format on the MPEG Test System installation CD.

BS Digital

For ISDB-S streams it possible to extract and display TMCC information by enabling the **Get TMCC Information** checkbox. A description of the TMCC Information window can be found at The vertical scale can be expanded using the technique described for zooming in to the PCR Statistics Graphs (page 56).

TMCC Information, page 65.

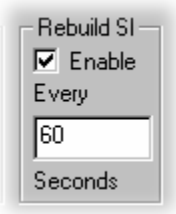
In addition, ARIB (Association of Radio Industries and Businesses) SI tables can be interpreted and displayed in the main part of the Structure View rather than in the Private Table section, by enabling the **Using ARIB-SI** checkbox. This will also enable ARIB tables to be labelled in the PID view.

Rebuild SI Table Interval

Allows the interval at which stored SI is refreshed to be set.

Range: 60 to 1000 seconds in one second increments.

Deselect the **Enable** checkbox to disable rebuilding.

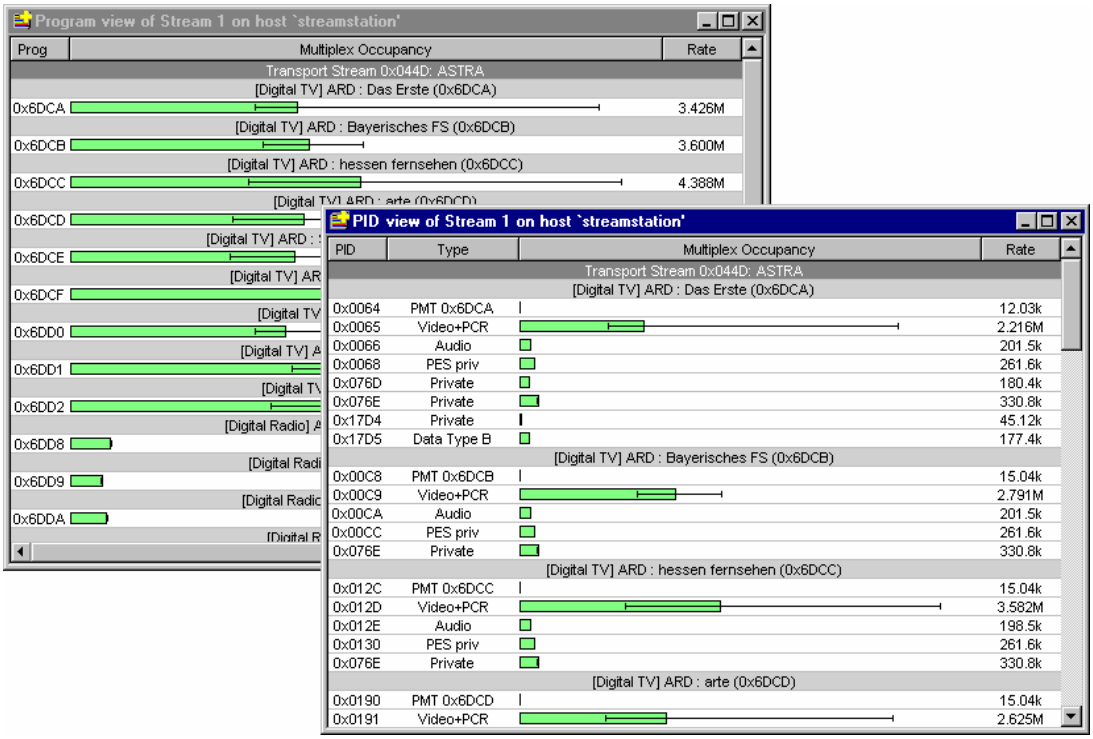


Monitoring Streams

A variety of views are available (excluding the log view) for monitoring transport streams. These may be opened from both the **Stream** menu and Toolbar. Multiple instances of each view may be open. This feature is provided to allow more than one stream to be monitored at the same time. It also enables a stream to be examined using variations of the same view.

Program and PID Views

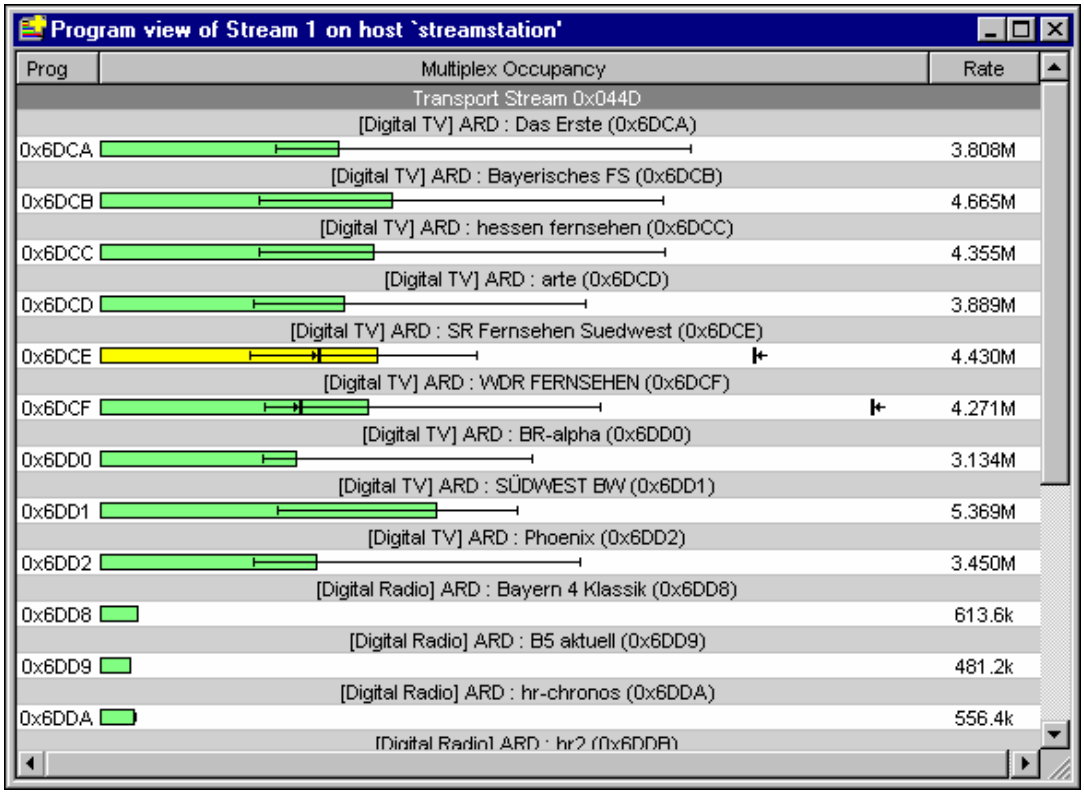
The Program View and PID View windows both display a histogram. They show what proportion of the Transport Stream was taken up by each Program or PID during the sampling period.



Range parameters can be set for the occupancy of each program and PID. Stream Monitor Plus colour codes each bar to show if the program or PID is or has been out of range. These and other common features of both views are described later.

Program View

The program view displays the occupancy and data rate for each program, derived from the sum of all the PES PIDs in each program. Select the **Show Programs** option from the **Stream** menu to open the Program View:

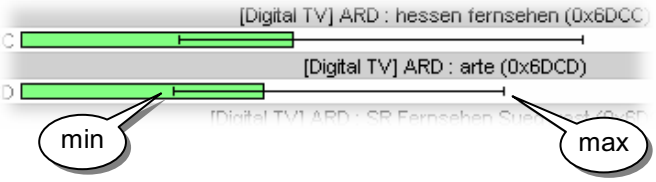


If there are more Programs than can be displayed a scroll bar will appear on the right hand side of the window. A dark grey bar near the top of the window identifies the stream and the network. A light grey bar above each program displays the program type and name.

There are three columns of information. From left to right they are:

Prog Displays the program number for each row of the table.

Multiplex Occupancy Shows the current occupancy of each program relative to the other programs as a bar chart, with a range bar. The range bars indicate the minimum and maximum for each program.

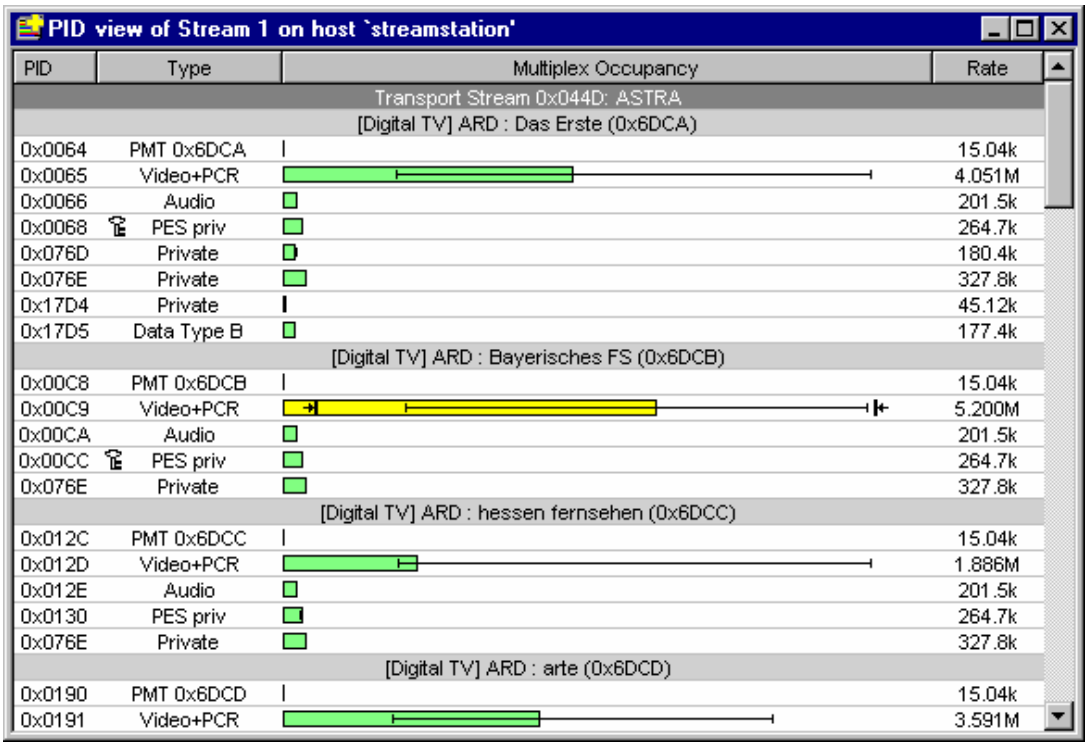


The range bars grow whenever a program drops to a new minimum or reaches a new maximum occupancy. They can be reset with the **Reset Min/Max Ranges** option from the pop up menu.

Rate Displays the combined data rate for the program.

PID View

The PID view displays the occupancy and data rate for each PID. The PIDs are listed in program order and by PID number within each program. Select the **Show PIDs** option from the **Stream** menu to open the PID View. Using the same transport stream as for the previous Program View example the PID View is:



When there are more PIDs than can be displayed, a scroll bar will appear on the right hand side of the window. A dark grey bar near the top of the window identifies the stream and the network.

The PIDs are grouped together according to the data they carry. The list is sorted by program, then PID number within each program. The groups also show those PIDs which carry PMT rate information. Above each group of PIDs is a light grey title bar which displays the program type and name.

PIDs which do not carry data belonging specifically to a program are grouped together after those carrying program streams. These are sorted by PID and preceded by a light grey bar with the title **Other PIDs in the multiplex**.

Scrambled PIDs are indicated with the icon:

From left to right the columns displayed in PID View are:

PID Shows the PID number to which each row of the table applies.

Type Indicates the type of stream contained by the PID. Here are some examples of stream type:

Media Types:

AC-3 Audio	AC-3 Audio
Audio	Audio
aux	ISO/IEC 13818-1 auxiliary
DSM-CC	Annex A - DSM-CC
H.222-1	ITU-T Rec H222.1
MPEG	MPEG
PES priv	ITU-T Rec H220.0 ISO/IEC 13818-1 PES packets containing private data
Private	ITU-T Rec H220.0 ISO/IEC 13818-1 private_sections
Reserved	Reserved or 'Reserved ITU-T Rec H220.0 ISO/IEC 13818-1 Reserved'
Type A	ISO/IEC 13818-6 type A
Type B	ISO/IEC 13818-6 type B
Type C	ISO/IEC 13818-6 type C
Type D	ISO/IEC 13818-6 type D
User	User private data
Video	Video or 'ITU-T Rec H262 ISO/IEC 13818-2 Video' or 'ISO/IEC 11172.2 constrained parameter video stream'
PMT123	PMT 123
EMM 123	EMT 123
ECM123	ECM 123
PCR	Only has PCRs

If a PID also carries PCR data **+PCR** is appended to the type.
XXX +PCR

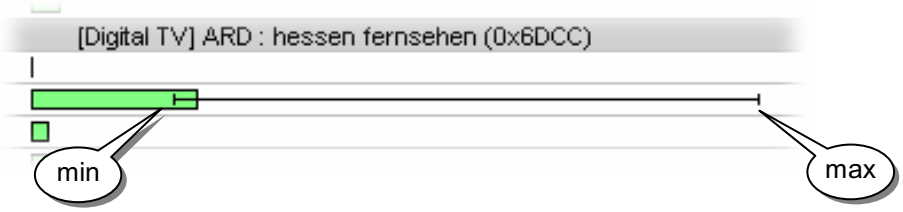
For example a video stream would look like this:

Video+PCR PID carries packets of video and PCR data.

Fixed Table Types:
PAT CAT TSDT NIT SDT/BAT EIT
RST TDT/TOT DIT SIT

Other Fixed PIDs:
Null
A/65 Base

Multiplex Occupancy Shows occupancy of each PID relative to the others as a bar chart with a range bar. The range bars indicate the minimum and maximum for each PID.



The range bars grow whenever a PID drops to a new minimum or reaches a new maximum occupancy. They can be reset with the **Reset Min/Max Ranges** option from the pop up menu.

Rate Shows the PID number to which each row of the table applies.

Common Features

Pop Up Menu

There is a Pop-Up menu which provides options to configure ranges limits, pause display updates and reset the range bars. Place the mouse pointer over the desired program or PID and click the right mouse button to 'pop up' the menu. The available options are:

Set Limits… Opens the dialog for setting and clearing Minimum and/or Maximum limits for the program or PID. Position the pointer over the required Program or PID, then click the right mouse button.

Once limits are set an error condition is indicated by the colour of the bar if the Program or PID goes outside of the limits.

Save Limits… Saves the current limit settings to a text file.

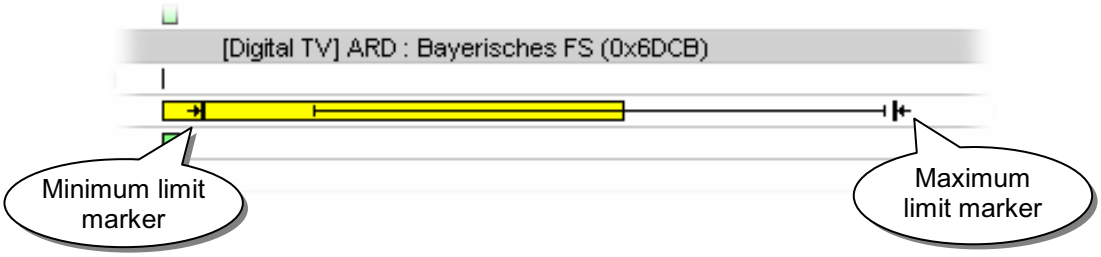
Load Limits… Loads limit settings from a file.

Pause Pauses and resumes the display update. A check mark, ✓, appears next to this option when the display is paused.

Reset Min/Max Ranges
Resets the minimum and maximum values shown by range bars in all the PID and Program views for the current stream.

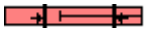
Range Limits and Colour Coding

A minimum and / or maximum limit may be specified for the occupancy any program or PID. If the program or PID goes outside of this range the bar changes colour. If a limit is specified it is indicated on the histogram like this:



The bars are colour coded to indicate if a stream has exceeded the user specified range limits (see also Errors, Events and Indicators, page 19). The colour codes used are:

Green The program or PID has stayed within the specified range since monitoring started or the user entered a Reset Alarms and Events command. Programs and PIDs which have no range set are always shown in green.

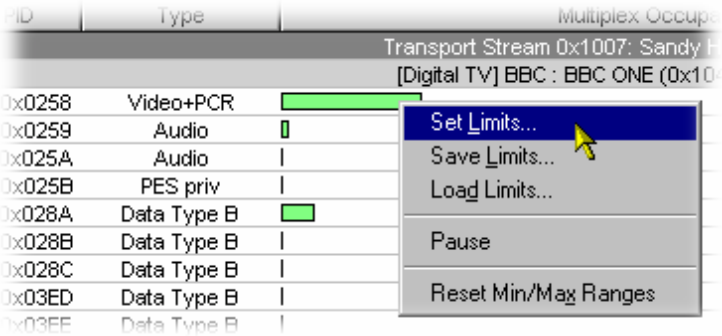


Red The PID or program is now outside the specified range.

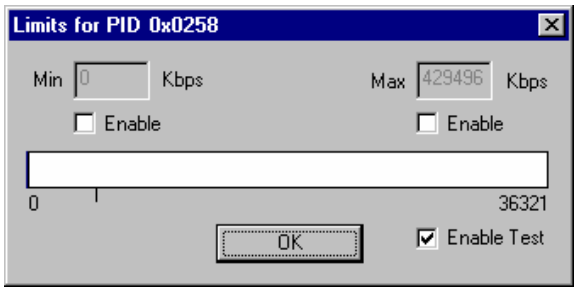
Yellow The program or PID is currently within the specified range. It has taken one or more excursions outside the range since monitoring started or the user entered a Reset Alarms and Events command.

Setting Range Limits

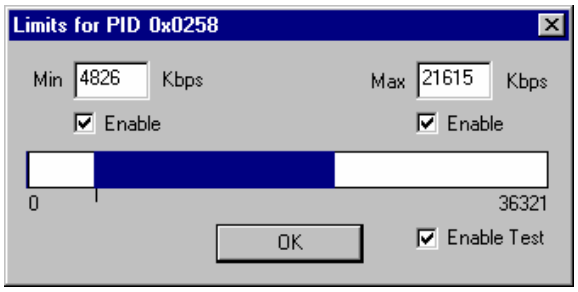
To set the limits for a program or PID position the mouse pointer anywhere on that row and click the right mouse button. Then select the **Set Limits…** option from the pop-up menu. Double-clicking the row will also open the Limits dialog:



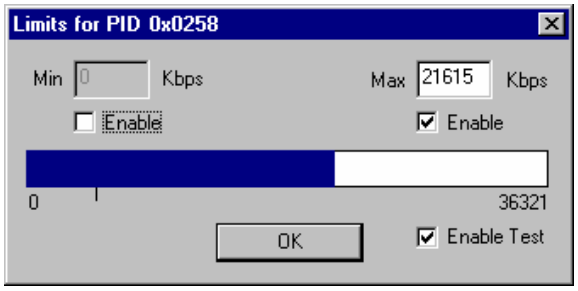
This will open the Limits dialog, which displays the current limits and allows them to be changed or removed. The PID in the previous screenshot had no limits set, in which case the dialog will looks like this:



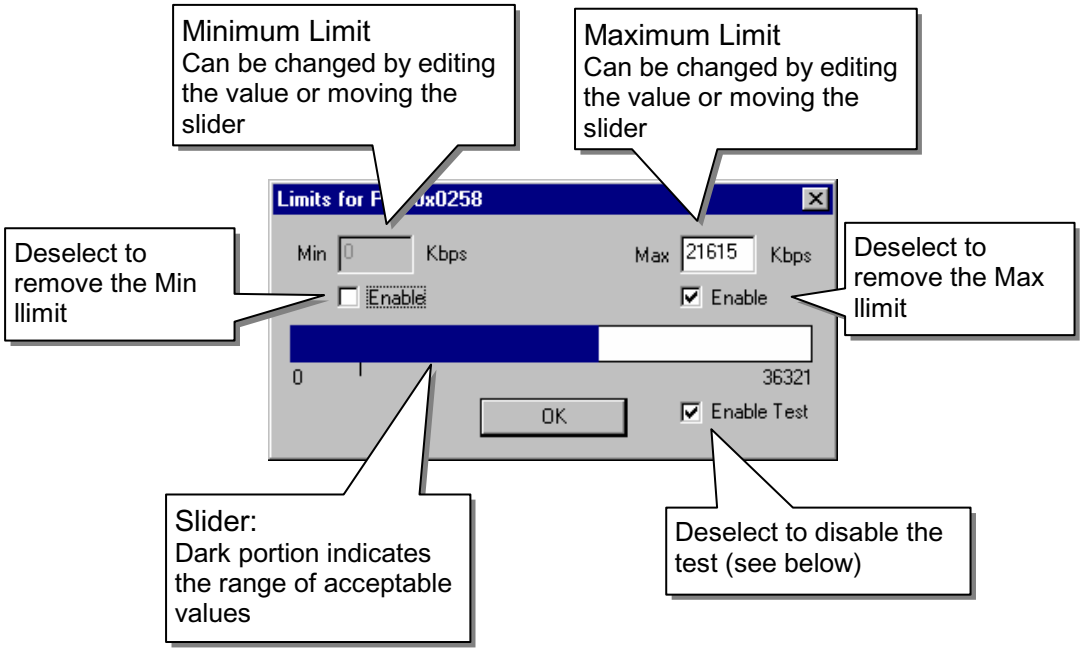
If a program or PID has limits set the values are shown in both the Min and Max fields and on the slider:



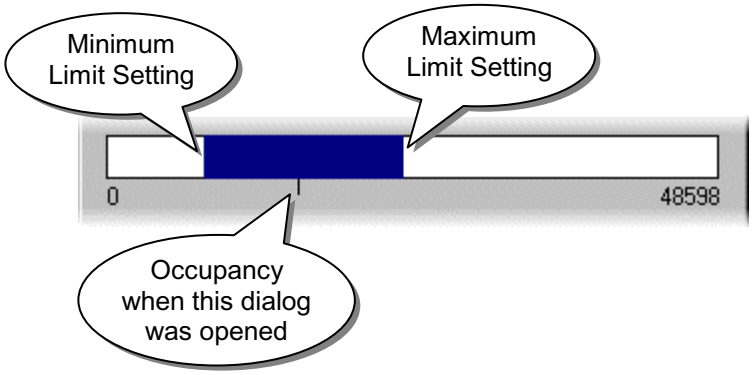
A program or PID may have just one limit set. For example, just a maximum:



The fields and controls in the Limits dialog are:



The slider at the bottom of the dialog allows the minimum and maximum limits to be set by dragging the ends of the range bar. If the mouse is clicked on the slider whichever limit is closest to the mouse pointer is moved to that point.



To set or change the minimum occupancy limit edit the value in the **Min** field or drag the minimum limit on the slider. If a minimum limit is not specified type the required value in the **Min** field. Alternatively click inside the slider, close to the left hand end, then drag to the required position. Both of these set the **Enable** option automatically.

Similarly to set or change the maximum occupancy limit edit the value in the **Max** field or drag the maximum limit on the slider. If a maximum limit is not specified type the required value in the **Max** field. Alternatively click inside the slider, close to the right hand end, then drag to the required position. Both of these set the **Enable** option automatically.

To remove a limit, deselect the **Enable** option for that limit.

To disable the test completely, deselect the **Enable Test** checkbox. Note that the actual test disabled will depend on whether the Limits dialog was opened from the Program or the PID view. In Program view, DVB test 1.5a (PMT Error) is disabled; in PID view, DVB test 3.4a (Unreferenced PID) is disabled.

Saving and Loading Limits from file

Limit settings for the current stream may be saved to file with the **Save Limits…** option form the Pop-Up menu. Selecting this option from a Program View saves the program limits. Selecting it from a PID View saves the PID limits. Stream Monitor Plus opens a standard file browser to specify the file name and location.

The file may be viewed, printed and edited with an ordinary text editor. The Network Name and whether the limits are for Programs or PIDs is held at the start of the file. This is followed by the settings. For example, a Program limits file looks like this:

```
#
# Tektronix Program limits file
#
# Stream: Transport Stream 0x0001: TEKTRONIX NETWORK
#

Program=5 min=15644000 max=16509000
Program=1 min=2250000 max=2750000
```

The settings are only recorded for limits which are in effect. Each program or PID is held on a separate line. The above example had 5 programs, but limits were only set for program 1 and program 5. If only a minimum or maximum limit is specified there will only be one value on the line. For example, here is a PID limits file where some PIDs only have a maximum limit set:

```
#
# Tektronix PID limits file
#
# Stream: Transport Stream 0x0001: TEKTRONIX NETWORK
#

PID=8191 max=30000000
PID=410 min=8706000 max=12031000
PID=430 max=1250000
PID=420 max=1250000
PID=510 min=10000000 max=25000000
PID=520 max=1250000
PID=530 max=1250000
```

The settings for Program limits and PID limits may be loaded from a previously saved file. Providing the above format is adhered to limits file may be edited or created using a standard ASCII text editor. A file may be edited to contain both program and PID limits, for example:

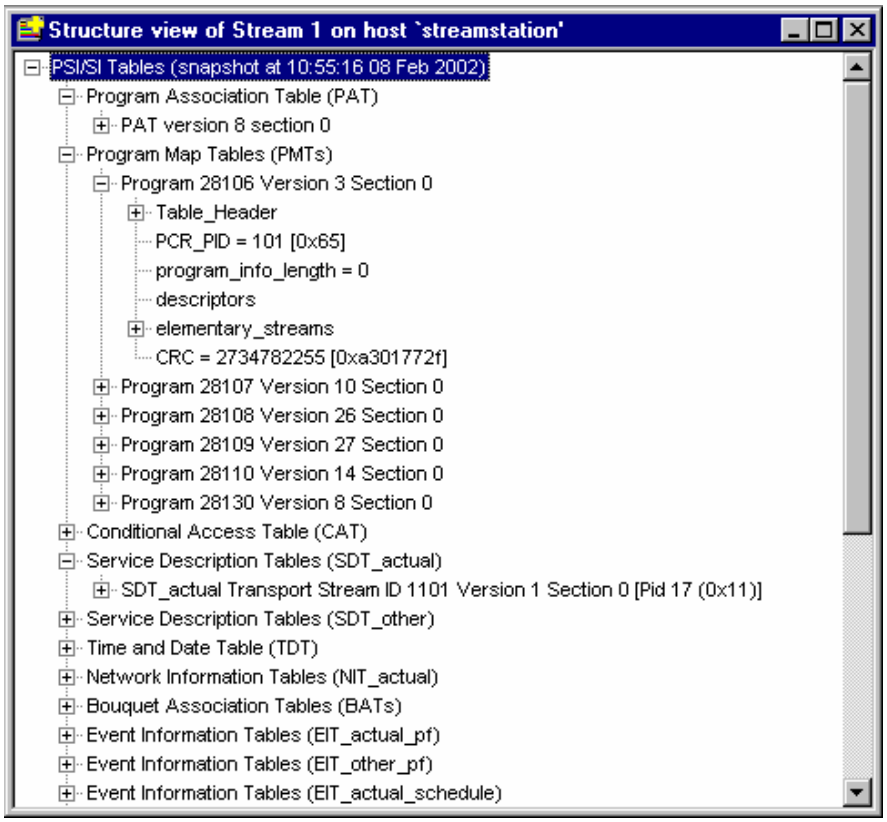
```
#
# Hand made limits file
#
#
#

Program=5 min=15644000 max=16509000
Program=1 min=2250000 max=2750000
PID=510 min=10000000 max=25000000
PID=520 max=1250000
PID=530 max=1250000
```

Loading such a file will update both program and PID settings.

Structure View

The Structure View displays the Service Information (SI) and Program Specific Information (PSI) Tables, including their payload information, as a tree structure. Select the **Show Structure** option from the **Stream** menu to open this window:



The Structure view is a snapshot of the PSI/SI data in a stream. Two refresh options are available from the right-click menu:

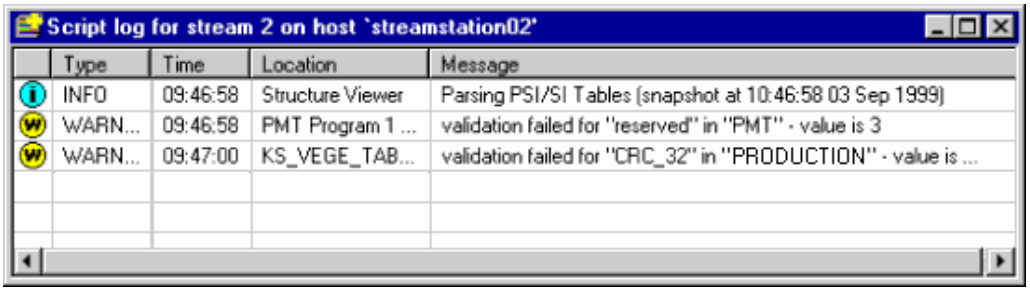
Refresh View Refreshes the Structure view using a snapshot of PSI/SI received to date.

Rebuild SI Initiates a complete rebuild of the SI and PSI. This option will be required after a seamless transport stream switch whereby no sync loss is detected.

The time and date at which the Structure in a window was frozen is displayed in the root node of the PSI/SI.

Private tables, interpreted by an appropriate script, are displayed under a Private Tables branch. Standard tables whose data is modified by scripts appear in the usual position and are not moved to the Private Tables section. In the screenshot above, two Private Tables are shown and a script modified form of the standard PMT table.

Any errors generated when processing streams (i.e. generating the structure view) are reported in the Script Log. The Script Log can be displayed by selecting the **Show Script Log** option from the Stream menu or  from the toolbar.



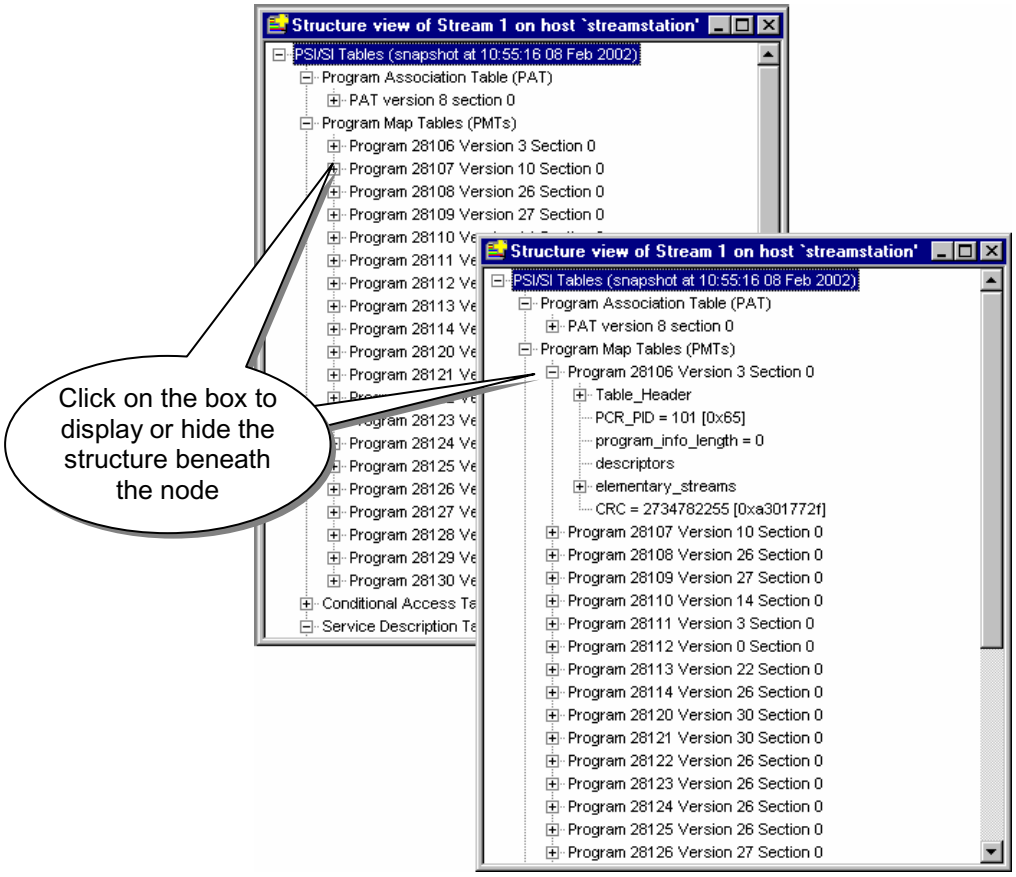
Note that each time the stream is parsed (e.g. the Structure View is opened, or refreshed), a new block of error data is written, starting with the Information icon .

The structure can also be saved to file for off-line analysis.

Each stream maintains it's own Script log.

Structure Diagram

A tree diagram, with the 'root node' or highest level component at the top represents the structure. A square box indicates components that contain more information beneath them in the structure.



If the node has a minus sign ⊟ in the box the level of detail below it is displayed. Clicking the mouse pointer on the box will hide the lower level(s).

If the box contains a plus sign, ⊞, there is another level contained by the node which is currently hidden. Click the mouse pointer on the box to display the next level of information under the node.

Components that are connected to a branch of the tree without a square box are leaf nodes. They display the lowest and finest level of detail.

Save as text

There is a Pop-Up menu which provides an option to save the complete structure to an ASCII text file. Place the mouse pointer anywhere inside the window and click the right mouse button to pop-up the menu. Then select the **Save As Text…** option.

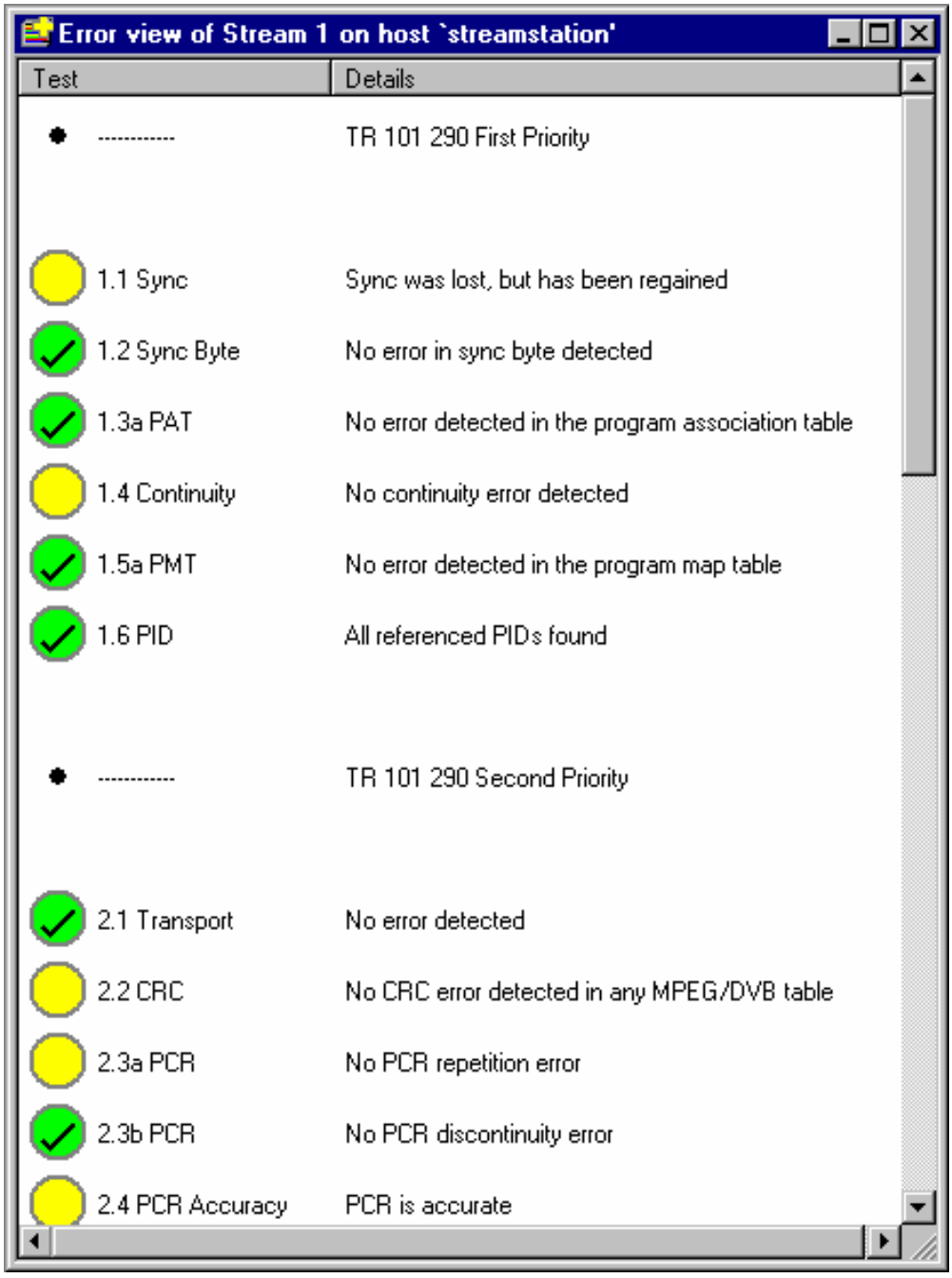
This saves all the information for the entire structure as a fully expanded tree. For example, here is the start of a file saved from the stream used for the previous screenshots:

```
PSI/SI Tables (snapshot at 10:55:16 08 Feb 2002)
  Program Association Table (PAT)
    PAT version 8 section 0
      table_header
        table_id=0
        section_syntax_indicator=1
        section_length=93
        version_number=8
        current_next_indicator=1
        section_number=0
        last_section_number=0
      transport_stream_id=1101
      program_number=0, network_PID=16 [0x10]
      program_number=28130, program_map_PID=2000 [0x7D0]
      program_number=28107, program_map_PID=200 [0xC8]
      program_number=28120, program_map_PID=3000 [0xBB8]
      program_number=28121, program_map_PID=3100 [0xC1C]
      program_number=28111, program_map_PID=600 [0x258]
      program_number=28128, program_map_PID=3800 [0xED8]
      program_number=28109, program_map_PID=400 [0x190]
      program_number=28126, program_map_PID=3600 [0xE10]
      program_number=28127, program_map_PID=3700 [0xE74]
      CRC_32=0x3AF0B450
  Program Map Tables (PMTs)
    Program 28130 Version 8 Section 0
      Table_Header
        table_id = 2 (0x02 PMT)
        section_syntax_indicator = 1
        section_length = 58
        program_number = 28130 [0x6de2]
        version_number = 8
        current_next_indicator = 1
        section_number = 0
        last_section_number = 0
      PCR_PID = 701 [0x2bd]
      program_info_length = 0
      descriptors
      elementary_streams
        2 (MPEG-2 Video)
          stream_type = 2 (MPEG-2 Video)
          elementary_PID = 701 [0x2bd]
          ES_info_length = 0
          descriptors
        4 (MPEG-2 Audio)
          stream_type = 4 (MPEG-2 Audio)
                                                                . . . . . .
```

Error View

Stream Monitor Plus performs conformance tests on transport streams, as specified in the DVB and ATSC standards. Error View displays a table of the test results and user specified limit test results since monitoring of the stream started or was reset.

Note: The screenshots used below relate primarily to DVB tests and standards.



Each row of the table shows the results for one of the conformance tests. The table is ordered by the priority and test number defined by the relevant standard.

From left to right the columns of information displayed for each test are:

Test Displays the test number, name and a colour coded 'at a glance' indicator icons of the test results (see also Errors, Events and Indicators, page 19). These icons are:

There have been no non-conformances for this test since monitoring started or a **Reset Alarms & Events** command was last issued.

No errors are currently being detected, but one or more PIDs in the program has failed this test.

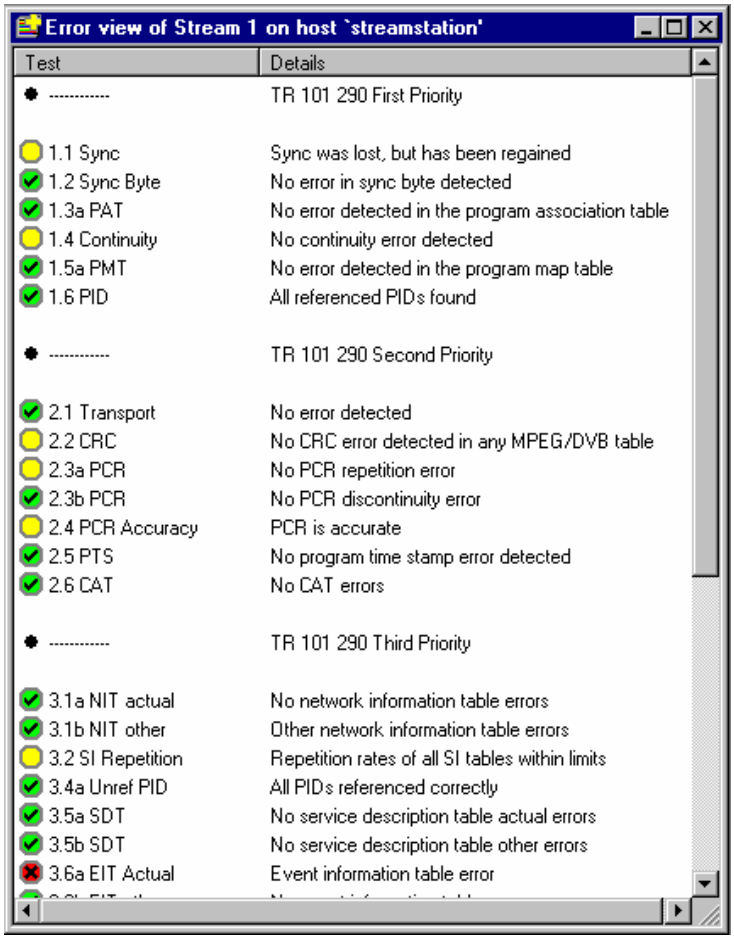
One or more PIDs in the program is currently failing this test.

Test disabled

Details Provides a textual description of the test results.

The tests are performed in real time and the results are updated frequently.

There is an option to change the size of the icons. The previous example shows the large icons. To switch to small icons select the **Options** option from the **View** menu. Then uncheck the **Large Icons** option from the Options dialog. Close and re-open the Error View window to apply the change. The new window will look similar to this:



The above example shows all of the tests including the results of the user specified limits for PID and program occupancy.

Pop-Up Menu

There is a Pop-Up menu which provides options to configure test parameters, explain tests, cancel and reset alarms. Place the mouse pointer over the desired test and click the right mouse button to 'pop up' the menu. The available options are:

Test Settings… Opens a dialog to change any user configurable parameters, enable or disable the selected test.

Explain Test… Displays an explanation of the purpose of the selected test.

Reset Events Clears the results status of all tests. All of the 'at a glance' icons are returned to the no error state: , unless the error is 'ongoing'.

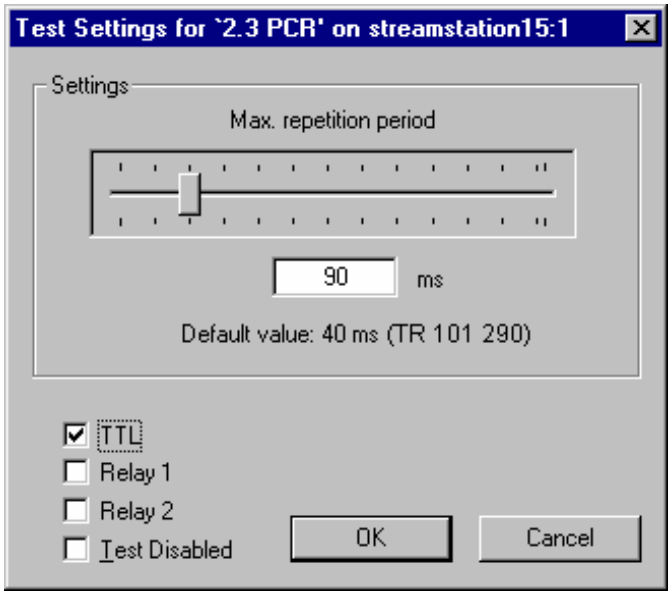
Test Settings

Test may be disabled and re-enabled from the Test Settings dialog. Some tests also have user definable parameters that may be adjusted. Right click on the required test and select **Test Settings…** from the pop-up menu. Alternatively double click on the test with the left mouse button. The dialog looks like this:

This example is from DVB test '**2.3a PCR**' which may be disabled/enabled and the maximum repetition period adjusted.

The slider bar is disabled (greyed out) when there are no user definable parameters.

To prevent this test being performed select the **Test Disabled** option (see also below).



Settings for tests which support user definable parameters can be adjusted by dragging the slider bar or editing the value in the field underneath. Whichever control is used the other is updated automatically as changes are made.

If the System Monitor Card (SMC) is fitted, the occurrence of an error can be set to generate a TTL output or operate a relay. To activate an alarm output enable the required checkbox(es). (See also 2.1 Standard Set-Up.) If the SMC is not fitted, the alarm options are not displayed.

Select **OK** to apply the new settings or **Cancel** to abandon any changes.

Test Disabled

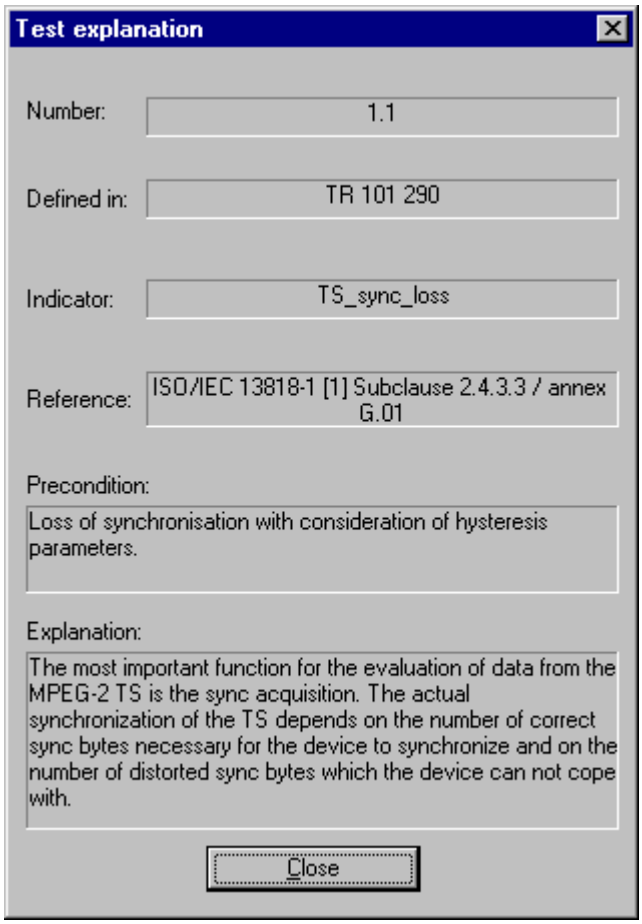
Note that when a test is disabled:

- the error indicator will be greyed out,
- log entries will not be generated,
- error triggering will not take place for that error.

In many cases test information is still available. For example, the PCR Arrival graph (see below) still shows the red/blue split, even when the test is disabled. However, for tests requiring a high level of computation, the collection of test information *is* suspended. Currently this applies only to the PCR Inaccuracy test, in which case the graph will consist only of a thick black line when the test is disabled.

Explain Test

For an explanation of a test right click on it and select the **Explain Test** option from the pop-up menu. This opens a Test explanation dialog. For example, the information displayed for test **1.1** is:



When the Explanation contains more information than it can display use the scroll bar to scroll through the text. The cursor control keys may also be used to scroll through the text, by first clicking in the field.

Select **Close** when finished with the dialog to remove it from the display.

Refer to Error Classification, page 27 for a description of the error hierarchy.

Error LEDs

Stream Monitor Plus performs conformance tests on transport streams, as specified in the DVB and ATSC standards. Select the **Show Error LEDs** option from the **Stream** menu to open this simple display of the results of the conformance tests:

Error LEDs shows a small status panel for the result of each test, and user specified limit test. The results show the state of each test since monitoring of the stream started or was reset.

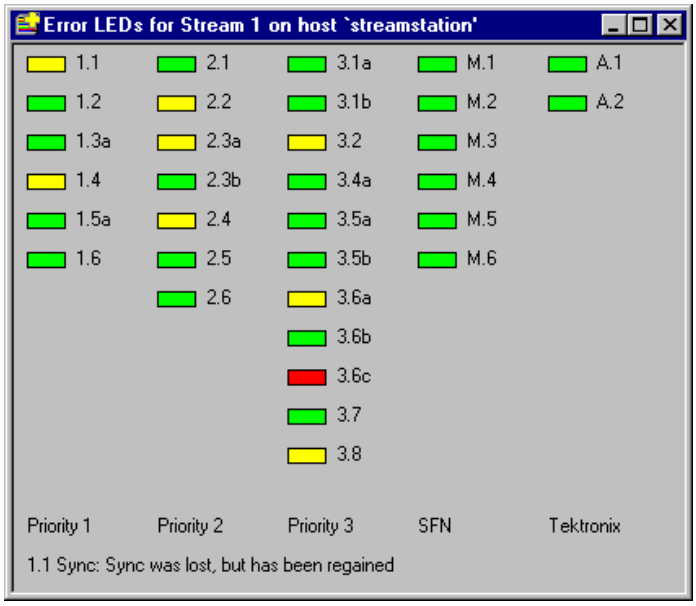
Each indicator is numbered according to the test it represents.

The indicators use the same colour code convention as the Error View, see Errors, Events and Indicators, page 19 for a general explanation.

The details which are displayed for a test in the Error View may be viewed in Error LEDs.

Click on an indicator to see the test details. For example click on **1.1** too see the details for the DVB TS_sync_loss test.

The details are displayed at the bottom of the window.



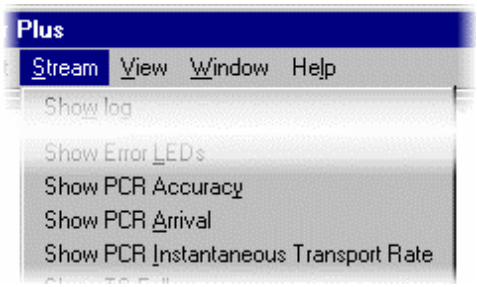
PCR Statistics Graphs

Stream Monitor **Plus** performs real time analysis of the timing of Program Clock References (PCR). Three different forms of analysis are performed. The results are displayed as graphs, which are updated frequently.

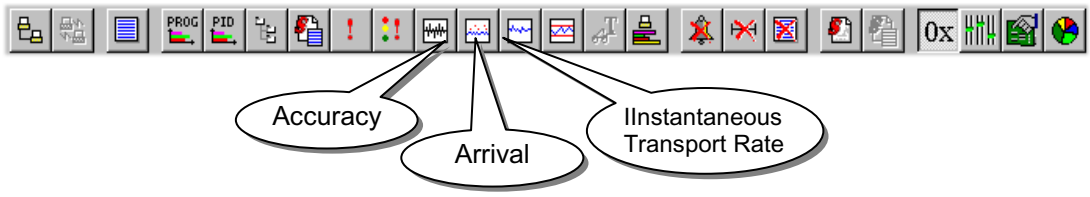
Each graph shows results, using one form of analysis, for one program within the stream. Many graphs may be open concurrently to look at different programs and interpretations. The graphs are described on the following pages.

Opening a Graph

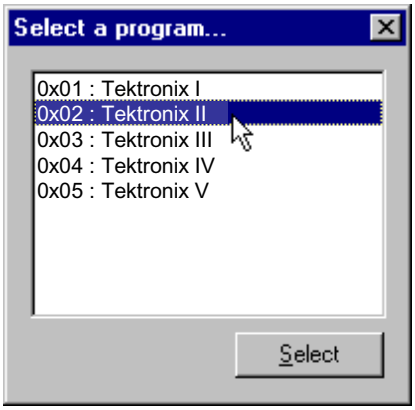
To open a graph, select the required option from the **Stream** menu:



Alternatively click on the equivalent button from the Toolbar:



After selecting the menu option or toolbar button for the required graph Stream Monitor Plus asks which program to plot. It displays a dialog which lists all of the programs which can be identified within the stream:



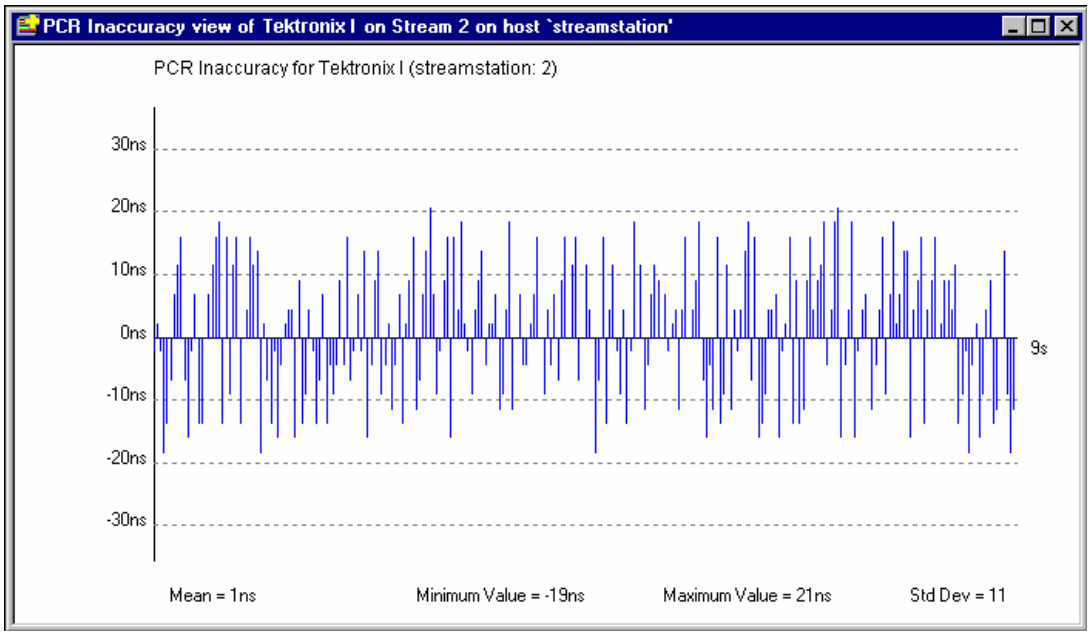
Click on the required program (for example program **0x02 Tektronix II**) and then the **Select** button.

A window is now opened containing the selected graph for the selected program.

If the window is already open, this action will bring it to the front of the display.

Graph Format and Zooming

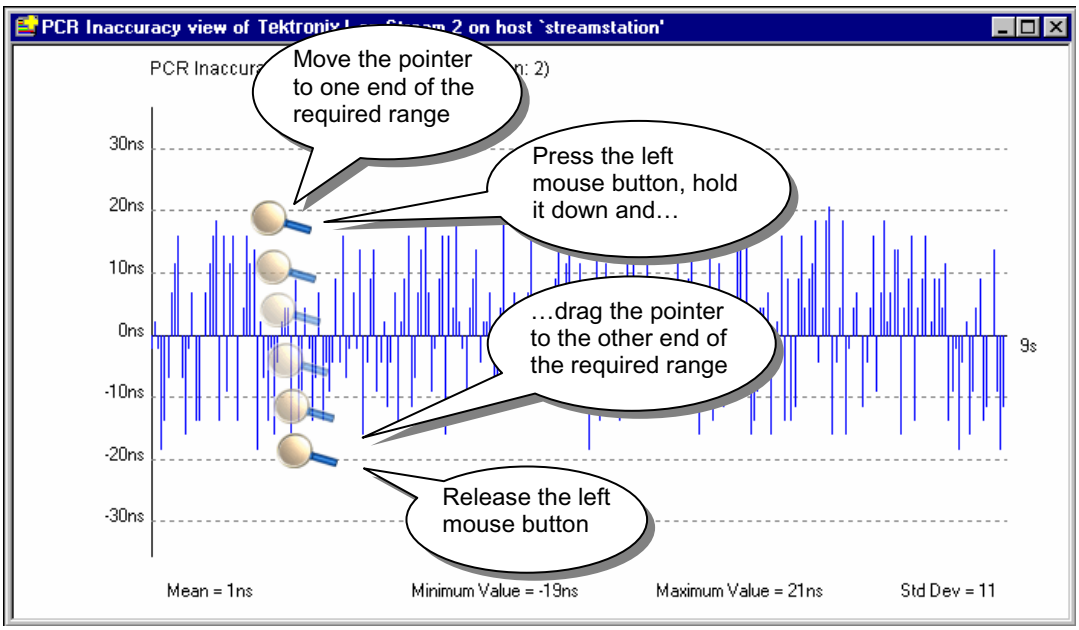
All three graphs have a similar format and controls. They show information for the last 250 samples, which is updated frequently. Time is plotted along the x-axis; if the default repetition rate is in force, this will be equivalent to approximately ten seconds. The measurement specific to each graph is plotted against the y-axis. For example:



Each graph is initially displayed at a default scale. Subsequently, several options are available to the user for scaling the vertical axis of the display.

Note that over a period of time, the x-axis range in seconds may appear to fluctuate. This is because the graph is derived from the 250 most recent PCR samples received and not from a constant ‘timebase’. Thus DVB compliant streams with a constant 40ms PCR interval, will appear to display regularly spaced elements over a 10s x-axis. Fluctuating PCR intervals will be reflected in the time taken to collect the information and therefore in the x-axis value.

The vertical scale of any graph may be expanded to show finer detail using the mouse. To zoom in, place the mouse pointer over the highest or lowest value required in the range. The mouse pointer changes to a magnifying glass, . Press and hold down the left mouse button. Drag the mouse pointer to the other end of the required range and release the left mouse button.



The range selected will be magnified to fill the vertical axis. The graph will continue to be updated frequently even while selecting the zoom range.

Other scaling options are available from the pop-up menu displayed when the right-hand mouse button is clicked anywhere over the graph.

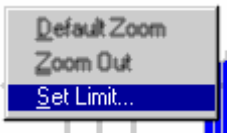
Default Zoom: Select this option to zoom the graph back to the default scale.

Zoom Out: Select this option to zoom the graph to maximum scale on the Y-axis.

To zoom back out to the full scale, place the mouse pointer anywhere inside the graph window, and click the right button.

Settings Threshold Display

Where a PCR period Setting exceeds the value set, the associated graphical point (or bar) is displayed in red. In the examples given in these pages, the normally red lines are made black; points (or bars) which do not exceed the period set are printed as grey.

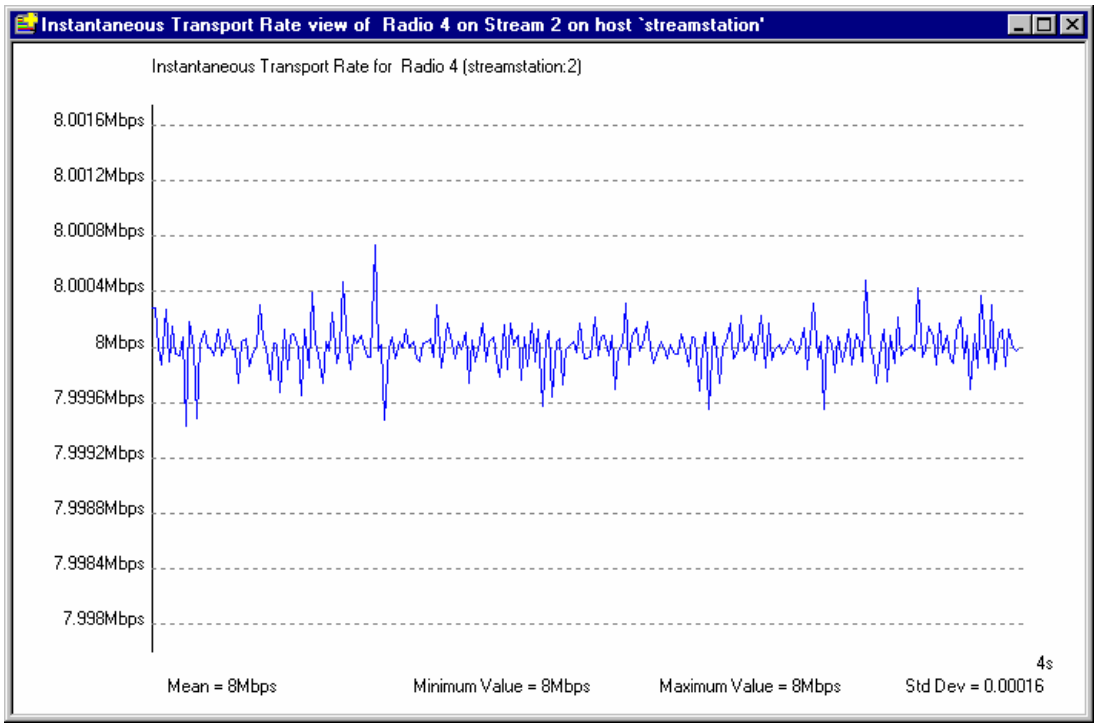


Settings…: Opens the relevant Test Settings dialog (see page 52).

Note that **Settings…** are not available for the Instantaneous Transport Rate graph.

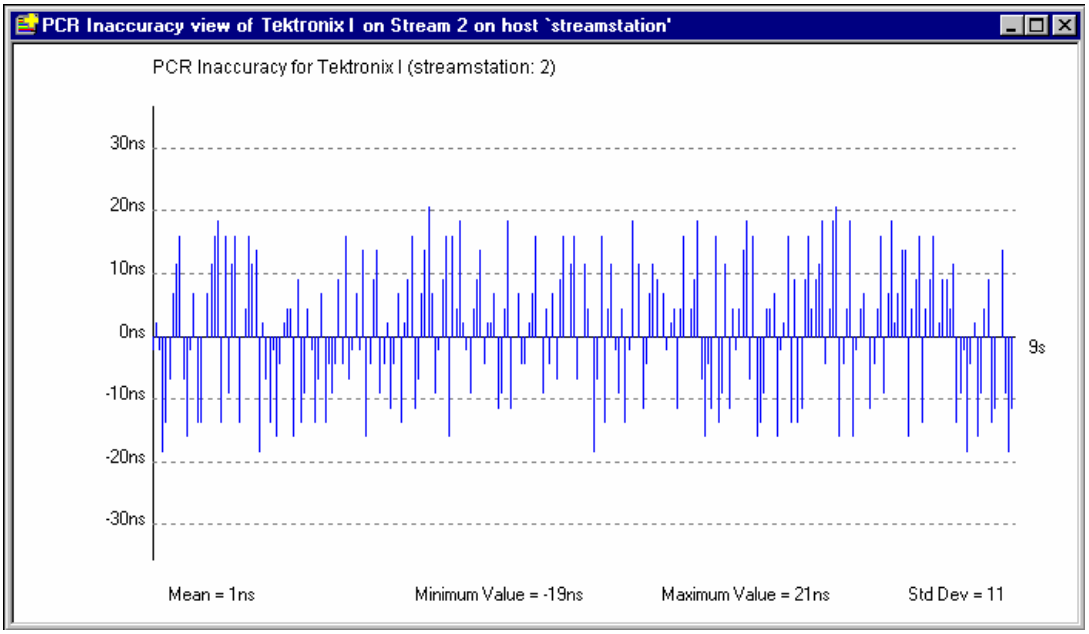
Instantaneous Transport Rate

This graph displays the instantaneous transport rate, plotted against the y-axis. It is derived from each pair of PCRs and displayed in the form of a graph. Each point on the graph represents the rate for a particular PCR.



Accuracy

The Accuracy graph shows the difference between the actual and expected values for each PCR on the y-axis. Expected PCR values are calculated from the mean rate of change over the last 250 samples and the expected value of the previous PCR.



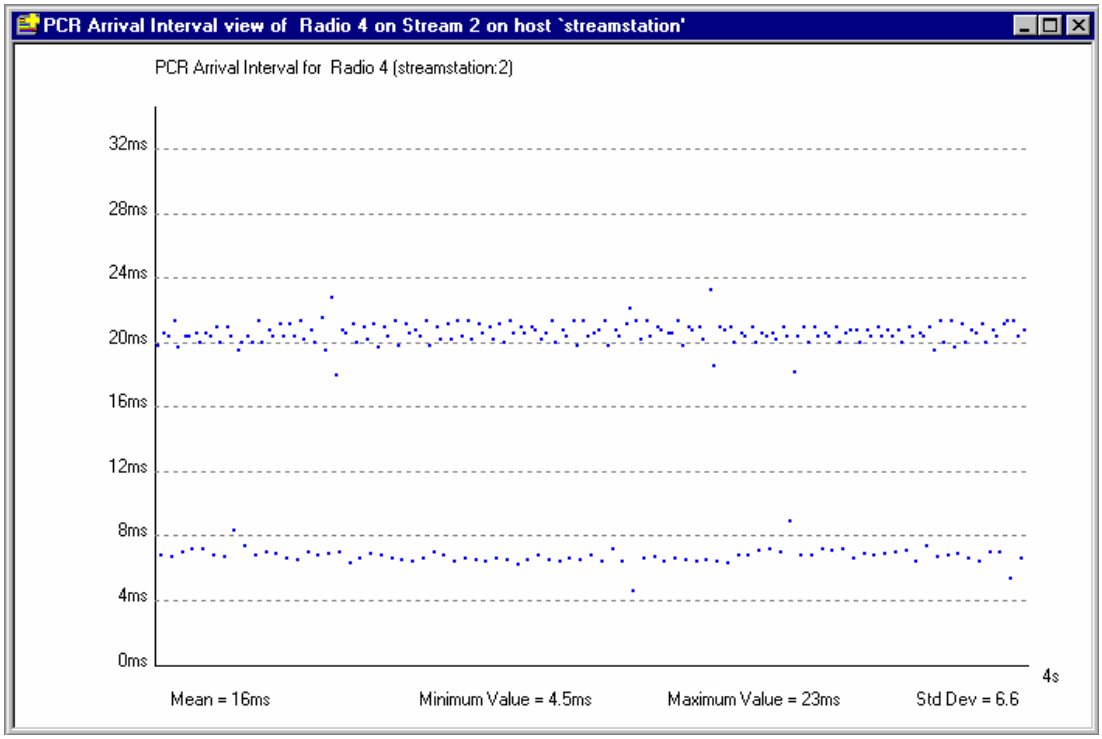
The MPEG-2 and DVB standards specify that PCRs must be within ±500ns of the actual transport rate. By default the scale is set to ± 500ns. As described above, the expected transport rate can be set; values which exceed the set rate are displayed in red.

As with the other graphs the vertical scale can be expanded to show finer detail. Each vertical bar is colour coded with respect to the setting of the **Max inaccuracy** in test **2.4 PCR Accuracy**. By default this is 500ns, to test conformance to the DVB standards. Bars are plotted in blue when they fall within the specified interval. Any bars which exceed the specified interval are plotted in red. If a value is not available or if a test is disabled, a thick black line is plotted at zero.

Arrival

This graph provides a display of the time interval between successive PCRs, during the last 250 PCRs. The interval is displayed on the y-axis.

As with the other graphs the vertical scale can be expanded to show finer detail. Each point is colour coded with respect to the setting of the **Max repetition period** in test **2.3a PCR**. By default this is 40ms, to test conformance to the DVB standards. Points are plotted in blue when they fall within the specified interval. Any points which exceed the specified interval are plotted in red. For example:



PCR Statistics Graphs (ASI Timestamping)

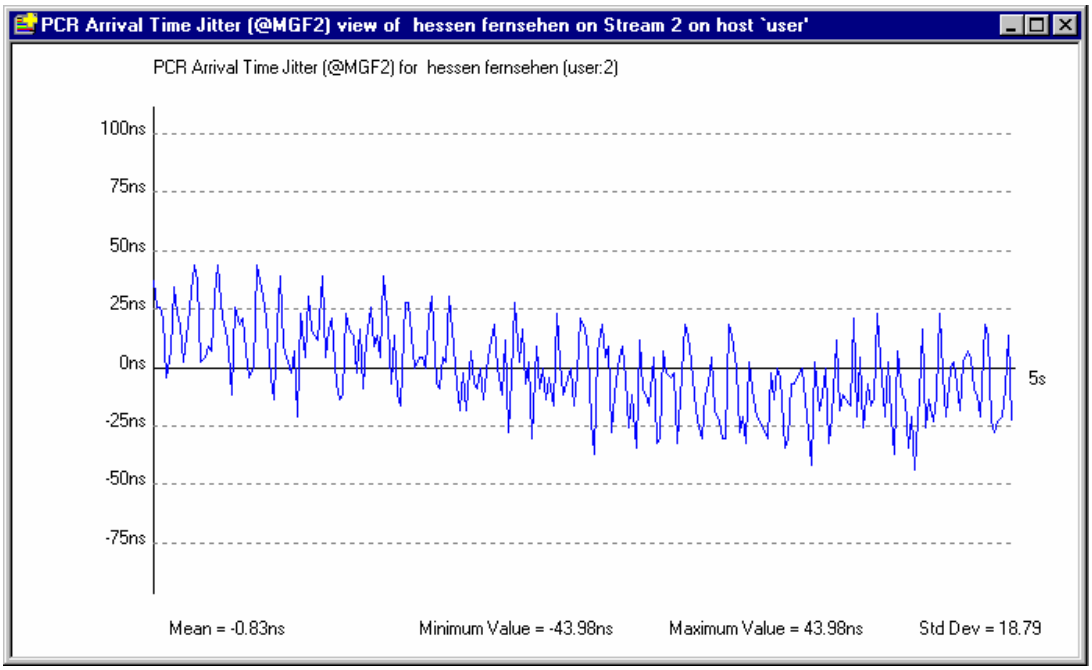
The following graphs are calculated using time stamping information appended to each packet when a transport stream is monitored with Time-Stamping active. Note that the ASI+TS card must be fitted for the time-stamping feature to be available. Only time-stamped streams can be graphed in this way.

(For more information about PCR statistics, refer to Appendix I of Reference [1].)

Arrival Time Jitter (PCR-AJ)

(Also known as Network Jitter.) This graph displays the time interval between the actual arrival time of a PCR packet and its expected arrival time based on its byte index.

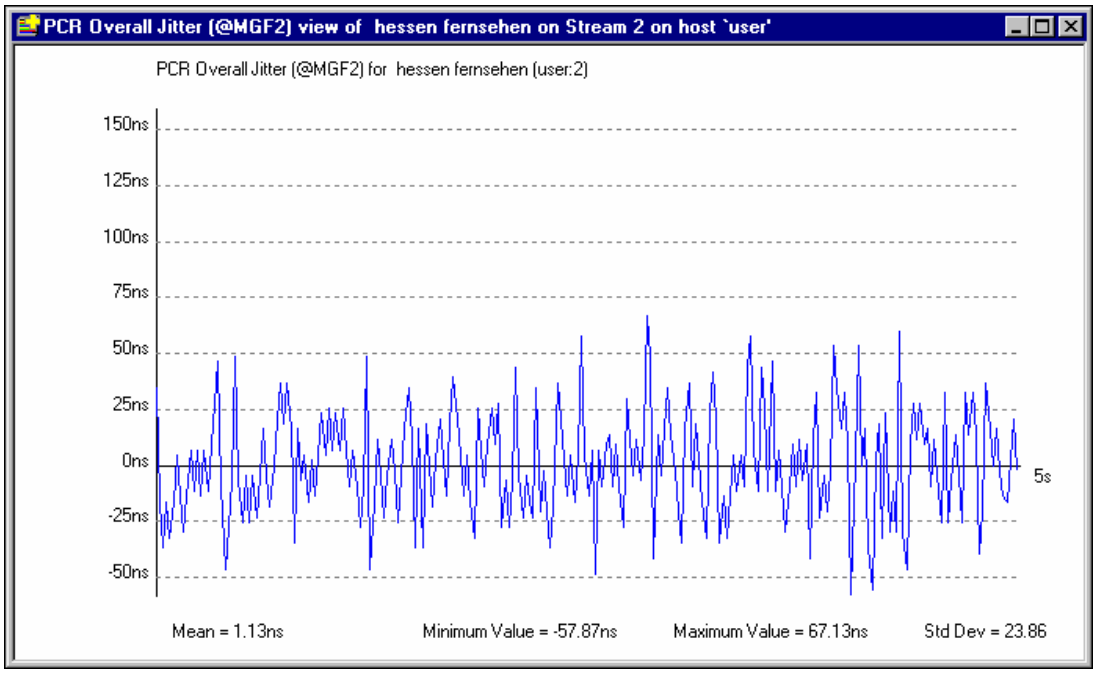
Arrival Time Jitter = PCR_OJ - PCR_AC



Overall Jitter (PCR-OJ)

The Overall Jitter graph shows the time interval between the actual value of the PCR and its expected value based on its arrival time.

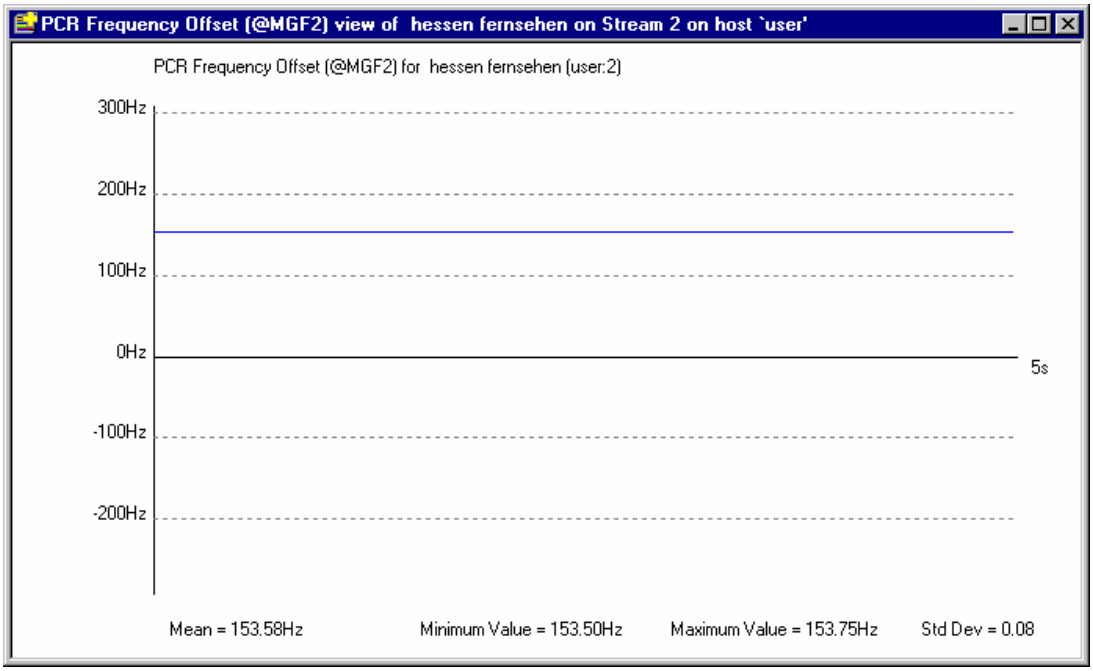
PCR_OJ = PCR_AC + Arrival Time Jitter



This value can be compared against the maximum error specification in ISO/IEC 13818-1 for PCR Accuracy of ±500 ns only if the jitter in the transmission is assumed to be zero.

Frequency Offset (PCR-FO)

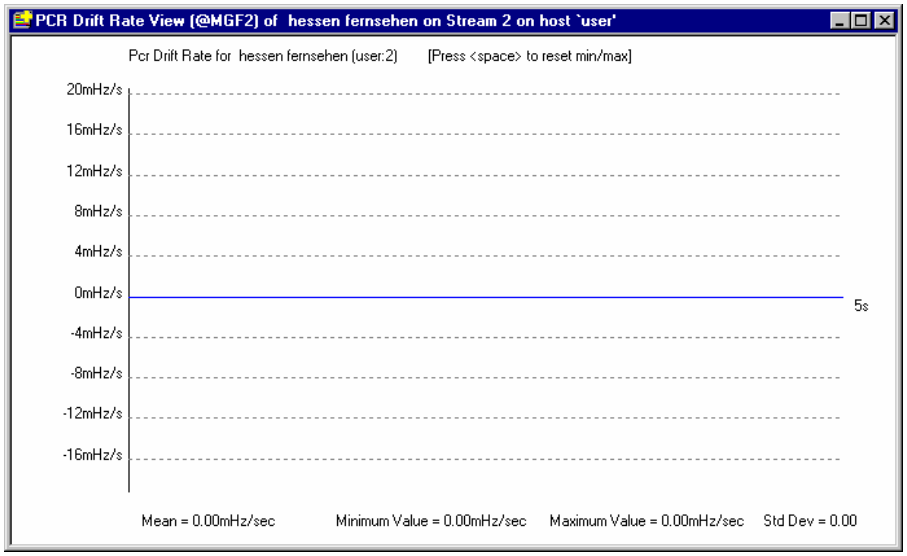
The Frequency Offset graph shows the difference between the program clock frequency and the nominal clock frequency (measured against a reference which is not PCR or TS derived).

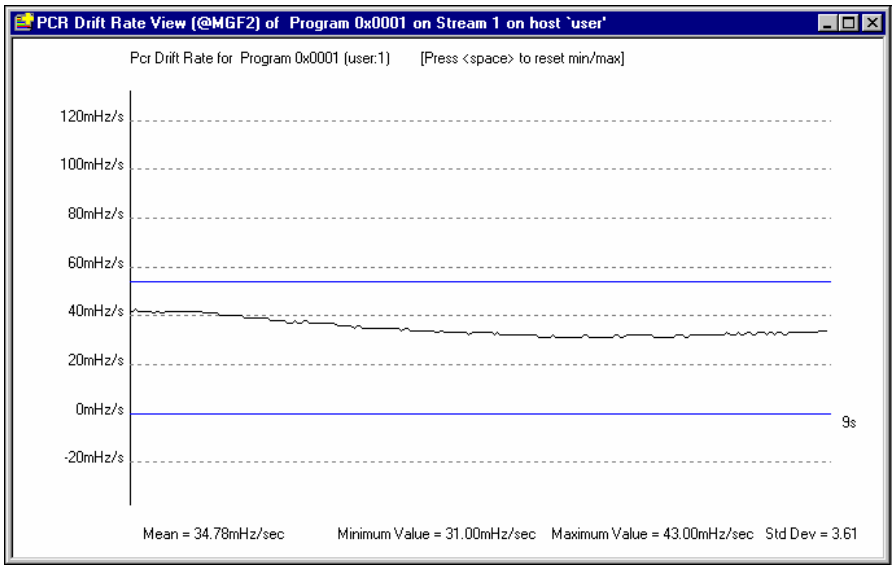


PCR_FO is a measurement of the error in the PCR frequency from the specified 27MHz; the MPEG specification sets the limits at ±810Hz.

PCR Drift Rate Measurement (PCR_DR)

The Drift Rate graph shows the rate of change of the PCR frequency offset (PCR_FO).





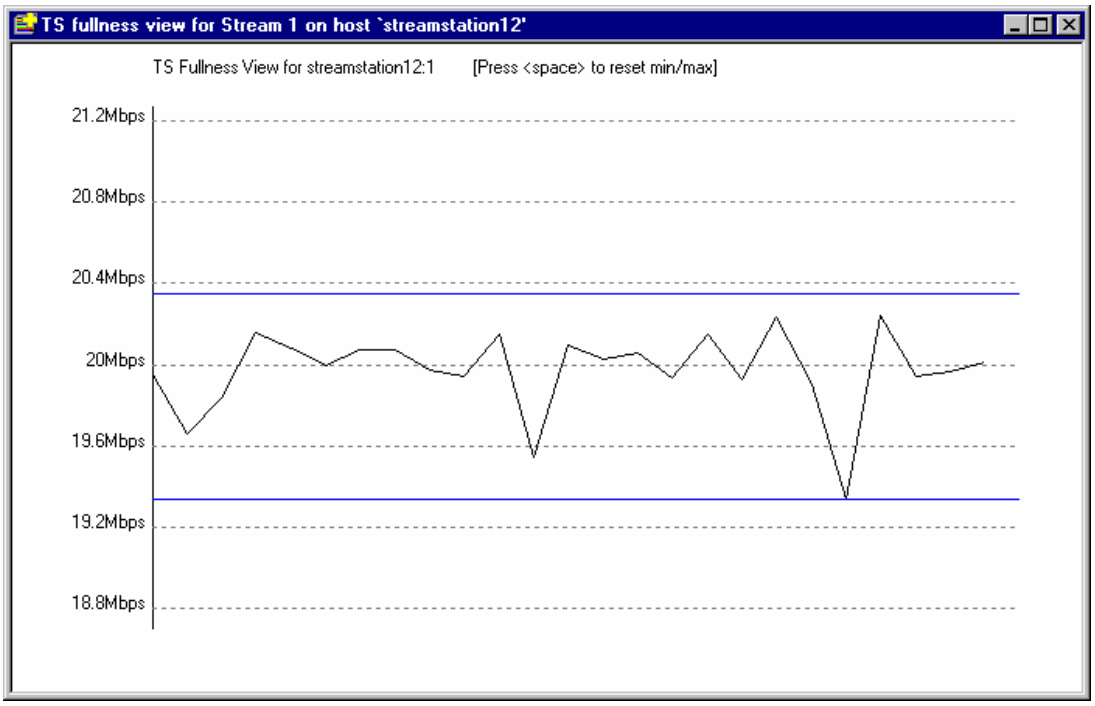
The horizontal blue lines are range bars indicating the minimum and maximum drift rate values for the transport stream (not visible on the screenshot above). These are calculated from the time the connection was made to the host or when the ranges were last reset.

Press the space bar to reset the minimum and maximum range bars or select **Reset Min/Max Range** from the right-click menu.

The vertical scale can be expanded using the technique described for zooming in to the PCR Statistics Graphs (page 56).

TS Fullness Graph

Select the **Show TS Fullness** option from the Stream menu to display a fullness graph for the current stream. Like the PCR Statistics Graphs, PID and Program Views it is updated frequently. The graph shows how full the transport stream was over the last 25 seconds:



The horizontal blue lines are range bars indicating the minimum and maximum fullness values for the transport stream. These are calculated from the time the connection was made to the host or when the ranges were last reset.

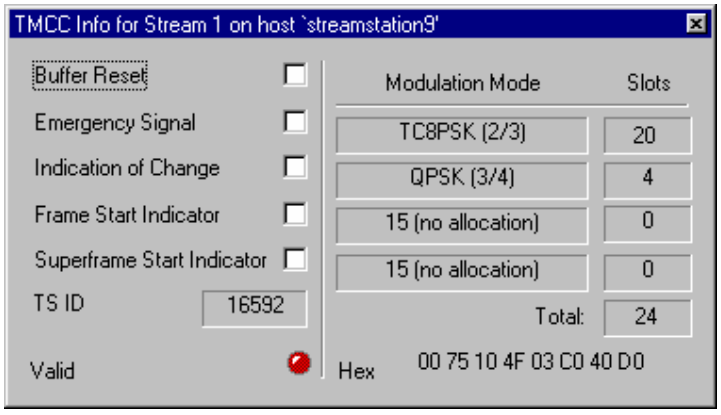
Press the space bar to reset the minimum and maximum range bars or select **Reset Min/Max Range** from the right-click menu.

The vertical scale can be expanded using the technique described for zooming in to the PCR Statistics Graphs (page 56).

TMCC Information

Select the **Show TMCC Information…** option from the Streams menu to display TMCC information derived from an ISDB-S stream. The menu option is only enabled when **Get TMCC Information** is enabled in the Configuration dialog, see Stream Configuration, page 35.

The following information window is displayed:



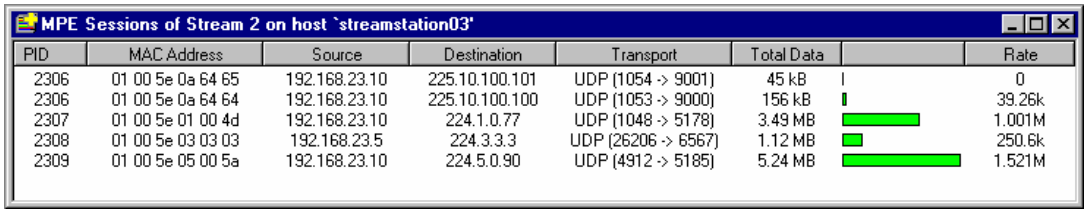
In addition to standard TMCC information, two fields are displayed at the bottom of the window: **Valid** and **Hex**.

The TMCC information presented in this window is for information only; no changes can be made to it via this window.

MPE Sessions

The Multi-Protocol Encapsulation (MPE) provides a mechanism for transporting data network protocols on top of the MPEG-2 Transport Streams in DVB networks. It has been optimised for carriage of the Internet Protocol (IP), but can be used for transportation of any other network protocol by using LLC/SNAP (Logical link Control / Subnetwork Access Protocol) encapsulation. It covers unicast (datagrams targeted to a single receiver), multicast (datagrams targeted to a group of receivers) and broadcast (datagrams targeted to all receivers). 48 bit MAC addresses are used for addressing receivers.

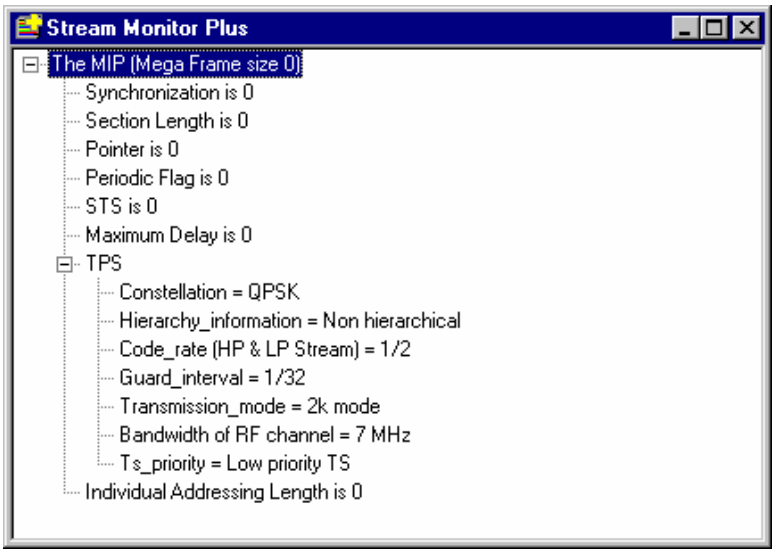
Select the **Show MPE Sessions** option from the Streams menu to display the MPE Sessions window.



The window presents a real-time view of all MPE sessions detected since the view became active. It uses the MAC address as a unique identifier for each session and displays useful header fields from the Network and Transport layers such as source and destination identifiers as well as flow rates.

MIP Sessions

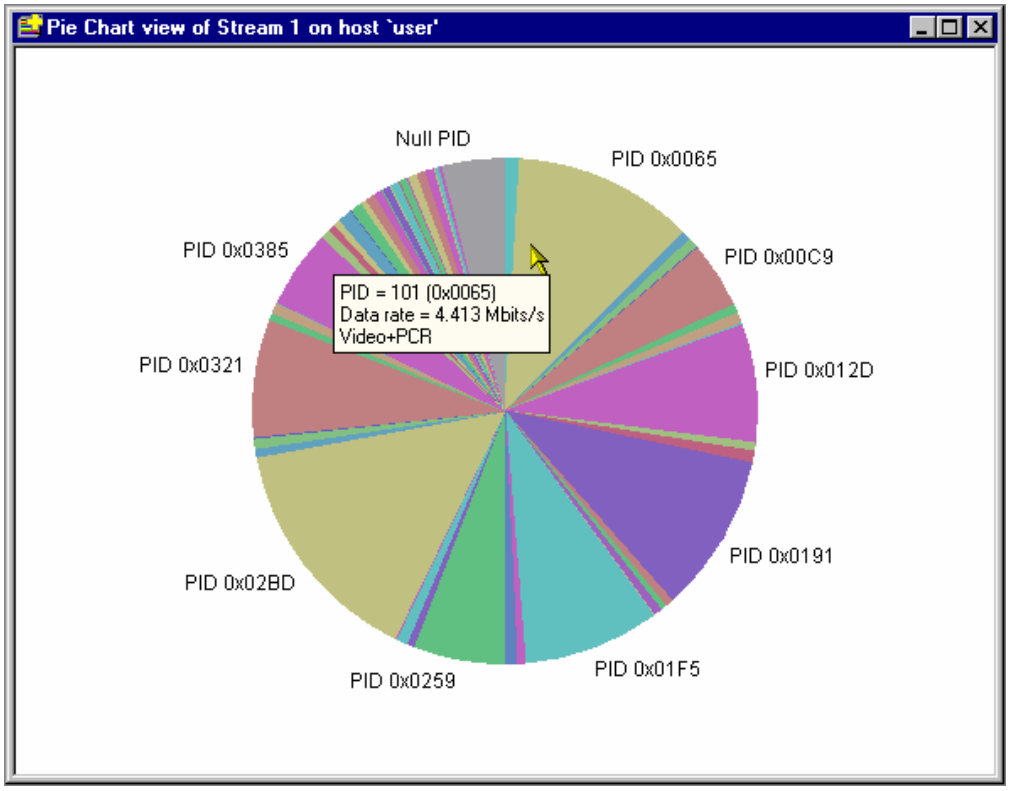
Where Single Frequency Network (SFN) information is included in a stream, it can be viewed by selecting the **Show MIP information** option from the Streams menu to display the Mega-frame Initialisation Packet (MIP) information window.



The information shown is a snapshot of the Mega-frame Initialisation Packet, including a breakdown of the TPS MIP and function descriptors.

While the window is active (or has the focus), the MIP information will not be updated. If the focus is temporarily passed to another window, the MIP information will be continuously updated until the focus returns to the MIP window.

Pie Chart



The Pie Chart view shows what proportion of the Transport Stream is taken up by each PID. It can be particularly useful for assessing the number of null PIDs in a stream; for example, the unused bandwidth.

More information can be displayed by double-clicking a section of the pie chart. This causes the program to display a pop-up window showing additional information for that PID. The information displayed is the same as that shown in the PID view.

Recording Streams

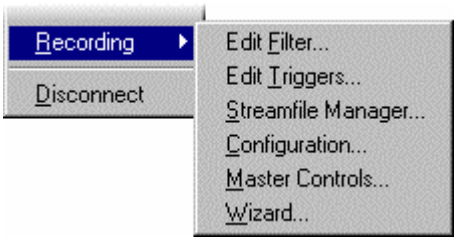
Transport streams are recorded to, files in the directory **E:\Recordings**, on the hard disk of the host machine.

Recorded File Size

All recorded file sizes are in multiples of approximately 1.2Mbytes (depending upon the packet size recorded). The minimum size for any recorded file will be four times this multiple; for a multiple of 1.2Mbytes the minimum file size is 4.8Mbytes. Any file which is less than four times the multiple will be rounded up. If a number of small files are to be recorded, the minimum file size (4.8Mbytes) should be taken into account when calculating available disc space.

Recording Commands

Commands for recording streams are available from the **Recording** side menu of the **Host** menu.



Shortcuts for all of these options are also available from the Record Bar.

There are 5 dialogs and one wizard for configuring and managing the recording process. The menu command and shortcut buttons to open these are:

Configuration…  Brings up the Recorder Configuration dialog to select the percentage of the file to be saved prior to the trigger event and which stream to trigger from.

Edit Filter…  Opens the Filter Editor dialog to select which PIDs to record.

Edit Triggers…  Invokes the Trigger Editor dialog to set up the conditions to trigger recording a file.

Master Controls…  Opens the Record Master Controls dialog which allows manual triggering and pausing of recording. It displays trigger status and progress.

Streamfile Manager…  Opens the Streamfile Manager dialog to create, delete, queue for recording, deselect for recording and rewind files.

Wizard…  Invokes the Record Wizard which provides guidance through the process of setting up a recording session.

Suggested Workflow

The Record Wizard follows a set path (or workflow) through the dialogs for configuring the recording options, starting and managing recording. It is an ideal tool for becoming familiar with, or re-capping, the recording facilities.

The next sub-section describes how to start and use the Record Wizard.

Record Wizard

The Record Wizard acts as a guide through the process for setting up and starting a recording session. It contains a sequence of thirteen pages, which have buttons to open the appropriate dialog for each step.

To invoke the Wizard select the **Wizard…** option from the **Recording** side menu or click on the shortcut button in the Record Bar.

Introduction

The first page provides an introduction.

Select the **Next** button to move on to the next page of the Wizard. From Step 2 onwards he **Back** button will be enabled. To go back to earlier pages select **Back** as many times as needed. Selecting the **Cancel** button stops the Record Wizard.

Cancel does not undo any changes made through the dialogs while running the Wizard.

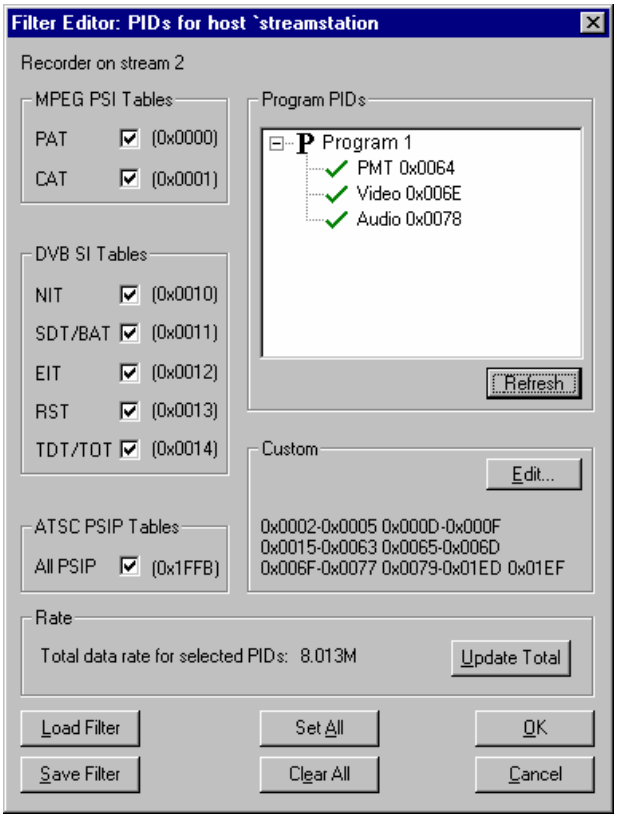
Recording

Follow the instructions on each page to configure, start and manage the recording session. More detail, where required, is given in the following sections.

Filter Editor

Stream Monitor Plus will record all of the data in the selected transport stream. Unwanted PIDs may be filtered out, to record a subset of the PIDs carried by the stream. The Filter Editor provides facilities to select which PIDs to include in recordings made by the host selected in the Streams Bar.

To open the Filter Editor ensure the required host is selected from the Streams Bar. Then select the **Edit Filter…** option from the **Recording** side menu or click on the shortcut button on the Record Bar. This will open the Filter Editor dialog:



PIDs may be selected via the **Tables**, **Program PIDs** and **Custom** panels. The **Set All** and **Clear All** buttons allow all PIDs to be selected for recording and or de-selected respectively.

If the Program PIDs panel is blank, check that the Recorder is set to a stream actually receiving data. The recorder stream can be changed in the Recorder Configuration dialog (page 90).

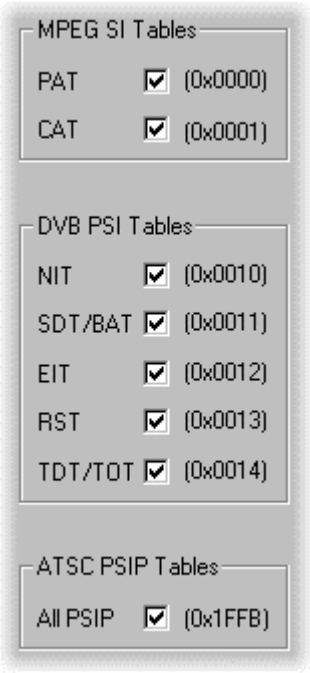
Select **Save Filter** (which opens a standard file browser) to save the filter settings to a file on the client machine. **Load** restores settings which were written to a file with **Save**.

Selecting **OK** downloads the filter settings to the interface adapter which is handling the current stream. Select **Cancel** to abandon any changes made in this dialog, leaving the settings in the interface unchanged.

MPEG SI, DVB PSI and ATSC PSIP Tables

Each of the tables shown in these panels may be included in recordings. Select the Table/PID to record all packets of that PID, or deselect it to filter them out.

PIDs selected for recording are indicated by a check mark, ☑.

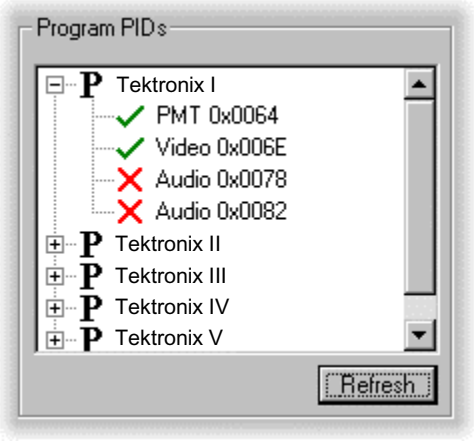


Program PIDs

The Program PIDs control displays the programs and PIDs using a tree structure.

Programs are represented as a node with the letter **P** followed by a program identifier. Beneath each program node in the tree are the PIDs carrying the streams and tables which belong to that program.

If a program node, **P**, has a minus sign ⊟ in the box the level of detail below it is displayed. If the program node, **P**, box contains a plus sign, ⊞, there are PIDs in the program which are currently hidden.

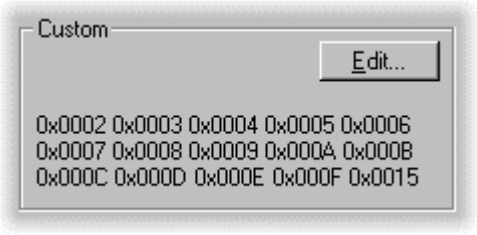


Click the mouse pointer on the box to toggle the display of the PIDs in that program.

Nodes representing PIDs display the stream or table type followed by the PID number. A tick, ✓, in front of the PID type indicates that the PID will be recorded. PIDs which will be filtered out (i.e. not recorded) are marked with a cross, ✗.

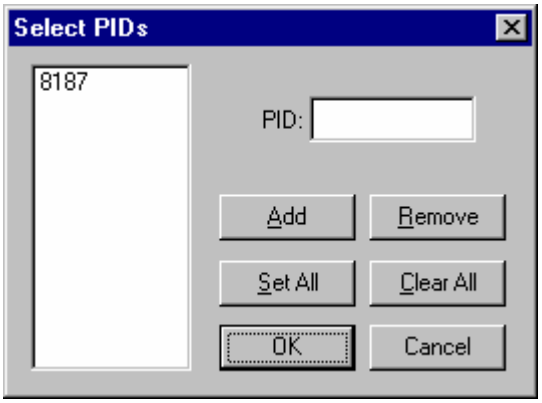
Custom PIDs

Packets may be selected for recording by PID number alone from the **Custom** panel. PIDs selected in this panel are added (using a logical OR) to those in the **Tables** and **Program PIDs**. The **Custom** panel lists the first 15 of these PIDs.



To view the full list of PIDs, add and remove PIDs click on the **Edit…** button. This opens the Select PIDs dialog:

The list on the left displays all of the PIDs selected for recording in the **Custom** panel.



PIDs may be selected by typing the required number in the **PID:** field then clicking on the **Add** button. Values may be entered using decimal or hexadecimal.

The full set of all PID numbers from **0x0000** to **0x1FFF** may be added by selecting **Set All**.

To remove one or more PIDs select them in the list, then select **Remove**. To remove all PIDs select **Clear All**.

Adding and Removing PIDs will be reflected in the Tables panels. For example, if PID number 0x0012 (EIT) is added in the Custom panel, the EIT checkbox in the DVB PSI Tables panel will be enabled and the number 0x0012 will not appear in the Custom list.

Filter Editor Window

Set All Selects all SI, PSIP and Program PIDs, even if they have been previously cleared.

Clear All Clears all SI, PSIP and Program PIDs.

Select PIDs Window

Set All Selects full set of current transport stream PID numbers within range 0x0000 to 0x1FFF.

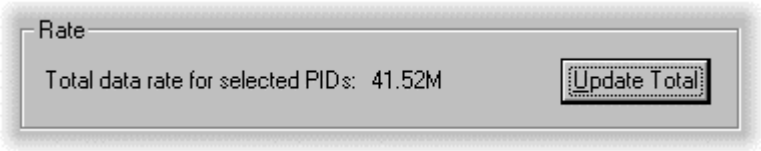
Add Add selected PIDs. If a PID had previously been deselected in the Filter Editor window, this command will reset it.

Remove Removes any PID other than SI, PSIP or Program.

Clear All Clears all PIDs other than SI, PSIP or Program.

Rate

The Rate Panel shows the estimated data rate for all PIDs which are selected for recording.



Always select the **Update Total** button to recalculate the rate after changing which PIDs will be recorded. The estimate is based on the data rates for each PID when the Filter Editor dialog was opened.

Trigger Editor

Recording a sample of a transport stream may be started manually or when a trigger event is detected. The Trigger Editor provides the facilities to specify what events may act as the trigger. These may include: Packet Content type, Transport Priority, Scrambling, Payload Start, DVB, ATSC and MPEG-2 non-conformance errors, SI Information and Date/Time.

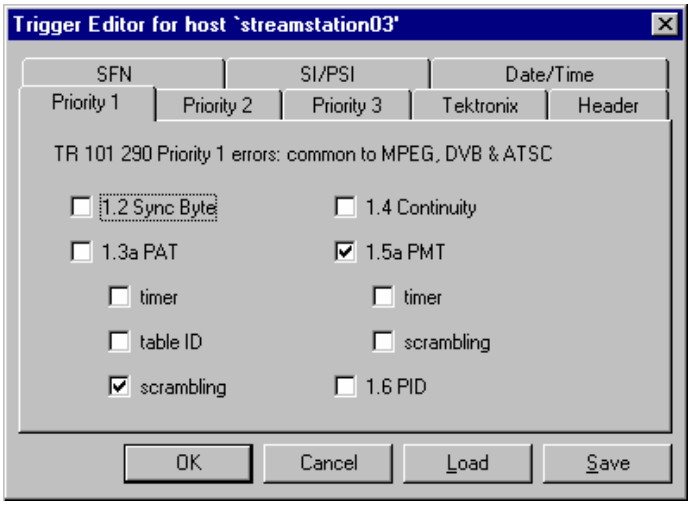
To configure the triggers select the **Edit Triggers…** option from the **Recording** side-menu. Alternatively click on the Edit Triggers button on the Record Bar. This will open the Trigger Editor dialog. The tabs displayed will depend on the stream Mode selected as shown in the table below.

	Priority 1	Priority 2	Priority 3	ATSC	Tektronix	Header	SFN	SIPSI	Date/ Time
MPEG	✔	✔	-	-	✔	✔	-	✔	✔
DVB	✔	✔	✔	-	✔	✔	✔	✔	✔
ATSC	✔	✔	-	✔	✔	✔	-	✔	✔
DVB/ATSC	✔	✔	✔	✔	✔	✔	✔	✔	✔

A tick, ☑, in the check box for a test indicates recording will be triggered if a non-conformance is detected for that test.

By default none of the tests will trigger recording. Click in the check box to enable triggering when a non-conformance is detected.

Selecting **OK** downloads the new trigger settings to the interface adapter that is handling the current stream. Select **Cancel** to leave the interface settings unchanged.



Select **Save** (which opens a standard file browser) to save the settings to a file on the client machine. The file settings from all tabs are saved to the same file.

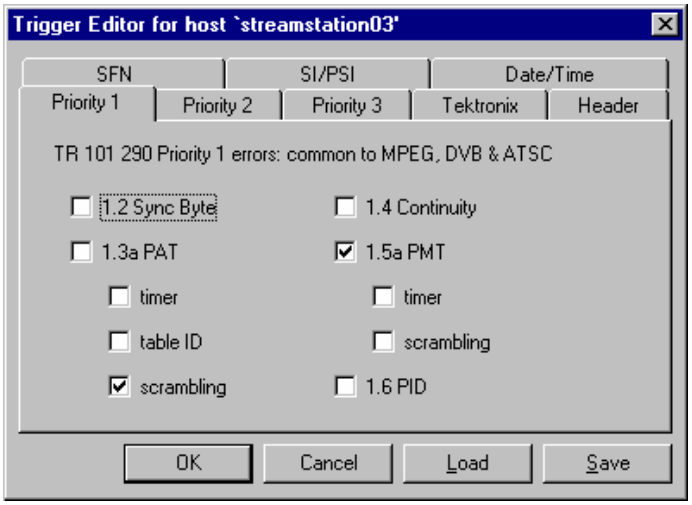
Load restores this dialog to settings that were written to a file on the client with **Save**.

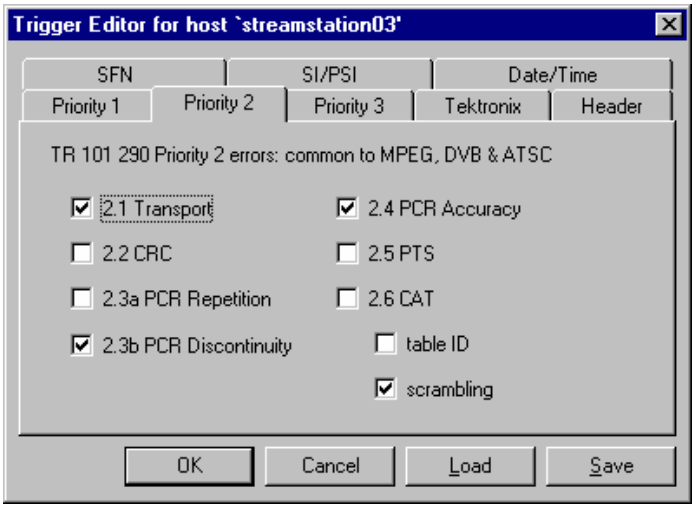
On the priority screens, it will be noted that the error hierarchy is reflected. Recording can be triggered by any level of error. Thus, in the example screen above, recording will be triggered specifically by a PAT scrambling error and by any PMT error.

The Trigger Editor dialog tabs are described below:

Priority 1 and Priority 2 tabs

This tab allows a set of the Priority 1 and 2 tests (as defined in the DVB standards, *TR 101 290*) to be selected to generate trigger events when a non-conformance is detected; the tests are also relevant for ATSC standards. The trigger for each test is enabled or disabled using a check box:

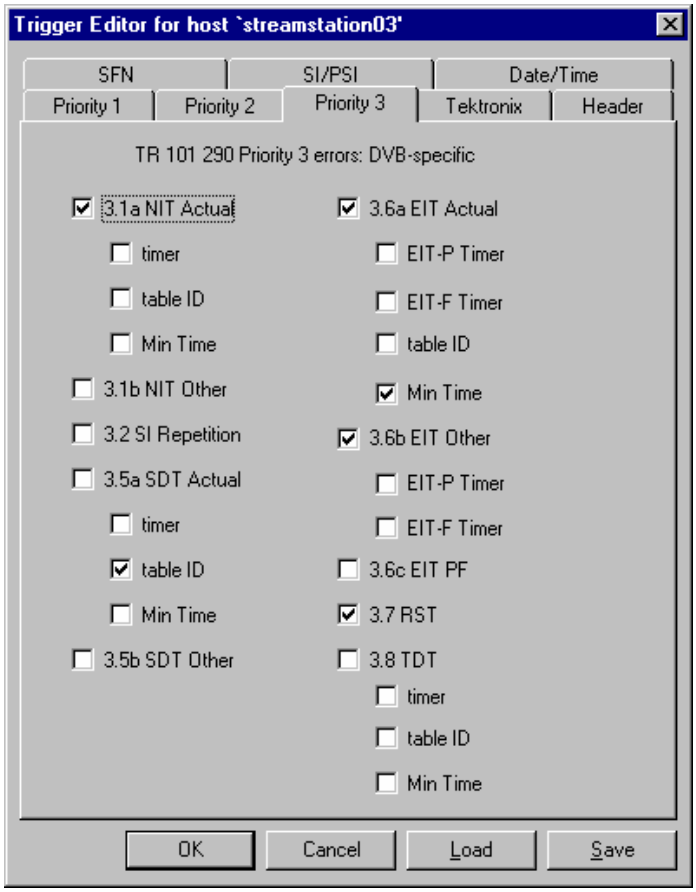




Priority 3 tab

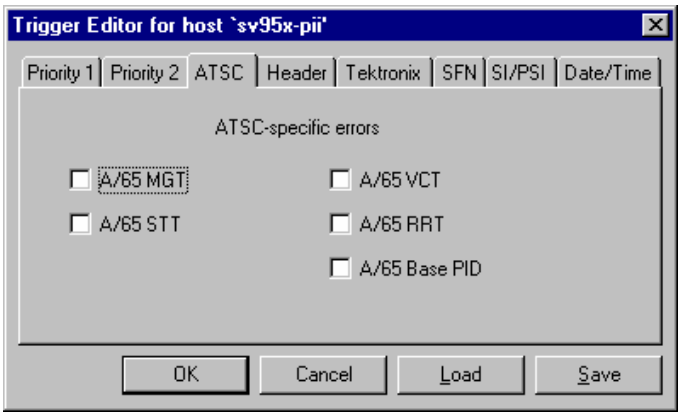
This tab allows a set of the Priority 3 tests (as defined in the DVB standards, *TR 101 290*) to be selected to generate trigger events when a non-conformance is detected.

The trigger for each test is enabled or disabled using a check box:



ATSC tab

This tab allows a set of the ATSC tests (as defined in the *ATSC standard A65*) to be selected to generate trigger events when a non-conformance is detected.

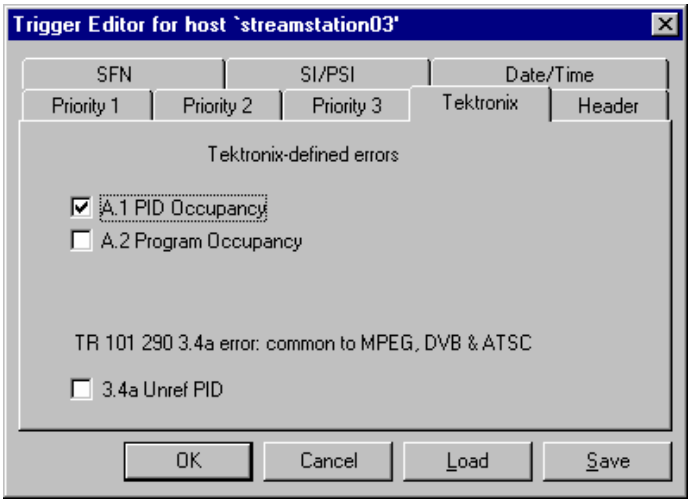


The trigger for each test is enabled or disabled using a check box.

Note that when ATSC mode is selected the Priority 3 tab is replaced with the ATSC tab.

Tektronix tab

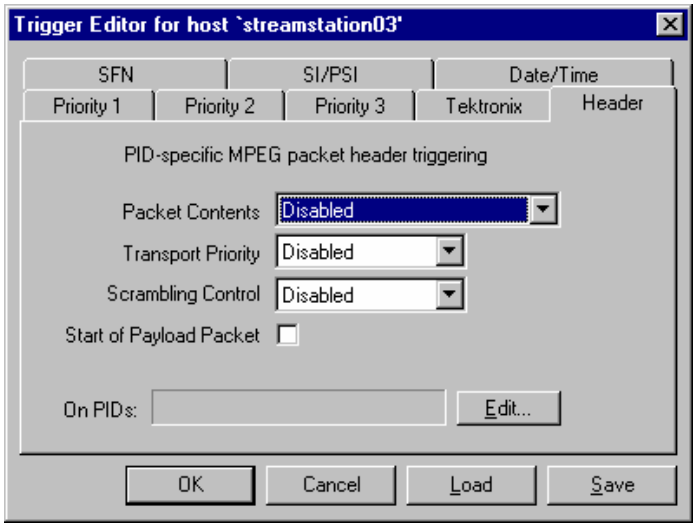
Recording may be triggered if any of the occupancy limits defined in the PID and/or Program views or the unreferenced PID tests are exceeded. Note that the test 3.4a Unreferenced PID is present on this tab because it can be applied to MPEG and DVB streams (The Priority 3 tab is not displayed in MPEG mode).



The trigger for each test is enabled or disabled using a check box.

By default none of the tests will trigger recording. Click in the check box to enable triggering when a PID or Program goes out of range.

Header tab



The Header tab has settings to test transport stream packet headers for trigger events.

The Header tab fields are described below:

Packet Contents

Trigger events are generated if the contents of the adaptation control field match the selection from the drop-down list. The possible test patterns to match are:

Disabled this trigger is turned off.

00 – Reserved recording is triggered when the adaptation field control bits have the value ‘00’. This value is reserved for future use by ISO/IEC.

01 - Payload Only triggers recording when the bits have the value ‘01’, indicating that the packet contains payload data but no adaptation field.

10 - Adaptation Field Only - recording is triggered when adaptation field is set to the value ‘10’, indicating that the packet contains an adaptation field but no payload data.

11 - Adaptation and Payload - triggers recording if the packet header adaptation field control bits have the value ‘11’ indicating that the packet contains payload data and an adaptation field.

?1 - Includes Payload - recording is triggered if the packet header adaptation field control bits have the value ‘01’or ‘11’, indicating that the packet contains payload data.

1? - Includes Adaptation Field - triggers recording if the packet header adaptation field control bits have the value ‘10’ or ‘11’, indicating that the packet contains an adaptation field.

Transport Priority

Generates a trigger event if the transport priority bit in the packet header matches the selected state. The test state is selected using the drop-down list:

Disabled this trigger is turned off.

Normal generates events when the packet header transport priority bit is set to 0 (zero).

High generates events when the packet header transport priority bit is set to 1.

Scrambling Control

Generates a trigger event if the state of the 2 bit transport scrambling control field matches the selected test state. The test state is selected with the drop-down list:

Disabled this trigger is turned off.

Not Scrambled Events occur if the transport scrambling control is set to 'off' (value 00).

User Defined gives an event if the transport scrambling control is set to any of the three user defined values. In binary these are: 01, 10, and 11.

Start of Payload Packet

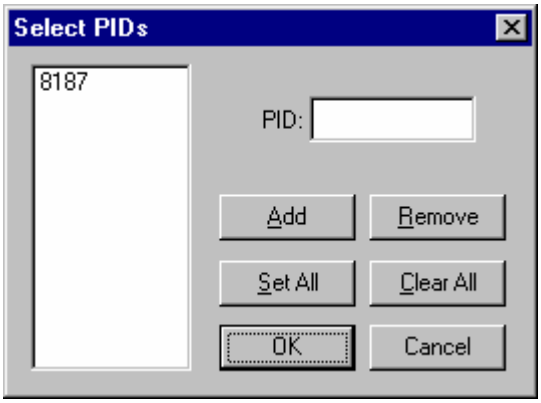
A trigger event may be generated when a packet has the payload start indicator bit set.

Select the checkbox (☑) to trigger when the payload start indicator is set.

On PIDs

Specifies the PIDs which are to be tested for trigger events using the criteria defined in the remainder of this tab.

Note that if the PIDs identified here are not selected for recording (via the Filter Editor), no pattern matching (and therefore triggering) can occur; no error message will be given.



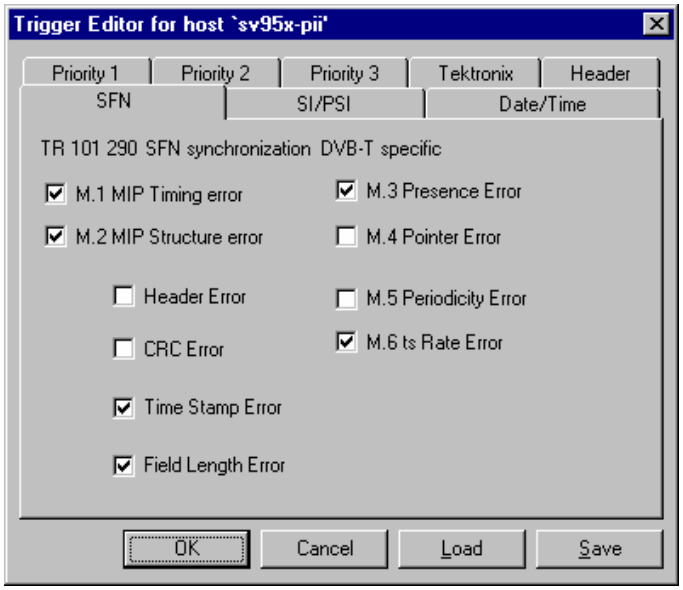
PIDs may be selected by typing the required number in the **PID:** field then clicking on the **Add** button. Values may be entered using decimal or hexadecimal.

The full set of all PID numbers from **0x0000** to **0x1FFF** may be added by selecting **Set All**.

To remove one or more PIDs select them in the list, then select **Remove**. To remove all PIDs select **Clear All**.

SFN Tab

The SFN tab allows a set of Single Frequency Network (SFN) tests (as defined in the DVB standards, TR 101 290) to be selected to generate trigger events when a non-conformance is detected. The tab is displayed only when DVB mode is selected. The trigger for each test is enabled or disabled using a check box:



M.1 MIP timing error

This test checks that successive Synchronisation Time Stamp (STS) values are self-consistent.

M.2 MIP structure error

These tests verifies that the syntax of the MIP complies with the specification in TS 101 191 *'Digital Video Broadcasting (DVB); DVB mega-frame for Single Frequency Network (SFN) synchronization'*.

M.3 MIP presence error

This test verifies that the MIP is inserted into the transport stream only once per mega-frame.

M.4 MIP pointer error

The MIP insertion can be at any location in the mega-frame. If the insertion is periodic as defined in the MIP, the MIP location in the mega-frame is constant over time. The MIP can be used to determine the mega-frame size and where each mega-frame starts and ends in the transport stream thanks to the pointer field verified by this test.

M.5 MIP periodicity error

In the case of a periodic MIP insertion (as defined in TS 101 191 chapter 5 and 6), the pointer value shall remain constant, as well as the number of packets between each MIP.

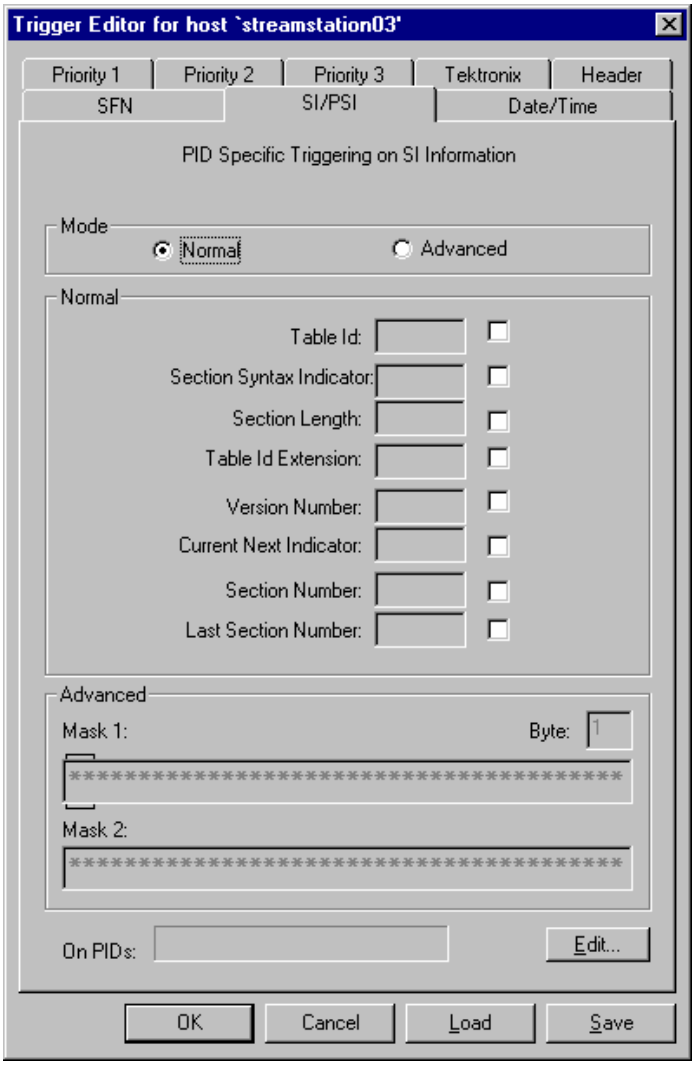
M.6 MIP ts rate error

This test verifies that the actual Transport Stream data rate is consitent with the DVB-T mode defined by the tps_mip (see TS 101 191 chapter 6 Table 3).

SI/PSI Tab

SI/PSI information can be used to trigger recording. Two modes are provided: Normal and Advanced. Normal mode allows the user to edit values from the standard MPEG header. Advanced mode allows the user to edit values in two 20 byte masks.

The modes are exclusive; that is, only one can be used at a time. Whichever mode is active when the OK button is pressed will provide the trigger data.



Normal Mode

In Normal mode, the trigger for each test is enabled or disabled using a check box.

Values can be entered in the adjacent box when the parameter is enabled. Values are entered in hex or decimal, depending on the overall Stream Monitor Plus selection.

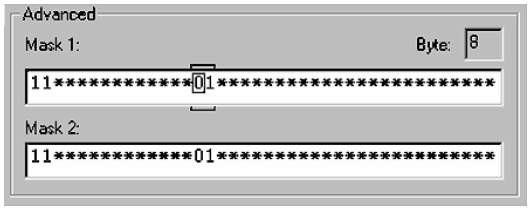
Values entered in Normal mode are copied (after confirmation) to the two masks when Advanced mode is selected.

Advanced Mode

Trigger data is entered via two 20 byte masks; the first eight bytes of each mask corresponds to the header region.

Values entered in the header region during Advanced mode can be copied (after confirmation) to the equivalent positions when Normal mode is selected.

Editing the Advanced Mask

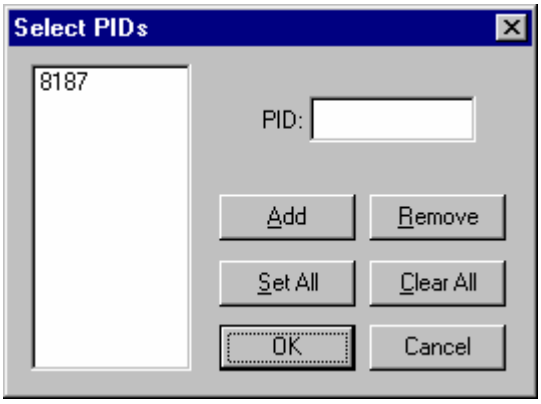


- The **Byte** counter indicates which byte is being edited to allow the user to position the cursor at the appropriate part of the mask.
- The byte marker bars above and below the edit box for each mask group the two nibbles that make up each byte. The cursor moves nibble-by-nibble as normal, the byte marker bars only moves when the user moves to another byte.
- The values are all hex values (The only values which can be entered into the mask are the 0-9 and a-f and '*').
- The delete key replaces a number with '*'. This symbol means ignore the nibble value when triggering recording.
- Each time the user switches from Normal mode to Advanced mode they are asked if they wish to copy the values to the two advanced masks.
- Any values, which have been entered into the advanced mask, which are outside of the header region (first eight bytes), are *not* overwritten when switching from Normal to Advanced mode.
- The user can copy the values from either of the masks in Advanced mode to Normal mode by a right mouse click. This also switches back to Normal mode.
- The user can clear all values in the Advanced mode masks from the right-mouse menu.
- If the user sets a nibble (say half of the table id byte) in Advanced mode to '*' then copies to normal mode the value in normal mode will use 0 instead of '*'.
  E.g. '*4' becomes 0x04, '4*' becomes '0x40'.

On PIDs

Specifies the PIDs that are to be tested for trigger events using the criteria defined in the remainder of this tab.

Note that if the PIDs identified here are not selected for recording (via the Filter Editor), no pattern matching (and therefore triggering) can occur; no error message will be given.



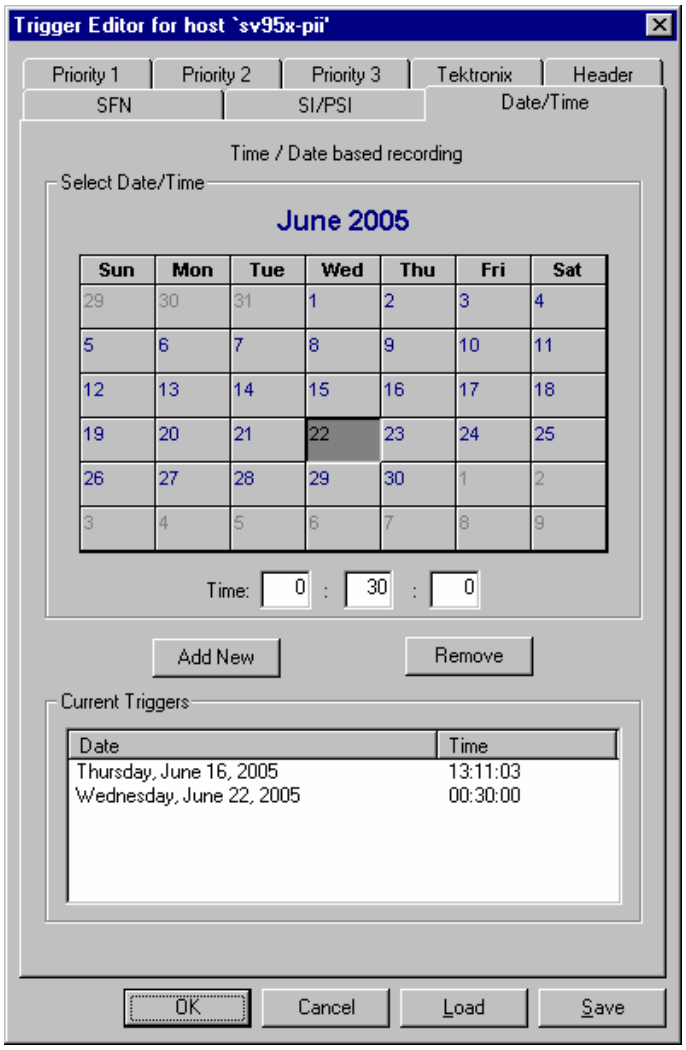
PIDs may be selected by typing the required number in the **PID:** field then clicking on the **Add** button. Values may be entered using decimal or hexadecimal.

The full set of all PID numbers from **0x0000** to **0x1FFF** may be added by selecting **Set All**.

To remove one or more PIDs select them in the list, then select **Remove**. To remove all PIDs select **Clear All**.

Date/Time Tab

The user can enter date/time triggers which trigger recording at a particular date/time, using the Date/Time tab.



The user can enter a date/time from the current time to a date/time up to two weeks in advance. Currently up to 10 Date/Times can be entered. Recording will begin at the specified date time (provided that a file is queued, and that no recording is taking place at the time the trigger point is reached).

Date/Time values that are past are removed when the user brings up the dialog for editing.

The user enters a value by selecting the date with the mouse and entering a valid time (hh:mm:ss) in the edit boxes. The Data/Time is added to the list when the user clicks the Add New button. The user can remove a trigger by selecting it and then clicking on the Remove button.

To move to the next month the user must click on the greyed portion of the calendar control (which shows the first few days of the following month, similarly clicking on the left-hand corner of the calendar control will take the user to the previous month).

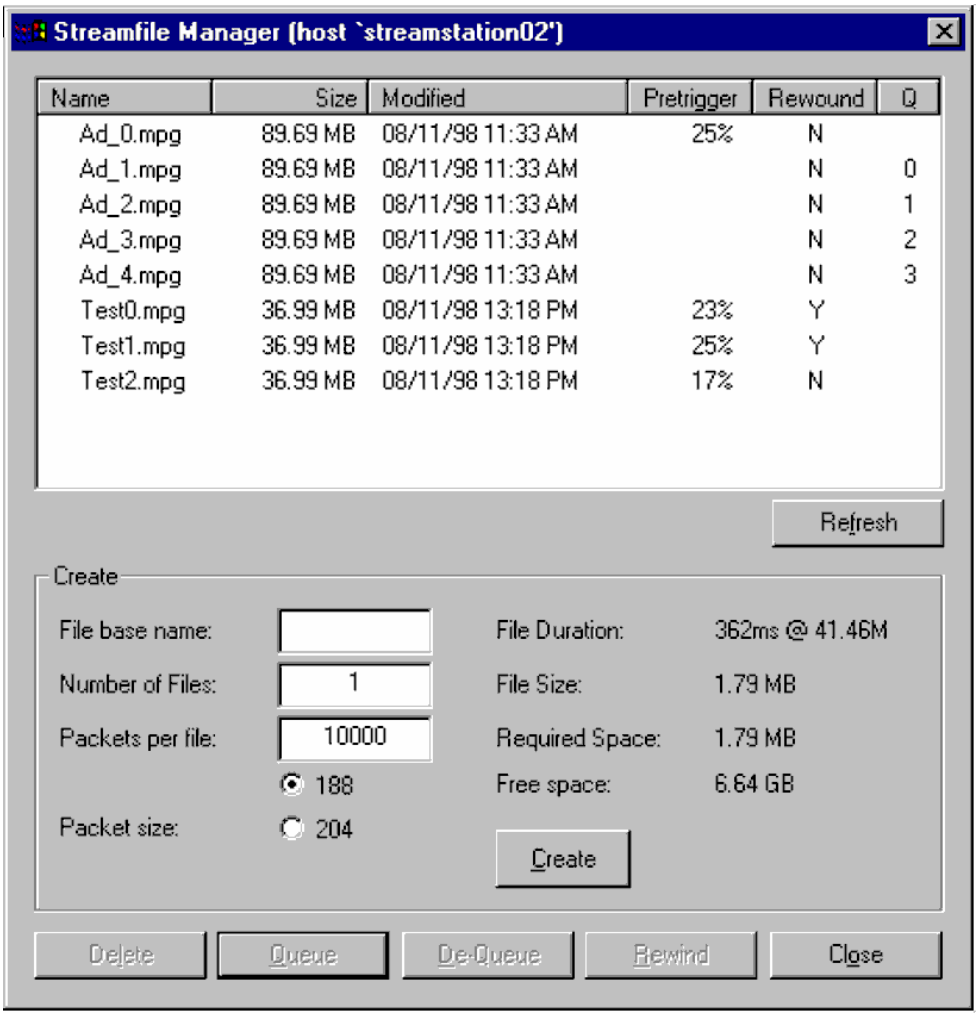
If the Date/Time is in the past or more than two weeks hence the user will not be allowed to enter the Date/Time.

Streamfile Manager

Streamfile Manager allows files to be created, queued up for recording and rewound after recording. The state of the queue and each file is displayed in a table.

Transport streams are recorded to, files in the directory **E:\Recordings**, on the hard disk of the machine hosting the server. Streamfile Manager interfaces to the server on the host which was selected, in the streams bar, when it was opened.

To open the Streamfile Manager select the **Streamfile Manager…** option from the **Recording** side menu, or click on the shortcut button in the Record Bar.



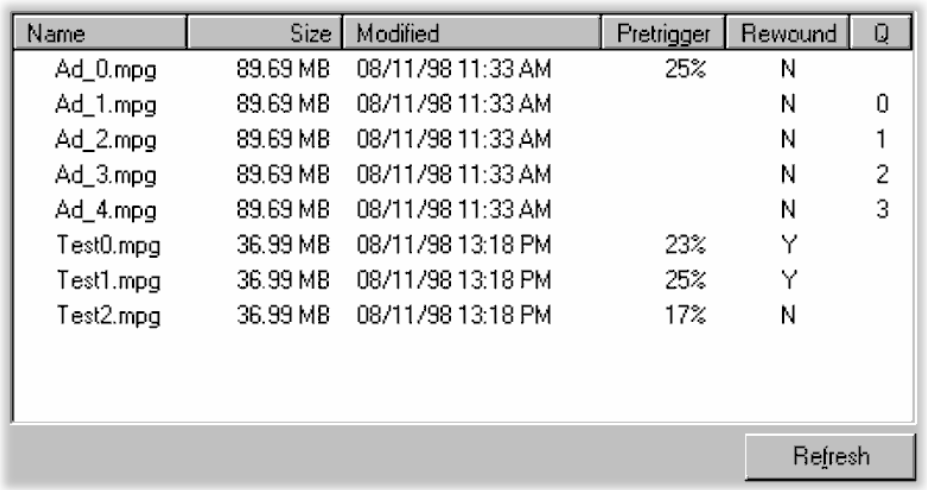
At the top of the dialog is the File Table which shows details of all files being managed. Beneath the table are the controls for creating new, empty, stream files which may be recorded to. The buttons at the bottom of the dialog provide the other management controls, which operate on any files selected in the File Table.

Note that the **Packet size** is only required as a guide to the final file size; it does not influence the actual data that is recorded.

The name of the host, whose files Streamfile Manager is controlling, is displayed in the dialog title bar.

The File Table

The Streamfile Manager gets details of the recording files being managed by the server and shows them in the table at the top of the dialog.



Each row of information contains the details for one file. From left to right the detail presented in each column is:

Name displays the filename, including the extension, of the managed files

Size shows the size of the file in kilo bytes (KB), mega bytes(MB) or giga bytes(GB)

Modified indicates the date and time the file was last modified. Usually this is when the file was written to. For new files it shows when the file was created.

Pretrigger is blank for files which do not contain finished recordings. Once recording is complete the **Pretrigger** column displays the percentage of the file which was recorded prior to the trigger event. All of the above files had 25% pre-trigger data specified. Both **Test0.mpg** and **Test2.mpg** were triggered before that much pre-trigger data had been captured.

Rewound contains an upper case 'Y' when a file has been recorded to and then rewound. A file can not be sensibly analyzed or played out until it has been rewound.

Q represents the position of the file in the recording queue. Files which have a number are queued for recording, those without are not.

If there are more files than can be displayed a scroll bar appears on the right, for scrolling up and down the list. A scroll bar also appears on the bottom since for scrolling left and right through the columns.

The dialog may be re-sized in the same way as a window to widen the file table. This will allow all of the columns to be viewed, without scrolling.

Refresh

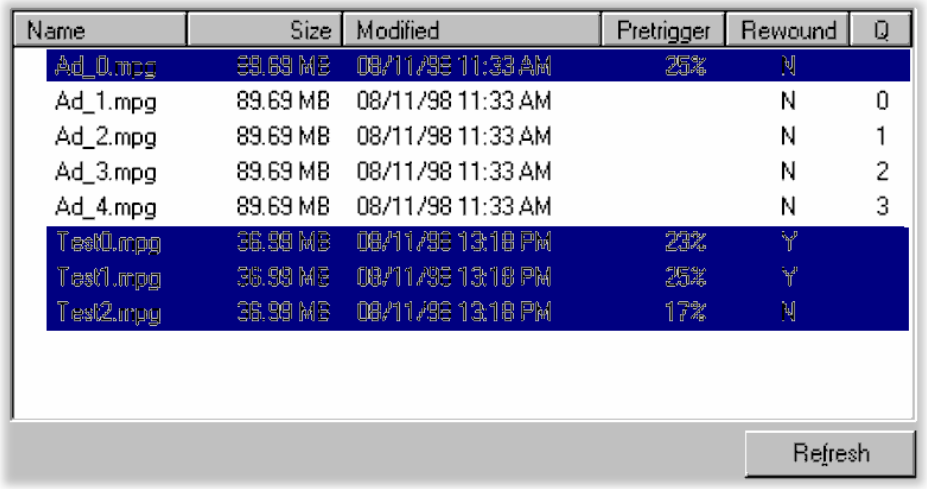
Streamfile Manager updates the display whenever it issues a command to the server which adds, deletes or changes the state of a file. The multi-tasking nature of the operating system makes it possible for another program to add, remove or change files in the **Recordings** directory. If this might have happened, click the **Refresh** button to re-acquire the file list and status from the server.

File Selection

The queue, de-queue, rewind and delete commands require one or more files be selected for them to operate upon.

A single file may be selected by clicking on it. To select a contiguous range of files: click on the first record to be selected, then hold the Shift or ⇧ key down and click on the last record required. To add individual files to the selection, or remove them, hold the Ctrl key down and click on the file.

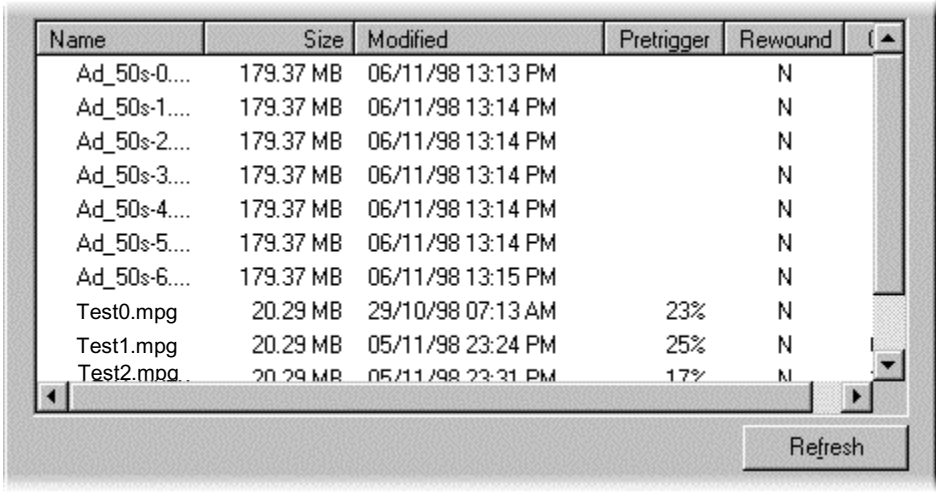
All selected files are highlighted. For example:



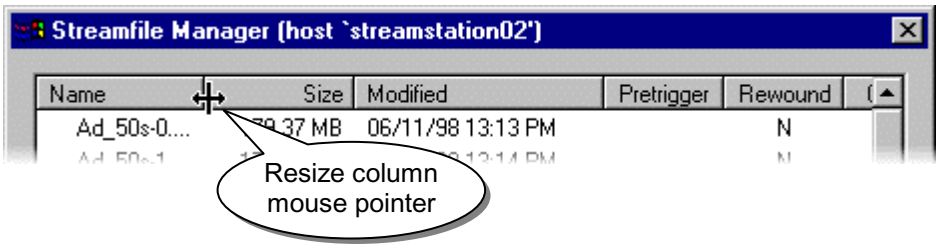
To create this screenshot, file **Test0.mpg** was selected first. Then the **Shift** key was held down and the mouse clicked on **Test2.mpg**, which selected all files between **Test0.mpg** and **Test2.mpg**. Finally **Ad_0.mpg** was added by holding down the **Ctrl** key and selecting it.

Adjusting Column Width

The width of each column can be adjusted. For example, some filenames may be too long to display fully in the default width for the **Name** column.

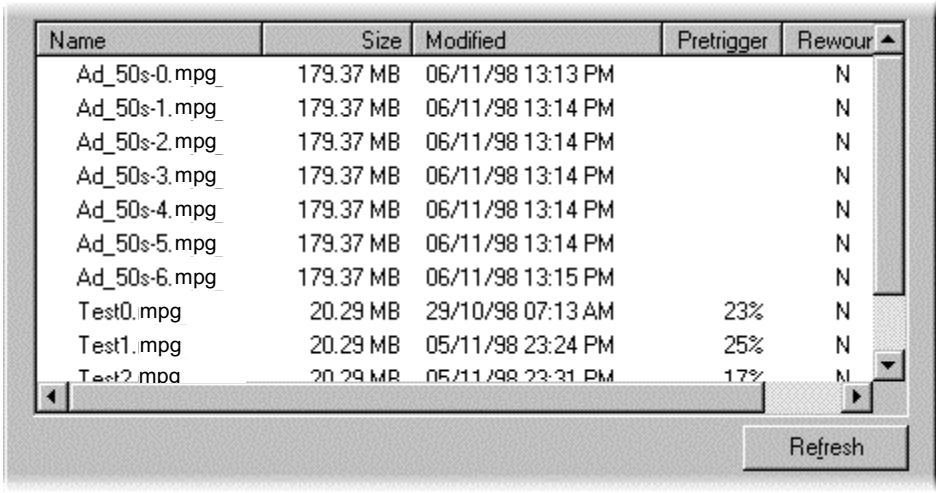


When the mouse pointer is moved close to a divider in the column title it changes to a column resize cursor, ↔.



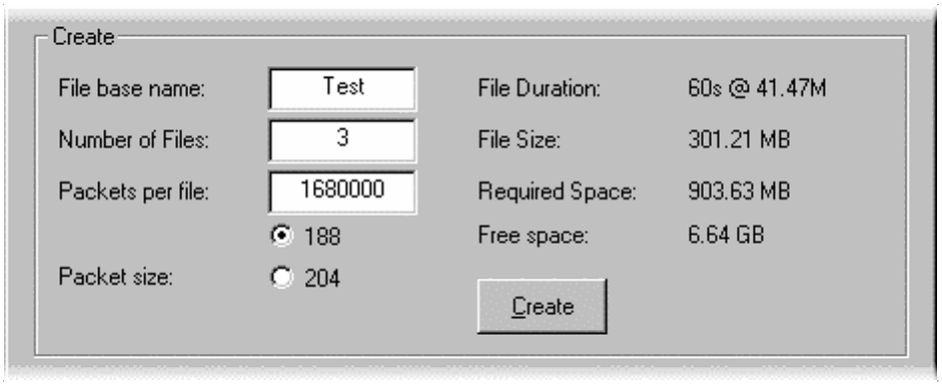
To adjust the column width move the mouse pointer over the column divider until it changes to the resize pointer. Then hold the left button down and drag the mouse in the required direction. When the column is at the desired width release the mouse button.

Widening the **Name** column moves all the other columns to the right and provides space to show the complete filename:



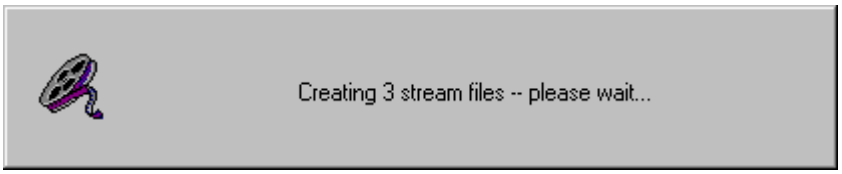
Creating files

One or more files may be created at a time, based upon a common set of parameters. The parameters are specified using the controls in the **Create** panel:



Enter the required parameters in the fields on the left (these are described later). Check details on the right. Then select the **Create** button to create the specified files. Depending on the size and number of files this may take some time.

Streamfile Manager displays this dialog while creating the new files.



If the server is recording (this includes waiting for a trigger event) Streamfile Manager will ask for confirmation before creating any files:

The parameters used for specifying new files are:

File base name when creating more than one file they will all have the same basic filename, suffixed with a unique number. All files are created with an extension of **.mpg**.

For example if the base name is **xyz** the first file created will be **xyz0.mpg**, the second **xyz1.mpg** and so on.

Number of Files specifies the number of files to create at one time. The files are given suffixes numbered from **0** to (**Number of Files - 1**).

Packets per file specifies the length of the file as the number of transport stream packets it should hold. The file size is calculated from this value multiplied by the selected packet size.

Packet Size selects the required packet size.

Streamfile Manager calculates the following information from the specification and displays it on the right of the Create panel:

File Duration	displays an estimate of the duration of a file and the transport stream rate it is based upon.
File Size	shows the size for each file calculated from the number of packets and packets size.
Required Space	shows the disk space required to create all of the specified files.
Free Space	indicates how much disk space is currently available on drive.

Queuing and De-Queuing files

To make a file available for recording it must be queued. Select the file(s) to be made available in the File Table then select the **Queue** button. The position of each file in the queue will be shown by a number in the **Q** column of the table.

Files may be removed from the queue by selecting them in the File Table and selecting the **De-Queue** button. The queue position, in the file table, of each de-queued file is cleared.

Rewind files after recording

In order to capture pre-trigger data Stream Monitor Plus uses the recording file as a buffer. When a recording has finished the file must be 'rewound' to position the start of the recording at the start of file.

There is an exception, which is files that did not reach their pre-trigger capacity limit, before their trigger event The start of the file is the start of the recording, since there was no need to buffer any data.

To rewind one or more files select them in the File Table, then select **Rewind**. To avoid disrupting other recordings, do not rewind files while recording is in progress. Depending on the size and number of files selected rewinding may take some time.

Deleting Files

This command deletes files from the **E:\Recordings** directory controlled by Streamfile Manager and updates the File Table. To delete one or more files select them in the File Table, then select **Delete**. A dialog will be displayed asking for confirmation. Select **Yes** to continue or **No** to abort the operation.

A file can not be deleted, by Streamfile Manager, if it is currently queued for recording. The Delete button will be disabled (greyed out) if any selected file is queued.

Recorder Configuration

These settings are applied to all files that are recorded while the settings are in effect.

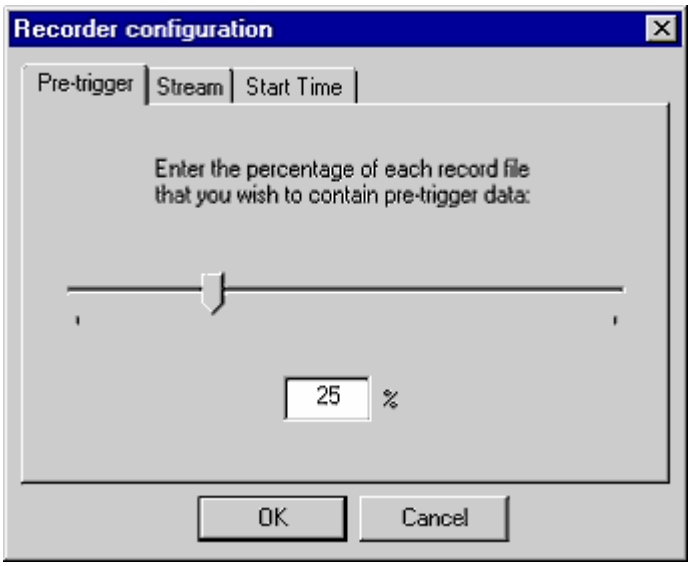
To change stream or the proportion of each file saved prior to the trigger event select the **Configuration…** option from the **Recording** side-menu. Alternatively click on the Configuration button in the Record Bar.

This will open the Recorder Configuration dialog that has three tabs.

Pre-Trigger

Transport stream packets are written to the first file, queued for recording, on the hard disk of the server's host. Packets are recorded to the file continuously until a trigger event is detected. Recording continues after a trigger event until the file holds the specified proportion of data from before and after that event.

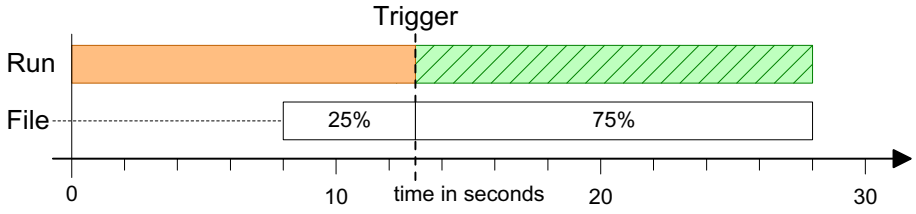
The Pre-trigger tab allows the proportion of data saved before and after trigger events to be specified as a percentage. Editing the value or dragging the slider in the tab can change the proportions:



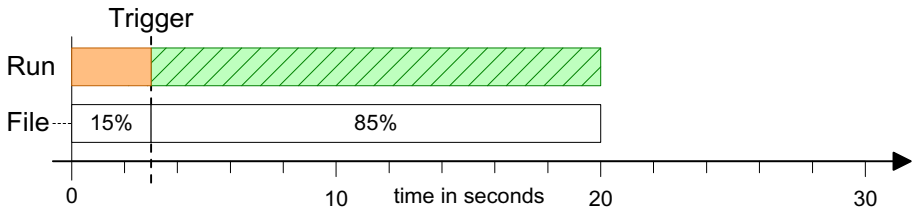
The default ratio is that 25% of the file will contain data captured prior to the trigger.

The actual ratio may vary since trigger events will seldom fall neatly on a buffer boundary. Data is buffered internally in buffers of an integral number of packets. The proportion of pre-trigger data may also be less than specified if the trigger event occurred before enough packets were recorded.

For example if a 20 second recording is made, with 25% pre-trigger specified, and an event triggered recording 5 seconds or more in to the run the contents of the file will be:

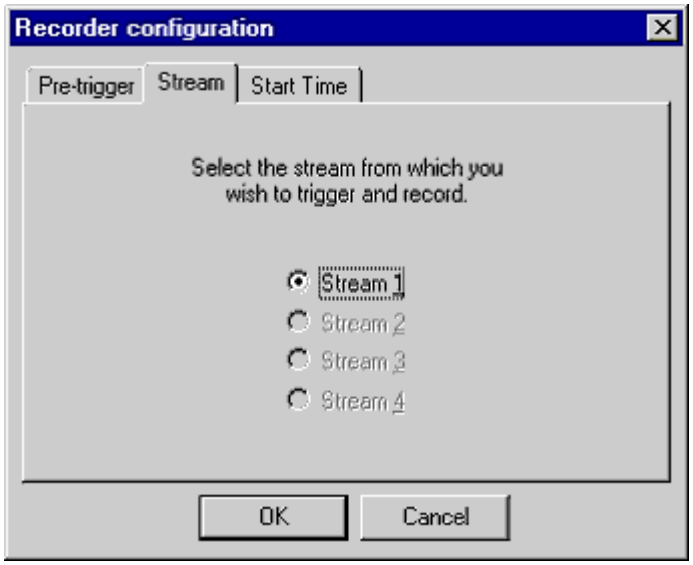


If the Trigger event was detected earlier than 5 seconds into the run, the 20 second file will contain all of the data up to the Trigger. Say recording was triggered at 3 seconds only the first 15% of the file would hold pre-trigger data. The file contents would be:



Stream

Machines capable of hosting the Stream Monitor Plus server may have up to four interfaces fitted. Each interface handles a single stream. Use the Stream tab to select which stream recordings will be made from:



If the serving machine has less than four interfaces only the available streams will be enabled. The other streams will be disabled (greyed out).

Select the required stream and, if no further changes are required to the Pre-trigger tab, select **OK** to make the change.

Start Time

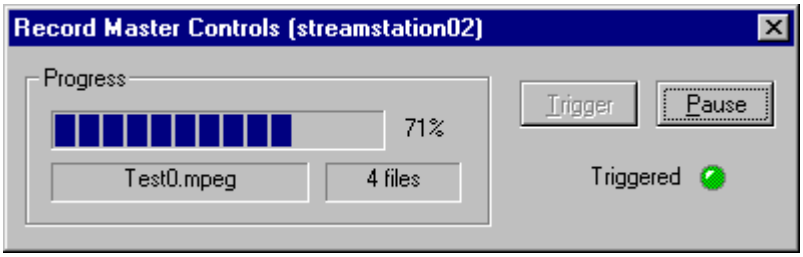
This dialog allows users to enter a single time and date until which all recording will be suspended.

When enabled, no recordings will be triggered before this date/time regardless of the other recording triggers that have been set (see Trigger Editor, page 74), including specific date/time triggered recordings.

If the dialog is disabled, recording triggers will function normally.

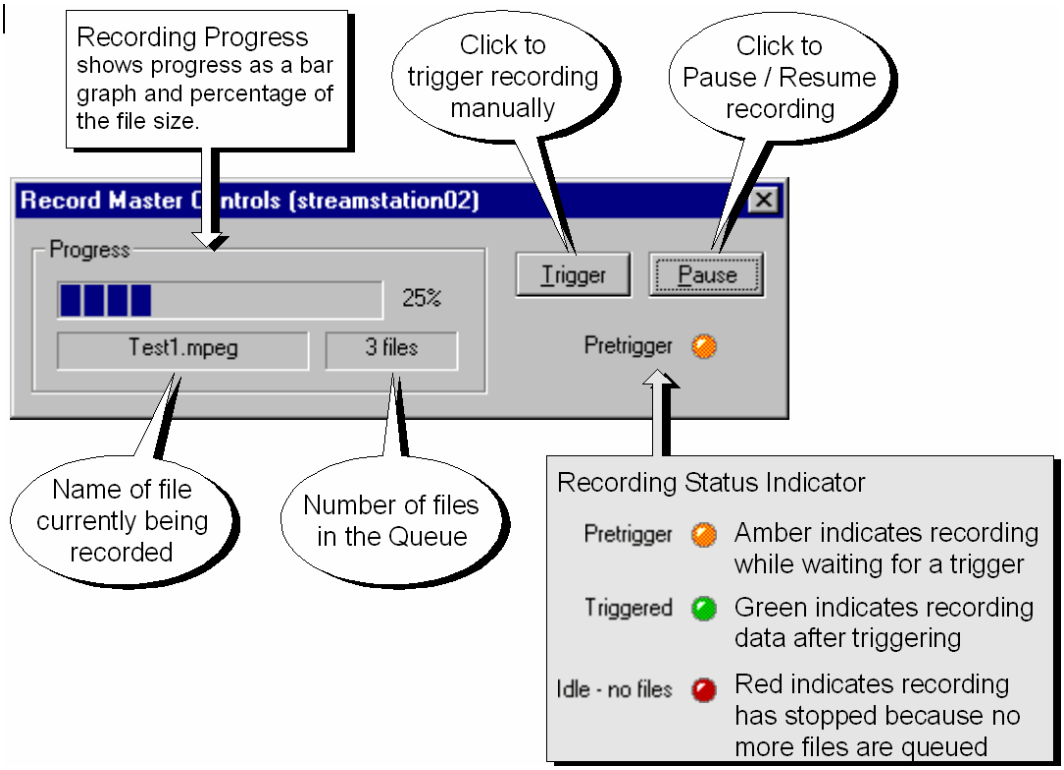
Record Master Controls

The Record Master Controls show the state and progress of recording for the current host. Recording can be triggered manually, suspended and resumed from this dialog:



To control a different host select the new host from the streams bar. Unlike the other recording dialogs, there is no need to close the Record Master Controls. The name of the host is displayed in the dialog tile bar.

The control facilities provided by the Record Master Controls dialog are:



Pretrigger

Prior to triggering the progress indicator will move up to the pre-trigger point, but go no further. The Recording Status Indicator glows amber and the flag **Pretrigger** is displayed.

To trigger recording manually select **Trigger**. Recording my be suspended and resumed using the **Pause** button.

Triggered

Prior to triggering the progress indicator will move up to the pre-trigger point, but go no further. The Recording Status Indicator glows amber and the Pretrigger flag is displayed.

Recording my be suspended and resumed using the **Pause** button. **Trigger** has no effect since recording is currently triggered.

Idle - no files

One or more files must be queued up before recording can commence. When no files are queued the Recording Status Indicator glows red and the legend reads Idle - no files. As recording to each file is completed that file is removed from the queue. Recording stops when there are no more files in the queue.

Trigger has no effect since there are no file to record to.

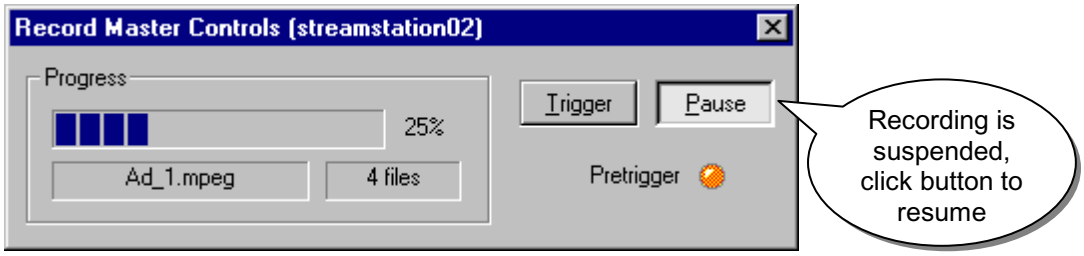
Recording my be suspended or resumed using the **Pause** button. This setting will control whether recording can start when files are queued for recording.

Triggering Recording

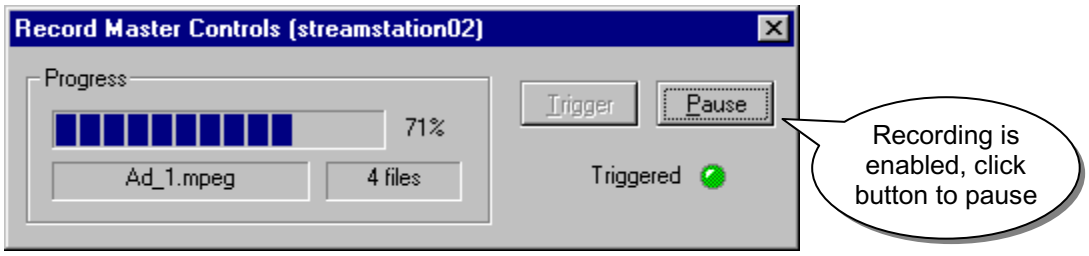
Recording will be triggered automatically by detection of any trigger event specified in the Filter Editor. Recording may be triggered manually, at any time prior to detection of a trigger event, by selecting the **Trigger** button.

Pausing and Resuming Recording

Recording may be suspended at any time by selecting the **Pause** button. When recording is suspended the Pause button appears depressed. For example:



To resume recording click on the **Pause** button again.

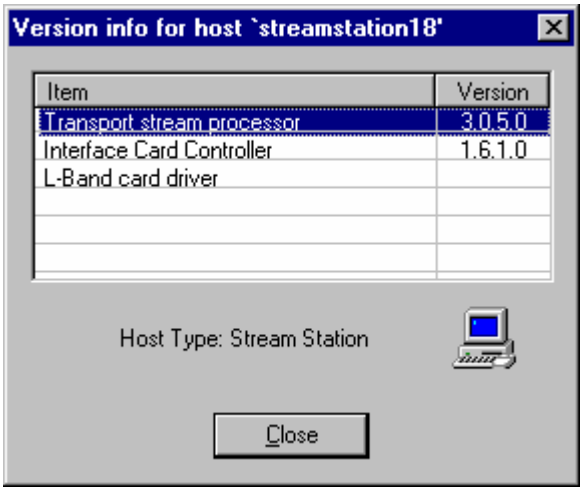


Monitoring Hosts

Stream Monitor Plus can report on the health and versions of both software and hardware of the local host. The information available depends upon the functionality of the host.

Version Information

To view the version information for the host select the **Versions…** option from the **Host** menu. This opens a dialog which displays a list of the possible components and version numbers of those present:



The type of host is displayed at the bottom of the dialog.

Click on the **Close** button to remove the dialog from the screen.

Disconnecting from a Host

To disconnect from the host first select the **Disconnect** option from the **Host** menu.

Stream Monitor Plus displays a dialog showing the name, or IP address, of the host and asks for confirmation. Select the **OK** button to disconnect or **Cancel** to stay connected.

References

[1] European Telecommunications Standards Institute TR 101 290: Digital Video Broadcasting (DVB); Measurement Guidelines for DVB Systems.

[2] ATSC Standard A/57 (1996) Program/Episode/Version Identification.

[3] ATSC Standard A/65 Program and System Information Protocol for Terrestrial Broadcast and Cable.

[4] ATSC Standard A/66
(Draft Technical Corrigendum No.1 to ATSC Standard: Program and System Information Protocol for Terrestrial Broadcast and Cable. Doc. A/65 (23 Dec 97))

[5] ATSC Standard A/67
(Draft Amendment No. 1 to ATSC Standard: Program and System Information Protocol for Terrestrial Broadcast and Cable. Doc. A/65 (23 Dec 97))

[6] Digital Video Broadcast (DVB); DVB Mega-Frame for Single Frequency Network (SFN) synchronisation. ETSI document TS 101 191 V.1.3.1.

[7] ARIB standards B10v1.2, B15v1.3 and B24v1.2.

[8] ETSI Technical Report TR 101 211 July 2000: Digital video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI).

[9] ISO/IEC 13818-4 Information Technology - Generic Coding of moving pictures and associated audio information - Part 4: Compliance testing.

[10] ETSI TS 101 812 V1.1.1

[11] TR 101 162 (November 2000)

[12] DVB A38r1

User Manual

Tektronix

AD951A/AD953A
MPEG Test System

Volume 2 of 2

071-1423-00

This document supports firmware versions:
AD95X MPEG Test Systems Version 6.7
AD960 Data Test Systems Version 3.0

www.tektronix.com

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077

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08/937,950	5848391	5,291,557	5,451,954	5 400 433
5,222,189	5,357,594	5 752 225	5,394,473	5,583,962
5,274,740	5,633,981	5 297 236	4,914,701	5,235,671
07/640,550	5,579,430	08/678,666	98/03037	97/02875
97/02874	98/03036	5,227,788	5,285,498	5,481,614
5,592,584	5,781,888	08/039,478	08/211,547	5,703,999
08/557,046	08/894,844	5,299,238	5,299,239	5,299,240
5,197,087	5,490,170	5,264,846	5,268,685	5,375,189
5,581,654	05-183,988	5,548,574	08/506,729	08/576,495
5,717,821	08/392,756			

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Table of Contents

Preface . . . . . **iii**
Related Material iii
Manual Conventions iii
Contacting Tektronix iv

Volume 1

Introduction
Transport Stream Analyzer . . . . . Sect. 1
Packetized Elementary Stream Analyzer . . . . . Sect. 2
T-STD Buffer Analyzer . . . . . Sect. 3
Tracer . . . . . Sect. 4
Player . . . . . Sect. 5
Monitor/Recorder . . . . . Sect. 6
Transport Stream Editor . . . . . Sect. 7
Multiple . . . . . Sect. 8
Make Seamless Wizard . . . . . Sect. 9
Stream Monitor Plus . . . . . Sect. 10

Volume 2

Elementary Stream Analyzer . . . . . Sect. 11
BS Digital Multiplexer . . . . . Sect. 12
BC Digital Multiplexer . . . . . Sect. 13
Carousel Analyzer . . . . . Sect. 14
Carousel Generator . . . . . Sect. 15
Transport Stream Maker . . . . . Sect. 16
Transport Stream Cutter . . . . . Sect. 17
ScriptP . . . . . Sect. 18
Custom SI Scripting . . . . . Sect. 19

Preface

This manual describes the software applications available to the Tektronix AD951A/AD953A MPEG Test System. All applications are installed; access will be dictated by the security dongle and those options purchased.

The manual is divided into sections, each describing one application. An overview of the applications is provided in the *Introduction* section.

Related Material

Getting Started Manual (071-1422-xx)
Describes the installation of the MPEG Test System.

Additional documentation, such as ReadMe files, may be included on the installation disks.

The following URLs access the Web sites for the standards organizations listed (the URLs listed were valid at the time of writing):

- MPEG-2 standards (International Organization for Standards) - http://www.iso.ch/
- DVB standards (European Technical Standards Institute) - http://www.etsi.org/
- ATSC standards (Advanced Television Systems Committee) - http://www.atsc.org/

Manual Conventions

Naming conventions for the interface elements are based on standard Windows naming conventions. Naming conventions for MPEG-2, ATSC, and DVB structures follow the conventions derived from the standards documents listed above. In addition, the following formatting conventions apply to this manual:

- **Bold** text refers to specific interface elements that you are instructed to select, click, or clear.
  Example: Select **Settings** from the Configuration menu.
- Boxed text represents buttons on the user interface.
  Example: Select **Trigger** on the Setup dialog.
- Mono-spaced text can indicate the following:
  - Text you enter from a keyboard
    Example: Enter the network identity (`http://TSMonitor01`)
  - Characters you press on your keyboard
    Example: Press `CTRL+C` to copy the selected text.
  - Paths to components on your hard drive
    Example: The program files are installed at the following location: `C:\Program Files\Tektronix\`

Contacting Tektronix

Phone	1-800-833-9200*
Address	Tektronix, Inc. Department or name (if known) 14200 SW Karl Braun Drive P.O. Box 500 Beaverton, OR 97077 USA
Web site	www.tektronix.com

Support - N & S America

Sales support	1-800-833-9200, select option 1*
Service support	1-800-833-9200, select option 2*
Technical support	Email: techsupport@tektronix.com 1-800-833-9200, select option 3* * - toll free in North America. 6:00 a.m. -- 5:00 p.m. Pacific time After office hours, please leave a voice mail message.

Support - Europe & the Rest of the World

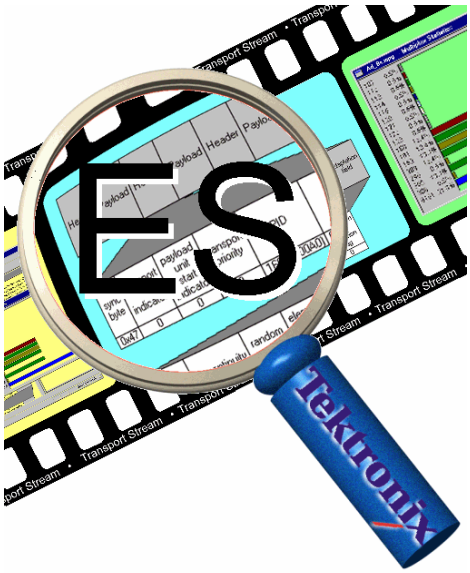
Sales Support	+44 (0)1344 392000

Service & Technical Support

Telephone	+44 (0)1223 200700
Fax	+44 (0)1223 200701

Section 11

Elementary Stream Analyzer



Introduction 3
Getting Started 4
Starting the Program 4
Opening an MPEG Stream 4
Understanding the Main Window and Icons 7
The Tree View and Navigation 11
Header, Extension and Hex Displays 12
Error Testing Methods and Outputs 16
Run Through Stream Test Mode 16
Error Filtering 18
The Status Bar 24
Regression Testing and Error Log Files 25
Reports and Field Selection 28
Demultiplexing Transport Streams to PES or Elementary Output Files 30
Working with Transport and PES Streams 31
Using Packet View 31
Understanding PES 32
Working with Video Streams 33
Viewing the Sequence Header 34
Viewing the GOP and Picture Header 35
Displaying the Slice and Macroblock 39
Analyzing Picture Quality 41
Using the Video Viewer for Picture Analysis 53
Working with Audio Streams 56
Understanding MPEG Audio Streams 56
Audio Player 57
Understanding Dolby Digital (AC-3) Audio Streams 62
Working with Program Streams 65
Viewing Pack and System Headers 66
Viewing the Program Stream Map 66
Working with Teletext 68
VBI (Enhanced Teletext Support) 69
Appendix A - Advanced Audio Compression 73
ADIF Stream Forms 75
ADTS Stream Forms 83
Appendix B - Closed Caption Analysis 85
Enabling Closed Caption Analysis 86
Selecting Closed Caption Analysis Standard. 87
CC–EIA608 Support 87
CC-EIA708 Support 88
Dumping Closed Caption Statistics 91
Appendix C - DVB Subtitle Stream Analysis 95
DVB Subtitle Data tab 97
Page View tab 100

Introduction

ES Analyzer is an MPEG (Motion Pictures Expert Group) stream analyzer that allows all MPEG-1 and MPEG-2 streams to be quickly analyzed. Developers of MPEG compliant encoder and decoder systems, or field application engineers (FAEs) supporting MPEG-based products will find ES Analyzer a powerful and easy to use tool and debugging aid.

ES Analyzer, which is incorporated as part of the MPEG Test System Product Family, provides the following facilities:

- Analyze in detail and verify whether MPEG-1 system and MPEG-2, video, and audio streams conform to MPEG standards (A built-in stream demultiplexer makes it possible to analyze elementary streams embedded in a transport stream. All streams are checked for both syntactic and semantic conformance. Syntactic conformance means conformance with the MPEG language, while semantic conformance relates to the field value and range restrictions.)
- Quickly zoom from transport streams, through PES and video streams into GOP, pictures, slices and all the way down to the macroblock layer.
- Play out audio streams to MPEG-1, MPEG-2, Layers I and II, Japanese AAC and Dolby Digital (AC-3) standards.
- Audio play to soundcard.
- Analyze Layer I, Layer II audio data, AC-3 audio and AAC audio.
- View video output with the incorporated video player and analyze picture data for any frame.
- Produce picture quality analysis data including Quantizer Scale distribution, motion vectors graph in a picture, and macroblock and picture size plots.
- View the coded block patterns that have been extracted.
- Display and analysis of DCT coefficients for each macroblock in a picture.
- View interpreted and hexadecimal view of headers for all streams.
- Display and analysis of DVB Teletext information.
- View and analyze DVB subtitle content.
- View and analyze ATSC closed caption to EIA608 and EIA708 standard.
- View PID spectrum analysis for transport streams.
- Analyze multiple streams in batch mode through the regression testing mode.
- Quickly navigate through stream hierarchy through its powerful and easy to use graphical interface including Stream Properties summary window.
- ‘Seekback’ at all levels, allowing users to go back in a stream at all levels, thus allow more flexibility in navigation.
- Set a level to report errors, filter them, and also store errors in log files.

It is assumed that the reader is familiar with MPEG compression standards and terminology. If you are new to MPEG and want to know about MPEG compression standards and terminology, refer to the documents: ISO/IEC 11172 (Vol. 1, 2, 3 and 4) for MPEG-1 and ISO/IEC 13818 (Vol. 1, 2 and 3) for MPEG-2 basics.

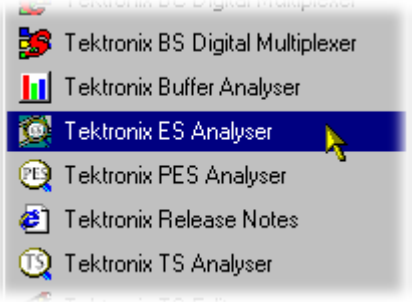
Getting Started

Starting the Program

The program may be started by selecting the **Tektronix ES Analyser** option from the **Start -> Programs** menu.

or

by double clicking on the **Tektronix ES Analyser** shortcut on the desktop.



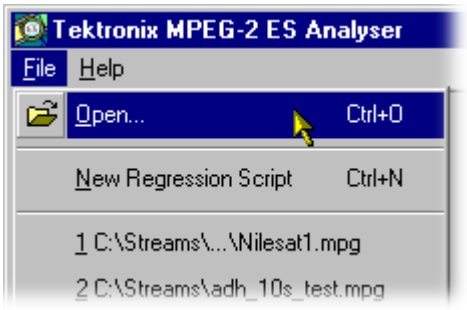
Initially an empty shell window is displayed. It is necessary to open a stream before any screen details can be seen.

Opening an MPEG Stream

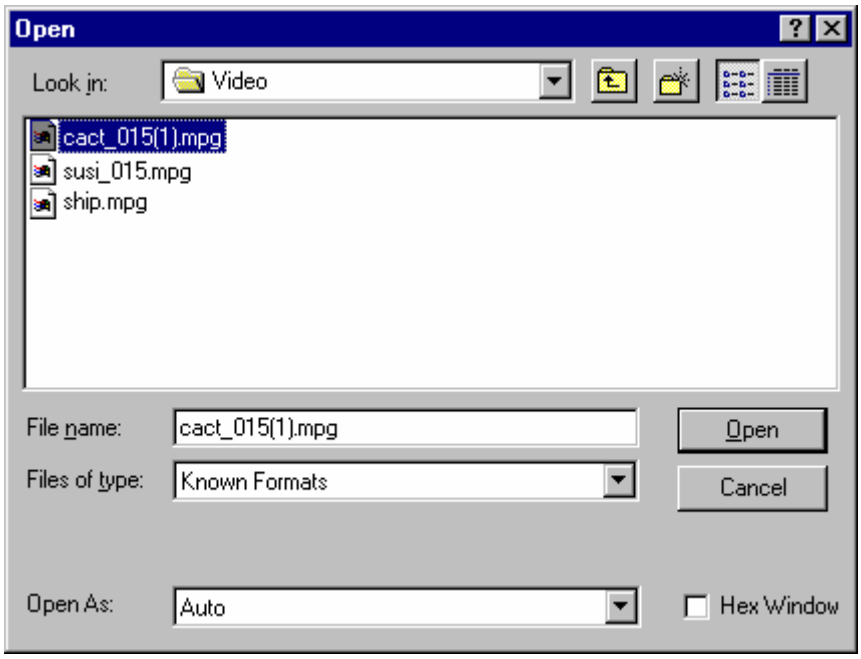
1. To open a file select the **Open…** option from the File Menu.

or

select the corresponding icon on the toolbar.



The following dialog box appears.



ES Analyzer displays a standard windows Open dialog box with two additional fields: **Hex Window** and **Open As:**.

2. Select the file you want to open.

   The types of files that can be opened are as follows:

   - Transport stream files
   - PES stream files
   - Elementary stream files
   - MPEG-1 and MPEG-2 files
   - Regression scripts
   - Mask files

   Note that:

   - If you want ES Analyzer to automatically detect the type of MPEG stream it contains, let the default **Auto** remain in the **Open as** field.
   - If you want to open the file as a specific type of stream and don't want ES Analyzer to detect it, select the stream type in the **Open as** field.

If you open an MPEG stream as an incorrect stream type, numerous errors may be reported and ES Analyzer may also behave unexpectedly.

If you open an ATSC stream as auto and the stream contains no PSIP service information, the AC-3 audio may appear as  and not decode. Close the file and re-open with ATSC Stream selected from the Open as field; the AC-3 audio will now decode correctly.

3. Enable or disable the hex window.

   ES Analyzer parses and demultiplexes the opened MPEG stream, and displays the packet header fields in two formats—interpreted and hexadecimal.

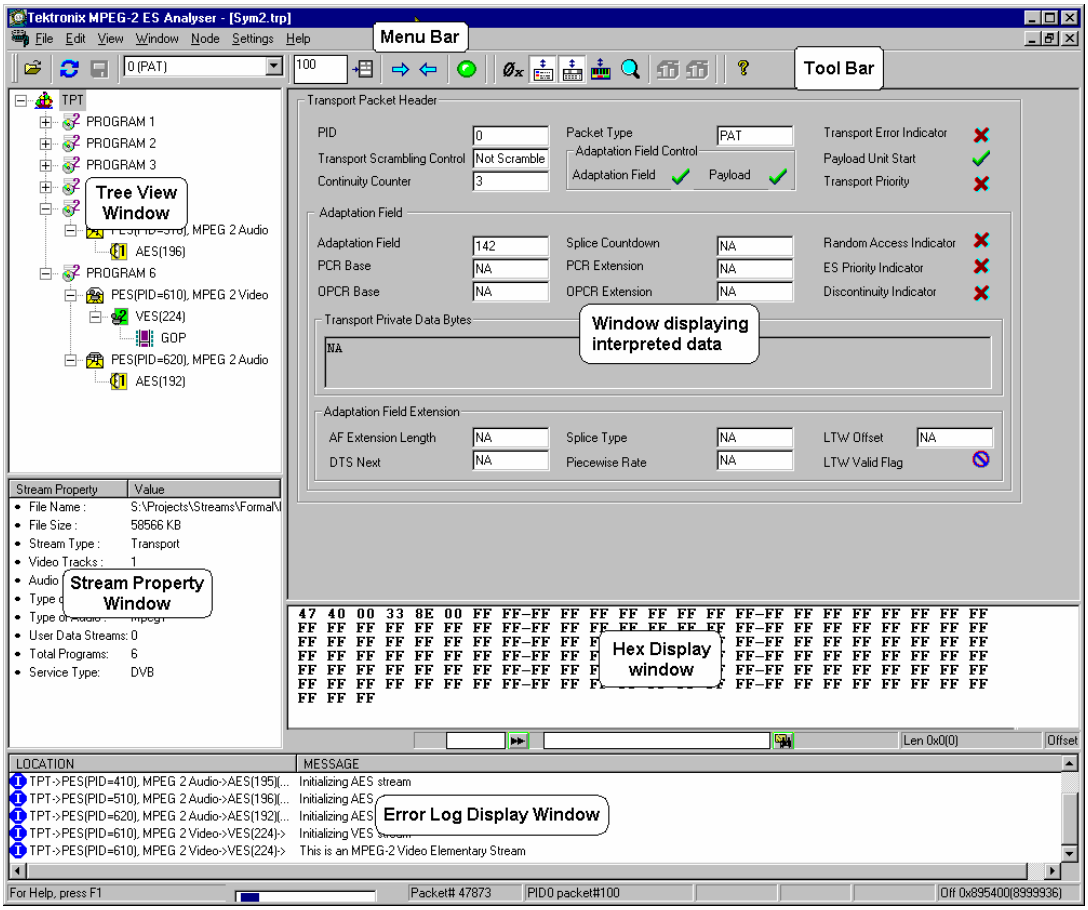
   - If you want ES Analyzer to display the packet header fields in both the formats, interpreted and hexadecimal, check the check box next to **Hex Window**. (The hexadecimal format is displayed in a separate window.)
   - If you want ES Analyzer to display the packet header fields only in the interpreted format, let the default remain. (By default, the check box next to **Hex Window** is clear.)

If you don't enable the Hex Window when you open a stream, you cannot enable it later when ES Analyzer is parsing the stream.

4. Click **Open** when you're through with this dialog box.

Understanding the Main Window and Icons

ES Analyzer allows you to view multiple programs and streams simultaneously. The tree view area on the left-hand side displays the stream hierarchy (refer to the earlier illustration). For the currently selected stream, the details of the header are shown on the right hand side. Errors, if encountered, are logged in the error log window at the bottom. A summary of the stream parameters is displayed in the Stream Property window. The status bar at the bottom of the window displays the current status and stream characteristics.

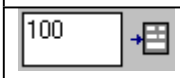


The Tool Bar

(Note: Not all buttons shown)

The tool bar provides a means of accessing frequently used menu bar commands quickly; each icon represents a menu bar item. Icons will display a tooltip description when the cursor is rested over it.

The table below lists the function of each icon and also indicates when the icon is available. Availability refers to an icon being enabled or disabled with respect to selected nodes in the left tree view window; disabled icons are ‘greyed out’.

Tool Bar Icon	Function	Availability (Enabled/Disabled)	Menu Bar equivalent
	Opens an MPEG stream, a saved regression file (.REG file by default), or dumped reports	Always enabled	**File > Open…**
	Restarts analysis from the beginning of the selected parent or child stream	Enabled for all nodes	**Node > Intialise**
	Extracts a PES, Audio, or Video stream from a multiplexed stream	Enabled for all the embedded stream nodes (PES, VES, AES)	**Node > Dump Stream**
	Allows navigation to the selected TPT packets; used in conjunction with the Next icon	Enabled for Transport and Program	**-**
	Enables navigation to the nth packet at TPT node or the nth GOP at GOP node or nth frame at AES node. Used in conjunction with the adjacent button	Always enabled; disabled only for VES node	**-**
	Allows navigation to the next/previous packet of the selected node	Always enabled; disabled only for VES node, or at end of file	**Next/ Previous Packet/ GOP**
	Toggles Start and Stop to run through Test mode	Only enabled at GOP level	**Start Stop**
	Toggles between hexadecimal and decimal display of data in fields	Always enabled	**-**
	Shows or hides the error log window	Always enabled	**-**

Tool Bar Icon	Function	Availability (Enabled/Disabled)	Menu Bar equivalent
	Shows or hides the Hex Viewer, which displays data in hexadecimal format	Enabled if Hex Window is checked when opening a stream, otherwise always disabled	-
	Enables or disables packet view analysis that displays the PID spectrum	Enabled only for PES	-
	Allows zooming into any part of data being displayed; useful when viewing Motion Vector Display in the Slice And MB tab	Always enabled	-
 (left-hand icon)	Shows Frame Size Statistics for different frames within a GOP	Enabled only for GOP node (Disabled if the Picture Player tab is selected)	**Frame Sizes**
 (right-hand icon)	Shows Slice Size Statistics, i.e., information about the sizes of the slices within a Picture in a GOP	Enabled only for a GOP node from within the Slice And MB tab	**Slice Sizes**
	Allows viewing the version and copyright information	Always enabled	**Help Topics**

You can toggle the tool bar display by selecting/deselecting the Toolbar command on the View menu.

Working with ES Analyzer Commands

When using ES Analyzer, you can issue commands in one of three ways:

- By clicking commands on the menu bar; this also includes the keyboard shortcuts which are shown next to the menu bar entries.
- By clicking icons on the toolbar; and

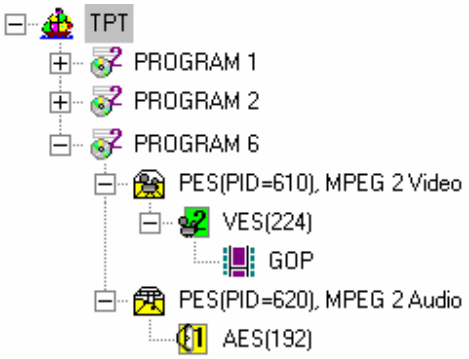
e.g.	Menu Bar Entry	Keyboard Shortcut	Toolbar Button
	File > Open…	**Ctrl+O**	

and

- By clicking the right mouse button and selecting a command on the quick menu.

After you've invoked ES Analyzer, you need to select the bitstream file you want to be analyzed by clicking Open on the File menu or by clicking the appropriate icon on the toolbar. If the bitstream file is a valid MPEG file, ES Analyzer displays the first packet of the top level stream. Now you can use commands, described below, to navigate randomly to any part of the stream. You can also run through a selected embedded stream using the Go command.

The Tree View and Navigation



The tree view window displays the stream hierarchy of the currently opened bitstream file. Each node in the tree view represents a level of hierarchy and is displayed with:

- An associated icon (The icon varies depending on the type of stream that the node represents; these are displayed in the table below.)
- A tip that describes the kind of stream represented by the node.
- The PID associated with the node, if applicable.

Icon	Stream type representation
	Transport stream.
	Program stream.
	System stream.
	Packetized elementary stream (PES); PES containing a video or audio stream, respectively.
	Audio stream; an MPEG-1 and/or MPEG-2 audio stream.
	Teletext.
	Dolby AC-3 audio stream.
	Video stream; an MPEG-1 and/or MPEG-2 video stream. If Closed Caption data is detected during analysis, '**CC**' is added to the video icon.
	User data stream.
	Group of pictures (GOP).
	DVB subtitle PES.

Suffix 1 and 2 in the Tree View icons (Video and Audio Elementary Streams) refer to MPEG-1 or MPEG-2. Note that MPEG-2 streams can contain MPEG-1 audio information.

If packets are scrambled or if stream analysis (AAC Audio) has been excluded by dongle, ES Analyzer does not display them.

Navigating through Streams

When an MPEG file is initially opened, ES Analyzer automatically determines the kind of MPEG stream it is. For a valid MPEG bitstream, ES Analyzer opens the tree view with a node for the top level stream contained in the file. By default, the stream hierarchy is expanded to only one level. You can expand/collapse a node by clicking it. You can select the stream to be viewed at any level displayed in the tree view window by simply clicking the left mouse button on the specific node. Automatically, the window on the right is refreshed to display the header and related information for the selected node.

ES Analyzer gives you full flexibility in viewing streams at any level. You can navigate through the stream independently at each level of the stream. For example, you may be viewing the first PES packet of a PES Stream, but in the embedded VES stream, you may be viewing the last GOP that is not contained in the first PES packet.

Using GoTo, Next and Previous Commands

These commands are applicable to all types of streams and assume that you have opened a valid MPEG file. Each of these commands can be executed for any node that is displayed in the stream hierarchy tree where each node is either a GOP or a valid MPEG stream (embedded or top level).

- Step forward/backward to the Next/Previous packet or GOP in a video stream for the selected node.
- Position the file pointer to the n^{th} packet or GOP in a video stream or frame in an audio stream for the selected video/audio node.
- Position the file pointer to the n^{th} packet of the selected PID; this is applicable to MPEG-1 system streams and MPEG-2 transport and program streams.
- Position the file pointer to the first packet of the selected node.
- Save the embedded stream corresponding to the selected node in a separate file.
- Toggle between hexadecimal and decimal display.
- Use the Transport Stream PID drop-down list to select a PID and navigate to the selected PID using the Next button.

Header, Extension and Hex Displays

The Header Display Window

The header display window shows the current header and related information for the selected node in a read-only mode. The fields are interpreted and displayed. The header is not displayed syntactically. Wherever field codes represent specific values, the corresponding value is shown rather than the code itself. For example, in a video sequence, although Chroma format is a two-bit code, it is displayed with the interpreted value of 4:2:0 or 4:2:2 or 4:4:4.

You can view field values in decimal or hexadecimal format by clicking the appropriate icon on the toolbar (). One bit fields are displayed using one of three icons:

Icon	Field value representation
✔	one-bit field was set to 1
✘	one-bit field was set to 0
⊘	one-bit field is not applicable here

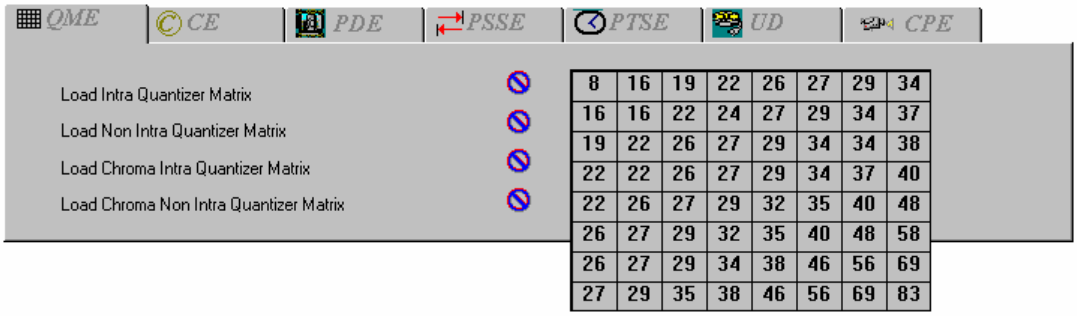
Almost all MPEG headers allow stuffing bytes and have marker and unused bits defined in their syntax. Although all these are parsed and checked for correctness, they are not displayed since they do not provide any meaningful information.

Wherever appropriate, ES Analyzer provides visual feedback, by the use of color, to represent different states.

Extension Displays

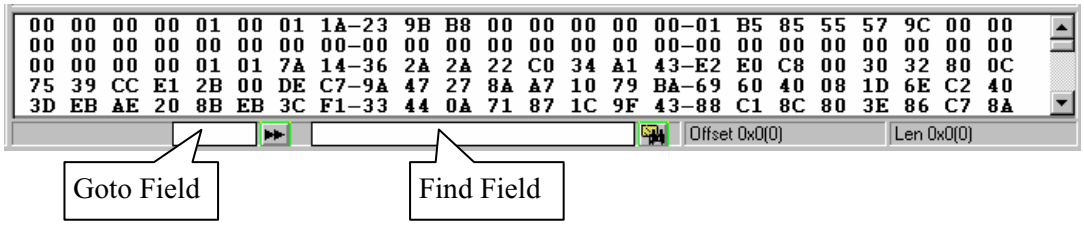
Besides this generic structure, individual headers may have special displays. For example, the video sequence header has a lot of information to be displayed in a small area. This is achieved by using tabbed folders for all the MPEG-2 extensions (see the following illustration). The tab corresponding to an extension is disabled if the corresponding extension does not appear in the sequence header.

When an extension appears in the video sequence, its presence is also communicated by the changed color of text (in red) on the corresponding tab.



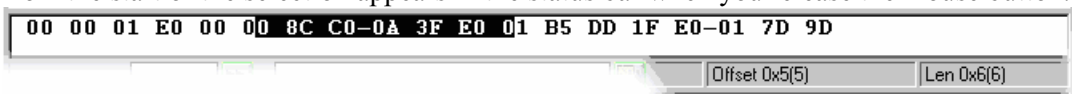
The Hex Display Window

The hex display window shows a hexadecimal dump of header bytes contained in the header being currently displayed in the header fields display window. This is useful if you are used to viewing the headers in the hexadecimal format rather than the interpreted format that is displayed in the header display window. Also able to be displayed are sequence information at VES level and frame information at GOP level (as shown below).



The data collection for the hex display window can sometimes be memory intensive and can affect ES Analyzer's performance. You can turn on the hex display or turn it off according to your requirements by checking or clearing the check box next to Hex Window in the Open dialog box. If you've not enabled the Hex Window option when opening a stream, you will be unable to open it when ES Analyzer is parsing the stream. However, you can dynamically turn off the Hex Window, whenever you want, by clicking the Show/Hide Hex Viewer icon on the toolbar if you enabled it when you opened the stream (see details in the *Opening an MPEG Stream* section).

The hex window displays a hyphen (-) after every 8 bytes for display purposes. The status bar in the hex window displays the current cursor position's byte offset from the start of the header. If you select a sequence of bytes in the hex window, the size and the byte offset from the start of the selection appears in the status bar when you release the mouse button.



To search for a specific byte pattern in the Hex Window:

1. Type the pattern in the Find field, on the left of the Find button, on the status bar.
2. Click the Find button.

   The specific pattern will be searched from the current cursor position. If the pattern is found, it is highlighted in the hex window. If the pattern is not found, you will hear a beep. The search loops back to the beginning of the file and subsequent occurrences of a pattern can be found by clicking the Find button.

To position the cursor to a specific byte location from the start of the packet header:

1. Type the byte position in the Goto field, on the left of the Goto button, on the status bar.
2. Click the Goto button.

   You will be positioned to the corresponding byte location in the header in the hex display window.

Summary of Displayed Information (Header and Hex displays)

The table below summarises the information displayed in the hex window that corresponds to the information displayed in the header display window.

Header display window information	**Hex dump in the hex display window**
Transport packet header	Header data of the current packet.
PES Header	Header data of the current packet.
MPEG-2 Program stream – Pack Header	Header data of the current packet.
MPEG-1 System Stream – Pack Header	Header data of the current packet.
Video stream—Sequence header / sequence extension	All the video level information which is above the GOP level.

Header display window information	Hex dump in the hex display window
Video stream—When viewing picture at Picture or Slice level display (with video analysis setting set to Macroblock level)	All the information for the currently selected picture. When the first picture is selected in the picture slider, data corresponding to the GOP header (if available) along with first picture data appears. For all pictures other than the first picture in the GOP, only picture data is shown. The subsequently read sequence header and extension data is updated in VES node.
Video stream—Hex data display when viewing picture at Slice level display (with video analysis setting is set to Picture level)	Same as above.
Video stream—Hex data display when viewing picture in Picture display form(with video analysis setting set to Picture level)	Same as above, but with the following exception. Picture data includes only picture header and extension data. No slice or macroblock level data is shown. However, when you go down to the slice level display by clicking the Slices button, ES Analyzer appends slice and macroblock data in the current picture data for the hex viewer. When you return to the Picture display dialog, ES Analyzer continues to show the complete picture data. The pictures for which you do not step down to the slice level, you'll still be shown picture data that includes only the picture header and extension data.
Audio Stream	Both frame header and audio data is shown.

Error Testing Methods and Outputs

ES Analyzer can error check an entire stream in an automated manner (regression test) or part of a stream, triggered from a node for a specific program, can be manually checked (run though mode).

Regardless of the stream type, testing is only possible at the compression layer; it is the task of Tektronix TS Analyzer and PES Analyzer to test at the systems layer. However you can still view the headers of the transport and PES packets, but note that no tests are performed (either run-through *or* regression).

Both the above test modes will produce screen or file output error messages. Manual test is also possible by examining the various block/slice/vector and picture display menu screens.

Error filters can be applied to the tests, and fields selected to allow diagnostics up to the error point to be dumped in a file for 'pre error point' analysis.

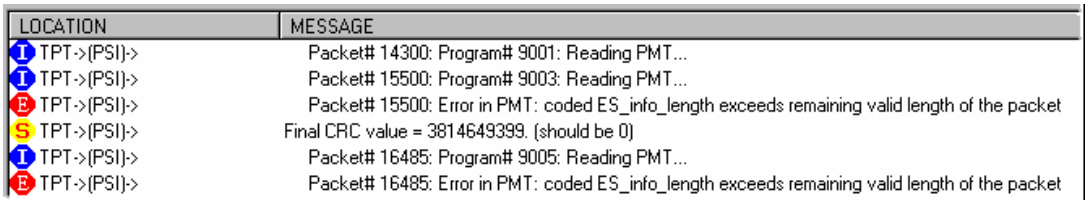
Run Through Stream Test Mode

This is operated by highlighting the test node - usually the GOP filmstrip icon - of the appropriate program required, then clicking on the Start/Stop (green ball) in the top toolbar.

The stream will be run though and errors reported in the error display window.

The Error Display Window

The error display window displays information, warning and error messages generated by the run-through test mode for a specific program node.



LOCATION	MESSAGE
I TPT->(PSI)->	Packet# 14300: Program# 9001: Reading PMT...
I TPT->(PSI)->	Packet# 15500: Program# 9003: Reading PMT...
E TPT->(PSI)->	Packet# 15500: Error in PMT: coded ES_info_length exceeds remaining valid length of the packet
S TPT->(PSI)->	Final CRC value = 3814649399. (should be 0)
I TPT->(PSI)->	Packet# 16485: Program# 9005: Reading PMT...
E TPT->(PSI)->	Packet# 16485: Error in PMT: coded ES_info_length exceeds remaining valid length of the packet

For each message, the following are shown:

- An associated icon that indicates the kind of message; the icons (E, I, and S) indicate a syntactic error, information, and a semantic error, respectively.
- An associated icon that indicates the kind of message (the icons E, I, and S shown below indicate a syntactic error, information, and a semantic error, respectively)

  where:
  E = protocol syntax (Rules) error.
  S = semantic-parameter or data range error.
  I = Information only; not an error.
  Both E and S should be regarded as errors.
- A string that identifies the exact location in the bitstream where the error was encountered; the format of the string is:
- (STREAMTYPE)-(STREAMTYPE, STREAMID)-(NODE)(packetNumber)

  For example, the following string

  TPT-PES(PID=210), MPEG 1 Audio-AES0(2)

  identifies the error in frame number 2 of the audio stream with the PID 210.
- The message string associated with the message.

Double clicking a message in the error display window lets you view more detailed information about the message.

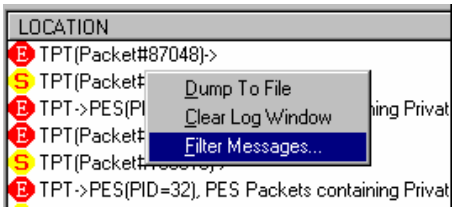
If you want to enable/disable the error log window, click the Show/Hide Error Log Window icon  on the toolbar.

Error Filtering

Configuring and Filtering Messages for Display

You can configure and filter the kinds of messages you want ES Analyzer to report. You can turn on/off messages of any type (Information, Errors, Semantic checks) to be reported for the entire stream, or any node in the stream hierarchy displayed in the tree view. You can also store the displayed messages in a file or clear the message window.

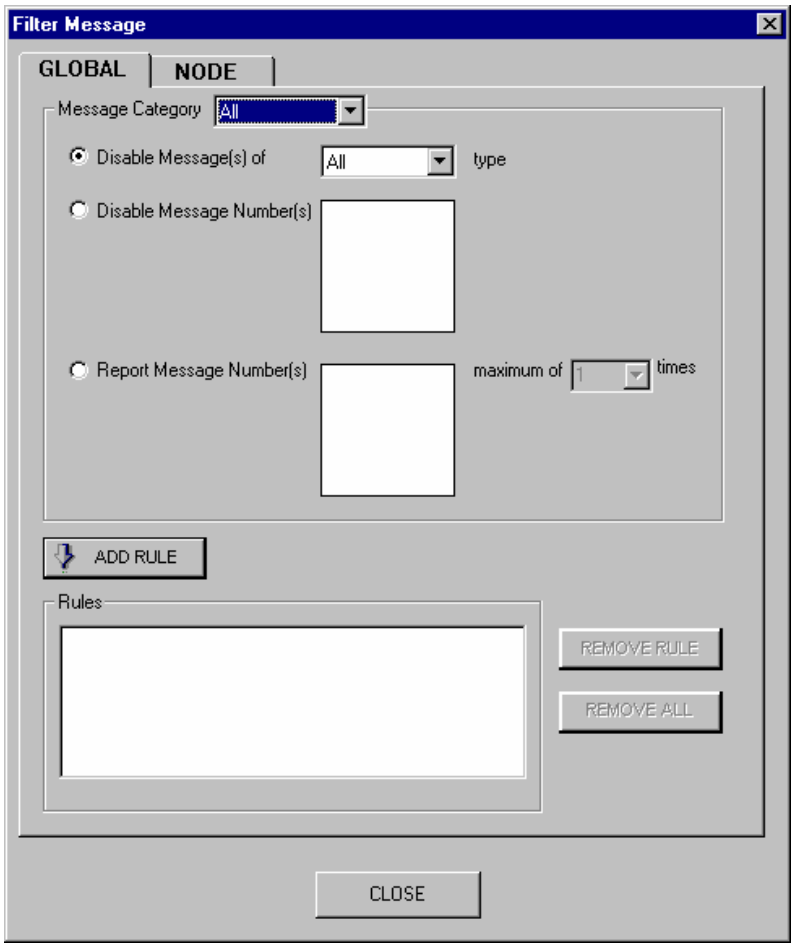
To configure messages:



1. Click the right mouse button anywhere in the error display window.
2. Select Filter Messages from the context menu that appears:

The Filter Message dialog is displayed. The dialog comprises two tabbed pages: Global and Node.

Message Filtering - Global



The Global Message Filter tab provides settings which can be used to select which messages are enabled and disabled and how many times enabled messages are to be displayed. The rules created are global; that is, they will be applied to all nodes in the active stream. Rules to be applied to a single node (PSI, PES, VES, etc.) can be added from the Node tab.

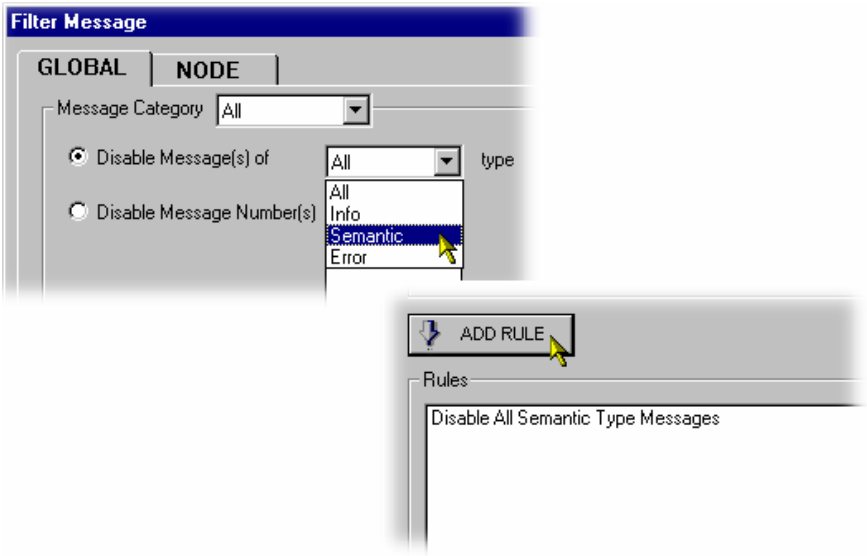
The top half of the Global tab comprises:

- a drop-down list from which the category of messages can be selected to which rules are to be applied, and
- three options for the display of messages.

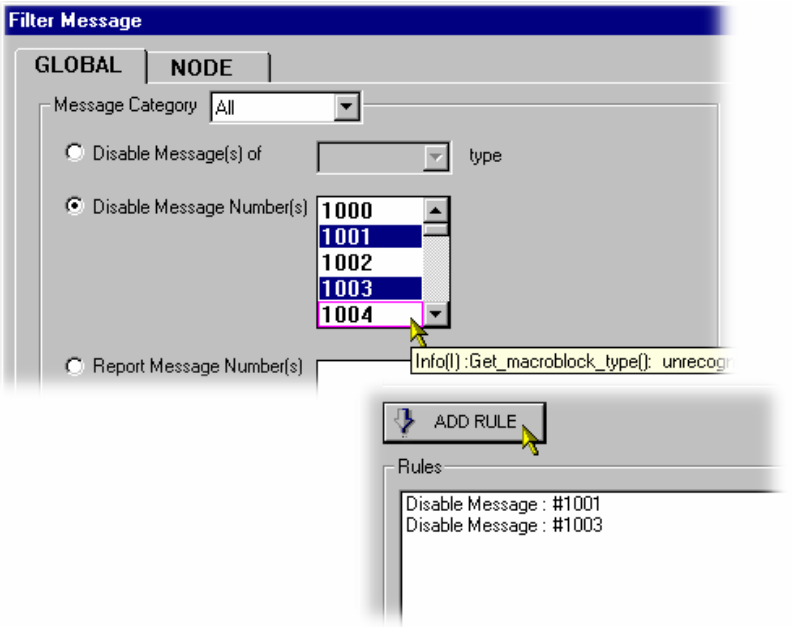
As rules are created using these fields, they should be added to the **Rules** text field below by selecting the **Add Rule** button.

The three options are as follows:

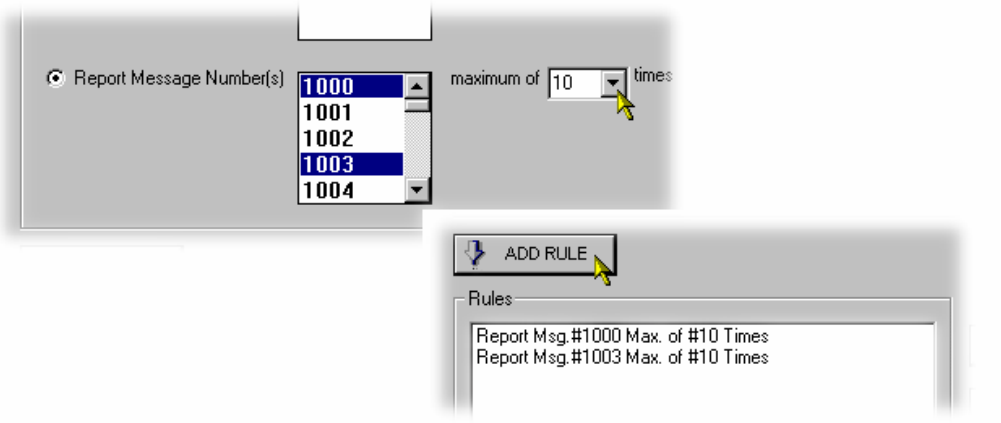
a) Disable all messages on the basis of severity, i.e. Info (I), Semantic (S) or Error (E). Enable the **Disable Messages(s) of** checkbox, select the type of message to be disabled and press the **Add Rule** button. Note that the rule is added in the **Rules** text field.



b) Disable messages on the basis of message number.
Each message is assigned a unique number based on the type of streams it is related to; a tooltip will be displayed when the cursor is passed over the message number. Enable the **Disable message Number(s)** checkbox, select the message numbers to be disabled and press the **Add Rule** button. The Shift and Control keys can be used to make multiple selections. Note that the rule is added in the **Rules** text field.



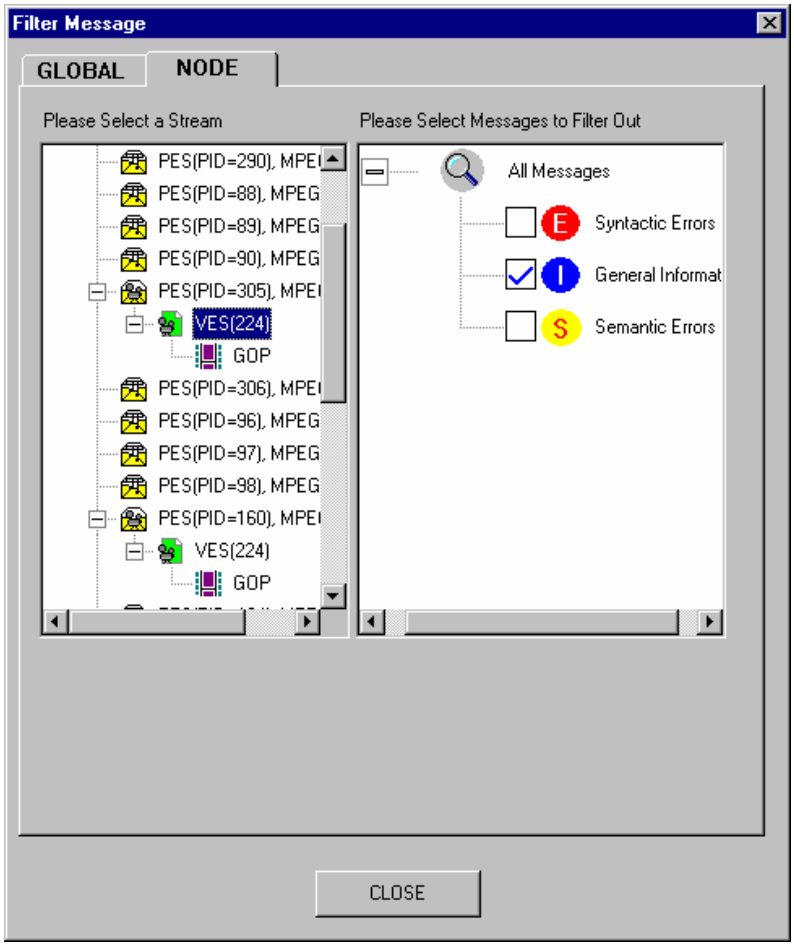
c) Report repeated messages only a specified number of times.
Enable the Report Message Number(s) checkbox and select the message numbers to be disabled. The Shift and Control keys can be used to make multiple selections. Select the maximum number of times that the message is to be reported and press the **Add Rule** button. Note that the rule is added in the **Rules** text field.



Combinations of message rules can be created; they will need to be created and added one at a time.

Rules can be removed individually (**Remove Rule** button) or globally (**Remove All** button). Rules that are already set cannot be edited; they must be removed and re-created.

Message Filtering - Node

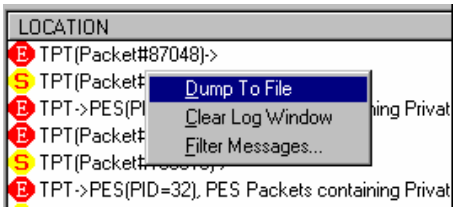


1. Select a stream in the left-hand scroll window and then select the types of messages you want to be filtered out. By default, all messages are displayed for a stream.

   - If you want your message filter(s) to be applicable to all streams opened until now, select it for the entire World. This option will apply the filter(s) to all nodes displayed in the tree view window.
   - If you want your message filter to be applicable to all streams, irrespective of whether they are opened or not, click the **Set for all Streams** button.

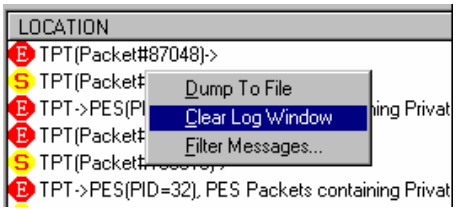
2. Click **OK** to accept to changes; **Cancel** to close the dialog box without applying the changes.

To store the displayed messages:



1. Click the right mouse button anywhere in the error display window.
2. Select Dump To File from the quick menu that appears.
3. The Dump Message dialog box is displayed. Enter the name of the file in which you want to store the messages.
4. Click the Save button when done.

To clear the window:



1. Click the right mouse button anywhere in the error display window.
2. Select Clear Log Window from the quick menu that appears.

The Status Bar

During regression and run-through mode, progress through the stream is indicated by the status bar at the bottom of the main window. The status bar is split into multiple fields and displays the following:

- A progress bar indicates the approximate byte position in the file for the currently selected stream.

Since you can view each embedded stream inside a multiplexed stream independently, it is possible that in each embedded stream you may be viewing packets which are far apart in the stream. In such cases, the file pointer will be at different positions for each embedded stream and the file progress bar is updated according to the stream being currently viewed. In addition, the byte offset in the file for the currently displayed unit of data is also displayed in the status bar. For example, when you are viewing a Packetized Elementary Stream (PES), the byte offset of the first byte of the start-code of the currently viewed packet in the opened file is displayed in the status bar. Similarly, when viewing a GOP in a Video stream that is embedded in a Transport stream, the byte offset of the start code of the corresponding GOP in the file is displayed in the status bar. More details are given with the explanation of status bar with each individual stream.

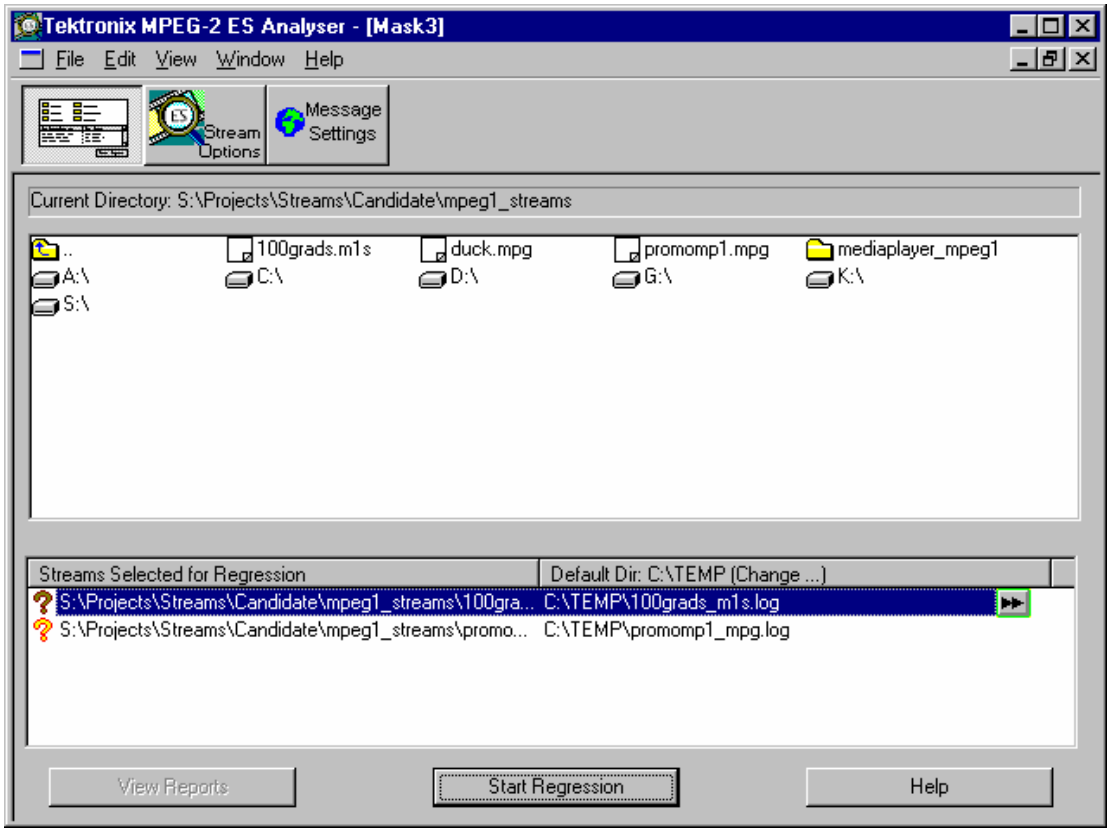
- Characteristics of the stream being currently viewed. These vary with the stream and are described in detail for each stream in subsequent chapters in this book.
- The state of the status bar display can be toggled by selecting/deselecting the Status Bar command on the View menu; i.e. **View > Status Bar**.

Regression Testing and Error Log Files

With ES Analyzer, you can regression test MPEG streams (with errors being saved to log files) and save data from selected fields to report files for viewing later (see the section *Reviewing a Report* for details).

Regression Test Window

To perform a regression test, close the file, if it is open, using the File menu. Select **File > New Regression Script…**. Note that disk drive icons are displayed on the right-hand side of the directory window; you may need to scroll right to view/access them.



Double click on the file you require and it should appear in the lower window **Streams Selected for Regression** with an orange question mark on the left-hand side.

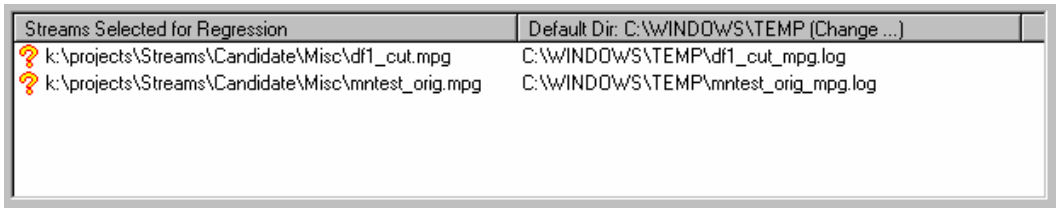
Later when regression is done, this will turn to a red or green ball depending on the errors found. A default log file name is entered; it can be renamed by clicking on the double-arrow button at the right-hand side of the name. After regression testing, the log file can be viewed by double-clicking on the log file name.

Error messages written to the log file can be controlled via the **Message Settings** screen.

The button **View Reports** is only available to show dump/.dat files if they have been set up beforehand (see *Select Fields* and *Reviewing a Report* sections).

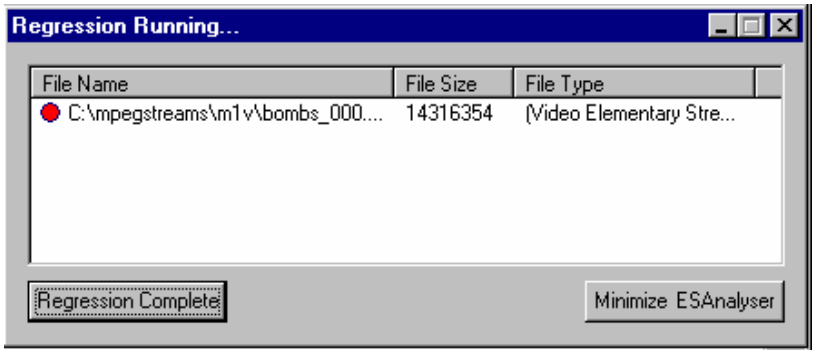
Setting up the Regression

You can select multiple streams for regression from the displayed list of files. (To select multiple files, double click a file or just select it and then drag-and-drop it in the lower window.) The streams selected for regression appear in the lower window.



For each stream, the following are displayed:

- File name.
- Default log file where the messages for the stream will go. You can change this by clicking the icon displayed next to the log file name. ES Analyzer displays a default directory where all log files are created that store the results of the regression. You can change the directory for storing log files by clicking the Default Dir… button.
- The stream type. Initially this is not known and is set to Unknown. Once the regression is complete, this is updated to reflect the type of stream that the file contains.
- An icon indicating the state of the stream. Initially, when a file is selected, the icon appears as a question mark indicating an unknown status. After the stream is regression tested, the icon changes to red if the regression reported errors, or changes to green if there were no errors.



For a regression test, you can also select embedded streams that correspond to nodes in the tree view for a stream hierarchy. You can do this by clicking the Streams Option button in the regression test window; see *Reviewing a Report* below. This displays the settings for the current stream. By default, the tests are enabled for all types of streams, which you can disable. Saving a regression script also saves these settings.

Running the Regression

Once you've set up a regression script, you can run it by clicking the Start Regression button. A status window displays the continuous status of the regression. If you want, you can cancel the regression anytime by clicking the Cancel Regression button in the status window. When the regression is complete, the state of the regression run on each stream is displayed in a dialog box through the changed icon which is red (for failure) or green (for success), and the updated file type. The icon remains a question mark if the file was not a valid MPEG file.

Viewing and Saving Results

You can view the error log file created for any stream after it has been regression tested by double clicking the specific bitstream file in the regression test dialogue. You will need to associate files of the type *.log with a text editor of your choice. (You may do so through the Explorer. Click View > Options to display the Options dialog, and then click the File Types tab. By default, ES Analyzer opens the log files with the application with which they are currently associated.)

You can save the regression script and the results in a regression script. To save the file, choose Save As from the File menu. The file is saved as a binary file and also saves the regression results. You can reload the regression file including the results of the last regression whenever you want. Regression can also be run on a previously saved regression script file.

Message Settings

Messages sent to the log file can be controlled via the **Message Settings** dialog. Rules to be applied to messages can be created as required. The operation of this dialog is similar to Message Filtering as described on page 18.

Reports and Field Selection

You can save and review reports consisting of field value dumps of specific fields when you regression test a stream. To review a report, it must first be created by selecting the fields to be viewed, then setting up and running the regression, and finally selecting the **View Reports** button (it is also possible to select and open multiple reports).

Creating a Report

A regression report is packet by packet details listed with information fields you can choose. A report is not an error list, although errors detected may appear in it. A report can be used to examine run-ups to problems (pre-trigger).

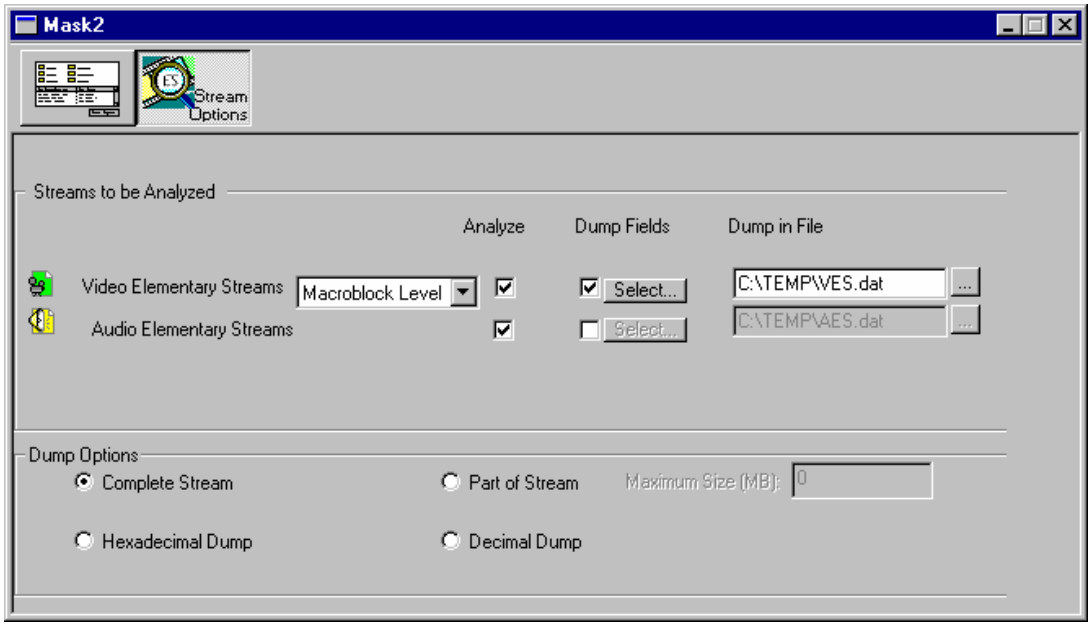
Before starting a regression test, select the **Stream Options** button in the Regression test window. Ensure that the **Dump Fields** check-box is enabled and select the adjacent **Select…** button. You can then add the fields to be listed in the dump file columns selectively or all of them.

You can check the dump in file box and name your dat file or use the default VES.dat or AES.dat.

Do this for video & audio elementary streams.

To select fields:

1 Click the **Stream Options** button in the regression test window to display the following screen.



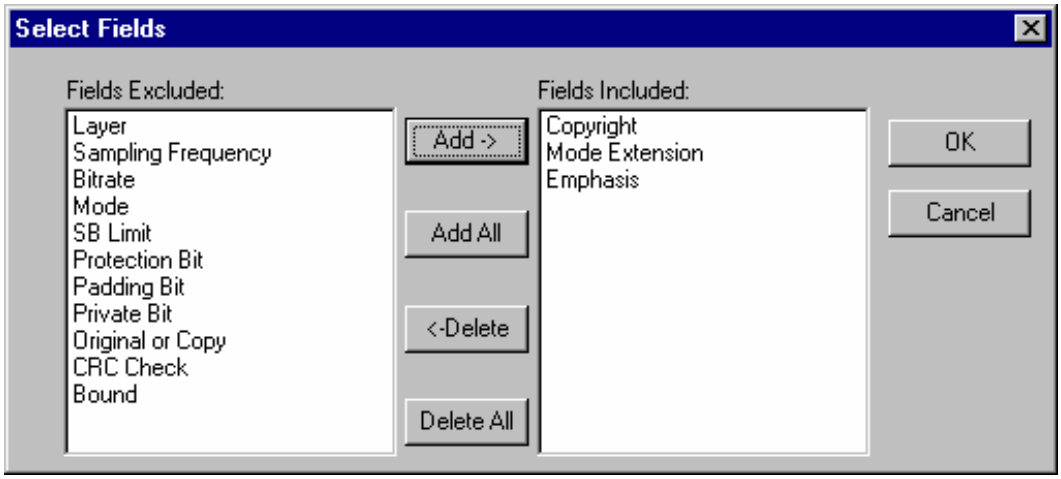
2 Enable and disable the streams using the checkboxes in the **Analyse** column.

Deselect the streams you don't want ES Analyzer to analyze. By default, all the streams are selected.

3 If you want to analyze Video Elementary Streams, you may either select **Macroblock Level** or **Picture Level** from the adjacent drop-down list.

4 Select the streams for which you want to dump data by enabling the checkbox under the **Dump Fields** column.

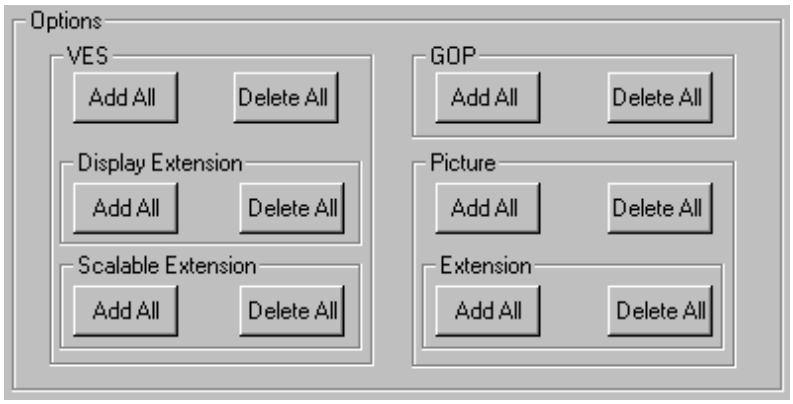
5 Click the highlighted **Select…** button to display the **Select Fields** dialog box.



6 Finalise the list of names by adding/deleting the field names in the **Fields Included** list box and click **OK**.

You may also double-click a field name displayed in the left list box to include it in the right list box.

- If you've selected a video elementary stream, ES Analyzer also displays options in the **Select Fields** dialog box.



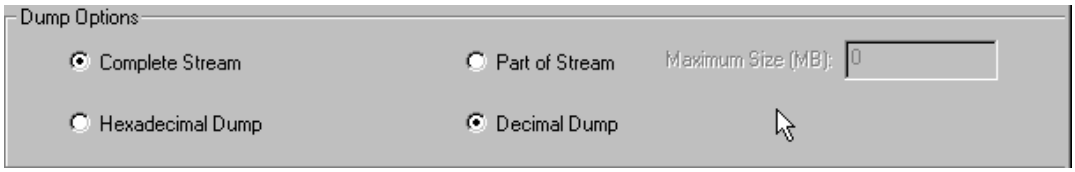
You may click the appropriate buttons to select fields specific to these options. This is a quick way to add/delete specific fields into the **Fields Included** list box; otherwise, you will need to manually find and add fields from the **Fields Excluded** list box.

For example, if you've added all the fields from the **Fields Excluded** list box, and now want to delete VES-related fields from the **Fields Included** list box, you may click the **Delete All** button in the VES section. Or click the **Add All** button under **Display Extension** to add related fields to the **Fields Included** list box.

7 Specify the file into which you want the fields to be dumped.

You may type the filename (*.dat) or select one by using the browse button next to the default filename.

8 Specify the dump options.



If you select **Part of Stream**, the **Maximum Size (MB)** field is enabled and you'll need to specify the size of the stream from which the fields will be dumped.

Once you have specified the fields, return to the regression test window by clicking the button next to the **Stream Options** button.

Reviewing a Report

A sample report looks like this:

```
Collecting Statistics for "C:\mpegstreams\mls\bird4.mpg"
Date 04/02/98              Time: 16:38:42

Packet                    Fixed       Audio
No.          SCR          Flag        Bound

   1            0           1           1
   2         1083           1           1
   3         2167           1           1
   4         3250           1           1
   5         4334           1           1
   6         5417           1           1
   7         6501           1           1
   8         7585           1           1
   9         8668           1           1
  10         9752           1           1
```

(Note that these 'dump' files have the default extension of .dat.)

Demultiplexing Transport Streams to PES or Elementary Output Files

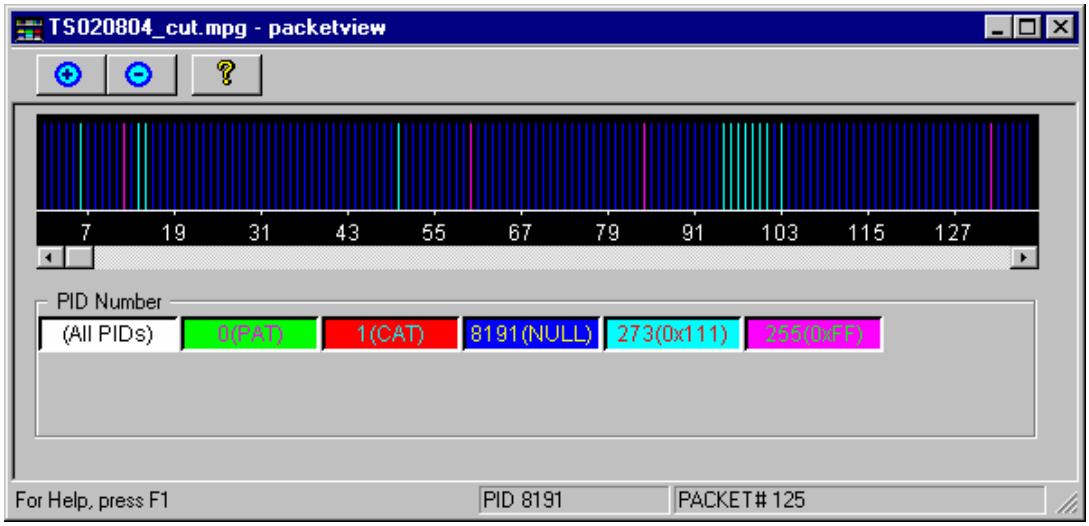
It is possible to select a given stream node in navigation view (such as PES video/audio) or VES audio/video (but NOT gop). The diskette icon will highlight on top toolbar at the left when the function is available. Select the icon, name the dump file and select it's type if required. ES Analyzer will then create a PES or elementary stream.

This can be loaded back into the ES Analyzer to check it, and then it can be used as input to Tektronix Multiplexer application to create a transport stream with SI/PSI to your own specifications.

Working with Transport and PES Streams

Using Packet View

ES Analyzer displays transport packets in a specific way that is useful for analyzing the Transport stream and also for quickly accessing a packet at random.



The packet view window can be displayed by clicking the Show/Hide Packet View icon on the toolbar. A window appears that shows a spectrum of the packets in the order in which they appear in the transport stream. Each PID is assigned a color and each packet is represented using a single line of the corresponding color. By double clicking the spectral line for any packet, you are positioned to the corresponding packet in the main window of ES Analyzer.

Packet View communicates with ES Analyzer's main window through OLE. You can selectively turn on/off the display of spectral lines for any PID in the Packet View by clicking the corresponding color index in the Packet View dialog. The color index is also a toggle for display. You can also view distance graph between packets of the same PID by just viewing spectral lines of the corresponding PID. To switch back to displaying all PIDs, double click the All index (represented by white color).

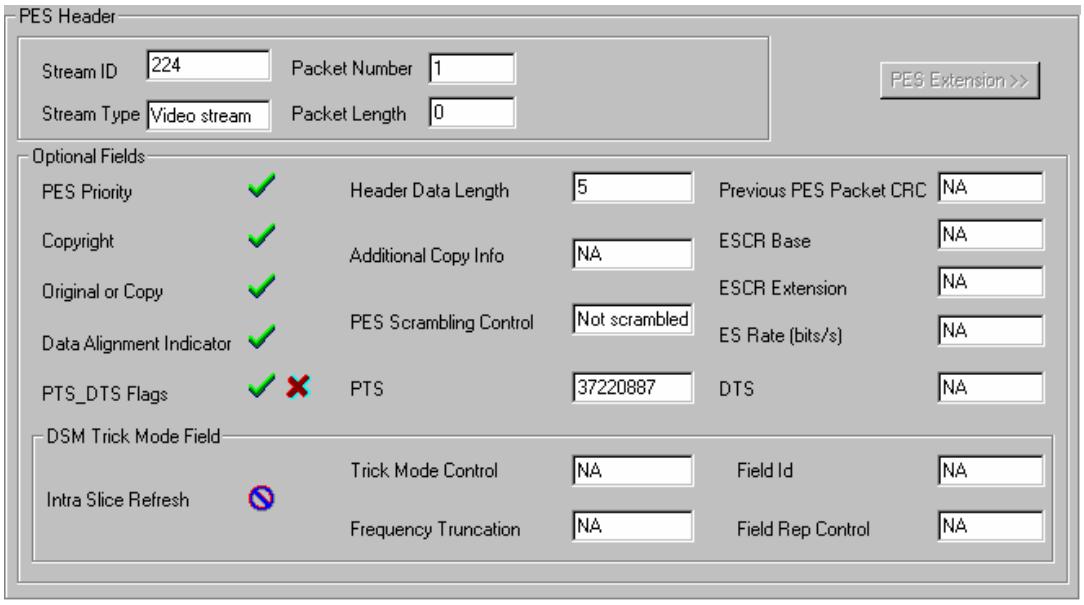
When you first open Packet View, it displays just the front page of the stream, so that not all of the PID numbers present in the stream are displayed in the button boxes below the main display. If you wish to see them all, drag the horizontal scroll bar pointer to the far right; all of the PID number buttons will then be displayed (This could take a few seconds for large stream files).

Note: Packet view does not operate when a program node is highlighted; it works at all other nodes in navigation view.

Understanding PES

A Packetized Elementary Stream (PES) as the name suggests is composed of contiguous packets of an elementary stream with packet headers, as shown below, prepended to the packet. A PES occurs only in MPEG-2 streams and its structure has been adapted from the packet structure of the MPEG-1 System stream.

For more information on PES streams, refer to the *ISO/IEC 13818-1* document.



An embedded stream is checked when you navigate through one; for details, see the *Navigating through Streams* section in the *Getting Started* chapter.

For PES streams, you can:

- Run through the stream; see details in the *Navigating through Streams* section in the *Getting Started* chapter.
- View packet headers as above with it's decoded fields.
- View an embedded elementary stream.
- View PES extension (if received).

Explaining the Status Bar Display

The status bar, for PES streams, displays the following:

- **Packet number**, which is the number of the current packet in the PES stream.
- **Byte offset** in the file, which is the first byte of the Pack header being currently viewed in both the hexadecimal and decimal formats.

Working with Video Streams

ES Analyzer performs detailed checks on MPEG Video streams. Video streams are complex with an embedded hierarchy. Structurally, very simply speaking, a Video stream consists of a video sequence which has a start code, end code, sequence header and any number of group of pictures (GOP). Each GOP consists of a GOP header and a group of pictures. Pictures may be of different types (I, B, or P). Pictures can also be frame pictures that correspond to progressive video or field pictures that correspond to interlaced video. Pictures are broken down into a slice structure and each slice consists of macroblocks.

For more details, you may want to refer to the documents ISO/IEC 11171-2 and ISO/IEC 13818-2 that describe the MPEG-1 and MPEG-2 video standards.

Using ES Analyzer, you can:

- View the sequence header along with the extensions.
- Navigate through a stream; see details in the *Navigating through Streams* section in the *Getting Started* chapter.
- Run through a stream with the option of analyzing the stream at the picture level or at the macroblock level.

When analyzing a group of picture, you can:

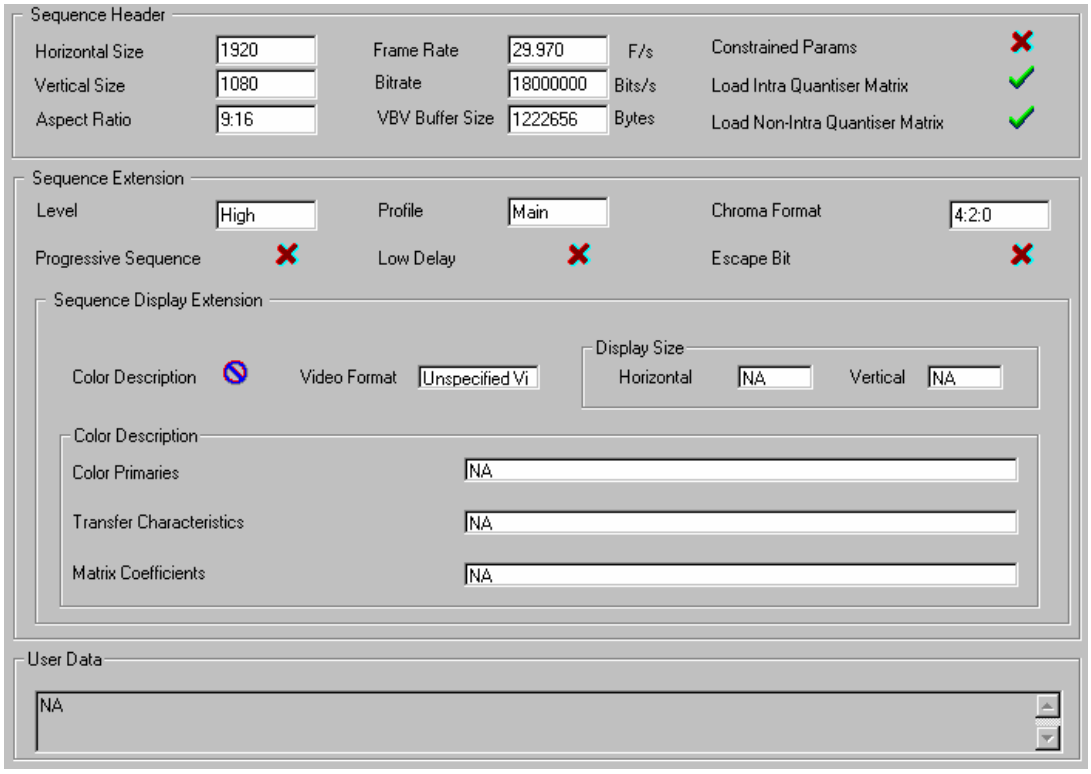
- Randomly access any picture within the group.
- View the picture type spectrum and picture size plots.
- Zoom into any picture and see its details at the slice or macroblock levels, or view the encoded picture. You may also use the video or picture player to play the entire video and pause at any picture when you notice a degradation in quality; you may then review the details of this picture down to the macroblock level. ES Analyzer provides an easy mechanism to switch between the Picture display and the data analysis display windows.
- Select any macroblock and examine it’s detailed coding.
- Perform picture quality analysis with special displays of quantizer scale distribution, slice size distribution, macroblock-size spectrum and motion vector plots.
- Interpret any video descriptors received in the higher level streams and validate them against the stream.

When analysis with the DCT option is enabled. you can:

- View 8x8 coefficients for all macroblocks within a picture.
- view coefficient tables for y, cr, cb, luma and chroma pixel data.

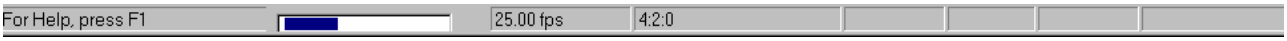
Viewing the Sequence Header

The sequence header is interpreted and displayed as shown below.



There is a special display of the quantizer matrices. When you take the cursor to the load-intra (or non-intra) quantizer matrix field, the applicable quantizer matrix is displayed. The check mark icon ✓ indicates that the matrix was received in this sequence header.

For MPEG-2 streams, an optional sequence extension and user data may also be received. User data is displayed as a hex dump. If data is in the ASCII format, the ASCII equivalent is displayed next to the hex dump.



The picture rate, chroma format, and the video type (NTSC/PAL/Unspecified, etc.) appear in the status bar when the sequence headers are displayed.

The information whether the stream is an MPEG-1 or an MPEG-2 stream is displayed in the tree view window as a single numeral (1 or 2) on the node icons.

Within a sequence, you can view the GOPs by clicking on the GOP icon in the left-hand-side hierarchy view of the stream. The GOP node appears below the sequence header node.

Viewing the GOP and Picture Header

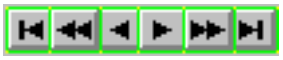
When displaying a GOP, ES Analyzer shows you a window with three tabs, as shown below.

Briefly, the contents of each tab are explained below; for details, see the specific sections, *Displaying the GOP Header*, *Displaying the Slice and Macroblock*, and *Using the Video Viewer for Picture Analysis*.

The GOP tab, displays the following:

- GOP header data.
- A slider for the pictures in the GOP. The slider can be used to randomly access any picture within the GOP; the slider moves in steps of two to facilitate working with large GOPs. The slider lists the pictures in the received (decoding) order.

  GOP position transport controls lie to the left of the slider bar

   -

  Using these controls, any picture can be selected within the GOP. The controls include Start and End GOP controls and Next and Previous I frame jump controls. Note that the I frame controls only works in streams where multiple I frames are present between GOP sequence headers.
- Picture header display for the picture selected in the slider.
- Picture extensions (applicable only to MPEG-2).

The Slice and MB tab:

- Takes you inside a specific picture and provides detailed information down to the macroblock level.
- Allows you to generate picture quality plots.
- Allows you to view a picture frame by frame and view macroblock level data for a selected macroblock in the picture.

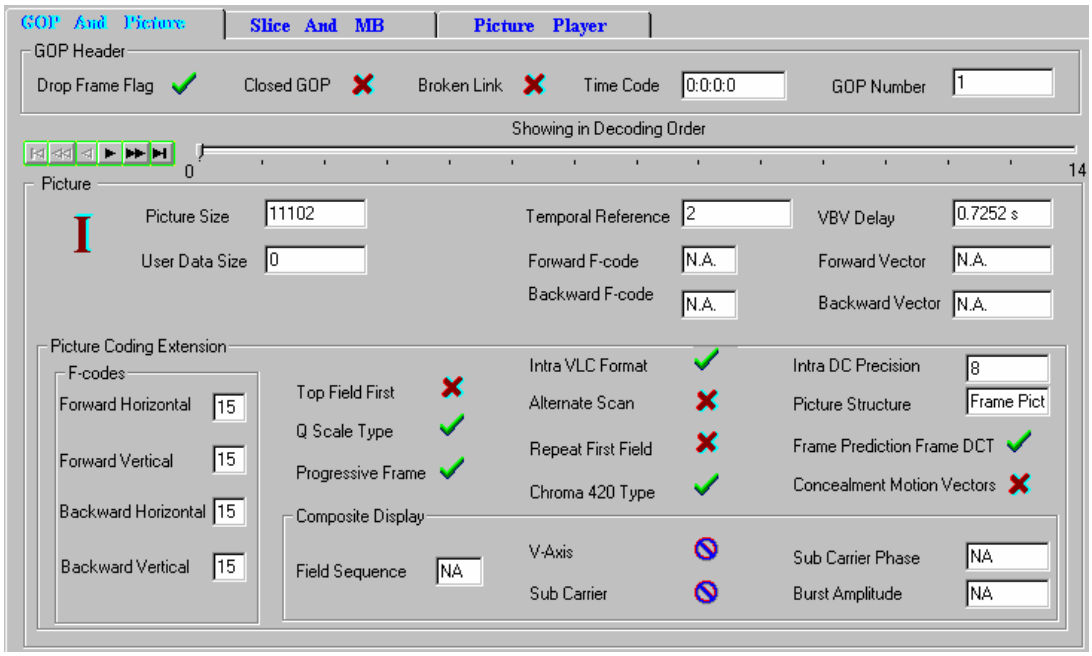
The Picture Player tab allows you to play and view the video output on your screen.

ES Analyzer synchronizes the picture being currently displayed by the video viewer with the picture/data that is displayed on the other tabs: GOP And Picture and Slice And MB. For example, if you select a macroblock and switch from the picture display to the other picture-quality analysis tabs, the same macroblock remains selected for easy identification.

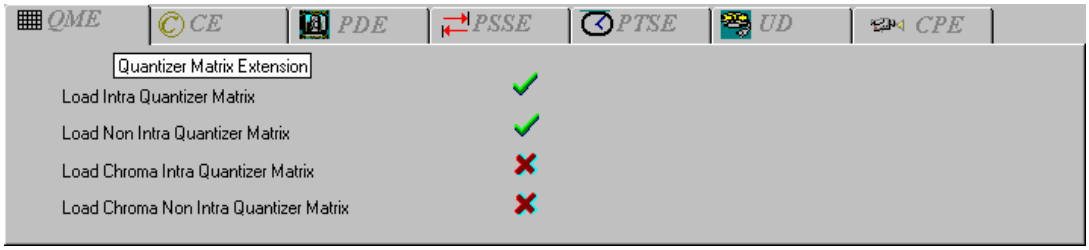
As an aid to locating a stream, you can click on any open GOP icon in the tree view to switch picture displays in the stream multiplex.

Displaying the GOP Header

The GOP header is an optional header and it is displayed, as shown below, when received.



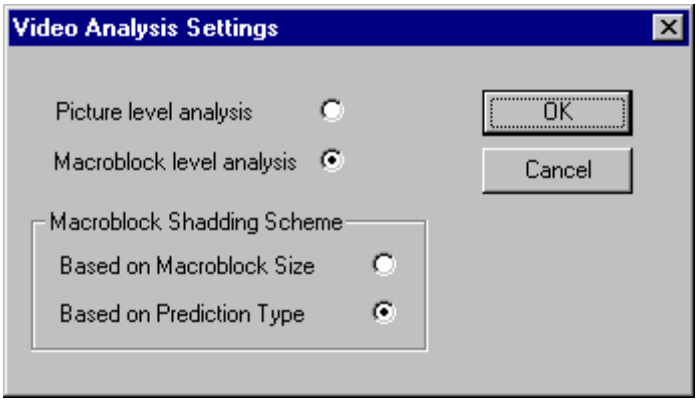
The lower part of the display also shows the picture extensions that have been received.



Video Analysis Settings

Analysis of GOPs can be carried out at picture level or macroblock level. This will affect the speed at which the 'next GOP' is analyzed. The setting is selected from the Video Analysis Settings dialog.

Select Menu Bar ➔ Settings ➔ Video Analysis. The following dialog is displayed:



Picture level analysis provides faster analysis but error reporting at the macroblock level is suspended. Macroblock level analysis provides error reporting but at the cost of analysis speed (see also page 49).

Status Bar (in GOP mode)

When ES Analyzer displays the GOP and picture headers, the status bar, as shown below, displays the:

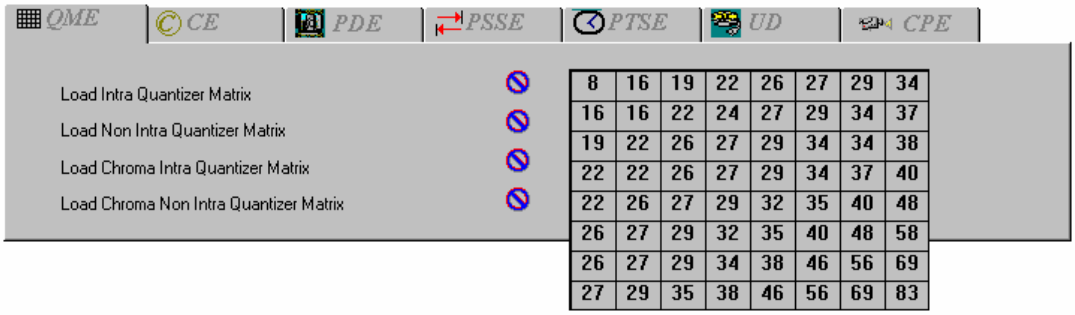
- Picture rate
- Chroma format
- Video Type (NTSC/PAL/Unspecified etc.)
- GOP number of the current GOP
- Picture number of the currently selected picture, relative to the current GOP (The first picture is given the offset 0.)
- Picture display number which gives the picture number in display order, relative to the first GOP received. This represents the actual picture Display number. It is calculated by adding the temporal reference of the current picture to the cumulative picture display number prior to the GOP.

Displaying the Picture Header

The GOP header tab has a slider for selecting the picture whose details you want to display. The header for the selected picture is displayed below the GOP header in the same dialog box as shown in the earlier illustration.

Displaying the Picture Extension

For MPEG-2, several picture extensions may be received. The picture coding extension is always displayed, while the other picture extensions are displayed on tabbed folders, as shown below. The tabs for each of these extensions are enabled and the text on the tab appears in red, only if the corresponding extension is received in the stream.



All tabs with red text represent extensions that have been received for the current picture. The next section describes each extension and its interpretation.

Explaining the Picture Extensions

QME
(Quantizer Matrix Extension)

This allows the quantizer matrices to be downloaded for any picture.

At most four matrices can be downloaded, namely, intra-quantizer matrix; non-intra-quantizer matrix, chroma intra-quantizer matrix, and chroma non-intra-quantizer matrix.

The QME tab displays through a check mark the matrices that were downloaded. A downloaded matrix is displayed when you move the mouse over the name of the specific matrix.

CE
(Copyright Extension)

This indicates any copyrights on the video. The copyright field is interpreted and displayed.

PDE
(Picture Display Extension)

This extension gives display extensions for MPEG-2 video.

PSSE
(Picture Spatial Scaleable Extension)

This is received when the spatial scalability of MPEG-2 video is used in the video stream.

PTSE
(Picture Temporal Scaleable Extension)

This extension is received when the temporal scalability of MPEG-2 video is used in the video stream.

UD (User Data)	This displays any user data associated with the picture in hexadecimal format. If the data represents ASCII text, the ASCII text is also interpreted and displayed.

These tabs will only operate if the appropriate extensions are present within the stream under test.

All four matrices will only display if they are downloaded with certain stream types e.g. HDTV streams.

- Indicates that only the default matrix will be displayed.

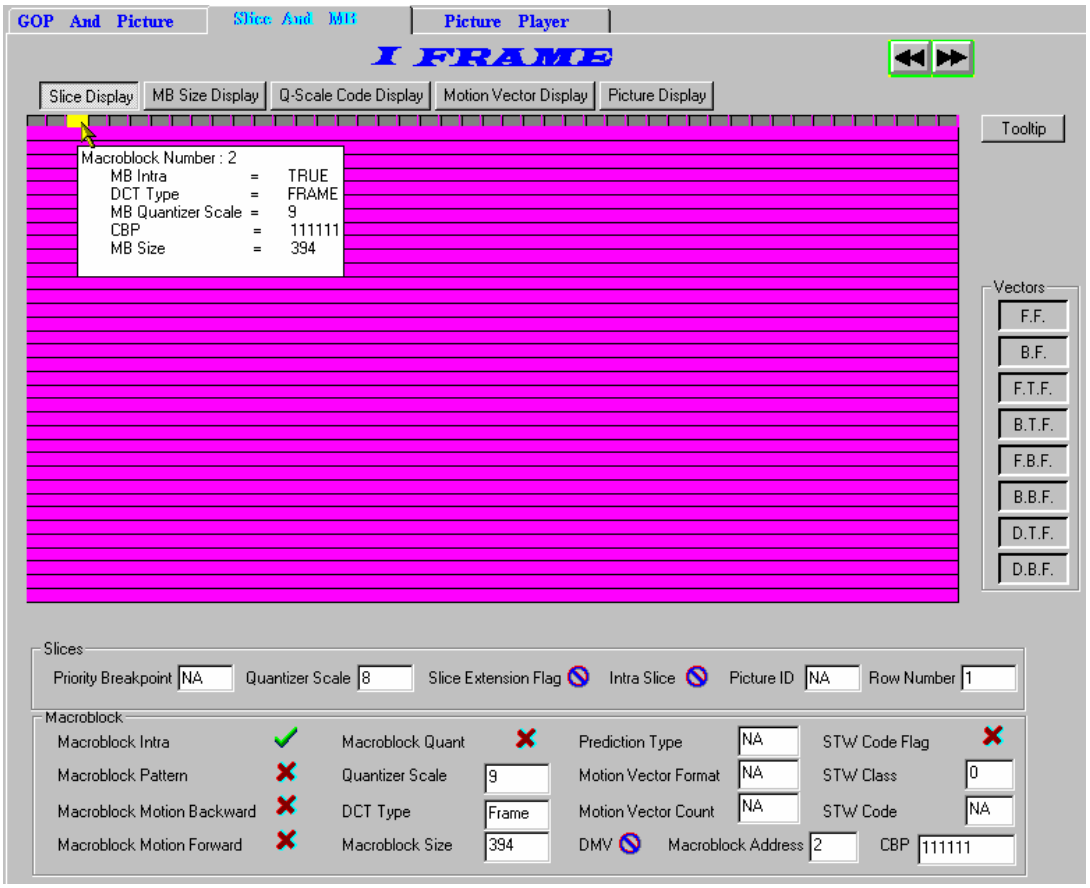
Displaying the Slice and Macroblock

ES Analyzer allows you to take a microscopic view of a picture by letting you view the picture's slice and macroblock structure.

To view slice details of any picture:

1. Select the picture by using the picture slider on the GOP And Picture tab.
2. Click the Slice and MB tab.

   The macroblocks for the selected picture are displayed as shown below:



The Slice dialog box graphically displays the slices and macroblocks in the picture and also displays the:

- Slice header for the selected slice.
- Macroblock details for the selected macroblock.
- Picture Quality data, which overlaps the slice display area.
- Decoded field/frame for the selected picture.

Explaining the Slice and Macroblock Display

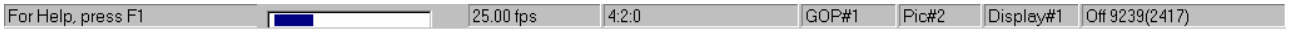
When displaying the slices, the current picture is represented by its constituent slices; see the above illustration. You can move the mouse to any slice and select it using the left mouse-button. The slice header display shows the header for the currently selected slice. MPEG-1 slices can span multiple rows and the display shows the same.

Slice display is color coded. Intra-slices are shown in green color, while slices that do not have this flag set are displayed in gray color.

Within a slice, the macroblocks are also shown. You can select a macroblock in the slice using the left mouse-button. The header and information of the currently selected macroblock is displayed below the macroblock display. Skipped macroblocks in a slice are shown using a different color and cannot be selected.

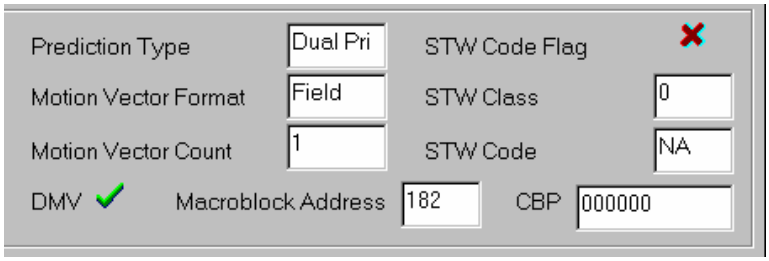
When viewing the slice display, you can move forward to the next picture or backward to the previous picture. You do this by clicking the picture navigation buttons on the top right corner of the dialog box. You can also return to the GOP display and select a specific picture. When moving backwards, you cannot cross the GOP boundary; however, when moving forward, you can cross a GOP boundary.

When displaying macroblocks, the status bar looks like this:



Viewing Coded Block Patterns for a Macroblock

While in the slice and macroblock level display, you can view the coded block pattern for any macroblock (except for the skipped macroblocks). This is displayed in the last field (CBP) as shown below.



Depending on the chroma format, the coded block pattern is displayed as a sequence of 6, 8, or 12 bits. From left to right, the bit pattern represents the blocks in the macroblock as they are numbered in the standard MPEG specifications. For more details, see the ISO/IEC 11172-3 and ISO/IEC 11318-3 documents.

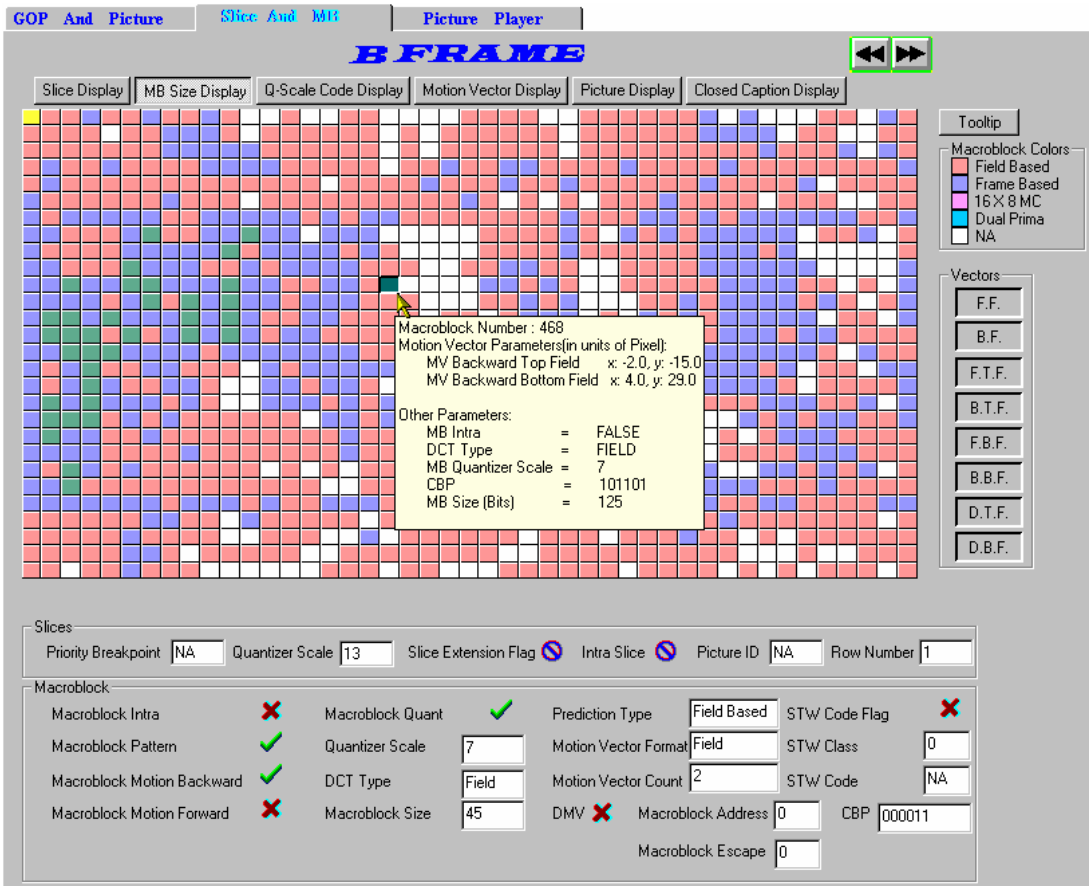
Analyzing Picture Quality

Viewing the Quantizer Scale Distribution

Quantizer scale distribution for the macroblocks in a picture is plotted where the picture slice is displayed. This gives you a graphical view of the scale code distribution and lets you visually check any obvious scale code problems. This plot can be viewed by clicking on the Q-Scale Code Display button in the Slices dialog box. The scale codes of 1 through 31 are mapped to shades of green with 1 being mapped to the lightest shade and 31 to the darkest (black). Skipped macroblocks are displayed in gray to indicate the same. The value of the scale code for the selected macroblock is displayed in the macroblock field display area below it.

Viewing the Macroblock Size Spectrum

The Macroblock Size Display provides a color-mapped two-dimensional graphical plot of the macroblock size and type distribution in a picture; it is plotted as an overlay on the slice display area. This plot can be viewed by clicking on the MB Size Display button in the Slice and MB tab. The types of all macroblocks in the picture are color-mapped; a key is shown at the right-hand side of the display and described below (see Macroblock Colors). Skipped macroblocks are displayed in dark green. The macroblock size for the selected macroblock is displayed in the macroblock field display area below it.



Macroblock Colors

The color-coded macroblock type represents the prediction type employed.

Field Based	Predictions are made independently for each field by using data from one or more previously decoded fields.
Frame Based	Predictions are made for the frame using the data from one or more previously decoded frames
16 x 8 MC	(16 x 8 motion compensation) In which two motion vectors are used for each macroblock. The first motion vector is used for the upper 16x8 region, the second for the lower 16x8 region. In the case of a bi-directionally predicted macroblock a total of four motion vectors will be used since there will be two for forward prediction and two for the backward prediction. 16x8 MC is only used with field pictures.
Dual Prima	In which only one motion vector is encoded (in its full format) in the bitstream together with a small differential motion vector. In the case of field pictures, two motion vectors are then derived from this information. These are used to form prediction from two reference fields (one top, one bottom) which are averaged to form the final prediction. In the case of frame pictures this process is repeated for the two fields so that a total of four field prediction are made. This mode is only used in P-pictures where there are no B-pictures between the predicted and reference fields or frames.
NA	Not Applicable - Refers to the instances where there is no prediction in the macroblock.

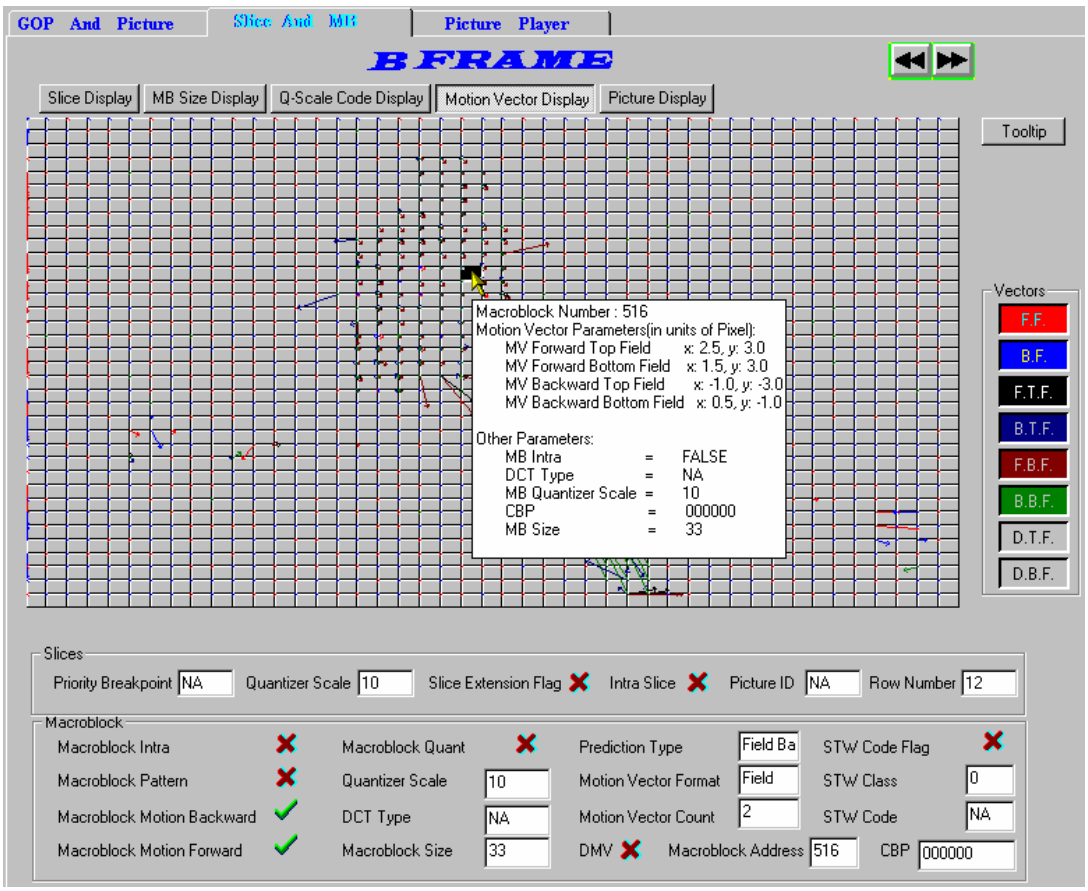
(For more detailed information, refer to
ISO/IEC 13818-2 : 1996, Information Technology - Generic coding of moving pictures and associated audio information, Part 2 Video.)

Viewing the Motion Vector Plots

ES Analyzer gives a detailed graphical display of motion vector for the selected B or P picture. Both MPEG-1 and MPEG-2 type vectors are interpreted and displayed.

To view motion vectors (applicable to only B or P pictures):

1. Position the cursor to the picture for which you want to see the slice size plot.
2. Move into the slice display.
3. Click the Motion Vector Display button in the slice display dialog box.



For each macroblock, the motion vectors corresponding to it are plotted to scale as a directed arrow. The direction of the arrow represents motion coding for the macroblock from the reference frame to the current frame. Different types of vectors are plotted in different colors. You can also selectively choose to display different motion vectors by using the buttons on the right.

FF	Forward Frame	BF	Backward Frame
FTF	Forward Top Field	BTF	Backward Top Field
FBF	Forward Bottom Field	BBF	Backward Bottom Field
DTF	DMV Top Field	DBF	DMV Bottom Field

If a button is greyed out, the associated vector is not currently available.

The motion vectors are plotted for the luminance blocks. They are to scale (in the resolution of full pel or half pel) according to the pel resolution fields received. For each macroblock, multiple vectors may be received. All or some of them may be displayed simultaneously.

When Tooltips are enabled, a summary of parameters is displayed in a popup window.

For MPEG-1 that has only frame pictures, two kinds of motion vectors are applicable - forward frame (for P and B pictures) and backward frame (for B pictures).

For MPEG-2 video, additional vectors may also be coded, which are: forward frame (for P and B pictures), backward frame (for B pictures), forward top field, backward top field, forward bottom field, backward bottom field, dual prime top field, dual prime bottom field.

ES Analyzer interprets all the above vectors and lets you view them graphically. When motion vectors cross the picture boundary, an error condition occurs and the same is reported in the error log window. In this case, the vector is drawn until the edge of the picture display.

Reviewing the Decoded Picture

ES Analyzer decodes and displays the selected picture when you click the Picture Display button. You can view I, B, or P frames or fields (only for MPEG-2).

ES Analyzer also allows you to view the previous and the next decoded picture (whether frame or field) by clicking the appropriate buttons. The actual size of the picture is displayed and if the picture is larger than the picture display area, scroll bars will appear. For the current picture being viewed, you can select a macroblock by clicking the left mouse button anywhere in the picture display area. When you do so, the slice and macroblock area below the picture displays the slice and MB data for the currently selected macroblock. If Tooltips are selected, a summary of the macroblock information is displayed in a popup box. When you switch from the picture display to the other picture-quality analysis tabs (e.g., MB Size Display, Q-Scale Code Display or Slice Display), the same macroblock remains selected for easy identification.

You can also enable a macroblock grid on the displayed picture by using the Show Hot Grid button to easily identify and select macroblocks.

The picture display has the following limitations:

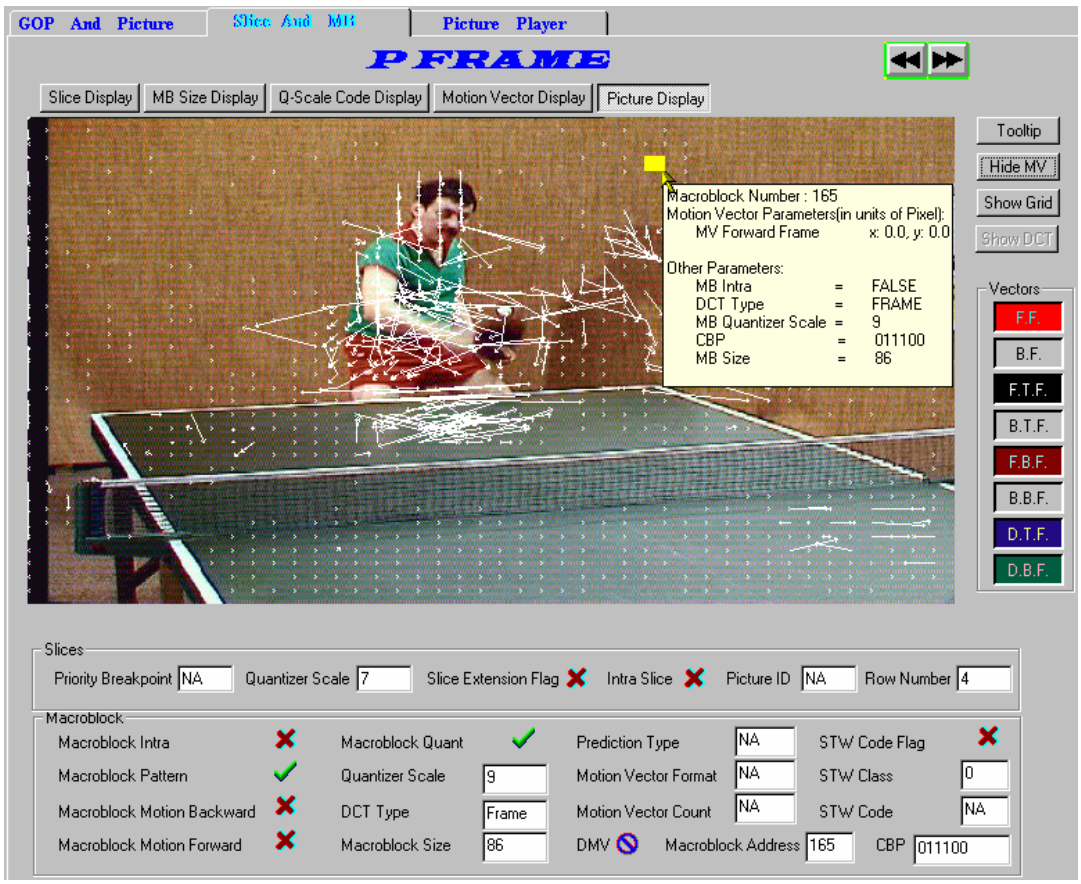
- When you navigate to a specific GOP using the toolbar icon, the picture display may be unable to display some B pictures correctly. These pictures are those that use a frame from the previous GOP for reference. This happens only when you navigate to a GOP that is not a closed GOP.
- For MPEG-2 scaleable streams, you will be able to display pictures only from the base layer. Other extension layer data cannot be displayed using ES Analyzer.
- ES Analyzer currently displays and decodes video streams within the following MPEG-2 profiles:
    - Main Profile @ High Level (MP@HL)
    - Main Profile @ Main Level (MP@ML)
    - 4:2:2 Profile @ Main Level (4:2:2P@ML)

Viewing the Decoded Picture with Motion Vector Plots

The decoded picture can be further enhanced with an overlay of motion vector plots. The interpretation of the display corresponds with the description in the previous section - Viewing the Motion Vector Plots.

To view the vector plots for the currently displayed picture:

1. Select the Show MV button on the right-hand side of the picture.
2. The vectors displayed will depend upon the selections made from the remaining buttons on the right-hand side of the screen.



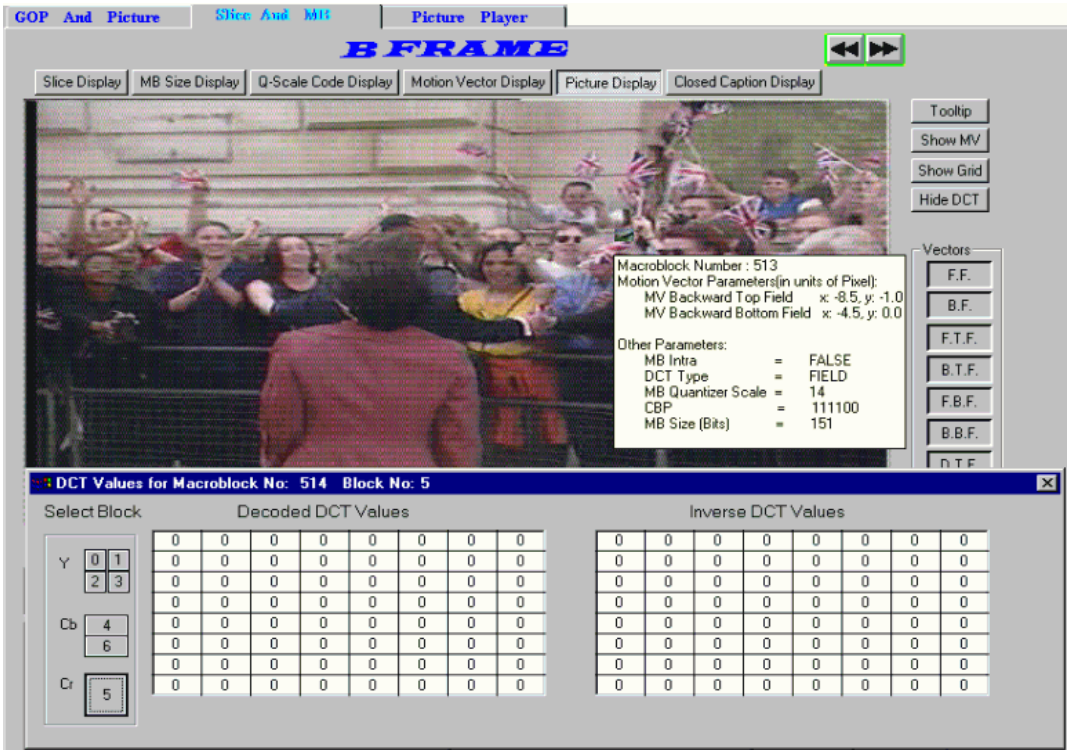
The picture display has the following limitations:

- When navigating to a specific GOP using the toolbar icon, the picture display may be unable to display some B pictures correctly. These pictures are those that use a frame from the previous GOP for reference. This happens only when you navigate to a GOP that is not a closed GOP.
- For MPEG2 scaleable streams, you will be able to display pictures only from the base layer. Other extension layer data cannot be displayed using ES Analyzer.
- For MPEG2 streams, ES Analyzer currently displays and decodes only decodes MP@HL, MP@ML, and 4:2:2 video streams.

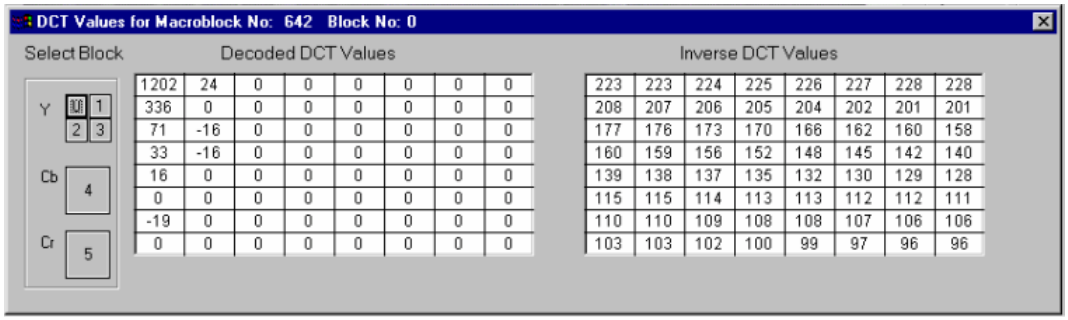
Note: Make sure that your monitor's Display Properties is set to either 24 or 32-bit true color; otherwise, you may find a distortion in the colors in the picture being displayed.

Displaying DCT Coefficients

The Discrete Cosine Transformation matrix of each block in a selected macroblock can be seen by selecting **Settings ➔ DCT Display** from the Menu Bar. The DCT Display option is available only when viewing the details of GOP in Video Stream Analysis. Enabling the DCT Display option will enable Show DCT button next to the displayed picture in Slice & Macroblock Tab, Picture View Mode.



The **Show DCT** button is used to toggle the DCT Coefficients display. To view the DCT values of the a macroblock, select the macroblock; a window containing details of coded and decoded DCT values will be displayed.



Decoded DCT Values							
1202	24	0	0	0	0	0	0
336	0	0	0	0	0	0	0
71	-16	0	0	0	0	0	0
33	-16	0	0	0	0	0	0
16	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
-19	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Inverse DCT Values							
223	223	224	225	226	227	228	228
208	207	206	205	204	202	201	201
177	176	173	170	166	162	160	158
160	159	156	152	148	145	142	140
139	138	137	135	132	130	129	128
115	115	114	113	113	112	112	111
110	110	109	108	108	107	106	106
103	103	102	100	99	97	96	96

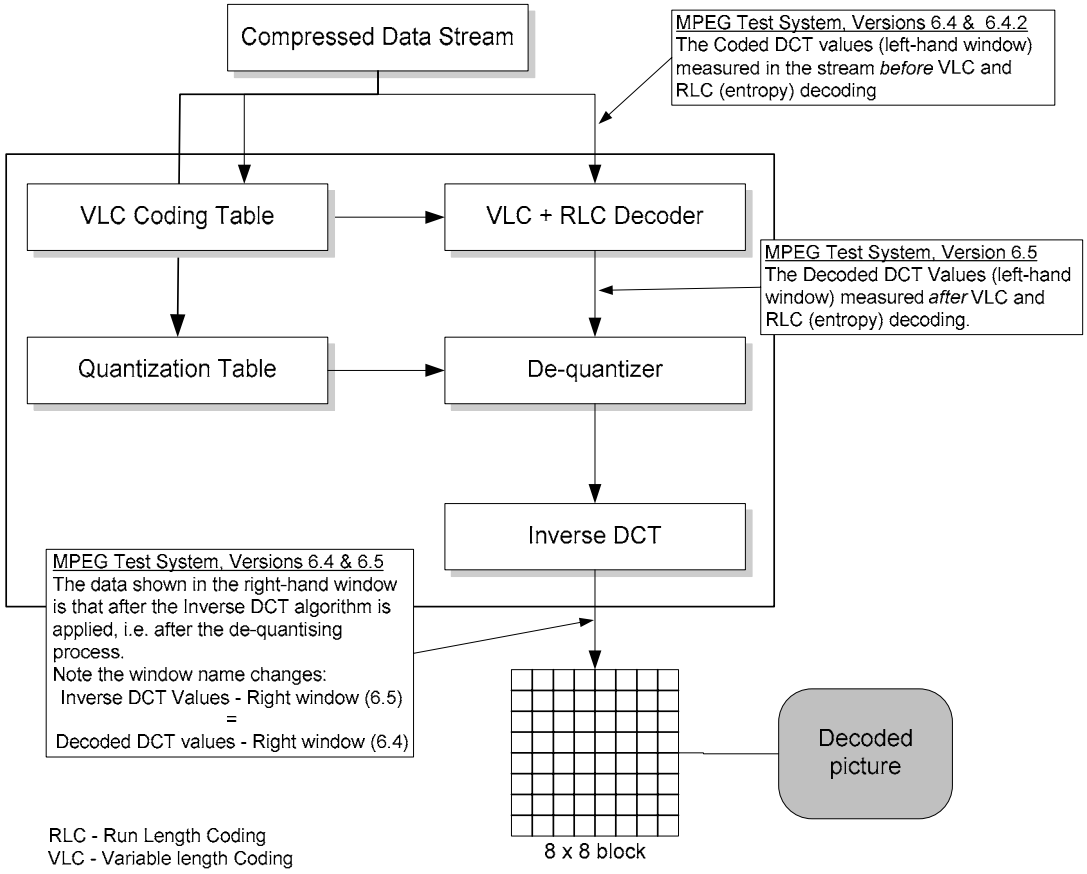
Note that the luma (y) control has four selections (0, 1, 2 and 3) which correspond to an 8x8 pixel corner of the 16x16 pixel selected macroblock. Chroma sub-sampling (Cb and Cr) will display matrices for the color differences between frames.

The picture display has the following limitations:

- When navigating to a specific GOP using the toolbar icon, the picture display may be unable to display some B pictures correctly. These pictures are those that use a frame from the previous GOP for reference. This happens only when you navigate to a GOP that is not a closed GOP.
- For MPEG2 scaleable streams, you will be able to display pictures only from the base layer. Other extension layer data cannot be displayed using ES Analyzer.
- For MPEG2 streams, ES Analyzer currently displays and decodes only decodes MP@HL, MP@ML, and 4:2:2 video streams.

DCT Value Display - Version Changes

The diagram below shows the monitoring points in the analysis process for the DCT values. The diagram also indicates the changes that occurred between ES Analyzer, Version 1.5 (MPEG Test System, Versions 6.4 and 6.4.2) and ES Analyzer, Version 1.6 (MPEG Test System, Version 6.5). The 'windows' referred to are those in the DCT Values window.



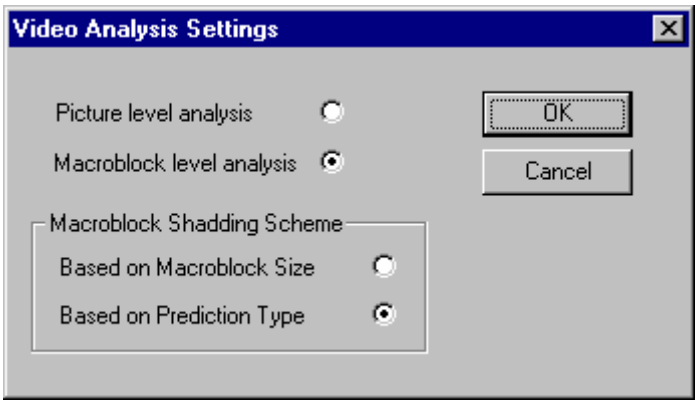
Configuring Video Analysis Settings

The video analysis or picture analysis default settings can be set as required.

The Video Analysis settings selected will not affect analysis on either the **Slice and Macroblock** or the **Picture Player** pages. On the **Slice and Macroblock** page, analysis is always at the macroblock level. On the **Picture Player** page, analysis is always at the picture level.

Video Analysis Settings

Select **Settings ➔ Video Analysis…** from the Menu Bar. The following dialog is displayed:



Select **Picture level analysis** to view frames quickly.

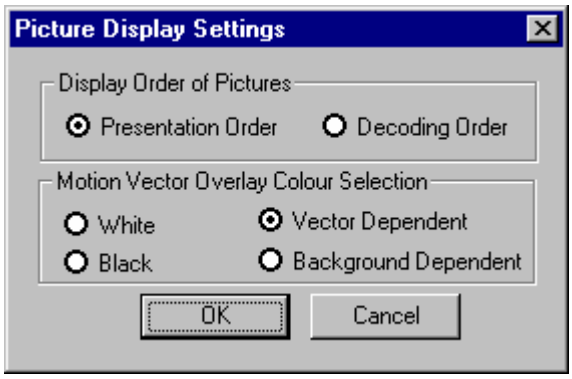
Select **Macroblock level analysis** if pictures/frames are to be analyzed at the macroblock level.

When **Macroblock level analysis** is enabled, select the shading scheme required.

Picture Display Settings

A number of display and vector parameters are set from the Picture Display Settings dialog.

Select **Settings ➔ Picture Display…** from the Menu Bar. The following dialog is displayed:



Display Order of Pictures

Select **Presentation Order** or **Decoding order**

Motion Vector Overlay Colour Section

White: All vectors will be displayed in white.

Black: All vectors will be displayed in black.

Vector Dependent: Colors will correspond to the vector selection button colors.

Background Dependent: Colors are combined with picture background to provide a contrast.

Viewing the Slice Size Distribution

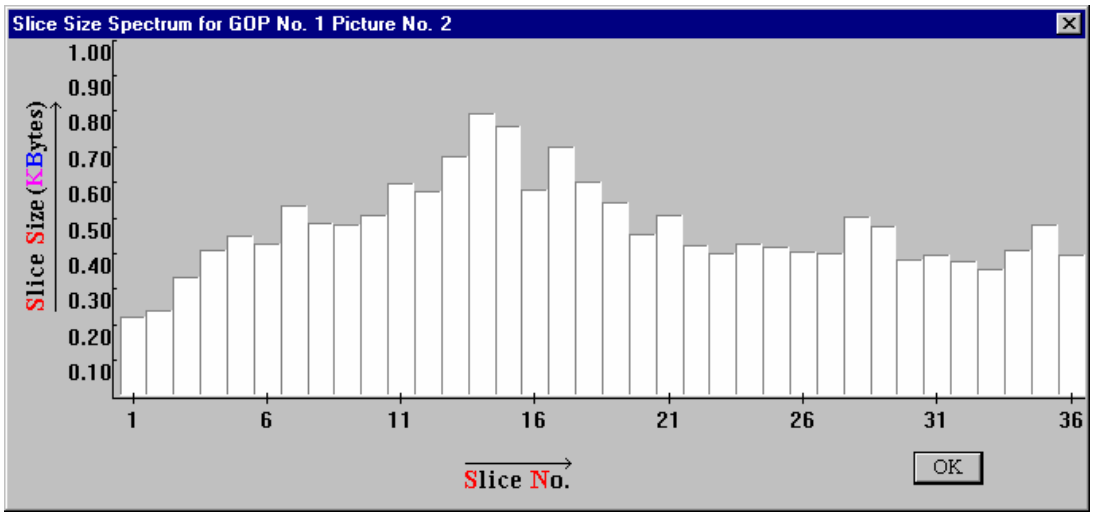
For any picture, you can also view the slice size distribution.

To view the plot:

1. Position the cursor to the picture for which you want to see the slice size plot on the GOP And Picture tab.
2. Move into the slices display by clicking the Slice and MB tab.
3. Click the Show Slice Size Statistics icon on the toolbar.

The Show Slice Size Statistics icon is greyed out on all tabs except the Slice and MB tab.

The plot appears in another window.



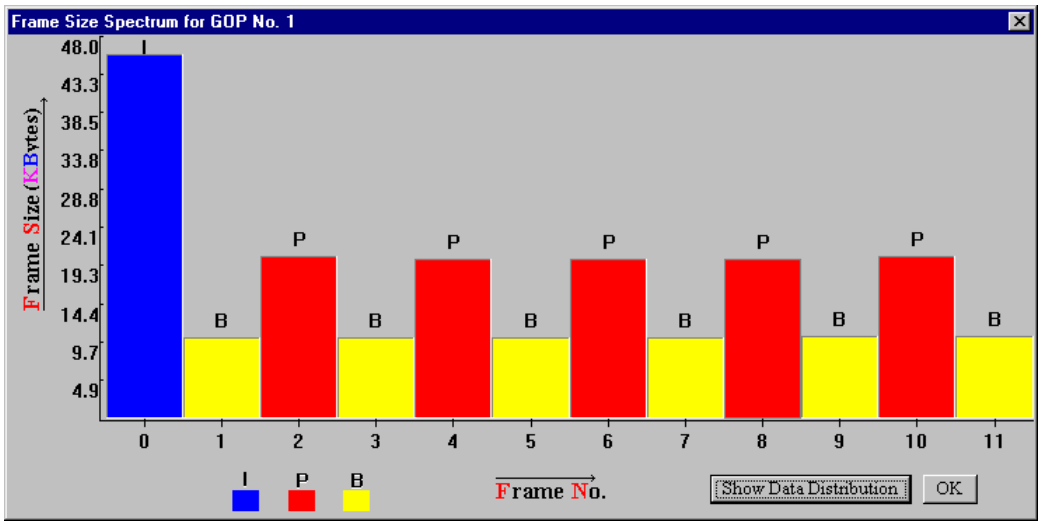
Viewing the Frame Size Spectrum

You can view the picture spectrum for a GOP and the frame size plots.

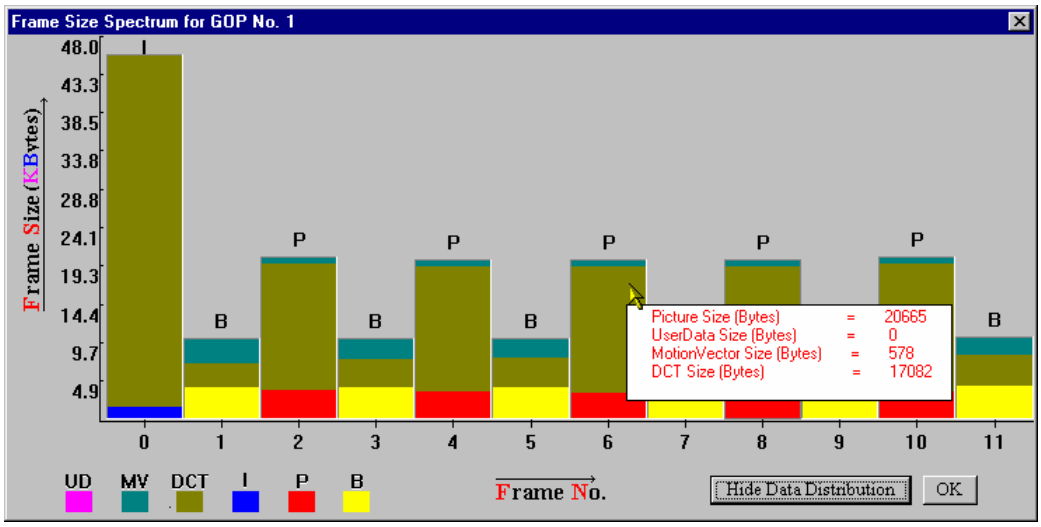
To view the plot:

1. Display the GOP for which you want to see the Frame Size Spectrum plot.
2. Click the Show Frame Size Statistics icon  on the toolbar.

The following plot is displayed. Each bar represents the frame size in kilobytes:



Selecting the Show Data Distribution button will further enhance the plot by showing the content of each frame.



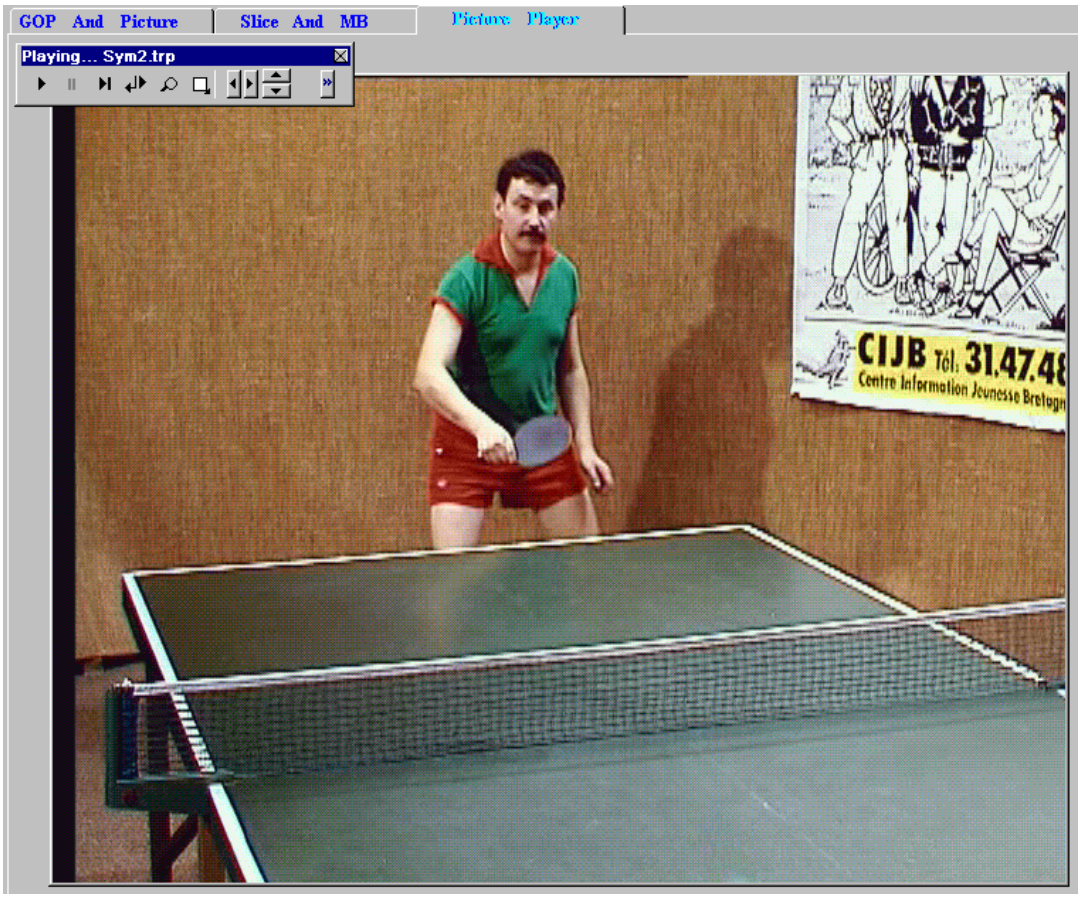
Content is color-coded as shown by the key in the bottom left-hand corner. Details of the content of each frame are available in a pop-up dialog displayed when the cursor is moved over a frame.

Using the Video Viewer for Picture Analysis

The video viewer (or Picture Player) allows you to play a video stream and display the decoded picture on the screen. The play speed maybe a little slower than the actual play speed. You may also notice certain pauses in the display at regular intervals. These pauses occur at GOP boundaries. The Remote Control (described below) allows you to pause and resume the display at any frame. You can also restart the display from the beginning of the current GOP, or from the start of the video sequence.

The display number of the current picture and the number of the last decoded picture are displayed, as shown in the illustration on the next page. Here's a typical sequence of steps in which you may use the video viewer:

1. Open the video stream you want to analyze.
2. Start the video viewer.
3. Monitor the displayed picture for quality problems.



4. Pause the player whenever you notice a problem in a picture, such as a degradation in quality. The player is intentionally made to play at a speed slower than the regular play speed to allow you to stop at specific frames.
5. Switch to the analysis tabs to view details of the currently displayed picture down to the macroblock level.

6. Step forward or backward in decode order in the Slice And MB tab, or switch back to the video viewer and resume play.

   ES Analyzer synchronizes the picture being currently displayed by the video viewer with the picture/data that is displayed on the other tabs: GOP And Picture and Slice And MB. This means that:

   - The GOP And Picture and Slice And MB tabs always display data for the same picture.
   - When you switch from the video viewer to either the GOP And Picture or the Slice And MB tab, you are presented the data for the picture being displayed on the Picture Player tab.
   - When you switch from the GOP And Picture or the Slice And MB tab to the Picture Player tab, the video viewer presents the picture for the data being displayed on the GOP And Picture or the Slice And MB tab.
   - If you select a macroblock and switch to the picture-quality analysis tabs (e.g., MB Size Display, Q-Scale Code Display or Slice Display), you'll find that the same macroblock remains selected for easy identification.

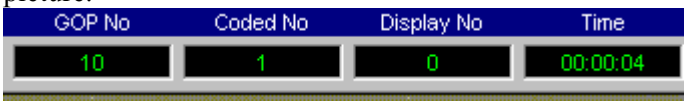
   The video viewer, however, has the following limitations:

   - When you navigate to a specific GOP using the toolbar icon, the picture display may be unable to display some B pictures correctly. These pictures are those that use a frame from the previous GOP for reference. This happens only when you navigate to a GOP that is not a closed GOP.
   - For MPEG-2 scaleable streams, you will be able to display pictures only from the base layer. Other extension layer data cannot be displayed using ES Analyzer.
   - ES Analyzer currently displays and decodes video streams within the following MPEG-2 profiles:
     - Main Profile @ High Level (MP@HL)
     - Main Profile @ Main Level (MP@ML)
     - 4:2:2 Profile @ Main Level (4:2:2P@ML)

Picture Player Remote Control

The Remote Control is displayed whenever the Picture Player tab is selected.

Play Video	Plays the video stream from where it had last stopped.
Stop	Stops the video stream and allows the other analysis tabs to be selected.
Next Picture	Steps forward one frame.
Play from GOP Start	Plays the pictures from the start of the current GOP.
Zoom/Restore Display	Enlarges and restores the area in which the picture appears.
Fit Best in Display Area/Display Picture at True Size	Fits picture in display area or displays picture at original size.
Left/Right Scroll	Scrolls the displayed picture left and right.
Up/Down Scroll	Scrolls the displayed picture up and down.
Show/Hide Information	Shows or hides the information panel for the displayed picture.



The following information is displayed:
GOP Number - in which the frame is present;
Coded Number refers to the picture number within the GOP;
Display **Time** in hh:mm:ss:cc; where cc is the display number in the *whole* file
Display Number refers to the display number of a picture within the GOP.

Working with Audio Streams

ES Analyzer analyzes both MPEG (-1 and -2) Audio streams and Dolby Digital (AC-3) Audio streams.

Understanding MPEG Audio Streams

An MPEG audio stream consists of a sequence of audio frames. Audio data may be received for multiple channels. Each channel is divided into sub-bands for which data is transmitted.

ES Analyzer verifies audio streams according to the MPEG audio recommendations. Support for both MPEG Layer I and Layer II audio is available. MPEG-2 extensions for Layer I and II (surround and centre channels, and low frequency channels) are also interpreted and analyzed. Multi-lingual extensions in MPEG-2 are currently not analyzed. ES Analyzer is also unable to analyze the MPEG-2 Audio stream if the extension bitstream is present.

For a detailed discussion on the MPEG audio syntax, refer to ISO 11172-3 and ISO 13818-3.

With ES Analyzer, you can:

- Navigate to any audio frame; see details in the *Navigating through Streams* section in the *Getting Started* chapter.
- View frame details, including frame header, and plots of the frame data, as shown in the following illustration.
- Interpret and display audio descriptors received in higher level streams and validate them against the stream.
- Play an audio stream.

For each audio frame, data may be received for at most two channels, as shown in the next illustration; additional channels may also be received in the MPEG-2 extension.

Audio Player

The Audio Player is available on MPEG-1, MPEG-2 and Dolby AC-3 streams (and AAC as an option). With a suitable sound card installed in the host PC, audio streams can be played.

Note that the speed and quality of playout, whilst not high fidelity, is sufficient to allow an audio stream to be monitored for analysis.

Note that while an audio stream is playing, you cannot access any other analyzer functions. In particular, do not close the Audio Player whilst an audio stream is playing (especially in loop mode), since you will be unable to re-open the player (and control the stream) until it has finished playing.

If more than one audio device is installed, a selection can be made from the **Device** drop-down list.

The channels to be played can be selected from the **Play Channels** drop-down list.

To open the Audio Player, select the player start button which is available on the audio stream header pages.

The Audio Player control panel is displayed:

The player controls follow the same convention as the Video Player controls:

- Play
- Stop
- Fast Forward
- Fast Rewind

(To use Fast Forward and Fast Rewind, press the required button and then stop the action with the Stop button.)

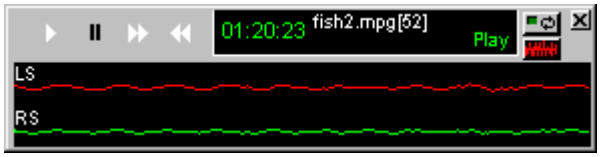
The Audio Player display shows the following:

- Play time
- Stream Name and Audio PID number
- Player status (Stop/Play)

The following controls are available in addition to those described above:

Toggles continuous (or looped) playout.

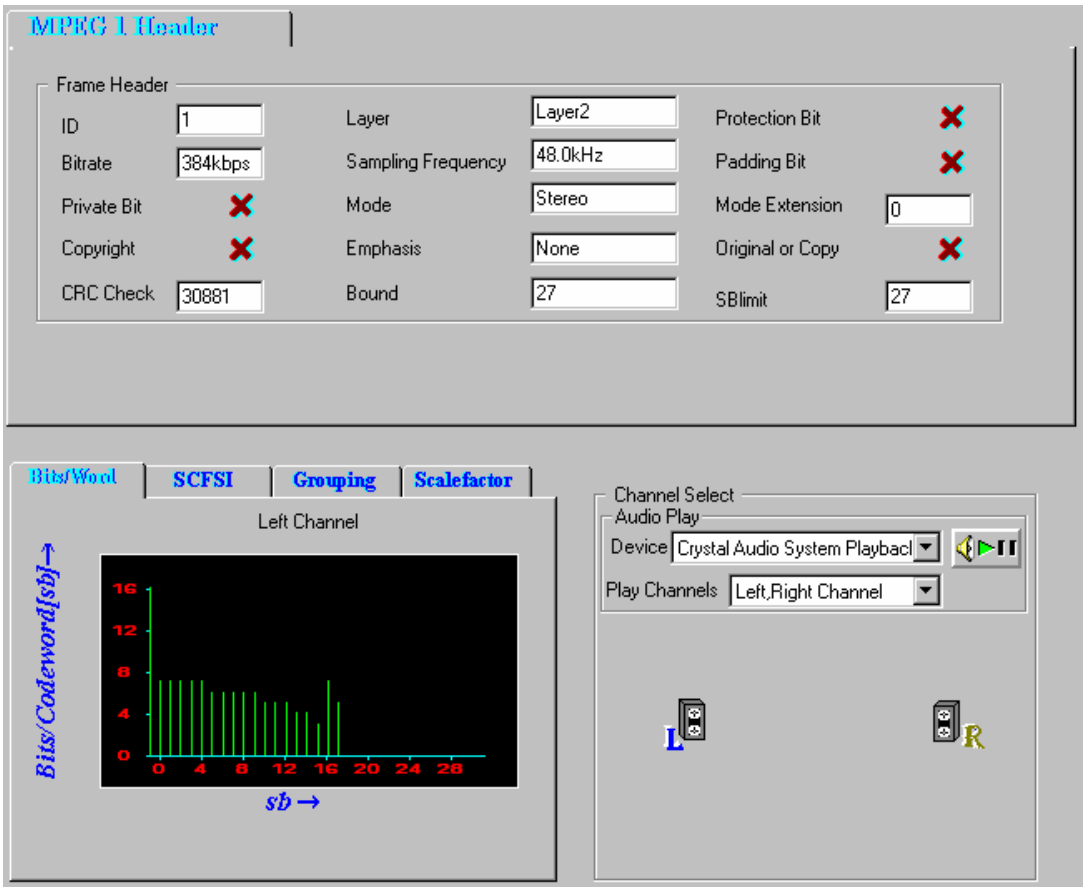
Toggles a real-time waveform display.



Currently two channels are output to the sound card. These can be assigned as required as mono or stereo from any of up to five channels in a stream.

Explaining MPEG-1 Audio Streams

ES Analyzer displays data for each channel separately.



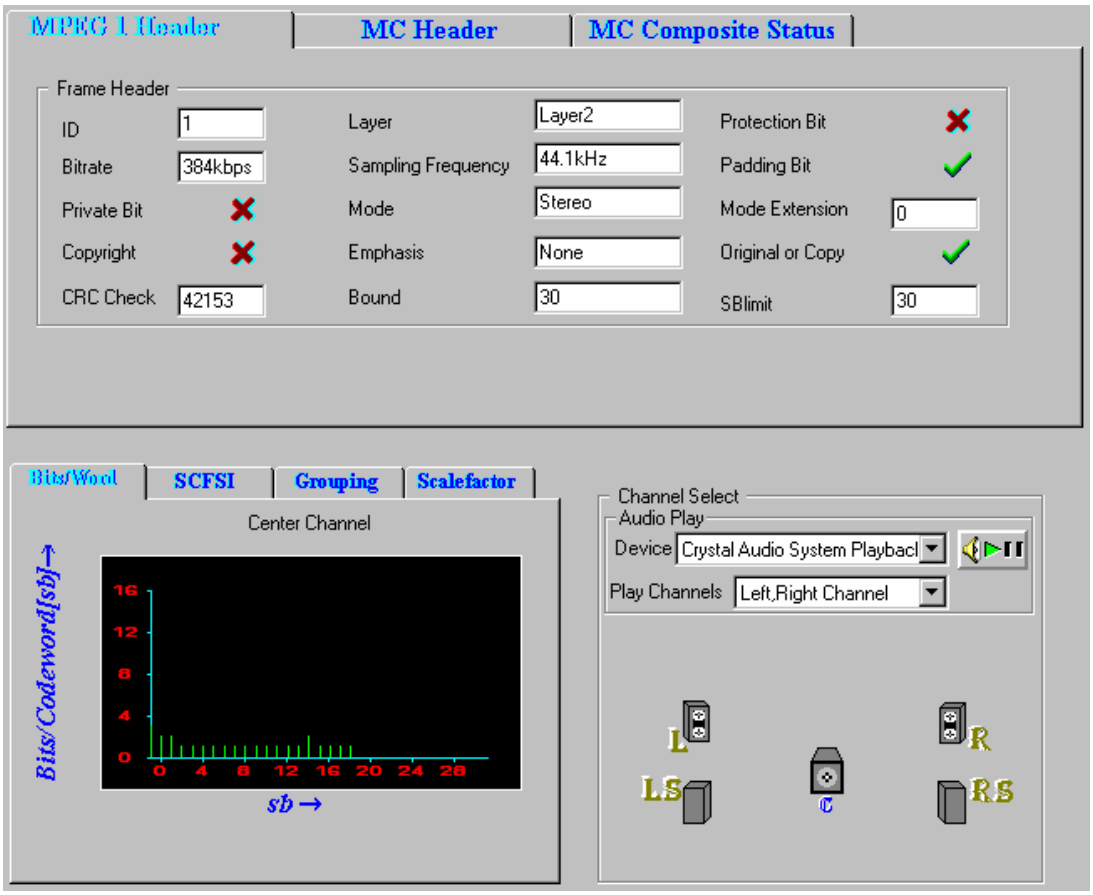
For the selected audio frame, ES Analyzer displays the following:

- The frame header.
- A plot of bits per code word against the sub-bands for each channel.

- SCFSI (Scale Factor Selection Information) plotted against sub-band for each channel.
- Grouping information plotted against sub-bands for each channel.
- The scale factor plotted against the sub-band.
- Channel selection and playout controls.

Explaining MPEG-2 Audio Streams

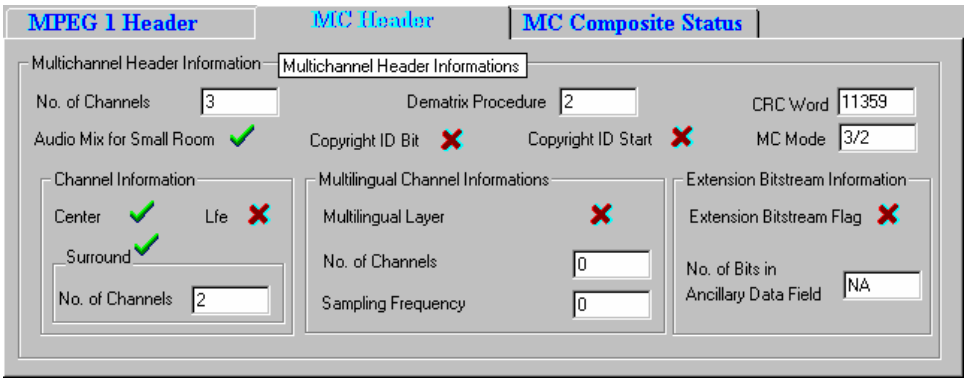
For MPEG-2 Audio streams, ES Analyzer analyzes the following channels if the data is present: Left, Right, Left Surround, Right Surround, Centre and LFE. Currently, ES Analyzer analyzes 5.1 Audio streams. When ES Analyzer detects an MPEG-2 Audio stream, the information displayed is similar to what is shown below.



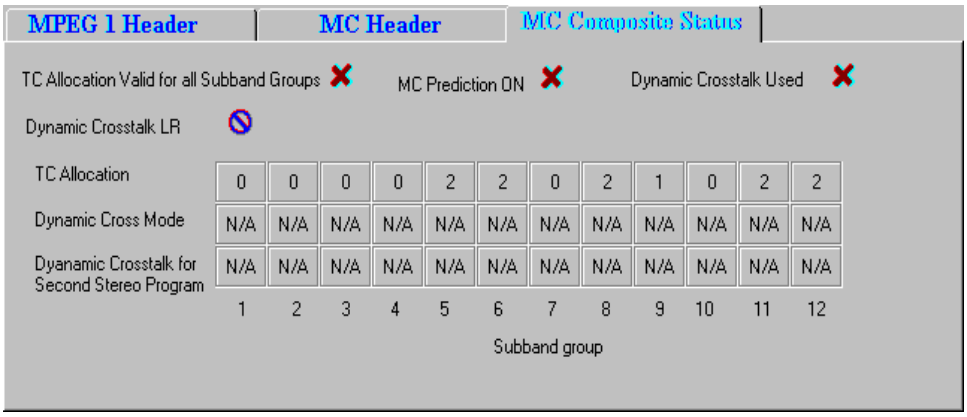
ES Analyzer displays information on the following tabs: MPEG-1 Header, MC Header (Multi-channel header), and MC Composite Status (Multi-channel composite status).

MPEG-2 Audio streams are backward compatible with MPEG-1 streams. Therefore, the MPEG-1 header for each frame is the same as that for an MPEG-2 Audio stream.

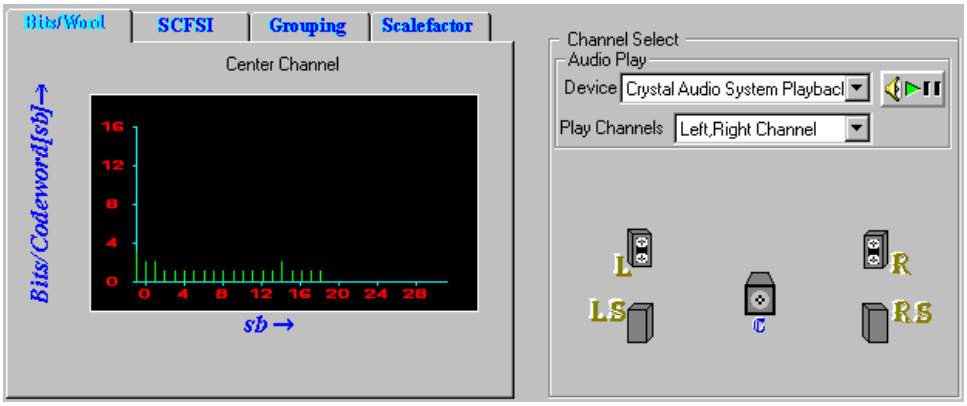
The MC Header tab displays information about the additional data present for the multi-channel extensions, over the two stereo channels. It gives you the number of channels that are present, the presence of the LFE channel, additional CRCs, and other relevant fields in the MC Header, as shown below.



The MC Composite Status tab provides the sub-band information of the channels; and their relationship with the transmission channels, as shown below.



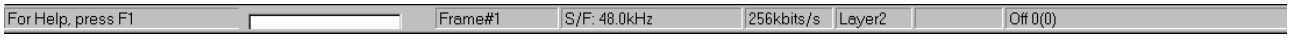
The lower part of the dialog box displays information specific to the channels. You can select the channel for which you want to see the details by clicking the appropriate graphic at right. The channel-specific data for the selected channel is displayed at left as for MPEG-1.



Explaining the Status Bar Display

The status bar, for Audio streams, displays the following:

- Frame number, which is the number of the current frame in the stream.
- Layer number, which is the number of the audio stream.
- Byte offset in the file, which is the first byte of the Frame header being currently viewed in both the hexadecimal and decimal formats.



Understanding Dolby Digital (AC-3) Audio Streams

ES Analyzer also analyzes Dolby Digital's audio streams, which could be an independent, stand-alone audio stream, or a multiplexed stream that is embedded inside an MPEG-2 System stream (ATSC transport or program stream). The Dolby Digital stream is analyzed by ES Analyzer for syntactic compliance with Dolby Digital specifications.

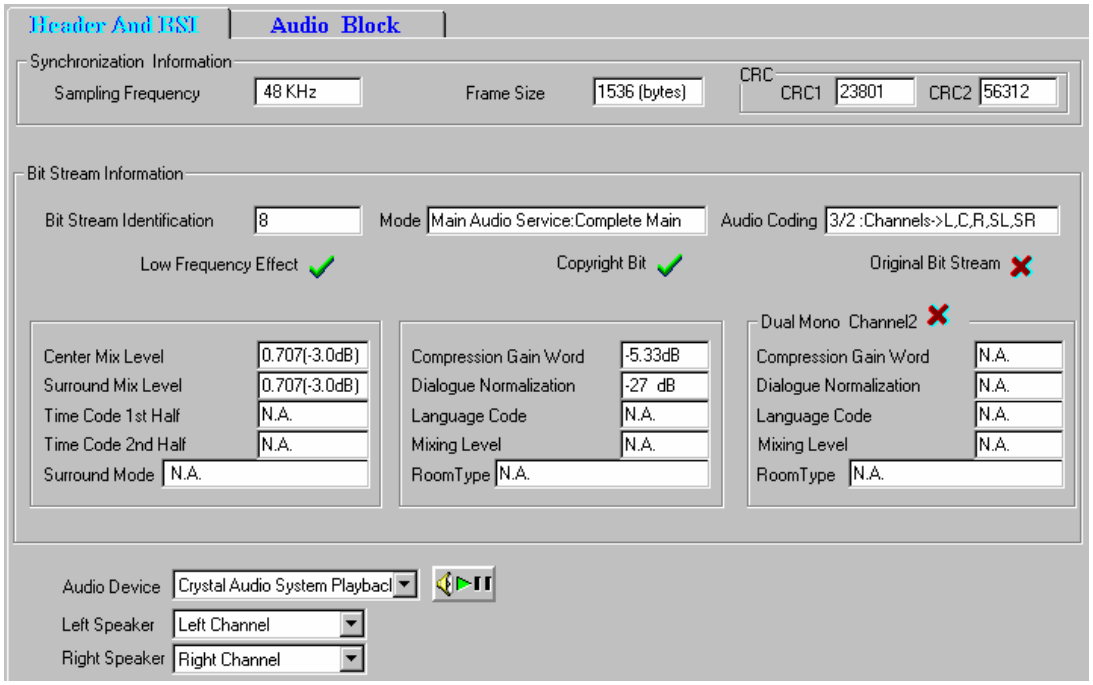
For a detailed discussion on the Dolby Digital audio syntax, refer to the document A/52 from Advance Television Systems Committee (ATSC).

ES Analyzer analyzes Dolby Digital stream frame by frame and also performs CRC checks for each audio frame. When analyzing a Dolby Digital stream, you may navigate to any frame and also view data specific to an audio block within it.

Automatically detecting the data format used in the Dolby Digital stream, ES Analyzer analyzes both the little endian and the big endian formats. For ease of debugging, ES Analyzer visually displays information for all the fields of any block for any audio frame.

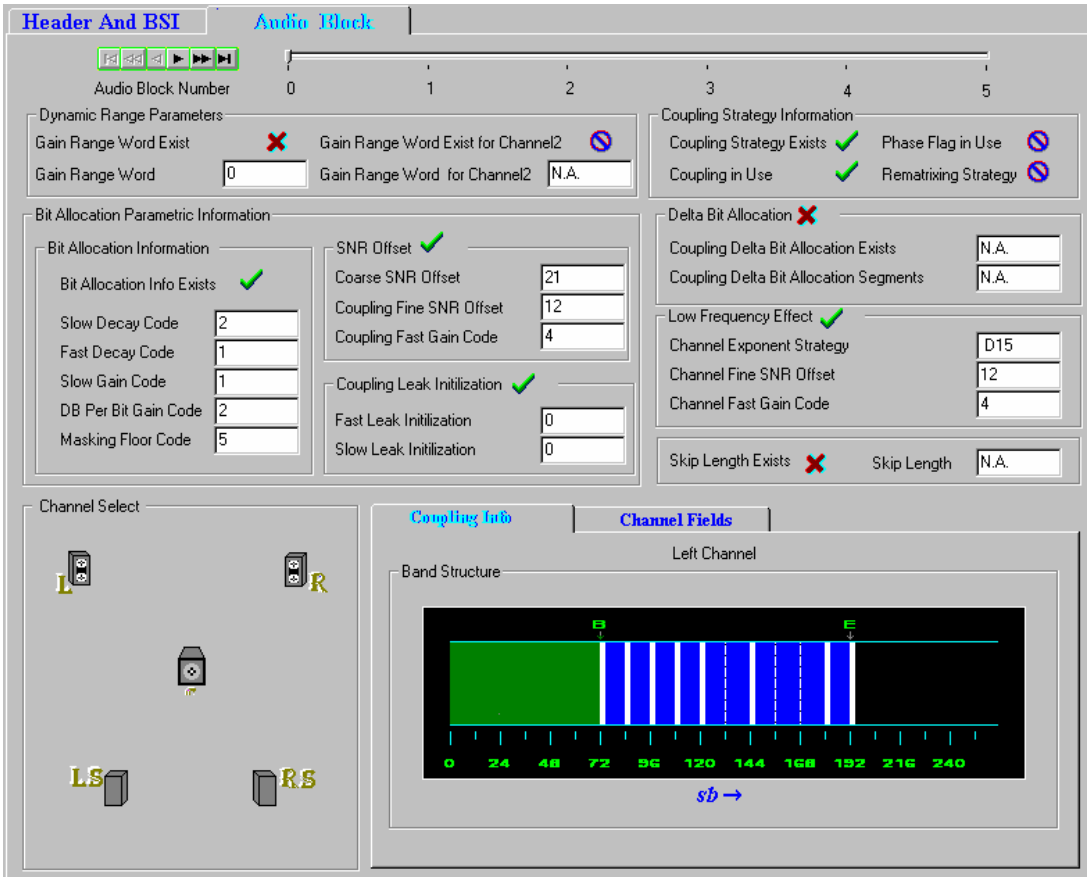
When errors are encountered in a stream, ES Analyzer reports the errors and synchronizes to the next audio frame to continue the analysis.

ES Analyzer displays the header and audio block information on specific tabs, as shown below. The Header And BSI tab displays the Dolby Digital synchronization and bit stream information.

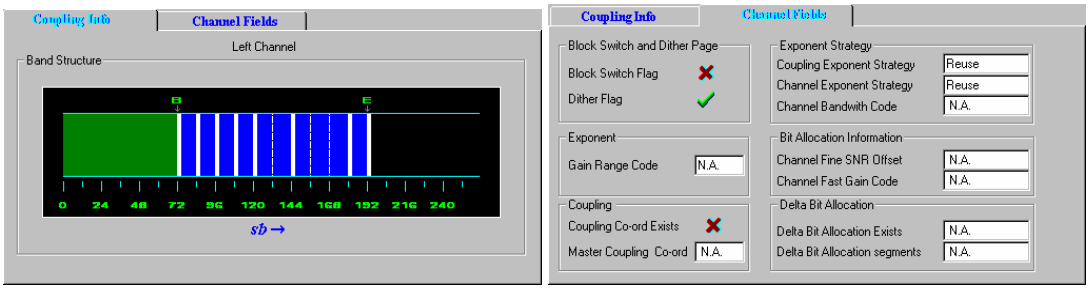


The audio controls are only available on the Header and BSI tab.

Depending on the selection, the Audio Block tab displays information for the corresponding audio block within the frame.



The lower part of the above illustration displays the channel-specific information for the selected audio block, as shown below.



The Coupling information tab distinguishes between the stand-alone and coupled data for the selected channel. The green band denotes the stand-alone information, while the blue region denotes the coupled information. The blue region may be further divided into bands; these appear as solid lines as opposed to the dotted lines that denote sub-bands.

Explaining the Status Bar Display

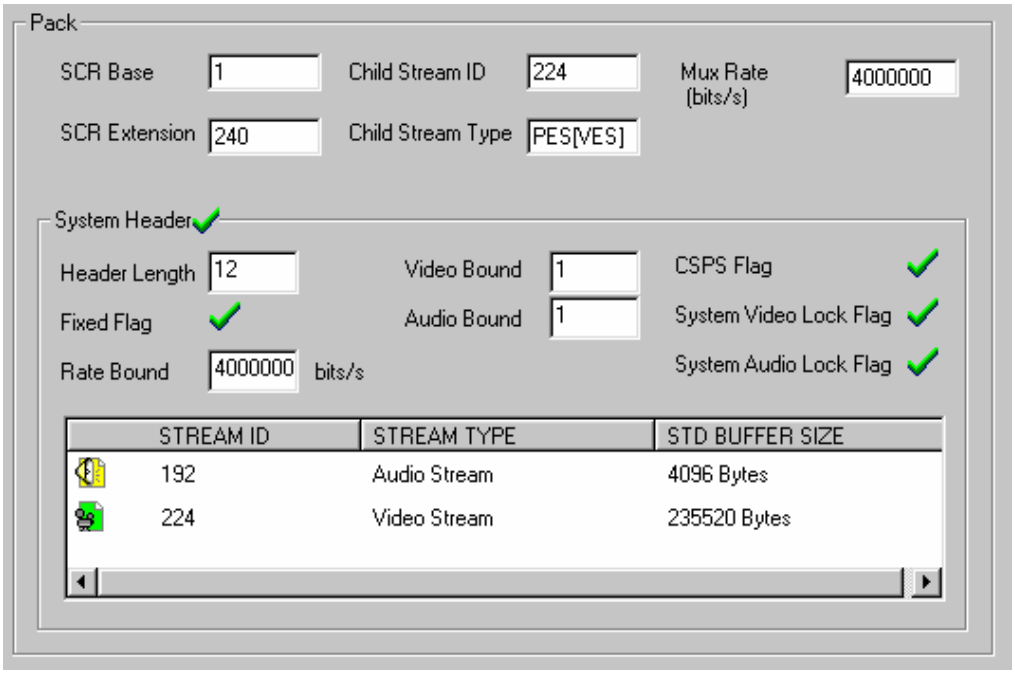
The status bar, for Dolby Digital Audio streams, displays the following:

- Frame number, which is the number of the current frame in the stream.
- Bitrate of the Dolby Digital audio stream.
- Sampling rate.
- Frame size information.
- Byte offset in the file, which is the first byte of the Frame header being currently viewed in both the hexadecimal and decimal formats.

Working with Program Streams

Program streams are quite similar to MPEG1 System streams in structure. A Program stream consists of a sequence of packs. Each pack has a header, an optional system header and any number of packets. If a system header is not received in a pack, then the last received header is applicable for the pack. The system header is sent periodically in the stream to facilitate random access. Each pack contains any number of packets. Each packet belongs to a particular stream and has a PID associated with it. If packets of a given PID are concatenated, you get the embedded PES stream with this PID. The PES stream in turn has an elementary stream embedded in it.

For more details on Program streams, refer to the ISO/IEC 13818-1 document.



ES Analyzer performs conformance and semantic checks at the program stream packet level as per the ISO/IEC 13818-1 recommendations. An embedded stream is checked when you navigate through one; for details, see the *Navigating through Streams* section in the *Getting Started* chapter.

For Program streams, you can:

- View pack and system headers, as shown above.
- View the program stream map; see the *Viewing Program Map* section for details.
- View an embedded stream at the PES or the elementary stream level; see the *Understanding Packetized Elementary Streams* section for details.
- Perform buffer analysis of the embedded audio/video stream using the STD model; see the *Analyzing Streams* chapter for details.
- Perform PCR/PTS frequency analysis model; see the *Analyzing Streams* chapter for details.

Viewing Pack and System Headers

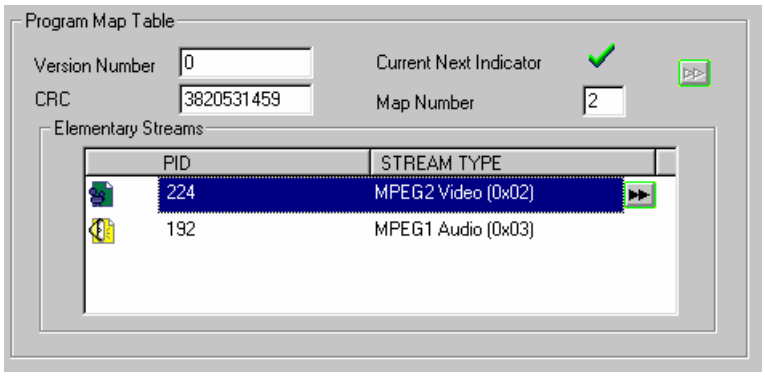
When navigating through a stream, the current pack is displayed in the header display area, as shown in the above illustration. The pack and system header fields are displayed for the current packet of the Program stream. The currently applicable system header is displayed for the packet. The receipt of a system header in the current pack is indicated by a check mark (✔) in the system header group box. A cross mark (✘) indicates that the system header was received earlier.

The list of streams declared in the header is displayed in the elementary stream list box. It is possible that the stream may contain some PES streams that are not declared in the System Header. Such streams are added in the tree view when a packet of the same is encountered.

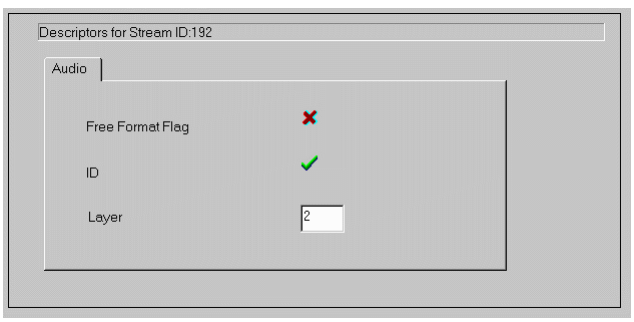
Viewing the Program Stream Map

The program stream map can be viewed by clicking the stream map icon (PSMAP) in the tree view window. This pops up the stream map showing the descriptors for the Program stream and the contained elementary streams. The descriptors associated with each elementary stream in a program can be viewed in one of two ways:

- By double clicking the corresponding icon for the stream in the display; or
- By clicking the more details icon shown for the corresponding stream in the elementary stream listbox.



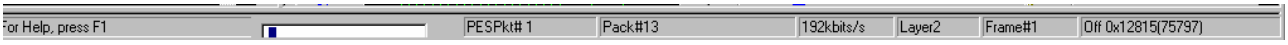
The form is extended (if not already extended) to add the descriptors display, as shown below. All descriptors that are received for the corresponding stream are displayed on tabbed folders. If a descriptor is not received, its tab will not appear in the descriptor display. The illustrations below, on left and right, show descriptors for the respective video and audio tabs.



Explaining the Status Bar Display

The status bar, for Program streams, displays the following:

- Pack number, which is the number of the current packet being displayed.
- Packet number, which is the number of the current packet in the entire stream.
- Packet number of SID, which is the number of the current packet taking into account only packets of the same stream ID (SID).
- At GOP level, the location of GOP header/start at PES level and Pack level is displayed by PES packet number & Pack number respectively.
- At AES & AC3 level, the location of frame header/start at PES level and Pack level is displayed by PES packet number & Pack number respectively.
- Byte offset in the file, which is the first byte of the Pack header being currently viewed in both the hexadecimal and decimal formats.

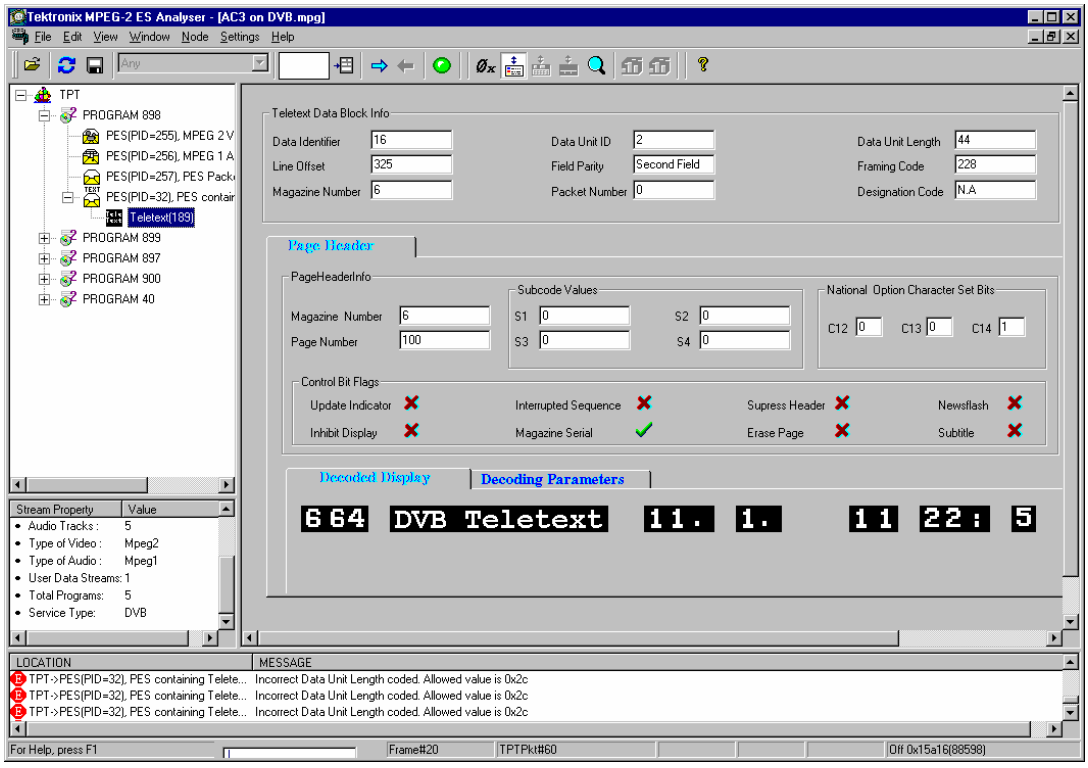


Working with Teletext

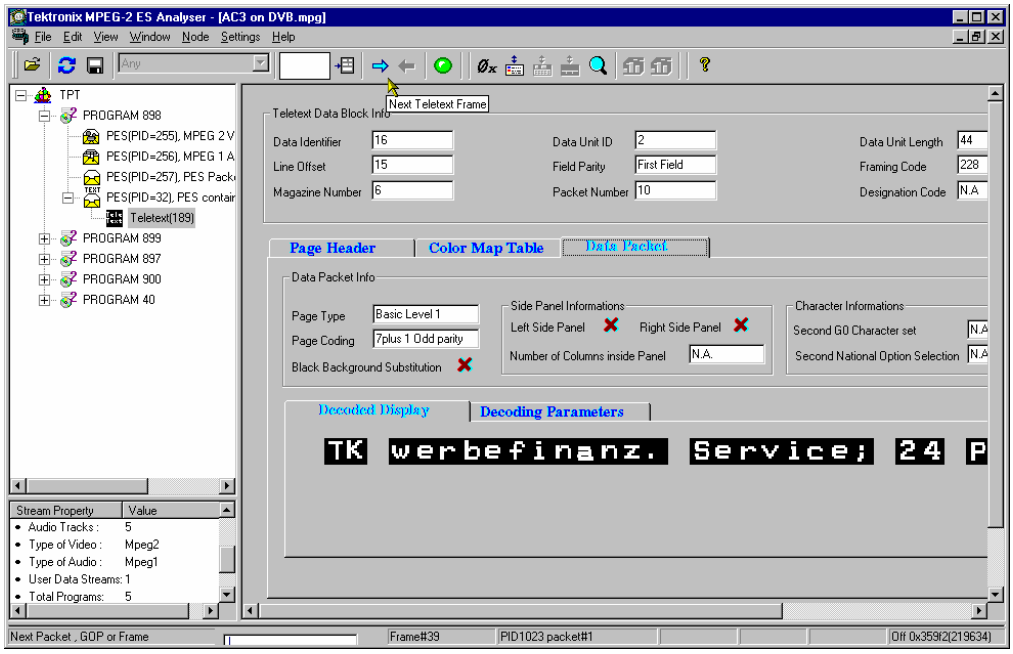
Teletext can be incorporated into DVB streams. ES Analyzer allows the associated data to be analyzed and viewed.

To view the teletext data, navigate to the teletext icon in the Tree View window.

Initially, the Page Header data will be displayed:



Using the Next button, details of the page can be viewed in the Data Packet tab:



Other tab pages are available (Colour Map Table, Decoded Display, Decoding Parameters) which each provide detailed teletext encoding data. These tabs will only appear as progress with the Next button is made through the stream and the analyzer detects them.

VBI (Enhanced Teletext Support)

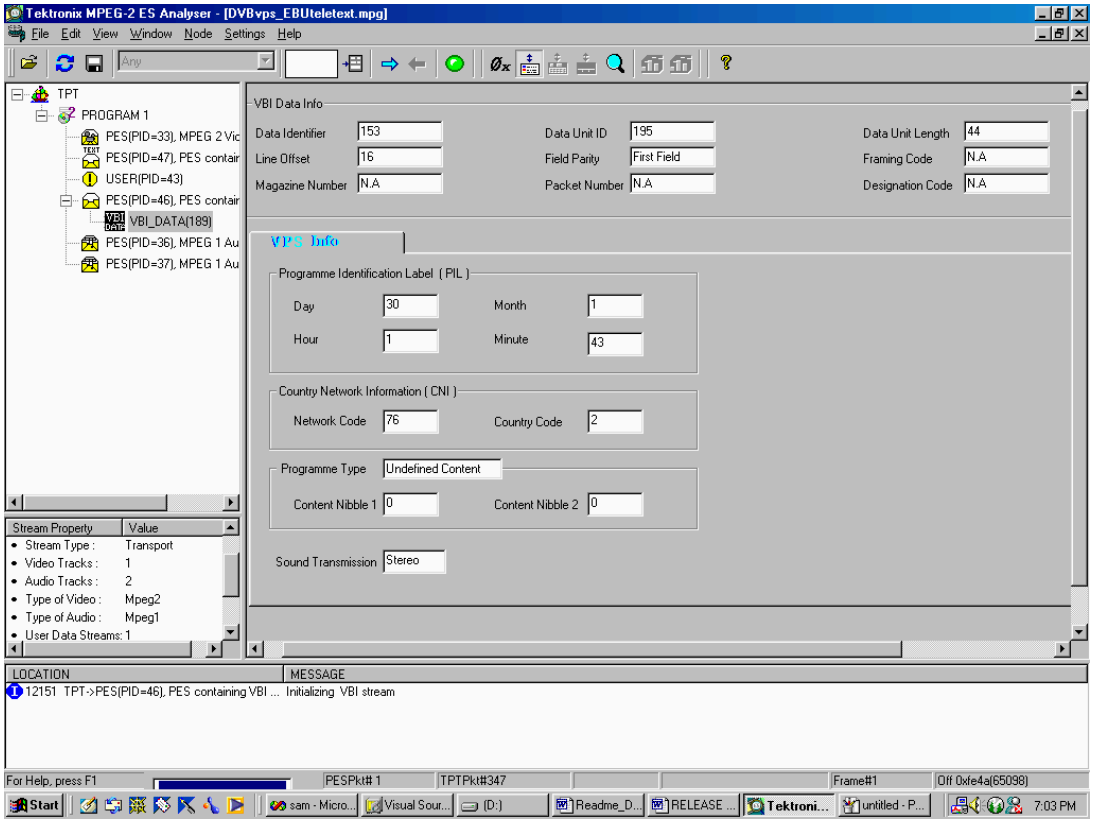
Enhanced teletext support is available (reference: ETSI EN 301-775). The supported extensions include the following:

- VPS (Video Program System)
- WSS (Wide Screen Signalling)
- Monochrome Data

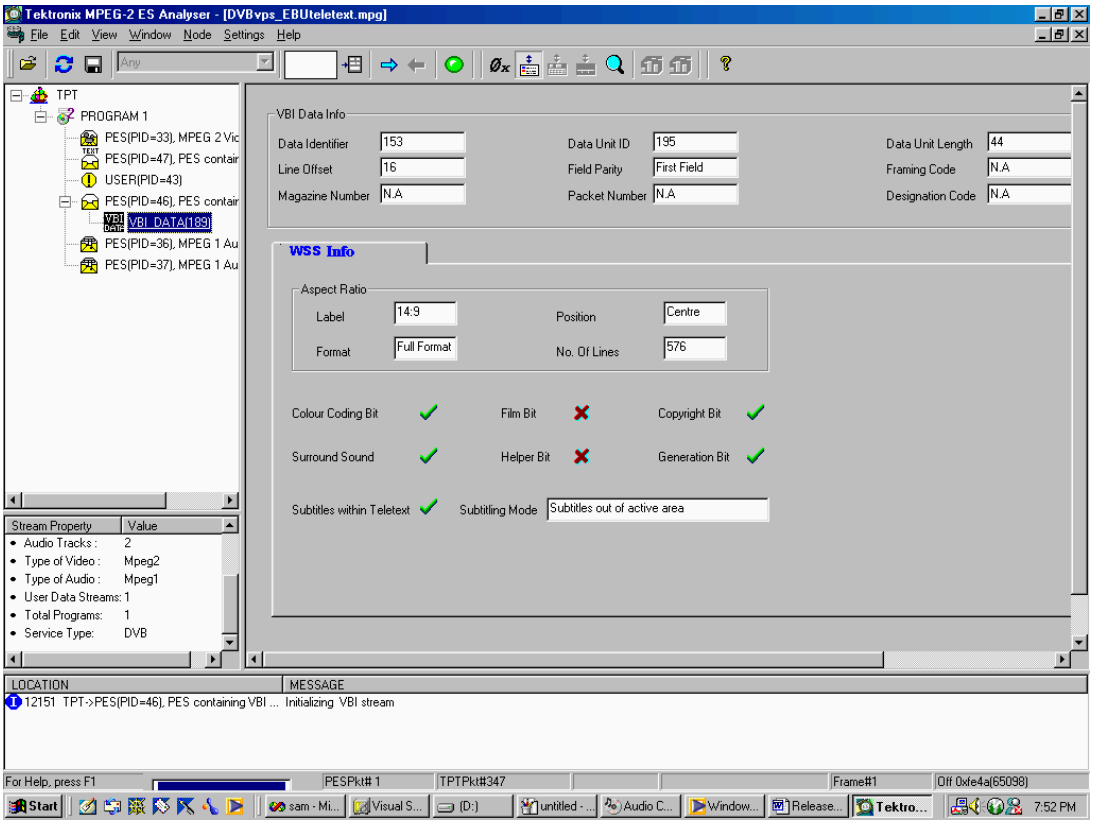
Note that the associated information screens will only be available for display where data of the specific type is available in the stream.

Examples of the screens are shown in the following paragraphs.

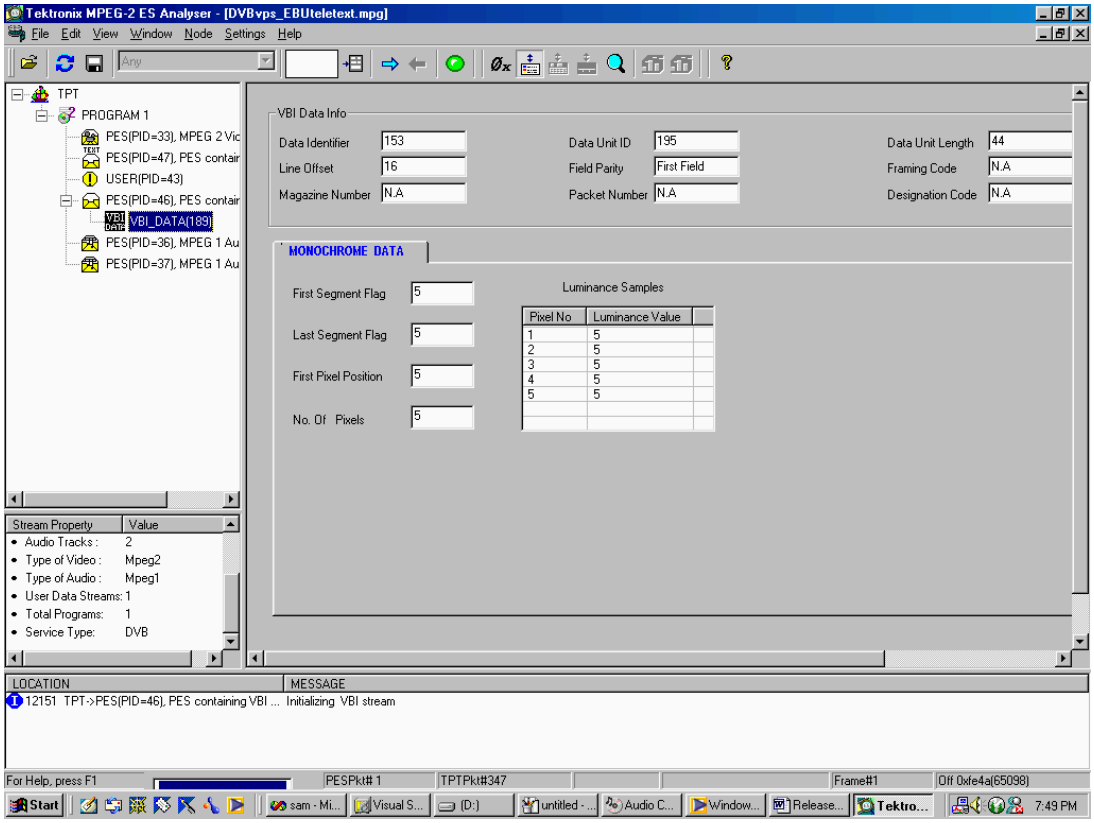
VPS (Video Program System)



WSS (Wide Screen Signalling)



Monochrome Data



Appendix A - Advanced Audio Compression

Appendix A - Advanced Audio Compression..... 73
ADIF Stream Forms 75
ADTS Stream Forms 83

Elementary Stream Analyzer (ES Analyzer) performs off-line stored stream analysis for MPEG1 Audio, MPEG2 Audio and Dolby Digital Audio streams as well as MPEG1 and MPEG2 video streams. The streams could be embedded inside DVB, ATSC or MPEG1 System streams.

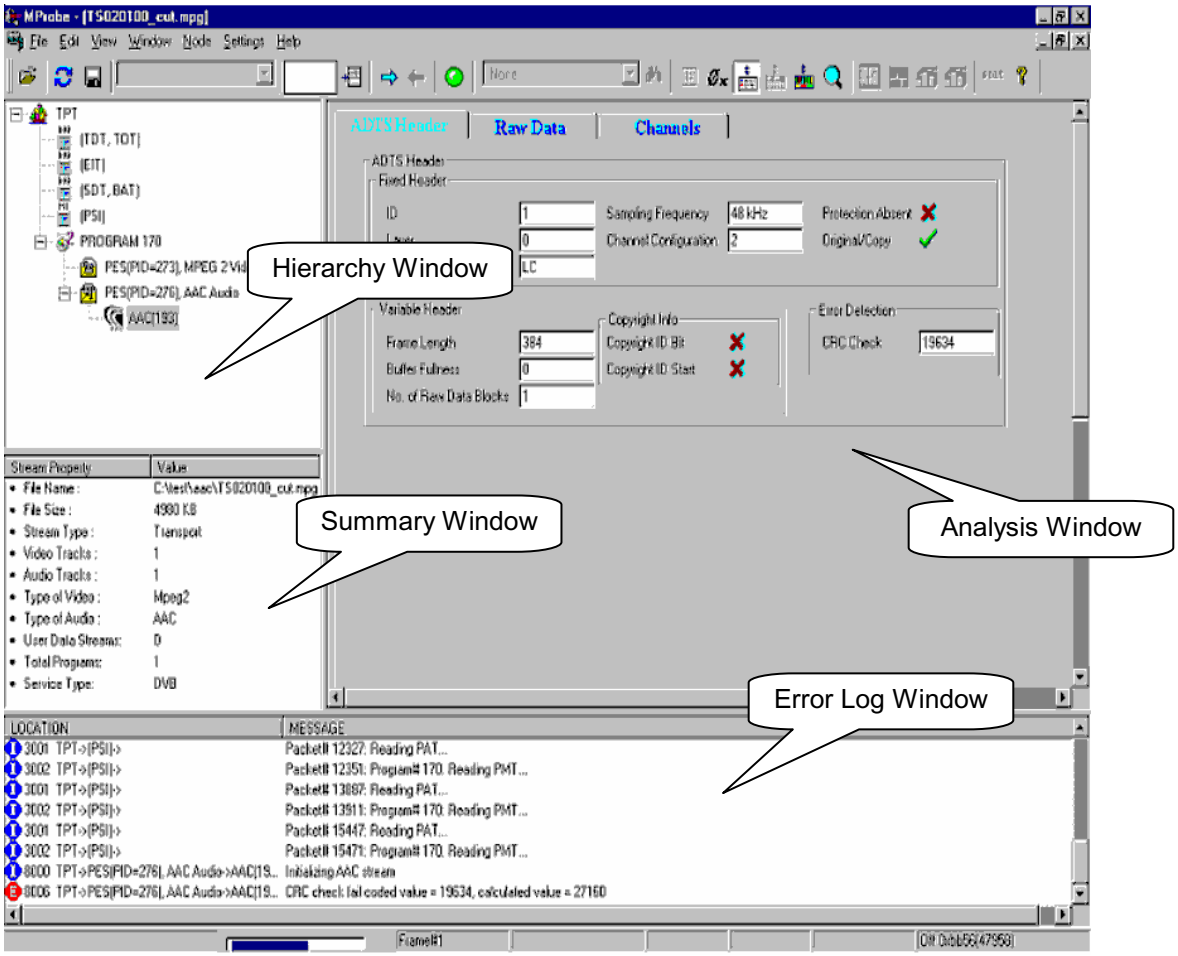
Advanced Audio Compression (AAC) is one of the audio compression formats defined by the MPEG-2 standard. AAC used to be called NBC (Non-Backward-Compatible), because it is not compatible with the MPEG-1 audio formats. AAC offers a better compression ratio than MP3 (MPEG-1 Layer 3) and is the state of the art in audio compression technology. It is able to include up to 48 audio channels, 15 low frequency enhancement channels, 15 embedded data streams and has multi-language capability. MPEG formal listening tests have demonstrated that it is able to provide slightly better audio quality at 96 kb/s than layer-3 at 128 kb/s or layer-2 at 192 kb/s.

Due to its high coding efficiency, AAC is a prime candidate for any digital broadcasting system. The Japanese authorities were the first to decide to use AAC within practically all-digital audio broadcasting schemes. As their first services will start in the year 2000, this decision already triggered the development of dedicated AAC decoder chips at a number of manufacturers. Due to its superior performance, AAC will also play a major role for the delivery of high-quality music via the Internet. Furthermore, AAC (with some modifications) is the only high-quality audio-coding scheme used within the MPEG-4 standard.

The AAC bitstream is encoded in either of two formats:

- Audio Data Interchange Format (ADIF)
- Audio Data Transport Stream Frame (ADTS)

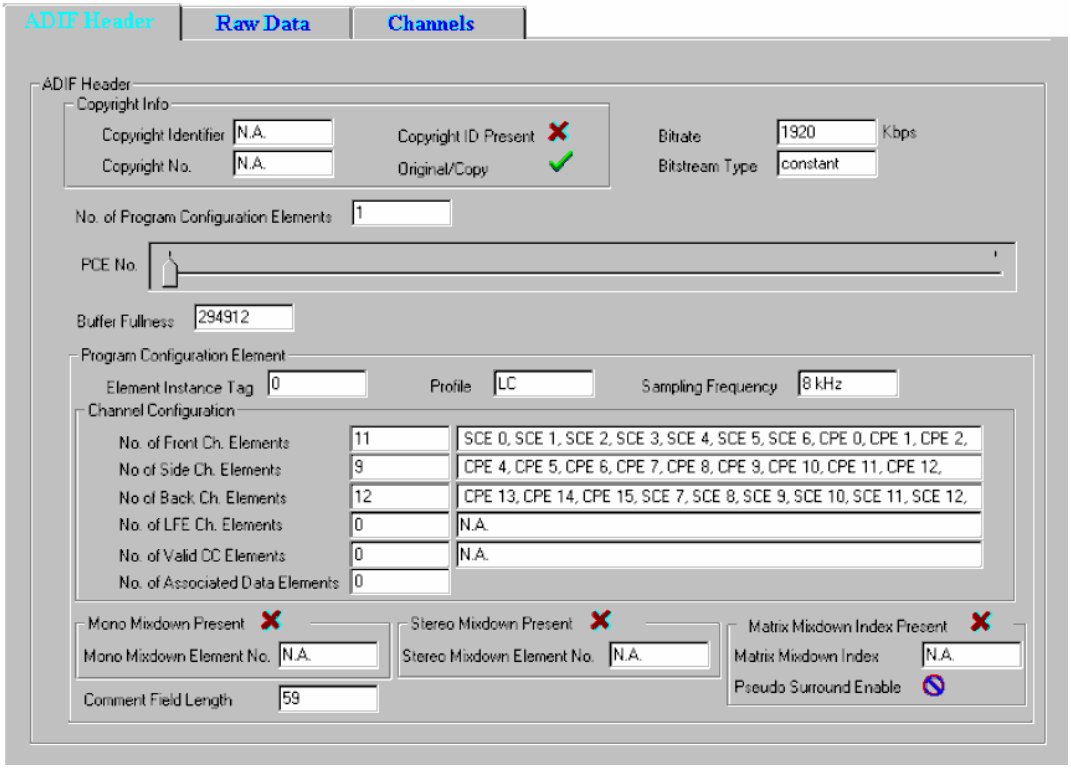
According to the format of the input bitstream the corresponding forms are displayed. These forms display the information contained in the fields of the Header and the Raw Data.


Hierarchy Window
Summary Window
Analysis Window
Error Log Window

ADIF Stream Forms

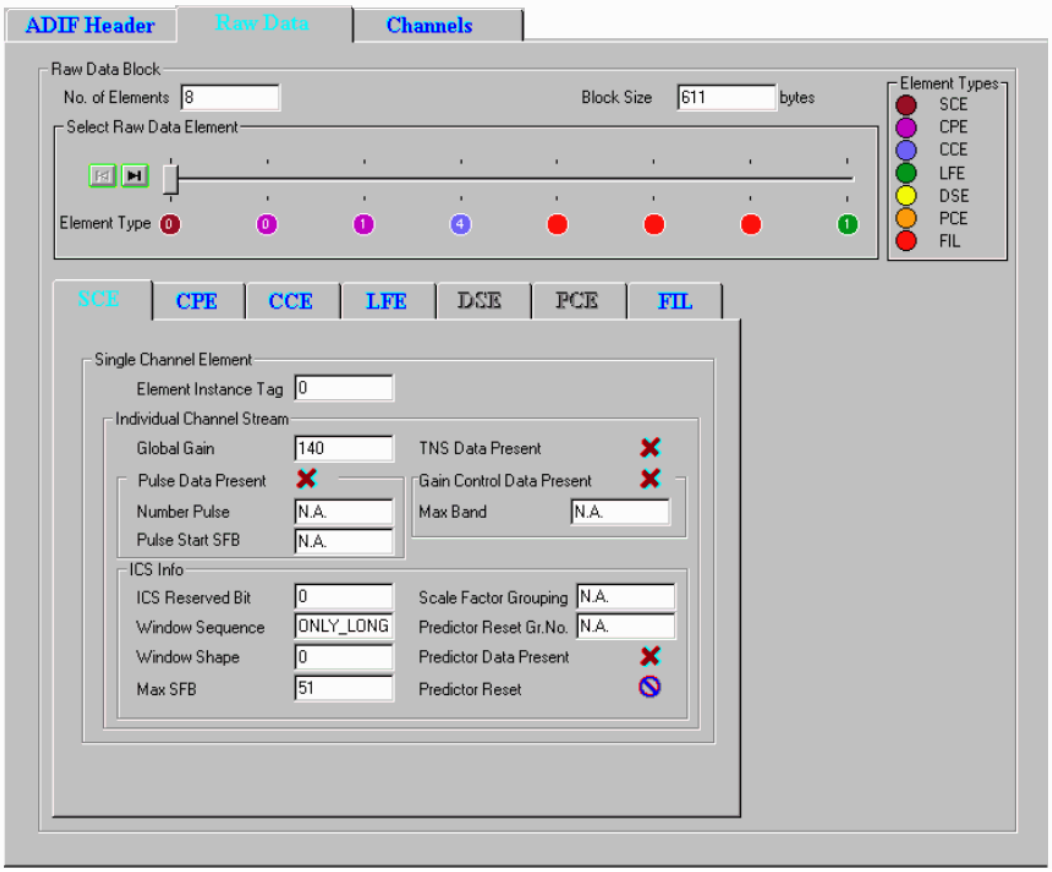
The analyzed information regarding the input ADIF stream is displayed by means of a property sheet containing three tabs.

The ‘ADIF Header’ tab (Frame 1) displays the fields of the header.



Frame 1: ADIF Header Information

The ‘Raw Data’ tab (Frame 2) displays the fields in each raw data block. A slider control helps to navigate through the various raw data blocks. The information regarding each raw data block is displayed by means of another child property sheet containing seven tabs (the fields in each tab are show in Frame 2.1 to Frame 2.7).



Frame 2: ADIF Raw Data Information

Element Color Coding in the Raw Data Tab

The **Element Type** (below the slider bar) is color-coded; the key is given on the right-hand side of the display in the **Element Types** box. The number displayed in the **Element Type** color spot indicates the EIT (element instance tag) of that syntactic element.

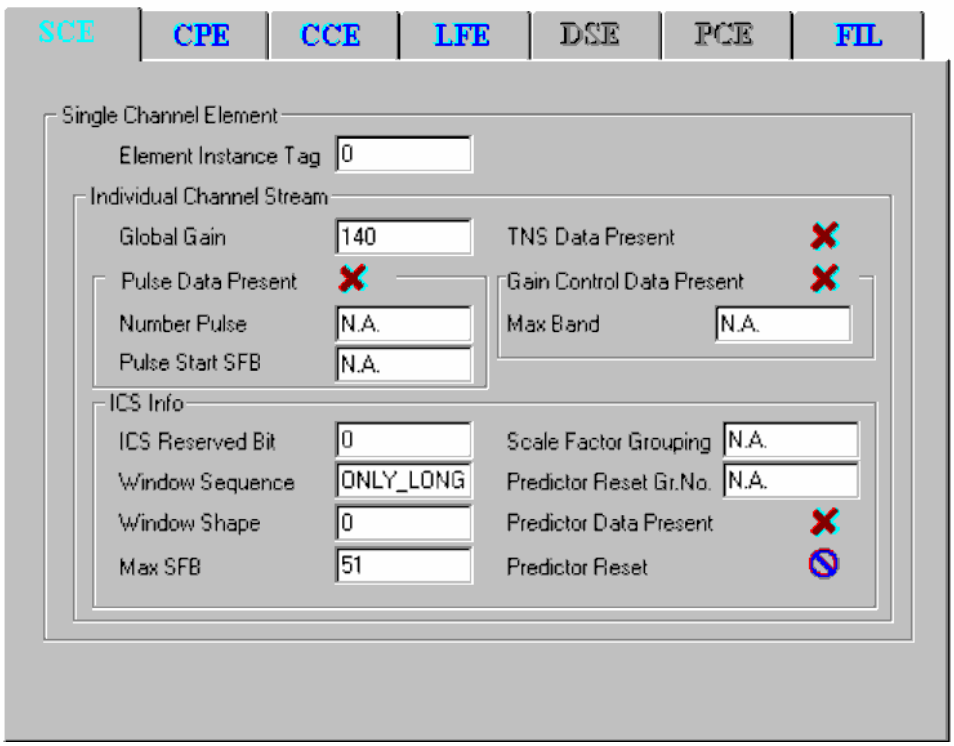
Color Coding of Raw Data Tabs

The text in the Raw Data tabs is color-coded as follows:

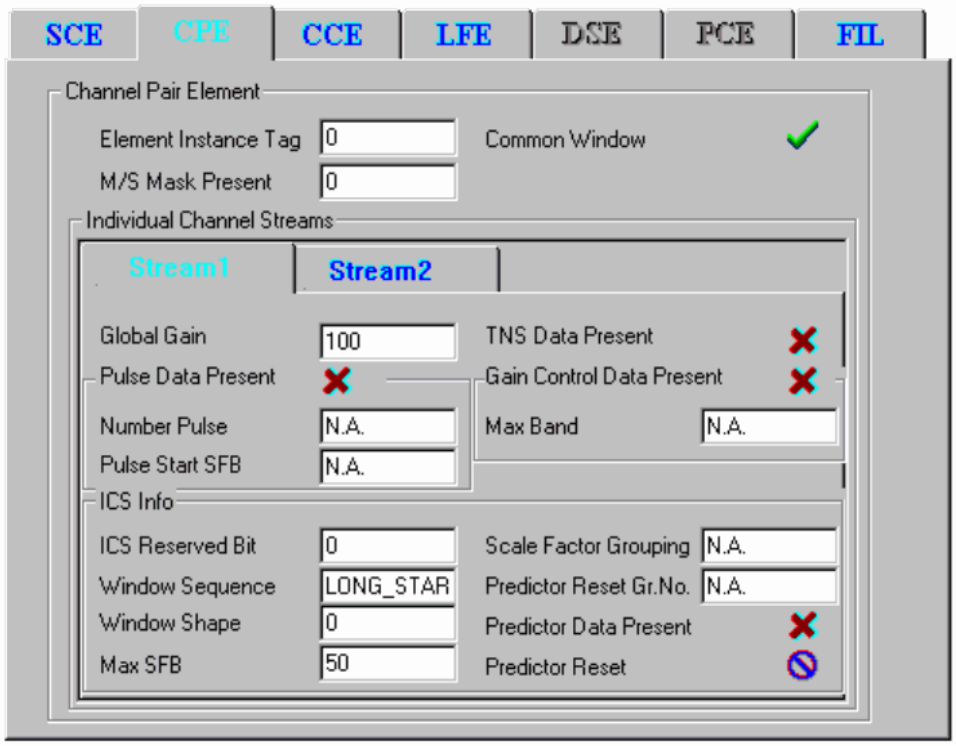
Light Blue — indicates the syntactic element is present and activated in the raw data.

Dark Blue — indicates that the syntactic element is present, but currently inactive in the raw data.

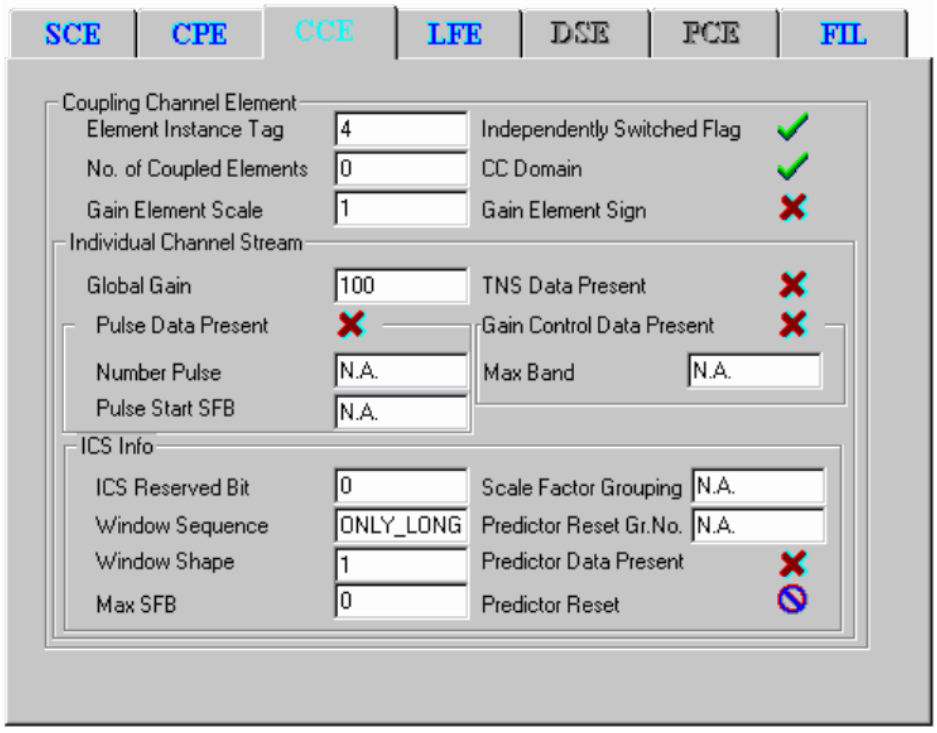
Dark Grey — indicates that the syntactic element is not present in the raw data.



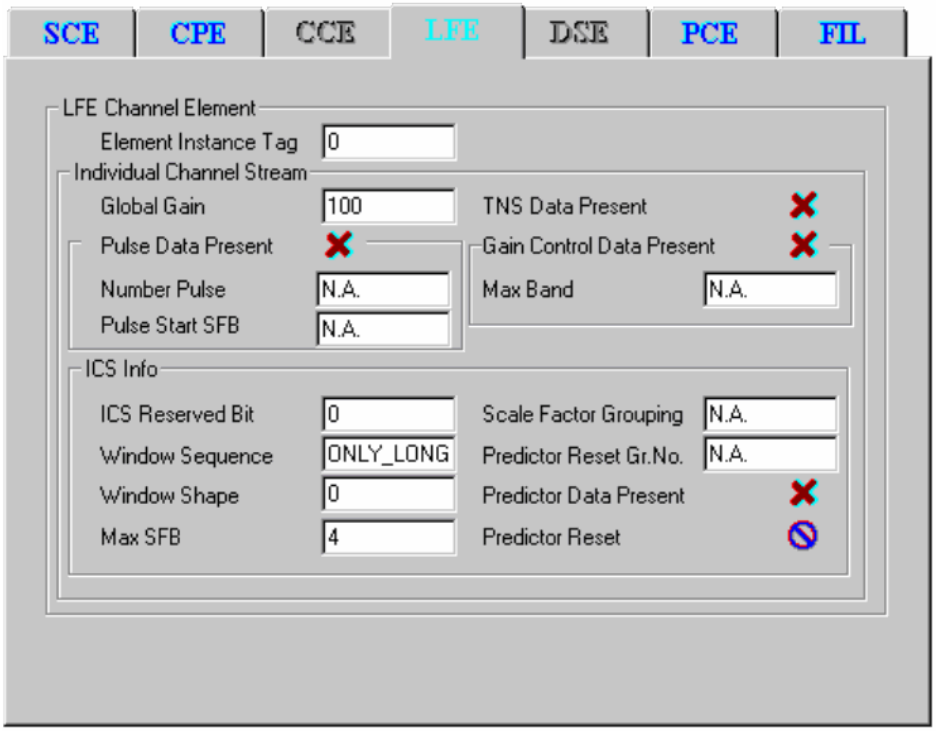
Frame 2.1: Single Channel Element Information



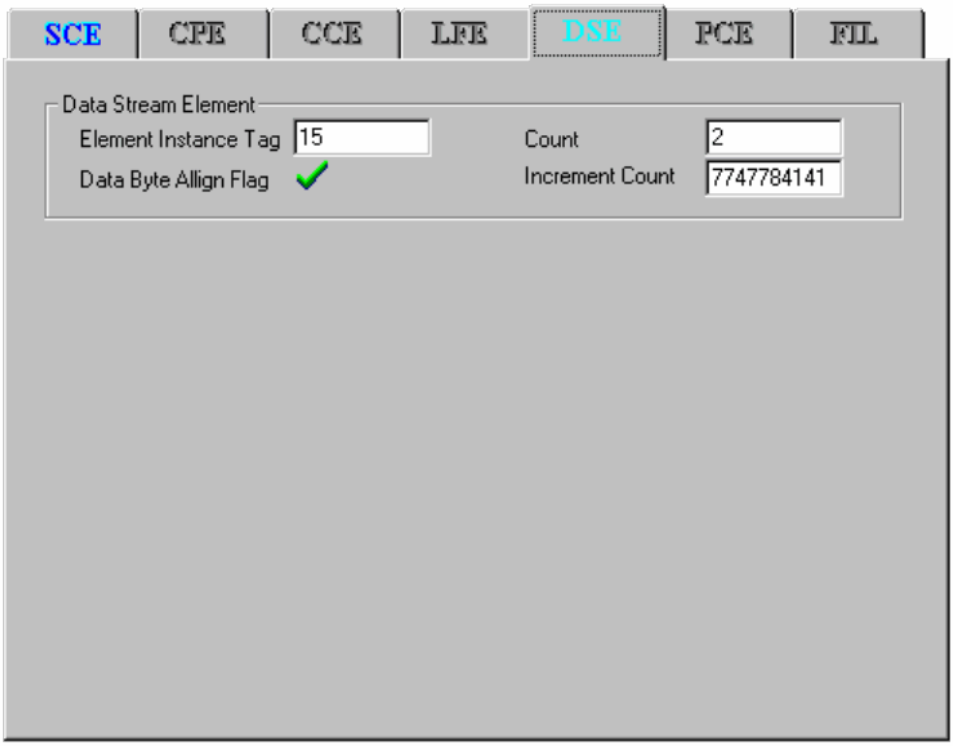
Frame 2.2: Coupling Pair Element Information



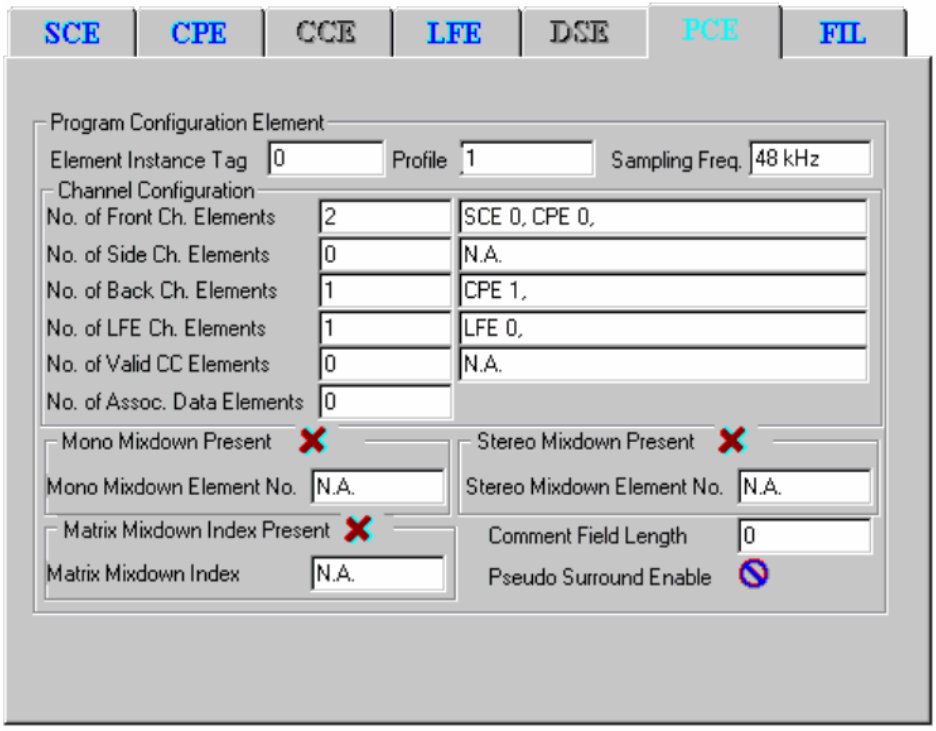
Frame 2.3: Coupling Channel Element Information



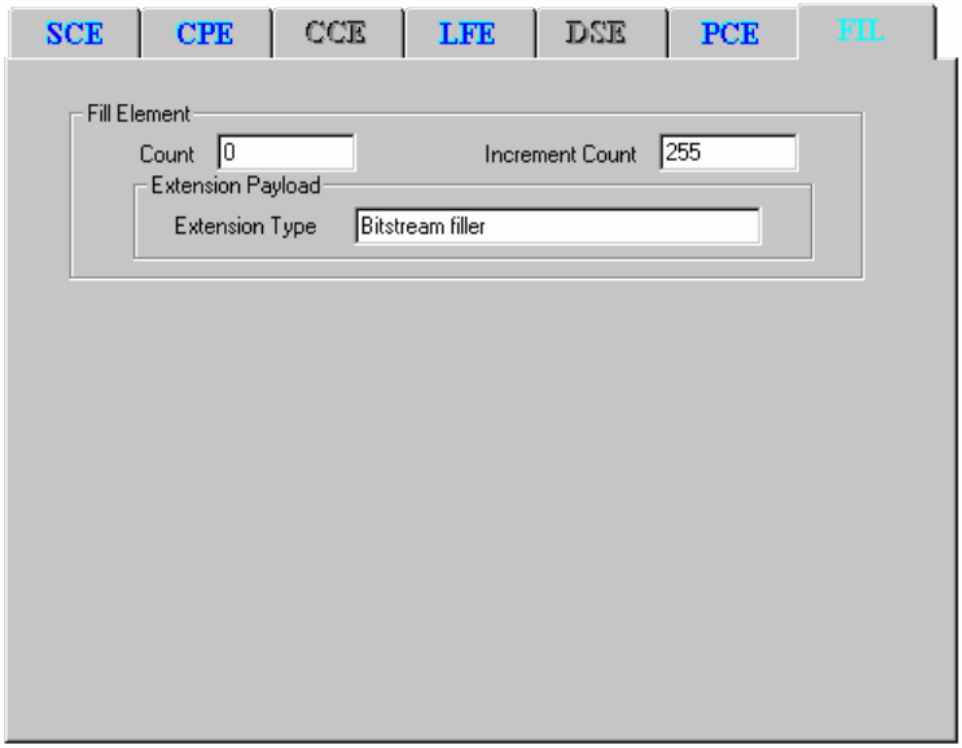
Frame 2.4: Low Frequency Element Channel Information



Frame 2.5: Data Stream Element Information

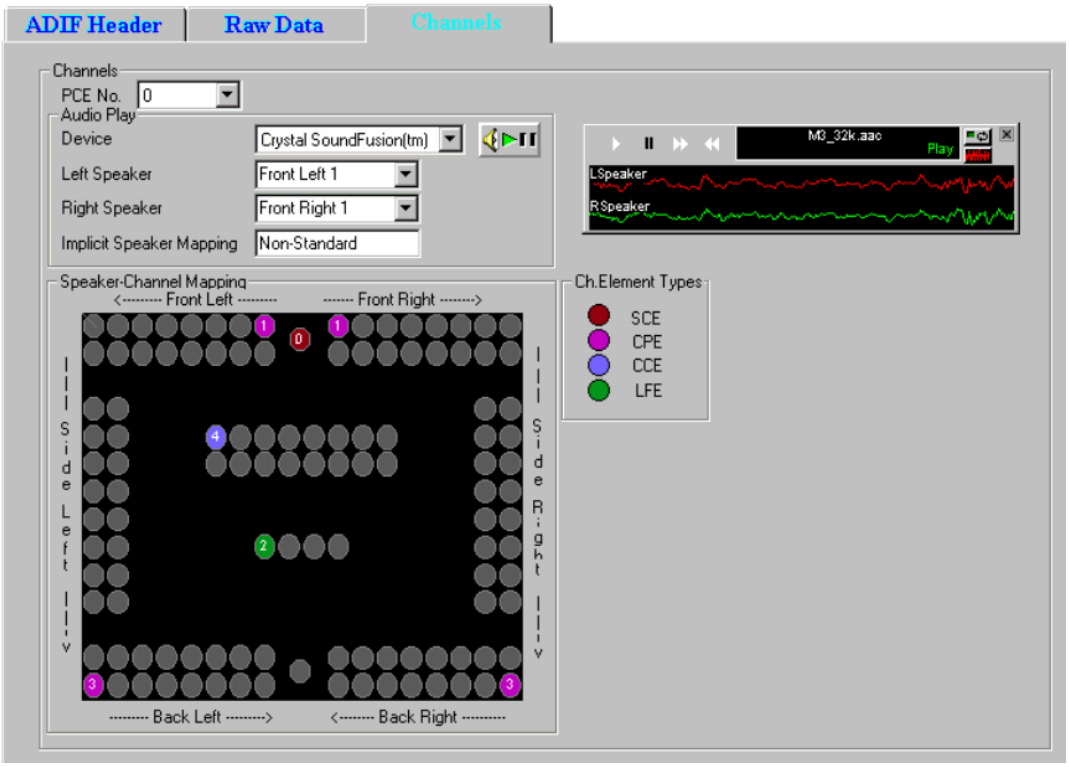


Frame 2.6: Program Configuration Element Information



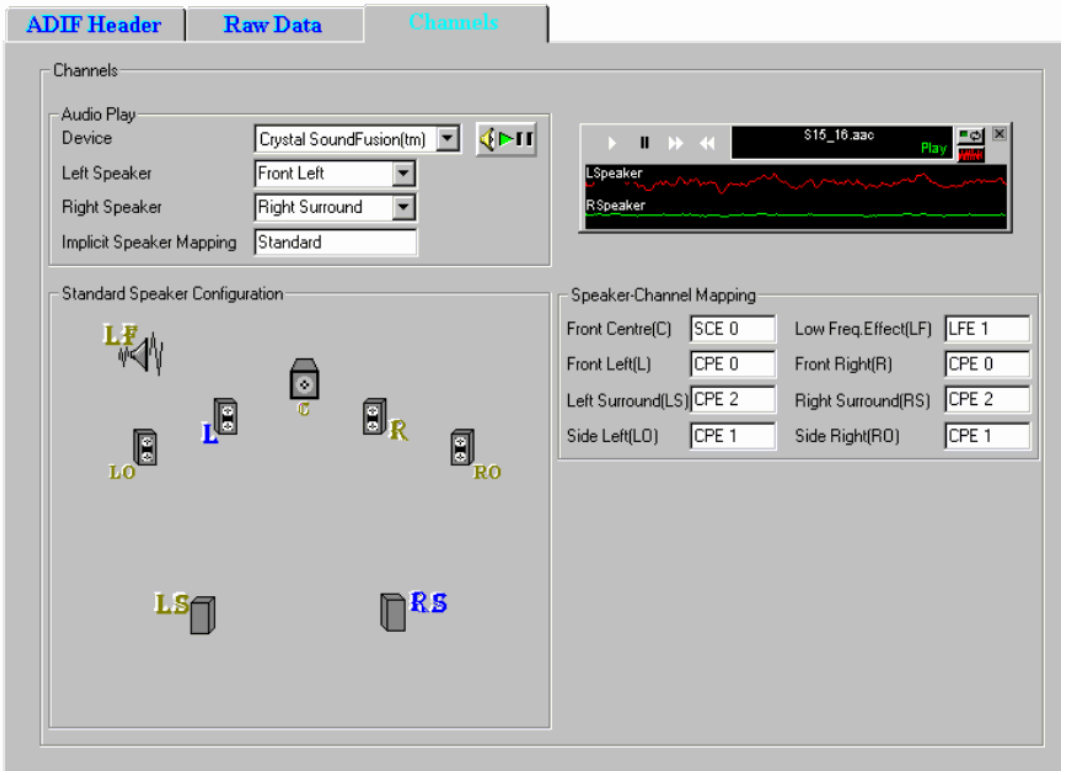
Frame 2.7: Fill Element Information

The ‘Channels’ tab (Frame 3) displays the configuration of the coded channels. The physical location of the speakers corresponding to the channels coded in the stream for standard and non-standard configurations can be displayed.



Frame 3.1: ADIF Channels (Non-Standard) Information

The syntactic element type corresponding to each speaker in the **Speaker-Channel Mapping** is denoted by a color-code scheme, the legend for which is given in the **Ch.Element Types** box. The number appearing in the color spots denotes the EIT (element instance tag) of that syntactic element.

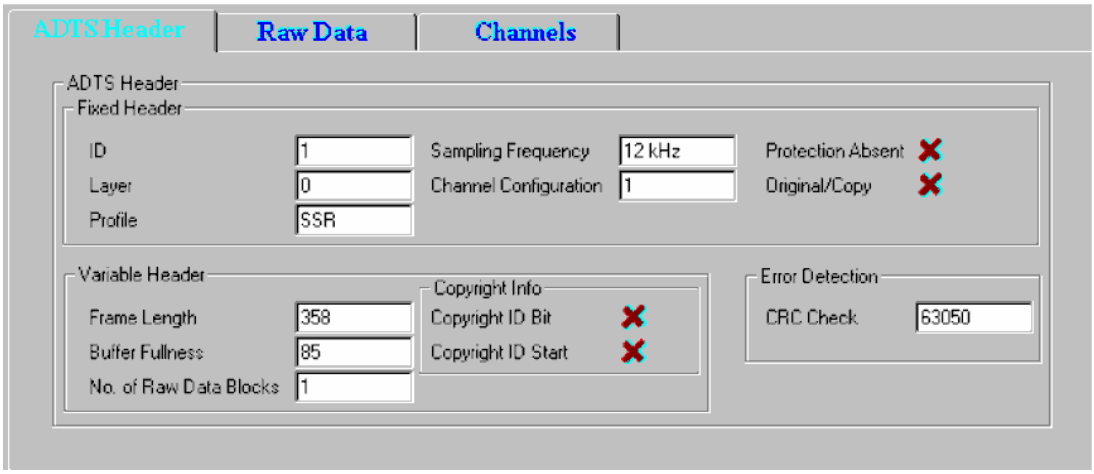


Frame 3.1: ADIF Channels (Standard) Information

ADTS Stream Forms

The analyzed information regarding the input ADTS stream is displayed by means of a property sheet containing three tabs.

The ‘ADTS Header’ tab (Frame 4) displays the fields of the header, while the ‘Raw Data’ tab (Frame 2) displays the fields in each raw data block and the ‘Channels’ tab (Frame 3) displays the configuration of the coded channels. The contents of the ‘Raw Data’ and ‘Channels’ tabs are identical to that in case of ADIF stream.



Frame 4: ADTS Header Information

Appendix B - Closed Caption Analysis

Appendix B - Closed Caption Analysis 85
Enabling Closed Caption Analysis 86
Selecting Closed Caption Analysis Standard . 87
CC–EIA608 Support 87
CC-EIA708 Support 88
Dumping Closed Caption Statistics 91

Closed captions are captions that are hidden in the video signal, invisible without a special decoder. The place they are hidden is called line 21 of the vertical blanking interval (VBI).

ES Analyzer allows closed caption data to be analyzed and inspected.

The two options are

1. CCA Standalone (Player + CC-EIA608 + CC-EI708 analysis)
2. Full Elementary Stream Analyzer + CC-EIA608 + CC-EI708 analysis

No special installation process is required. The options are dongle protected/enabled.

The full option is described below. The Stand-Alone option has full Closed Caption functionality, but other ES Analyzer functions are disabled.

XDS analysis is currently disabled. Extended Data Services is a supplementary data stream existing in Line 21 Field 2. It is used to provide additional data (primarily content advisory information) on the program being aired (Reference: EIA-744).

Enabling Closed Caption Analysis

1) Open a stream containing Closed Captions.

2) Expand the navigation tree and open either a VES or a GOP node.

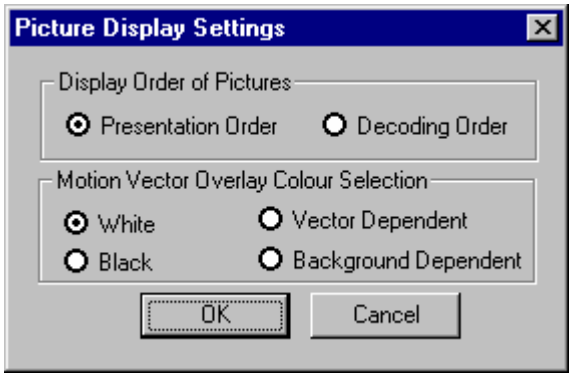
3) Enable Closed Caption Analysis in the **Settings** menu. A check mark (3) next to the option indicates that Closed Caption Analysis is enabled.

By default, Closed Caption Analysis is enabled. It is recommended that it be only enabled when required; disabling it will improve the speed of picture analysis processing.

However, disabling and enabling the Closed Caption Analysis feature should only be done when a stream is first opened, not during analysis. Opening the feature during analysis may result in improper analysis.

When Closed Caption Analysis is enabled, the **Closed Caption Display** tab will be visible in the **Slice and MB** GOP tab.

4) Ensure that the Picture Display Settings (**Settings → Picture Display…**) are as shown in the screenshot below:

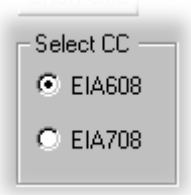


- **Display Order of Pictures → Presentation Order**
- **Motion Vector Overlay Colour Selection → White**

Selecting Closed Caption Analysis Standard

Two primary forms of Closed Caption Analysis are offered: CC-EIA608 and CC-EIA708. CC-EIA746 support is also supported in the EIA608 mode.

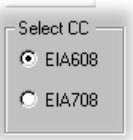
The selection of CC-EIA608 or CC-EIA708 is made from the **Closed Caption Display** tab available in the **Slice and MB** GOP tab.



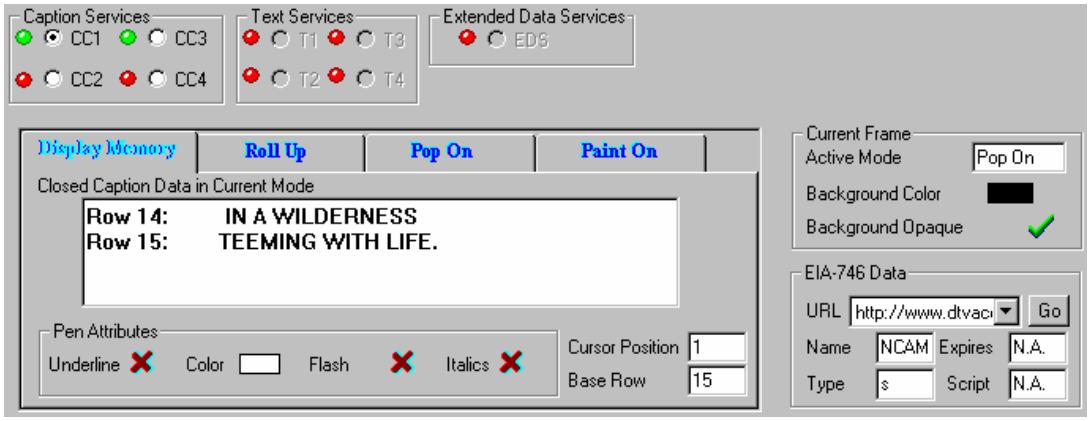
Note that whichever standard is selected, no closed caption content will be displayed until the file has been at least partially analyzed. To start analyzing the stream, select the **GOP And Picture** tab and press the **Go** button

A sign that closed caption content has been detected during analysis is that the Video icon in the navigation tree changes to include a **CC** symbol:

CC–EIA608 Support



The following dialog box is displayed below the picture display (in the Closed Caption Display tab) when CC-EIA608 Closed Caption Analysis is enabled:



At the top of the display, the LED icons indicate that closed caption data has been received in the Field and Services sections; green indicates that data has been received.

Where data has been received for the current GOP it should be displayed in the **Display Memory** tab and on the picture display:

The remaining tabs (**Roll Up**, **Pop On** and **Paint On**) display various parameters defining the manner in which the captions will be displayed.

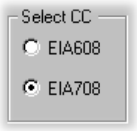
CC–EIA746 Support

Associated with CC-EIA608 is CC-EIA746 which supports the transmission of URLs (Uniform Resource Locators) within the closed caption data.

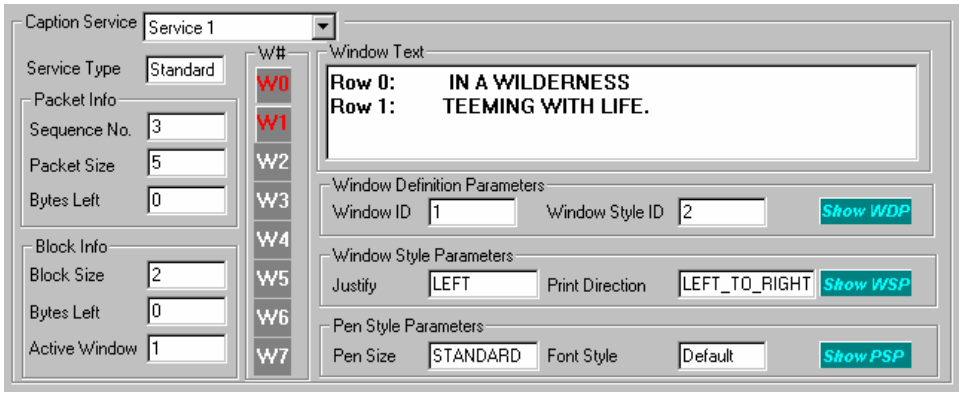
The URLs transmitted in the T2 closed caption service are parsed, decoded and displayed in the **EIA-746 Data** view.

- The attributes shown apply to the URL selected from the drop-down list.
- The selected URL is fetched and displayed on the default web browser installed on the system.

CC-EIA708 Support



The following dialog box is displayed below the picture display (in the Closed Caption Display tab) when CC-EIA708 Closed Caption Analysis is enabled:



Details of the fields in the Closed Caption Analysis window are as follows:

Caption Service

The service whose details are to be displayed can be selected from the drop-down list.

Packet Info

Sequence No. The sequence number of the packet from which the current service block has been extracted (e.g. Service 1, Service 2, etc).

Packet Size The packet size that has been coded in the packet header.

Bytes Left The number of bytes still to be received.

Block Info

Block size The size of the service block.

Bytes Left The number of bytes still to be received.

Active Window The Window ID which is currently the active window.

Window Identity

W# The buttons in red in the **W#** column indicated the defined windows in the received service.

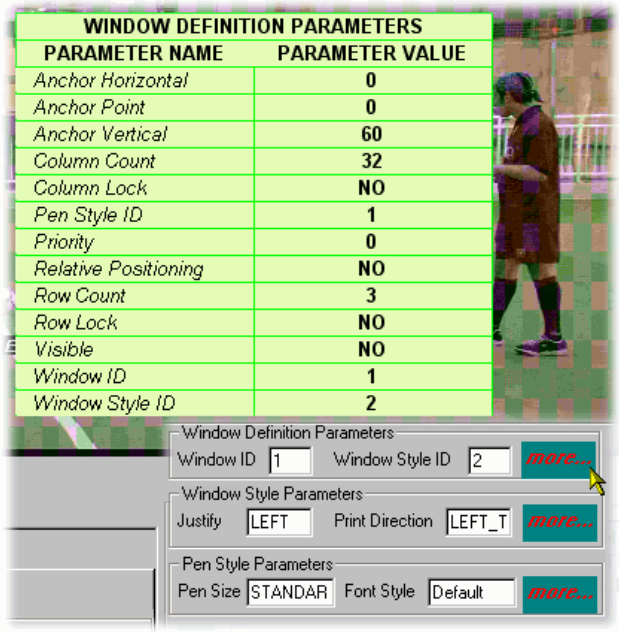
The parameters to the right of this column depend on the selection made here.

Window Text

The text shown in the current window.

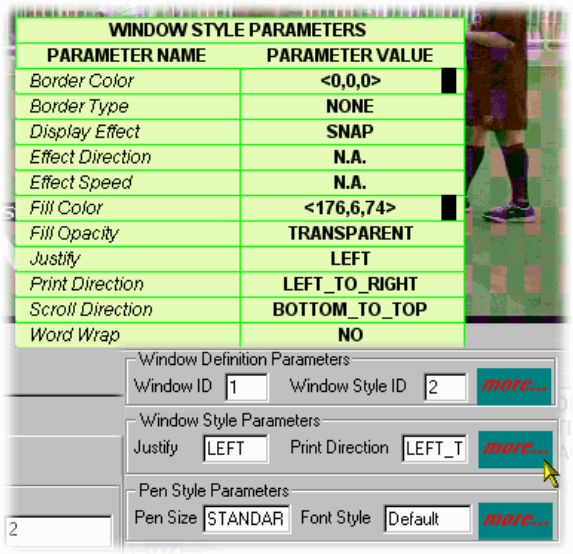
Window Definition Parameters

By placing the cursor over the **more…** field all the parameters related to the window definition can be viewed.



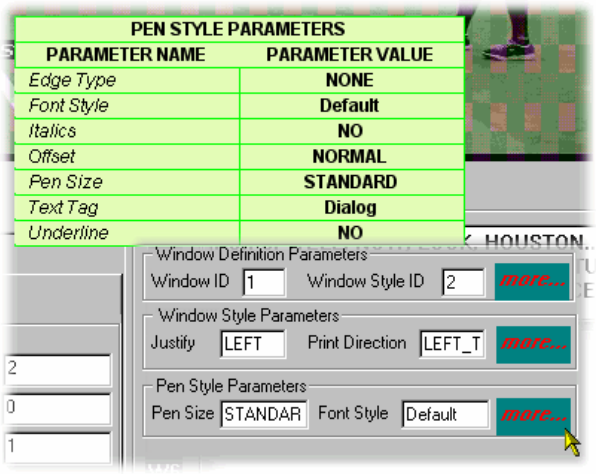
Window Style Parameters

By placing the cursor over the **more…** field all the parameters related to the window styles can be viewed.



Pen Style Parameter

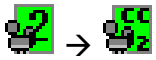
By placing the cursor over the **more…** field all the parameters related to the pen styles can be viewed.



Dumping Closed Caption Statistics

Closed Caption Analysis statistics can be written to file for each standard, EIA608 and EIA708.

Note that whichever standard is selected, no closed caption statistics can be dumped until the file has been at least partially analyzed. To start analyzing the stream, select the **GOP And Picture** tab and press the **Go** button 

A sign that closed caption content has been detected during analysis is that the Video icon in the navigation tree changes to include a **CC** symbol: 

The sequence of actions required for a dump of statistics to be successful is as follows:

a) The **Dump CC Statistics** option in the **Settings** menu will only become available when analysis (or partial analysis) has established that Closed Caption data is carried in the stream.

b) A standard must be selected from the **Dump CC Statistics** option sub-menu, e.g. EIA608.

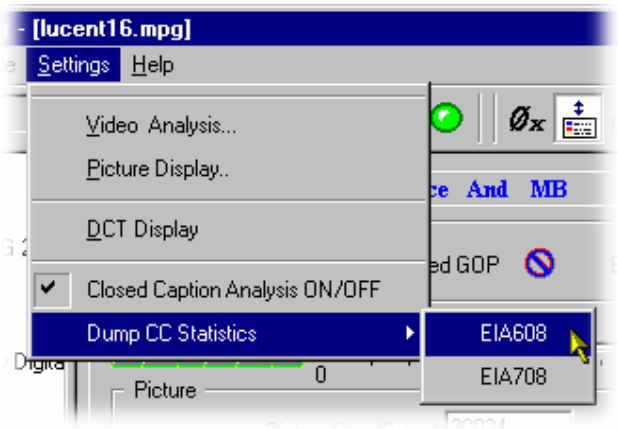
c) A destination file must be specified for the statistics dump.

d) Further analysis must be carried out to provide data for the statistics dump.

The following paragraphs describe the set-up required for each standard; however, the previous steps must be adhered to for the dump to be successful.

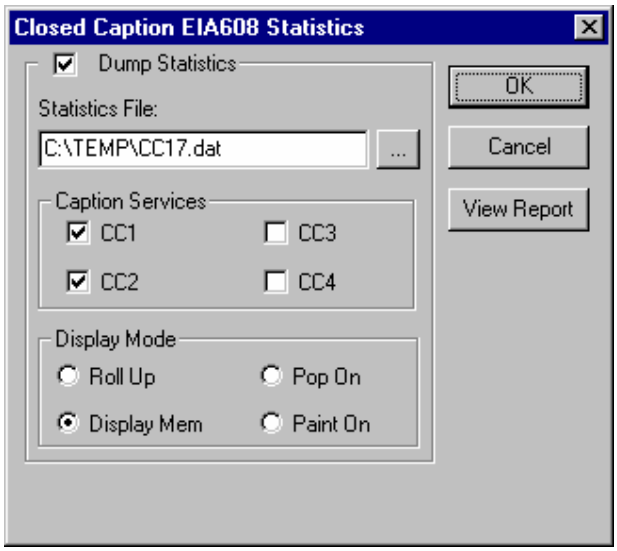
EIA608 Closed Caption Statistics Dump

1) Select the **EIA608** option from the **Dump CC Statistics** sub-menu.



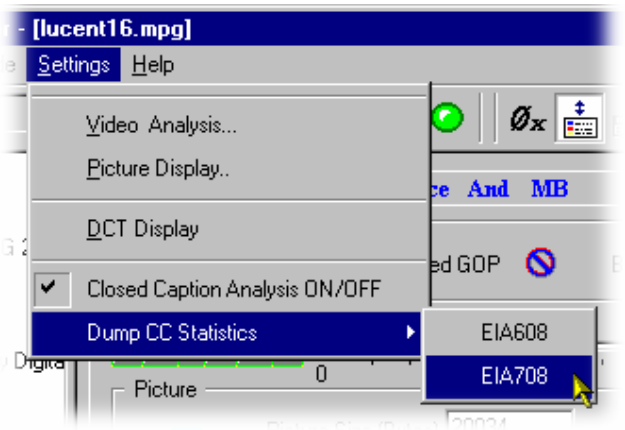
2) Enable **Dump Statistics**.
3) Identify a destination file in the **Statistics File:** field.
4) Enable the parameters to be dumped.
5) Select **OK**.

Existing reports (i.e. reports previously set up) can be viewed by selecting **View Report**.



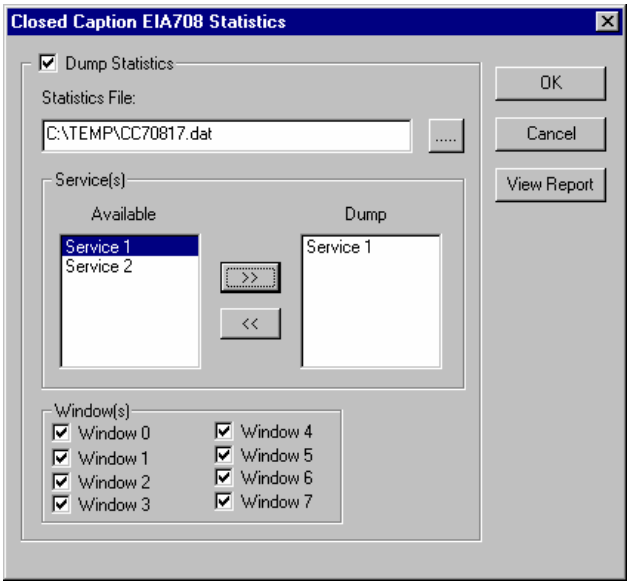
EIA708 Closed Caption Statistics Dump

1) Select the **EIA708** option from the **Dump CC Statistics** sub-menu.



2) Enable **Dump Statistics**.
3) Identify a destination file in the **Statistics File:** field.
4) Enable the parameters to be dumped.
5) Select **OK**.

Existing reports (i.e. reports previously set up) can be viewed by selecting **View Report**.

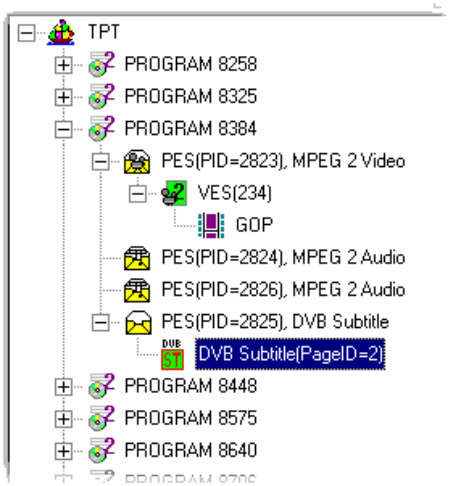


Appendix C - DVB Subtitle Stream Analysis

Appendix C - DVB Subtitle Stream Analysis 95
DVB Subtitle Data tab 97
Page View tab 100

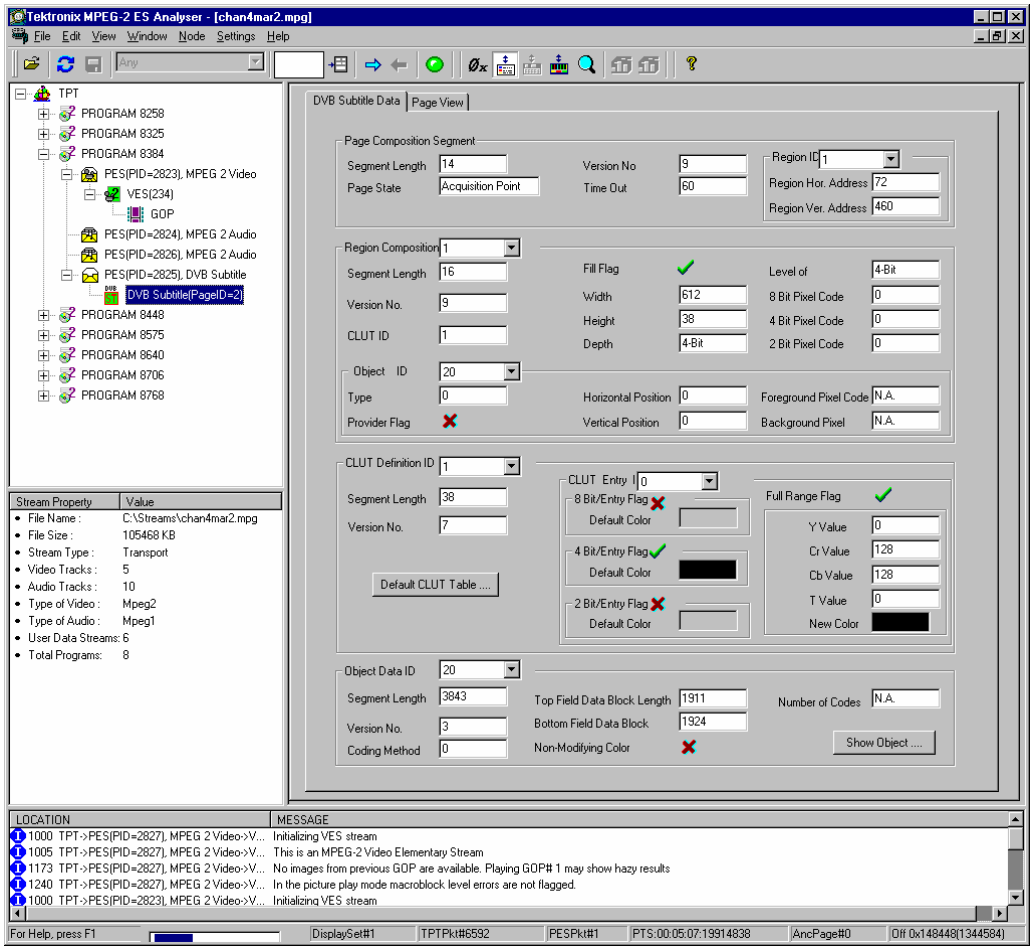
DVB Subtitling provides a means of conveying region-based bit-mapped graphics as MPEG-2 packetised elementary streams (PES). The bit-mapped pixel images are run-length encoded and transmitted with color look-up tables (CLUT) to a decoder where the stream is decoded and the subtitle image rendered with the on-screen display.

When a DVB Subtitle node is revealed and highlighted, the screen shown below is displayed:



Some streams may show subtitle nodes from which the Page View (described below) cannot display any subtitles.

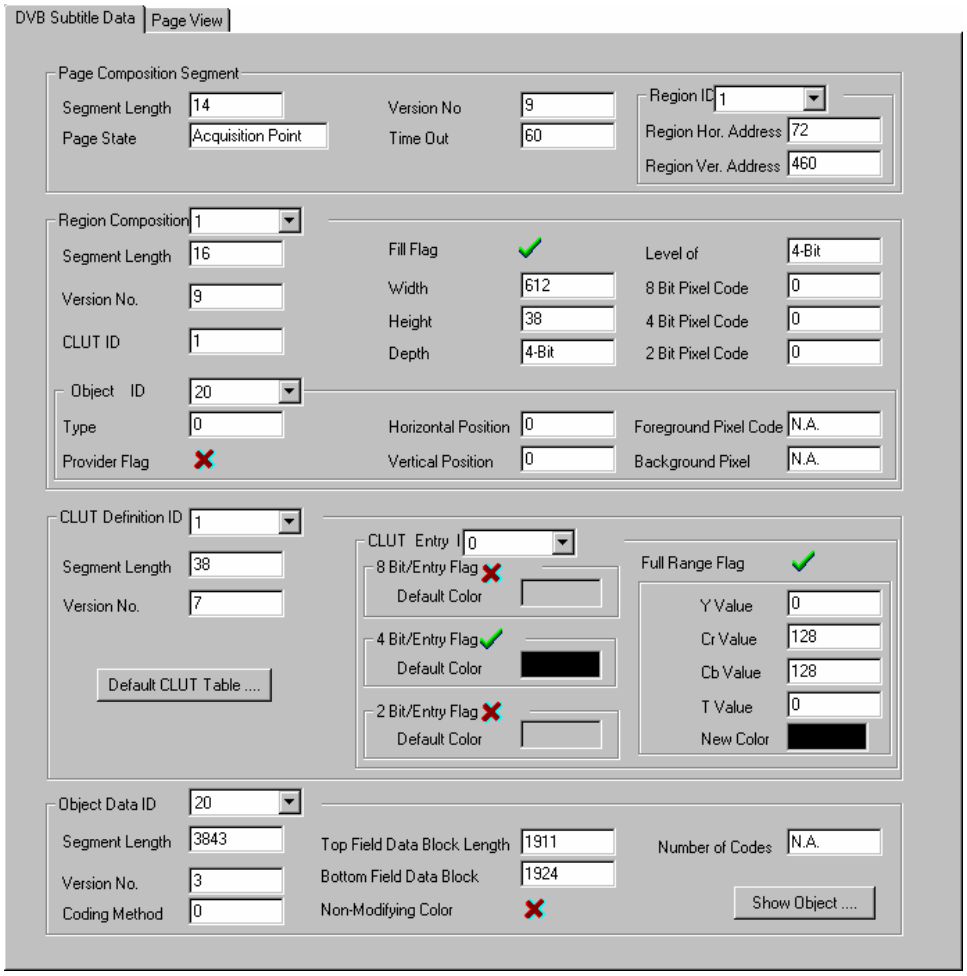
This is not an error, it is because the stream is too short to carry the requisite data. If possible, record a longer section of the stream and retry analysis.



The working are comprises two tabs: **DVB Subtitle Data** and **Page View**.

DVB Subtitle Data tab

The **DVB Subtitle Data** tab displays the fields associated with the current display. Access to two areas of detail is provided via the **Default CLUT Table…** and the **Show Object…** buttons.



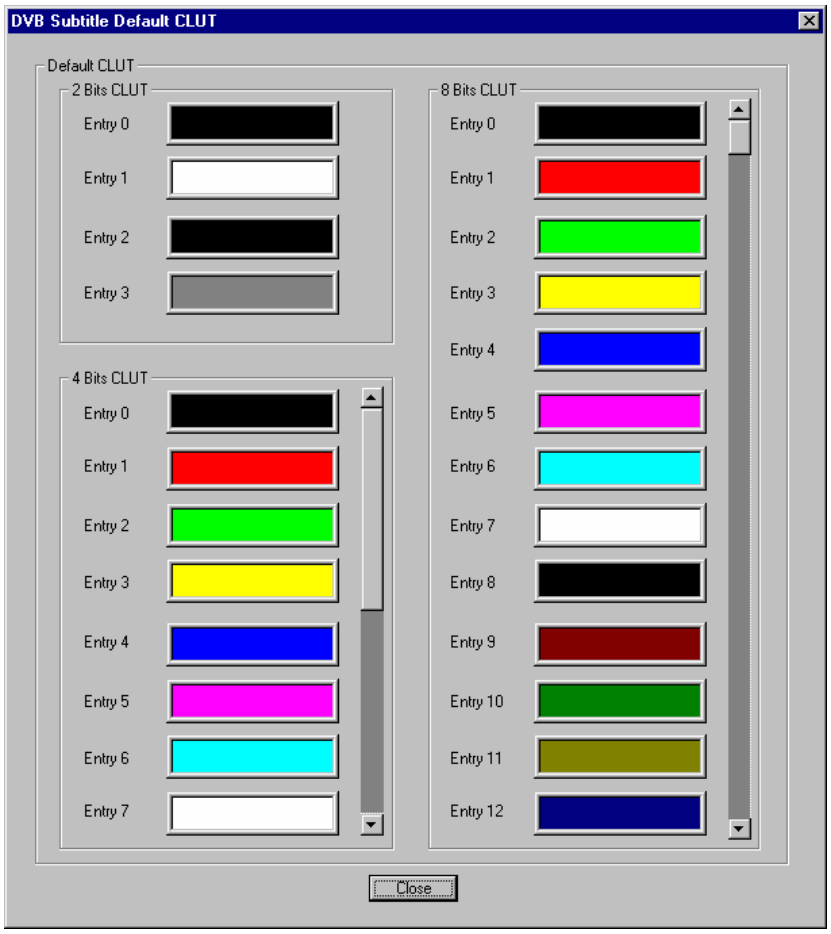
Object View

The Object View displays a decoded bitmap of the selected object rendered on a blank screen (i.e. with no underlying picture). The fields at the top of the dialog, provide the user with the options of changing the decoder type (2-bit, 4-bit or 8-bit), the background color and the CLUT identity. As described in the standard, the CLUT is attached to the region, not the object; therefore, the user can see the bitmap using all of the available CLUTs.

The Object view is displayed by selecting the **Show Object…** button on the **DVB Subtitle Data** tab.

CLUT View

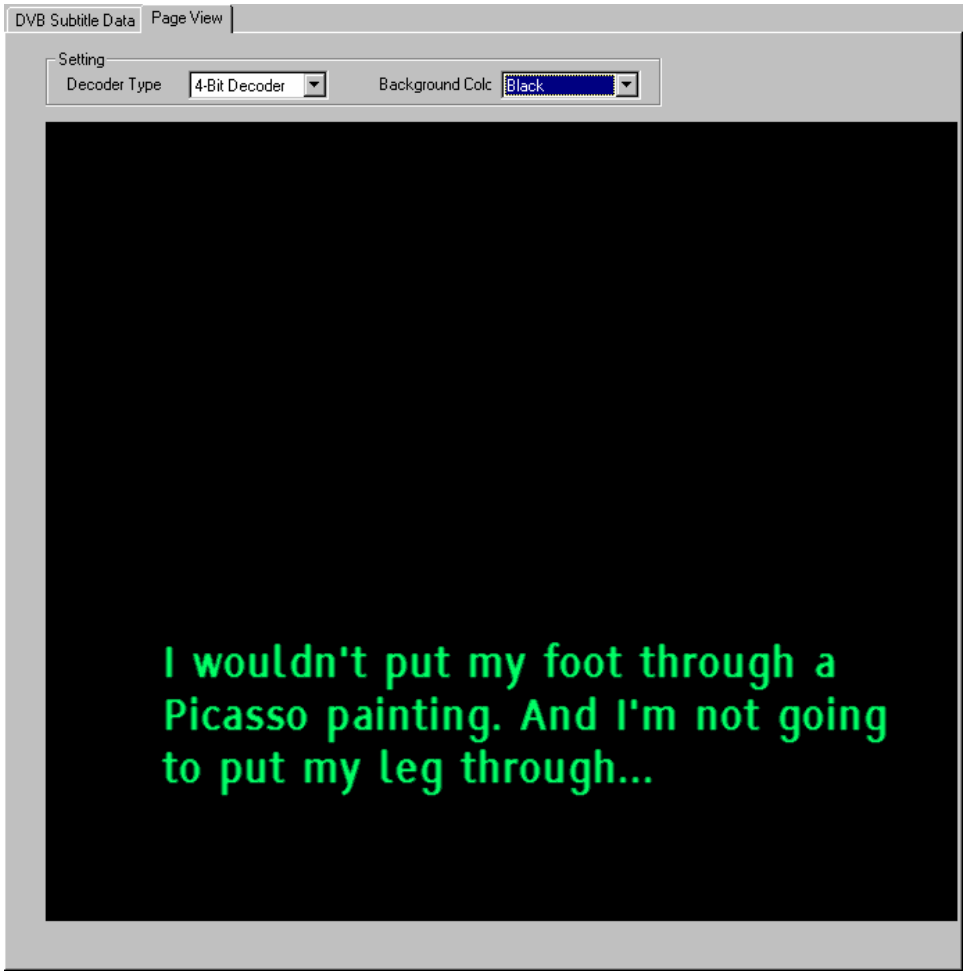
The Object view is displayed by selecting the **Default CLUT table…** button on the **DVB Subtitle Data** tab.



Subtitles in the UK are colored in a limited set, i.e. red, cyan, green, yellow, white; one for each of four speakers/actors and white for additional speakers/actors.

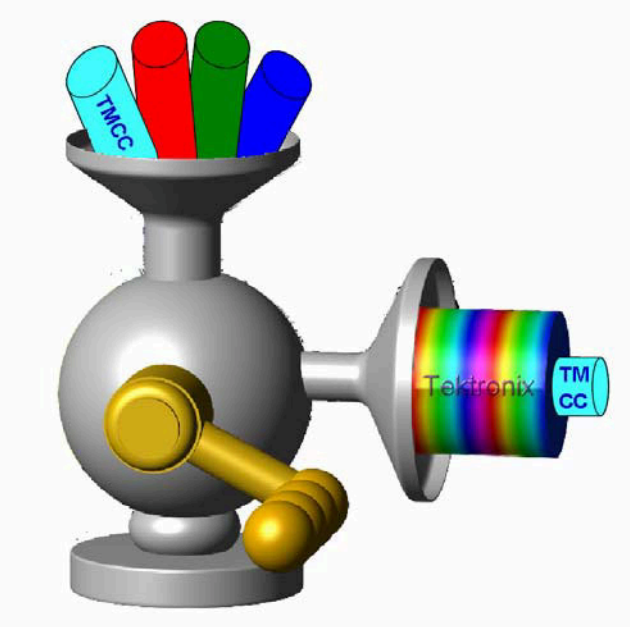
Page View tab

On the Page view tab, the regions listed in the Page Composition Segment area of the DVB Subtitle Data tab are rendered on a blank screen (size 720(H) x 576(W) pixels). The regions and objects are rendered at their actual locations on the blank screen. The user can select the Decoder Type and Background Colour from the drop-down lists.



Background color is not carried in the broadcast. The user can select a suitable color.

Section 12

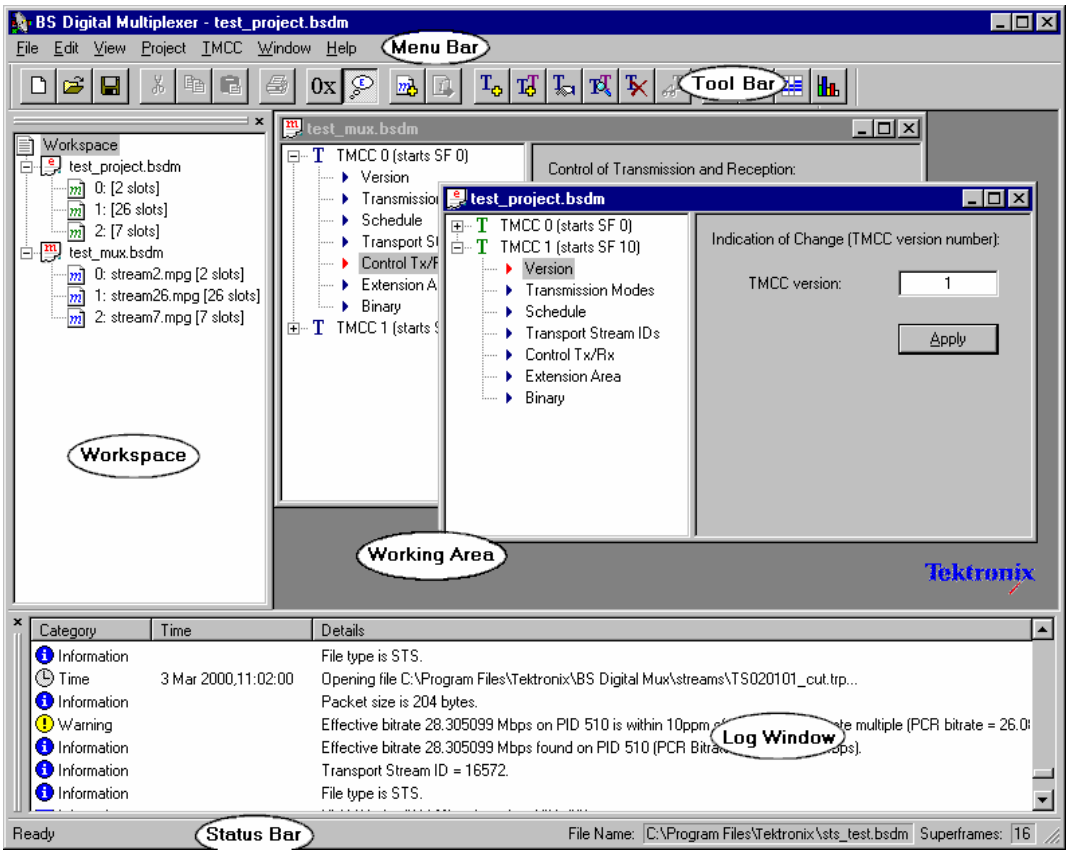


BS Digital Multiplexer

Introduction 3
ISDB-S Overview 4
Project File 5
STS Files 6
Starting the Program 10
Initial Appearance 10
Initial Menu Options 11
Main Window 12
Menus and Options 13
Toolbar 16
Status Bar 16
Workspace Window 17
TMCC Window 24
TMCC (STS) Window 35
Log Window 36
Continuity Information 37
Project Reports 37
Options… 38
Reference 39
Glossary and Abbreviations 39

Introduction

Tektronix Broadcast Satellite Digital Multiplexer (BSDM) provides off-line multiplexing of existing transport streams and TMCC information in order to produce ISDB-S transport streams. It can also be used to demultiplex existing ISDB-S transport streams and allow the TMCC information to be edited.



BSDM is a complete multiplexer, demultiplexer, editing and analysis tool for ISDB-S transport streams. The application enables the following activities:

- Creation of ISDB-S transport streams comprising one or more MPEG or STS files and TMCC information.
- Analysis of ISDB-S transport streams, showing constituent TMCCs, transport streams and continuity information; a number of conformance checks are also performed.
- Extraction of one or more MPEG or STS transport streams from an ISDB-S multiplex.
- Creation of hierarchical STS transport streams.
- Editing of ISDB-S transport streams, including addition and removal of MPEG and STS files and modification of TMCC information (including schedule and modulation modes).

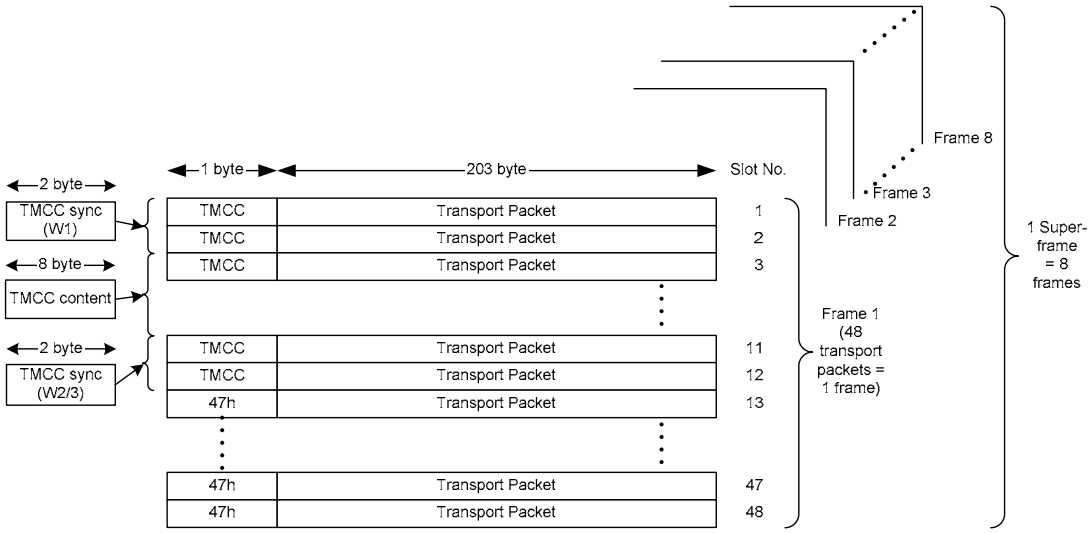
STS (Special Transport Stream) files are MPEG files that contain ARIB SI and TMCC information.

ISDB-S Overview

Up to eight transport streams can be multiplexed together to form an Integrated Services Digital Broadcasting – Satellite (ISDB-S) transport stream. The information describing the multiplexing and other information, such as modulation type, are described in the Transmission and Multiplexing Configuration Control (TMCC) information. The TMCC information is carried in the sync bytes of the transport stream packets.

Each TMCC signal is 64 bytes long, i.e. 48 bytes of TMCC information plus 16 bytes of outer coding (parity, etc.). A frame comprises 48 transport stream slots each of 204 bytes. Eight bytes of TMCC are transmitted in the first 12 bytes of each frame, with four bytes of markers (W1, W2 and W3). A super-frame comprises eight frames. Therefore, a complete TMCC is transmitted in each super-frame.

The ISDB-S specification refers to a transport packet as a slot. This convention is used in this section of the manual.



TMCC information is assembled and transmitted two super-frames before the information to which it refers becomes active.

TMCC Information Content

Each 48 byte block of TMCC information comprises the following information:

Content Change (5 bits)	Transmission Mode and Slot Allocations (40 bits)	Relative TS and Slot Allocation (144 bits)	Relative TS and TS ID (128 bits)	Control Tx/Rx (5 bits)	Extension Area (62 bits)

Content Change
is incremented every time the TMCC contents change.

Transmission Mode and Slot Allocation
indicates the transmission mode and the number of slots that will be required in each frame.

Relative Transport Stream and Slot Allocation
indicates the relative transport stream number. Range: 0 to 7.

Relative Transport Stream and Transport Stream Identity
indicates the identifier for each relative transport stream number.

Control Tx/Rx
Reception and transmission control.

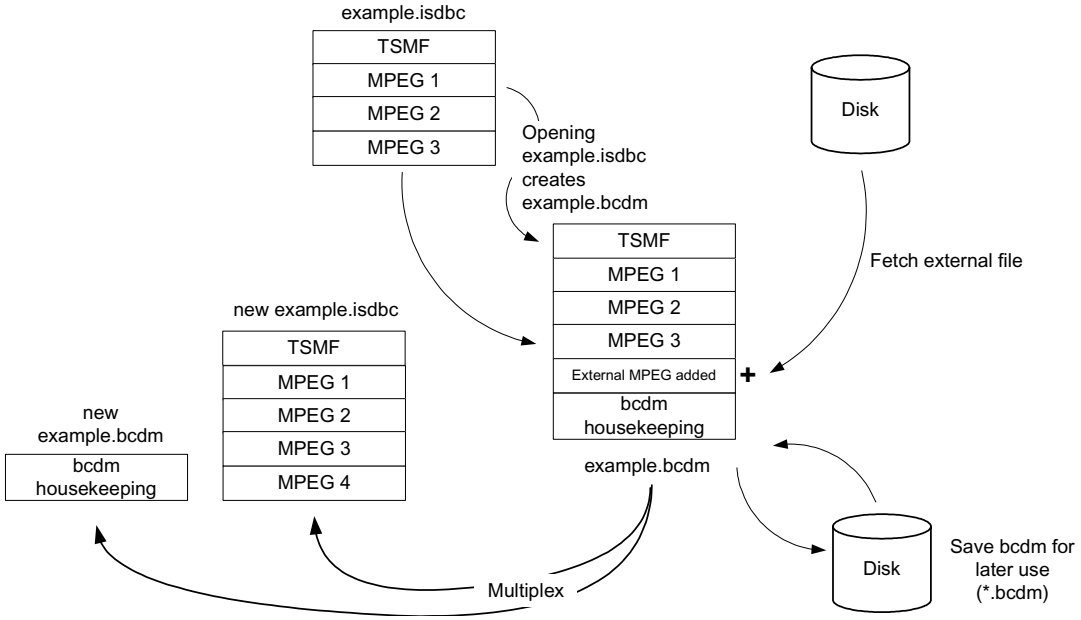
Extension Area
extends the content of the TMCC when required.

Note that the above is given only for information. The correlation between the prescribed TMCC information (given here) and the on-screen presentation (described below) is not exact, since the on-screen information combines some fields *and* provides extra information to make editing easier and more logical.

Refer to *ARIB STD-B20 Digital Broadcasting System and Related Optional Guidelines for Broadcasting Satellites* [1].

Project File

The ISDB-S streams are compiled by the BS Digital Multiplexer with the aid of a project properties file (*.bsdm). The project file contains all the information needed to generate ISDB-S stream file. This includes references to input MPEG and STS files, TMCC information and an output filename (e.g. *.isdb). A project file is automatically created when a new ISDB-S stream is created from constituent files.



If an ISDB-S stream is analyzed and no project file exists, a new project file is generated. In this instance, there are some restrictions on the extent of further editing.

When the stream is finally multiplexed, the information held in the project properties file is integrated into the output stream. Only housekeeping information is retained in the properties file.

STS Files

This section is provided for guidance in handling STS files.

Because the STS files contain TMCC which may conflict with the TMCC already existing in a project, there are certain rules which are applied to determine if an STS stream can be added and then whether it can be allocated space in the schedule.

Adding STS Files

If the TMCC for the STS file is inconsistent or contains irregularities, including:

- If PIDs appear under two different modulation modes within the same TMCC
- Changes in TMCC which are less than two superframes apart
- Duplicate modulation modes in the same TMCC (each modulation mode should only appear once per TMCC)
- Invalid values in TMCC
- More than 48 slots allocated in total.

…the STS file will be rejected.

Allocating STS Files

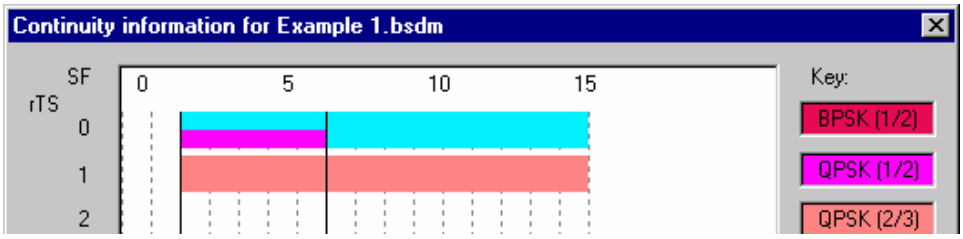
Once an STS file has been added to a project it can be allocated space in the schedule. The system will attempt to merge the TMCC information from the STS with the existing TMCCs which the user has added (there must be at least one).

The position of each TMCC is calculated and either the STS TMCC information is added to the existing TMCC or a new TMCC is created to represent the STS TMCC at this point in the output stream.

If the system adds a TMCC it will be fixed and read-only. The user has no need to edit these TMCC as they are removed (and possibly replaced) each time the allocation of rTS streams is changed. Any allocation of other streams is copied into the new TMCC by the system. For example in the partial continuity dialog shown below, an STS has been allocated for which the system adds a TMCC at Superframe 7. The allocation of rTS 1 (QPSK(2/3) is carried over into the new TMCC.

If the user removes a file then any TMCC that has been added for that file is removed.

If a TMCC does not allocate an STS but a following one does the TMCC information in the STS file is effectively delayed. Any TMCCs added for the STS will reflect this delay. For example:



- The above extract from the continuity dialog shows a delay of two superframes on the STS stream. The second TMCC which appears at Superframe 5 in the STS file now appears at Superframe 7 in the output file.

The following rules must not be broken:

- Any TMCC added for an STS must have a separation of two superframes from all other TMCCs in the project.
- Adding the TMCC would not cause the total allocation to be greater than 48 packets.
- Adding the TMCC would not cause more than four distinct modulation modes to be present in any TMCC.

…if they are the allocation is not permitted and all changes are removed.

Multiplexing STS Files

When multiplexing files the system automatically loops MPEG files. To be consistent the system also automatically loops STS files. However, in order to maintain consistency of the generated output, the following conditions apply:

- An STS file that contains more than one TMCC can not be looped (and therefore the project cannot be multiplexed).
- Only a whole number of superframes is multiplexed.
- Only packets beginning at the first superframe of the STS are multiplexed (other packets before the first packet that indicates a superframe start, are dropped).

Analysis of ISDB Files

ISDB-S files may have been created using STS streams, MPEG streams or a mixture of the both.

The STS allocations within an ISDB file can not be changed, unlike the MPEG components that can be have their modulation modes changed before remultiplexing the ISDB stream. This is because changing the allocation of an STS file often results in the removal or addition of a TMCC – but the TMCCs in an ISDB file are fixed and cannot be moved or deleted.

To work around this limitation, the STS file (and any other internal MPEG files required) can be exported and imported into a new project. The necessary allocations can then be made before multiplexing to a new ISDB file.

Extraction of STS Files

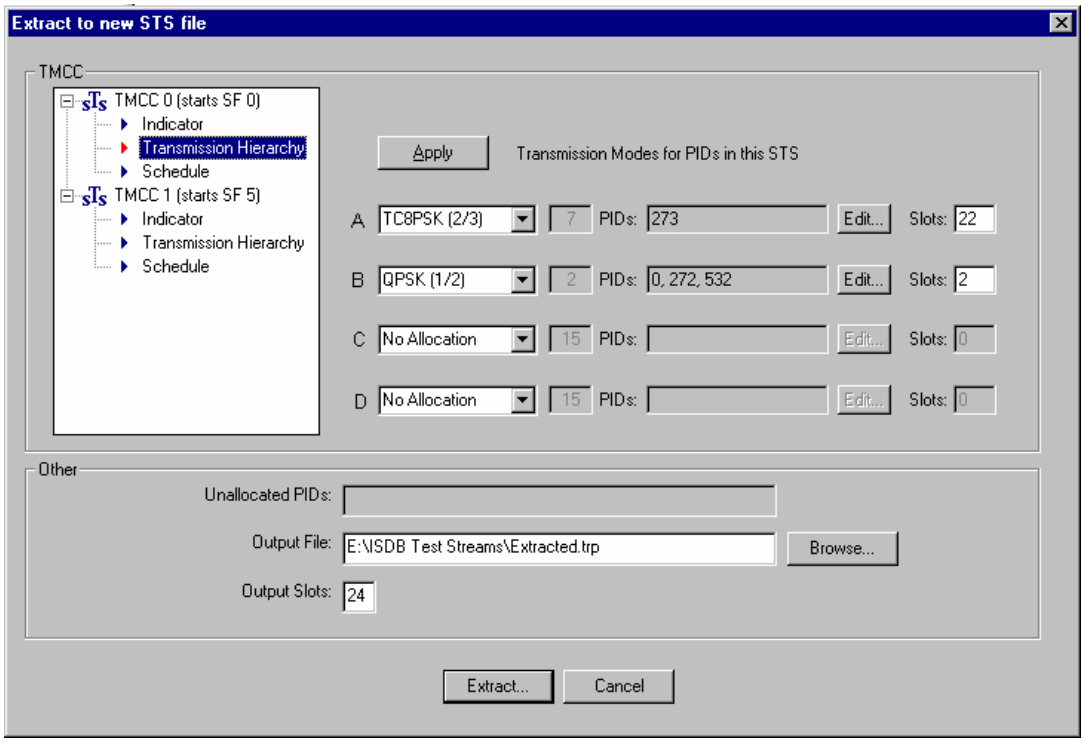
STS files can be extracted from an edit project (as can MPEG files). In addition to simply extracting the file the user can make changes to the file. The changes that can be made include the following:

- Change the modulation mode and slot allocation.
- Change the bitrate of the file.
- Add a new modulation thereby allowing creation of hierarchical STS streams.
- Move individual PIDs to a different modulation mode.
- Add or remove TMCC from the stream.

These changes only affect the new stream that is created as part of the extraction process and have no effect on the original data.

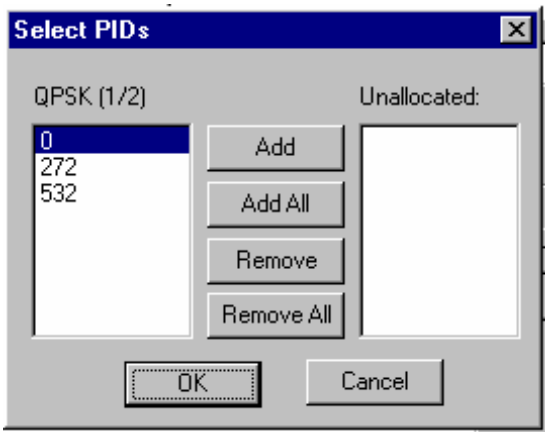
Because this process effectively produces a new stream it can be done on files in both ‘edit’ and ‘mux’ projects. In addition, a new STS stream can be created from an MPEG stream in an ‘edit’ project.

The following dialog is used to create the new STS stream:



Adjacent to each transmission mode is a list of the PIDs allocated to the mode. These can be re-arranged by selecting **Edit…** which displays the following dialog.

PIDs allocated to the selected transmission mode are listed in the left-hand panel. Any unallocated PIDs in the stream are shown in the right-hand panel.

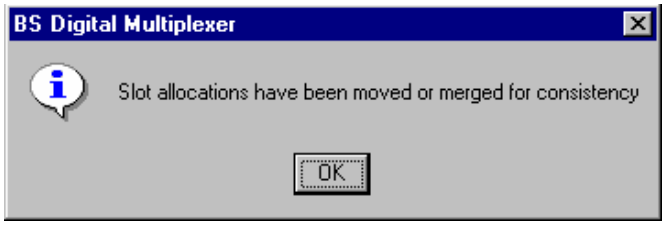


PIDs can be moved between the two panels either by highlighting individual PIDs and using **Add** or **Remove** or by using **Add All** and **Remove All**. To allocate newly unallocated PIDs to another mode, select **Edit…** for the appropriate transmission mode and move the required PIDs.

Notes:

- The TMCCs initially presented to the user are those from the STS file (not from the ISDB file).
- In the case of extracting an MPEG file as an STS file, a single TMCC is initially created which has one modulation mode (i.e. TC8PSK(2/3)) for all the PIDs.
- The output slots must equal the total number of slots allocated for the different modes (this applies to each TMCC).

- All PIDs *must* be allocated to a mode.
- The allocation modes can appear in any order *but* after pressing the apply button these modes will be reordered according to decreasing modulation mode (STS TMCC must be ordered in this way). The following warning will appear if this has happened:



  This message will also appear if the same allocation mode is used more than for a TMCC. In this case, the slot allocations will be merged into a single allocation.

- The number of slots allocated to each mode must be a multiple of the total number of slots that mode requires.

When the user selects **Apply** (or **Extract**) the system checks that the new allocation will fit within the output file. In any one frame, if the number of packets required (taking into account the dummy packets which will be inserted according to the modulation modes) exceeds the maximum number of packets per frame, an error will be issued. Errors are reported in the log, for example:

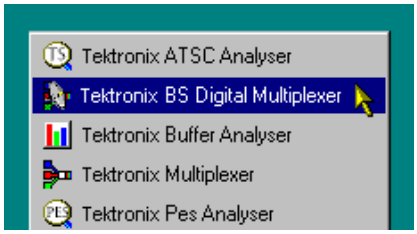
Category	Time	Details
Time	17 Feb 2000,09:59:03	Starting hiearchical modulation check of STS (rTS 0)...
Error		Allocation exceeded at SF 0:0 - 15 slots required, 8 slots allocated (mode is TC8PSK (2/3))
Error		Allocation exceeded at SF 0:1 - 15 slots required, 8 slots allocated (mode is TC8PSK (2/3))
Error		Allocation exceeded at SF 0:2 - 15 slots required, 8 slots allocated (mode is TC8PSK (2/3))
Error		Allocation exceeded at SF 0:3 - 15 slots required, 8 slots allocated (mode is TC8PSK (2/3))
Error		Allocation exceeded at SF 0:4 - 15 slots required, 8 slots allocated (mode is TC8PSK (2/3))
Information		Limit of 5 allocation errors detected - stopping analysis
Time	17 Feb 2000,09:59:03	Analysis failed... extraction will not proceed

The error message indicates the superframe and frame position of error. For instance in the above example the first frame there are 15 packets for PIDs allocated to mode TC8PSK but only eight slots have been allocated.

Any error means that the file extraction will not proceed; it is not allowable to exclude the packets which can not be accommodated. However, although a single error stops extraction the system will carry on checking the allocation of packets (until a user defined maximum limit is reached – five in the above example. This limit can be set in the Options dialog). This helps the user to see other allocation errors that will occur rather than fixing one only to find another similar problem a few superframes later.

Starting the Program

The program can be started by selecting the **Tektronix BS Digital Multiplexer** option from the **Start** > **Programs** menu.



or by double-clicking on the **Tektronix BS Digital Multiplexer** shortcut on the desktop.

Initial Appearance

Once the program has started and is ready for use, it will open a window similar to that shown below.

Initial Menu Options

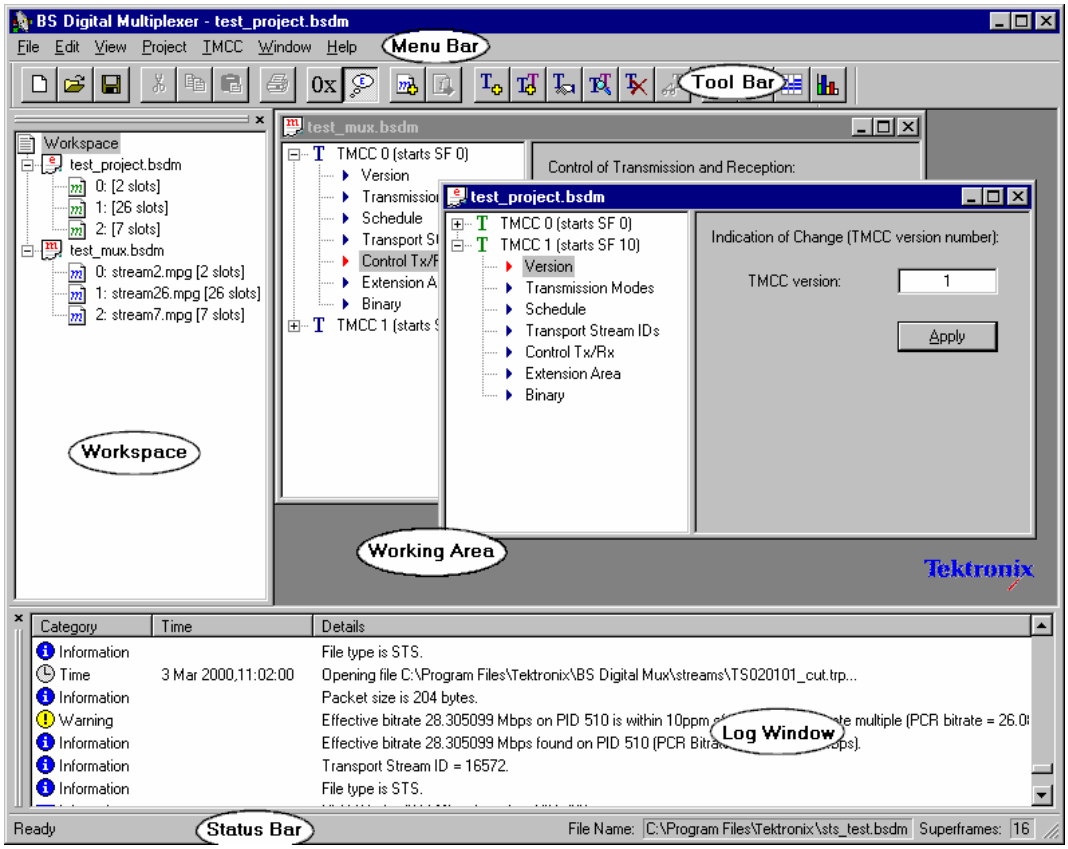
Initially, before any file is opened, BSDM presents only the File, View and Help menus (described in *Menus and Options*, page 13).

Opening an ISDB-S File

When opening an ISDB-S transport stream the following rules apply:

- If a project file (*.bsdm) of the same name exists, then the information subsequently displayed will have been extracted from the project file.
- If no project file of the same name exists, then the transport stream is analyzed and a project file (of the same name) created.

Main Window



The main window comprises the following items:

- Menu Bar
- Toolbar
- Workspace window
- Working area
- Log window
- Status Bar

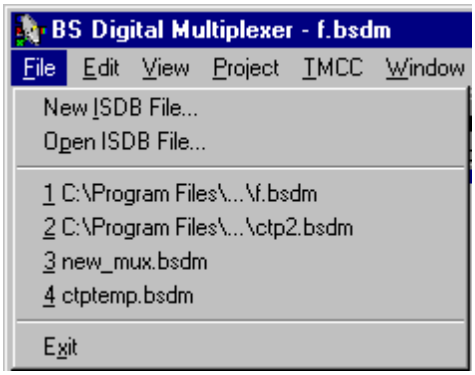
By default, the Workspace and Log windows are displayed; subsequent display selections may change the initial layout. The remainder of the main window (Working Area) remains blank until a project is opened.

Most commands are available via three routes: as a menu option, using a toolbar button or from a context-sensitive right-click menu. All commands are available from the Menu Bar. In describing activities, the following descriptions favour the right-click menu method, but the final choice of working practice rests with the user.

Menus and Options

This section outlines the menu options available. Where a command is available via a keyboard shortcut or a toolbar button, these are also given.

File Menu Options



New ISDB File…
Creates a new ISDB file.

Open ISDB File…
Opens (and analyzes) an existing ISDB file.

1 <filename>
A list (up to four) of the most recently used files. Selecting a filename opens that file for use.

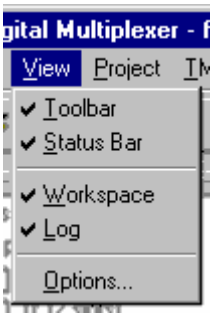
Exit
Closes the BSDM application.

Edit Menu Options

(None of the Edit options are implemented; they are described for information only.)

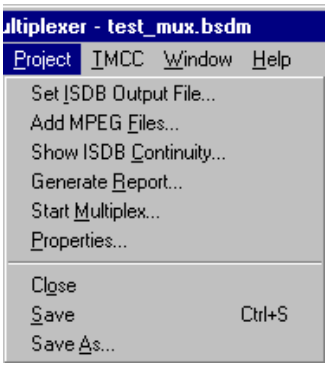
Undo	Undoes the last action.
Cut	Cuts the active ISDB file. It is stored temporarily on the Windows clipboard.
Copy	Copies the active ISDB file to the Windows clipboard.
Paste	Pastes the ISDB file currently held on the Windows clipboard to the workspace.

View Menu Options



Toolbar	Toggles the toolbar between being displayed or not. Select the option to change the state.
Status Bar	Toggles the status bar between being displayed or not.
Workspace	Toggles the window in which the workspace information is displayed.
Log	Toggles the window in which the log file is displayed.
Options…	Opens the Options dialog (see Options…, page 38).

Project Menu Options



Set ISDB Output File…
Allows the current ISDB stream in a Mux project to be (re)named.

Add MPEG Files…
Adds MPEG files to the current project.

Show ISDB Continuity…
Displays TMCC continuity graphically.

Generate Report…
Displays a text-based report of all project properties and parameters.

Start Multiplex…
Starts the multiplex engine to create a TMCC transport stream.

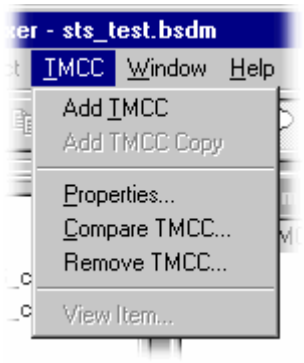
Properties…
Opens the project properties dialog of the currently highlighted project.

Close
Closes currently selected project.

Save **Ctrl+S**
Saves currently selected project.

Save As…
Saves currently selected project under a new/ different name.

TMCC Menu Options



Add TMCC
Adds a TMCC to the currently highlighted project.

Add TMCC Copy
Copies the currently highlighted TMCC within the project.

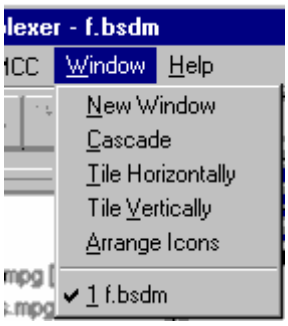
Properties…
Opens the properties dialog of the currently highlighted TMCC.

Compare TMCC…
Opens the Compare dialog which allows two TMCCs to be compared.

Remove TMCC…
Removes the currently highlighted TMCC.

View Item…
View the currently highlighted TMCC parameter.

Window Menu Options



New Window — Opens a new TMCC window containing a copy of the current TMCC.

Cascade — Cascades all the open TMCC windows in the workspace.

Tile Horizontally — Tiles all the open TMCC windows horizontally in the workspace.

Tile Vertically — Tiles all the open TMCC windows vertically in the workspace.

Arrange Icons — Aligns icons of any minimised TMCC windows at the bottom of the workspace window.

1 <window title> — Makes the named TMCC window active, bringing it to the front of any windows that may have been hiding all or part of it.

Help Menu Options

About BS Digital Multiplexer…
Opens the About dialog which gives details of the application's serial number and software version.

Toolbar

The Toolbar provides a set of convenient shortcuts for the more frequently used menu options. Buttons will be greyed out in line with their availability. A tooltip will be displayed briefly if the mouse is rested over a button.

Most of the toolbar buttons are identified in the foregoing section as shortcuts to menu options. In addition, the following two buttons provide shortcuts to the BSDM Options (**File ➔ Options…**).

Toggles the display of hexadecimal and decimal values throughout the application.

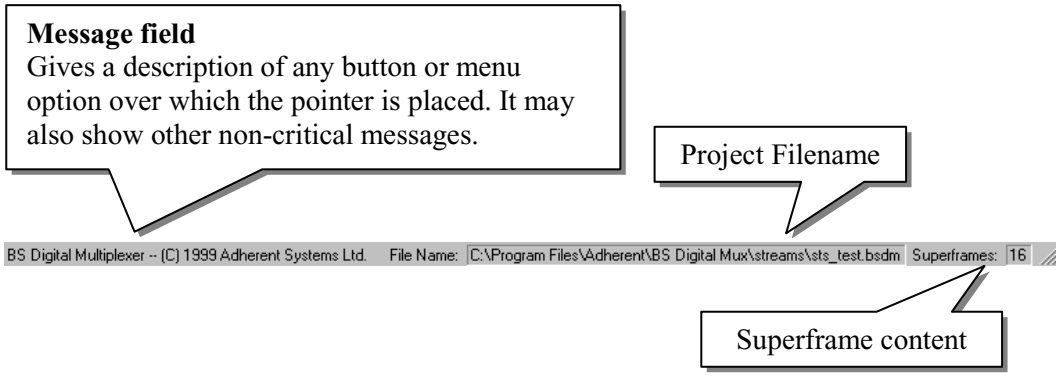
Toggles Expert mode on and off. Expert mode allows some TMCC values, such as **Version**, to be edited.

The Toolbar can be dragged off the edge of the main window to create a floating pallet. To do this place the mouse pointer on the background of the Toolbar, i.e. not on one of the buttons, hold the left mouse button down and drag the outline where required. The result will be the Toolbar in a self-contained window, thus:

To re-integrate the Toolbar with the window border, drag the outline over the border until the outline changes shape and then release it. The Toolbar can be placed on any of the four edges.

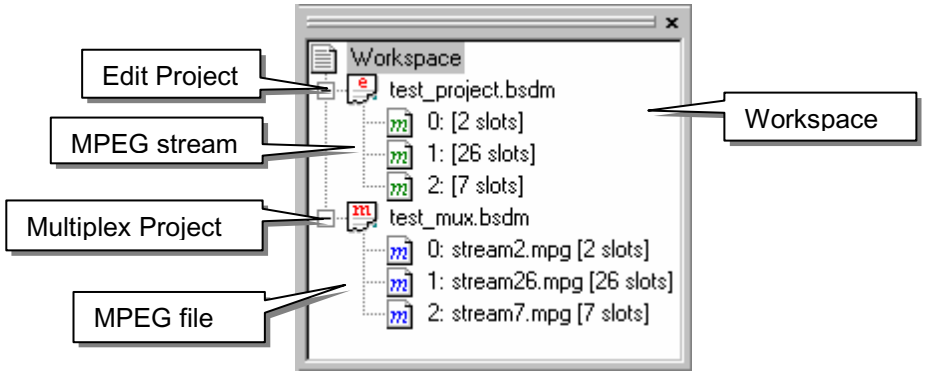
Status Bar

The Status Bar may be hidden from view, but when visible is always at the bottom of the main window.



Workspace Window

The Workspace window shows the MPEG files and/or ISDB-S files contained in each project. Multiple projects can be loaded into the workspace at any one time, as illustrated by the screenshot below.



The screenshot shows the two different project types, namely Multiplex and Edit.

A Multiplex project ( ) (red icon) is one in which the project file was created at the same time as the ISDB-S file was first multiplexed; that is, the project file references the constituent MPEG files ( ) (blue icon).

An Edit project ( ) (red icon) is one where the project file is created from an existing ISDB-S file; therefore the BSDM can only perform further edits; more MPEG files( ) can be added to an Edit project.

The restrictions placed upon an Edit project are:

- The overall ISDB-S file length may not be altered.
- The TMCC super-frame start number cannot be edited.
- A TMCC version cannot be removed.

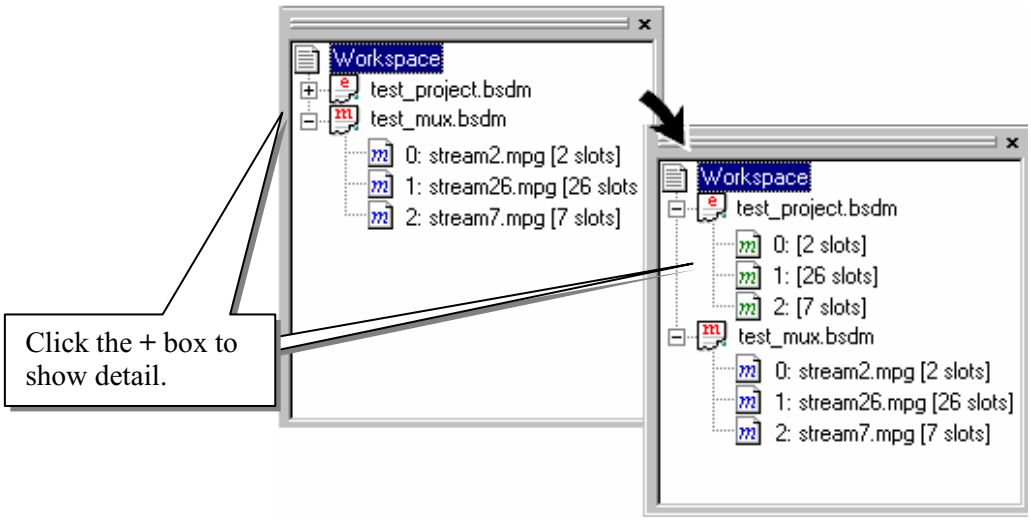
Workspace Icons

The following icons are used in the workspace.

Project Icons		Color Coding
Multiplex		Red
Edit		Red
File Icons		
MPEG		Blue – external file Green – internal file
STS		Blue – external file Green – internal file

Workspace Control

Projects are represented by a tree structure diagram, with the ‘root node’ or highest level being the Workspace. Components that contain more information beneath them in the structure are indicated by a square box (⊞ / ⊟).



Clicking on a box does not select that node, it only shows or hides the level of detail under that node.

If the node has a minus sign (⊟) in the box, the level of detail below it is currently displayed. Clicking on the box will hide the detail.

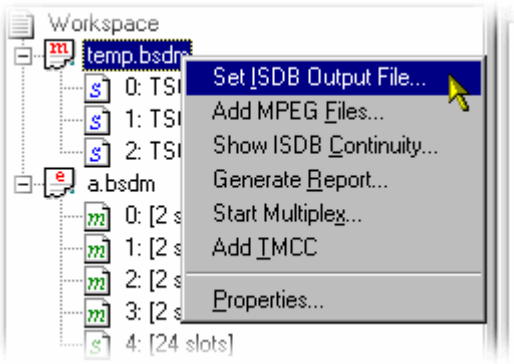
If the box contains a plus sign (⊞), there is a hidden level of detail. Clicking on the box will show the detail.

Components which are directly connected to the tree (with out a ⊞ or ⊟ box) are leaf nodes, below which there is no further detail. These correspond to MPEG files or information nodes.

The number preceding the colon before each MPEG file is the relative transport stream identity (rTS). The number after the filename (in square brackets) is the bitrate of the MPEG file in terms of slots per frame.

Multiplex Project Activities

With a project highlighted in the workspace, the right-click menu is as shown:



Set ISDB Output File…

This command is only enabled for Multiplexed projects.

During the creation of a mux project, the ISDB output file must be named. Note that until the project is multiplexed, the ISDB output file will not be fixed (When the file is multiplexed, an ISDB output file of the same name will be created).

Select **Set ISDB Output File…** from the right-click menu. A standard Windows Save dialog is displayed. Enter the required name of the ISDB file and select the destination.

Add MPEG Files…

MPEG files can be added to Multiplex and Edit projects.

Select **Add MPEG Files…** from the right-click menu. In the dialog displayed highlight one or more MPEG files and select OK. The files will be added to the project (blue icon -); Relative transport stream identity numbers will allocated automatically but can be changed manually.

The bitrate of any MPEG file selected must a multiple of 56.61Mbit/s divided by 48. The file can be either 188 or 204 byte slots (packets). The value 56.61Mbit/s assumes 204 byte slots.

188 byte packets must be a multiple of 52.17Mbit/s divided by 48.

Show ISDB Continuity…

The Continuity screen provides a graphic illustration of the continuity of the MPEG files in a project.

Select **Show ISDB Continuity…** from the right-click menu. The subsequent display is shown on page 37.

Generate Report…

Project reporting displays all of the project properties and parameters.

Select **Generate Report…** from the right-click menu. A text-based report window is opened containing all the project information.

(See Project Reports, page 37)

Start Multiplex…

Starts the multiplex activity using the accumulated project information (MPEG files, and TMCCs) to create an ISDB file.

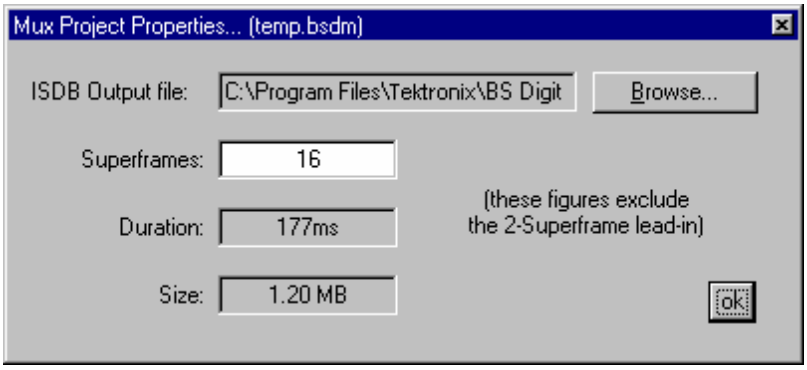
Select **Start Multiplexing…** from the right-click menu. The activity is reported in the Log window.

Add TMCC

(See Adding TMCCs, page 32)

Project Properties

The properties of an ISDB output file in a Multiplex project are displayed by selecting **Properties…** from the right-click menu. Select **OK** to close the dialog.



ISDB Output file: The ISDB output file name.

Superframes: The number of super-frames that the ISDB file is to occupy.
This number can be edited. Unless the TMCC information dictates otherwise, the constituent MPEG files will be looped to fill the specified number of super-frames where necessary.
Min: 1 Max:10^6

Duration: The length of the multiplexed ISDB file in milliseconds.

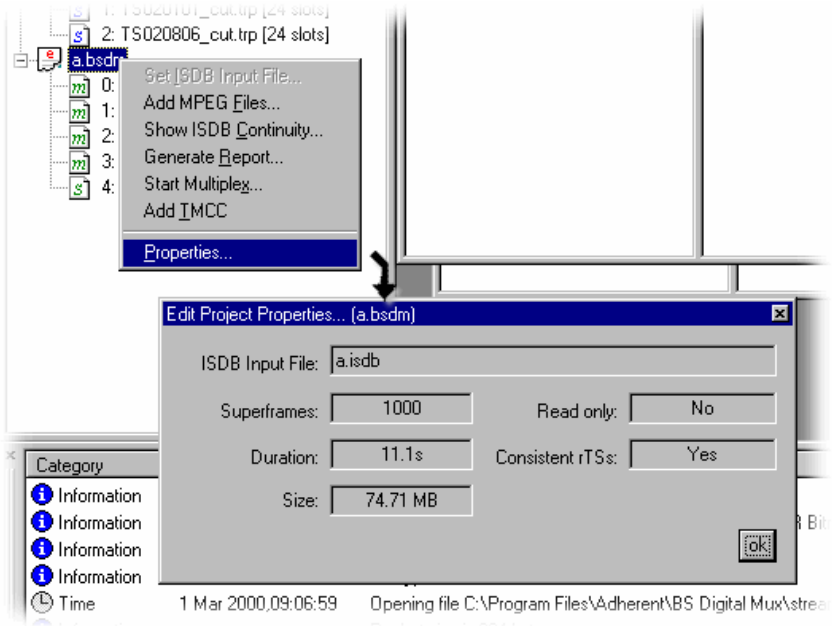
Size: The size of the multiplexed ISDB file in megabytes.

Note that the size of the file displayed in Windows Explorer will not correspond exactly to this value since it excludes the two-super-frame lead-in.

A useful approximation when estimating the size of an ISDB file is to allow 11ms and 76kbyte per super-frame.

ISDB Project File Properties

The properties of the ISDB project file can be displayed by right clicking the filename and selecting **Properties**.

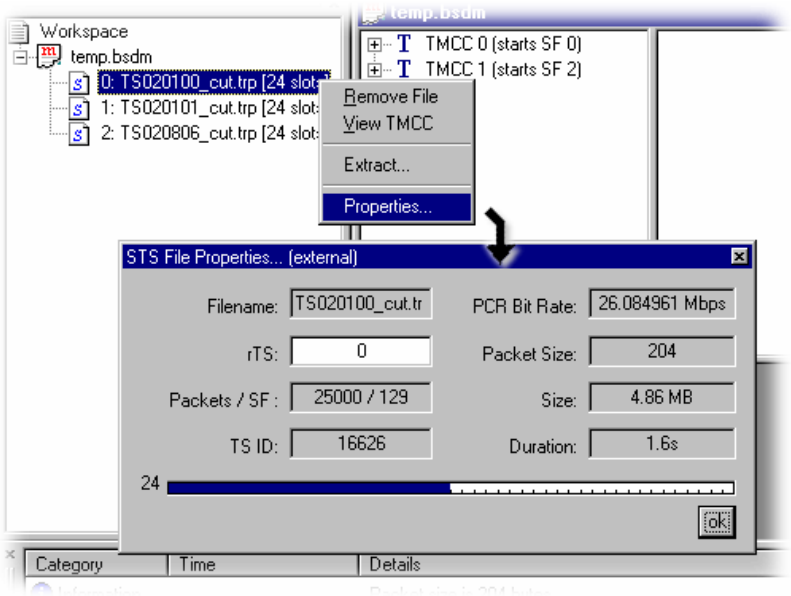


ISDB Input file:	Project file name.
Superframes:	Number of superframes.
Read only:	Read/Write status of project file.
Duration:	Duration of project.
Consistent rTSs:	Consistency of relative transport stream identities; that is mapping between the relative transport stream identity and the slots/transport stream identity remains consistent throughout the file.
Size:	Project file size.

All fields are read-only. Select **OK** to close the dialog.

External File Properties

The properties of an external MPEG file can be displayed by right clicking on the file name and selecting Properties. The **MPEG File Properties… (external)** dialog is displayed (shown below). The information shown is derived from the stream.



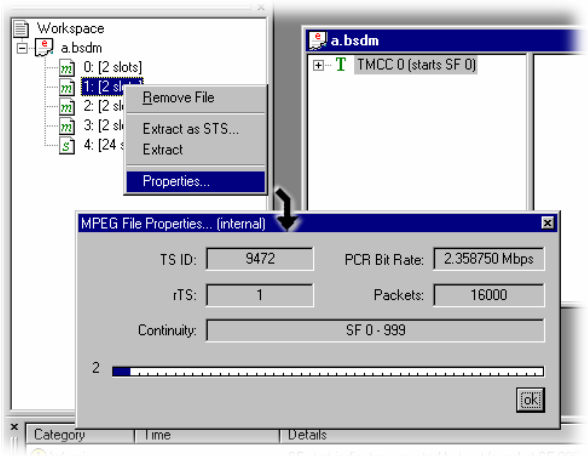
Filename:	MPEG or STS filename.
PCR Bit Rate:	The bitrate of the MPEG or STS stream.
rTS:	Relative Transport Stream – a unique identity for this stream in the overall ISDB-S stream (range: 0 to 7). This field can be edited as required.
Packet Size:	188 / 204
Packets / SF:	The number of packets/superframes (for STS files) in the stream.
Size:	File size.
TS ID:	Transport Stream Identifier.
Duration:	Duration of the file (Size / Bit Rate).

The **Slot Allocation Indicator** at the bottom of the dialog provides a guide as to the number of slots (i.e. 2 in the screenshot above) occupied by the MPEG stream in each packet.

All fields, with the exception of **rTS** are read-only. Select **OK** to close the dialog.

Internal File Properties

Internal file (MPEG stream) properties can be displayed by right clicking on the file name and selecting Properties. The **MPEG File Properties… (internal)** dialog is displayed (shown below). The information shown is derived from the stream. The stream can be extracted (exported) and saved if required.



TS ID: Transport Stream Identifier.

PCR Bit Rate: The bitrate of the MPEG stream.

rTS: Relative Transport Stream – a unique identity for this stream in the overall ISDB-S stream (range: 0 to 7).

Packets: The number of packets in the MPEG stream.

Continuity: Shows the range of super-frames occupied by the MPEG stream.

The **Slot Allocation Indicator** at the bottom of the dialog provides a guide as to the number of slots (i.e. 26 in the screenshot above) occupied by the MPEG stream in each packet.

All fields are read-only. Select **OK** to close the dialog.

Extracting the File

An MPEG stream can be saved (or extracted) as an individual stream file.

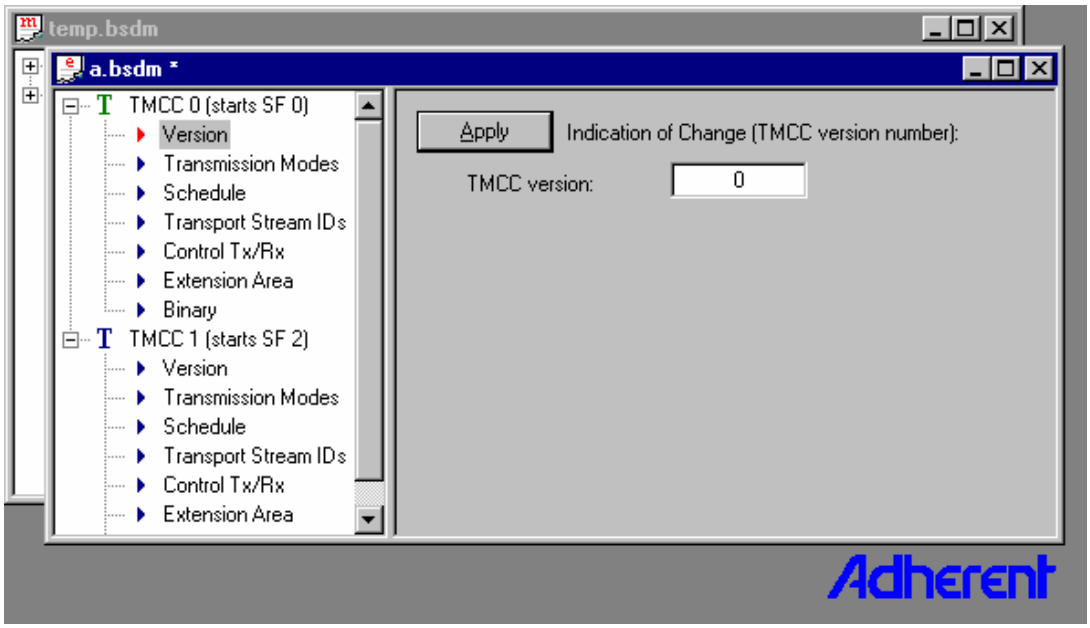
Highlight the file to be extracted and select **Extract** from the right-click menu. In the dialog box displayed, allocate the location and filename of the stream to be saved. Select OK. The progress of the save action is indicated by a new dialog containing a progress bar.

Extracting STS files is described elsewhere – see Extraction of STS Files, page 7 et seq.

TMCC Window

The area of the main screen not occupied by the Workspace and Log is given over to TMCC window(s). Each project has a resizable TMCC window associated with it. The active project TMCC window is displayed on top.

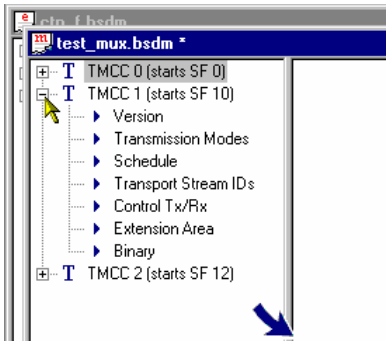
Note that the project file in the workspace is not necessarily highlighted when a different TMCC window is selected; conversely, when a different project is selected in the workspace, the corresponding TMCC window *is* activated and brought to the top.



Each TMCC in a project is represented as a tree structure and headed with a **T** icon, the TMCC number and the superframe number in which the TMCC becomes active. The color of the TMCC (**T**) icons also has significance. A blue **T** icon indicates that the TMCC was added during this session and therefore is not integrated into the project, whilst a green **T** icon indicates that it is part of (or internal to) an edit project and is therefore fixed and cannot be moved. The TMCC number is simply a sequential number allocated when the TMCC is created.

Each TMCC comprises seven parameters; clicking the **+** to the left of the T icon will display a list of the parameter names. Double-clicking a parameter name (or highlighting the parameter name and selecting **View item…** from the right-click menu or selecting from the toolbar) displays the parameter's properties in the right hand pane of the TMCC window. Most of the property windows have an **Apply** button. Where changes are made to the parameter, the **Apply** button must be selected before the change becomes available for use by the multiplex. Simply closing the TMCC window or selecting another parameter will discard any changes.

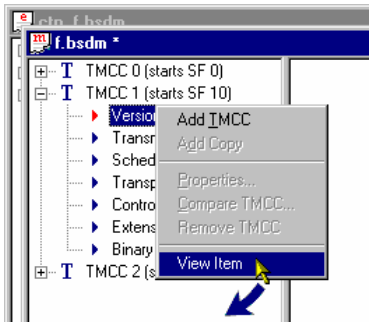
Viewing TMCC Parameters



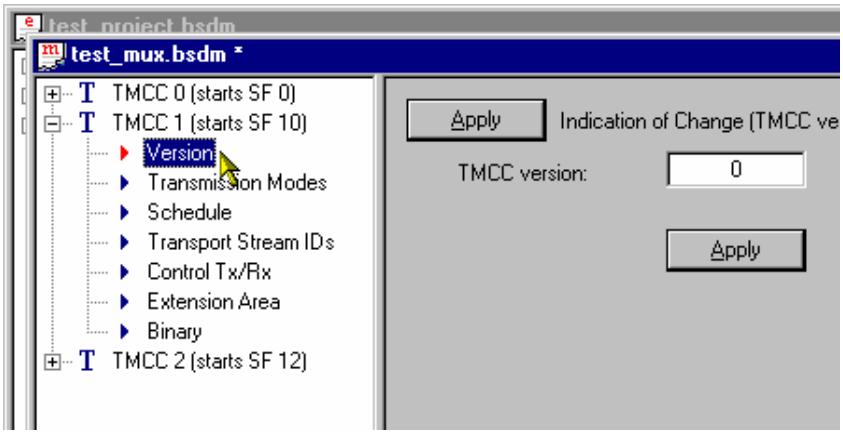
To view the list of parameters for a TMCC, highlight the TMCC label in the TMCC window and select the ⊞ symbol to it's left (or double-click the label).

The list of parameters for the selected TMCC is expanded.

Highlight the parameter to be viewed and select **View Item…** from the right-click menu (or double-click the parameter name).



Details of the selected parameter are displayed in the right-hand pane of the TMCC window.



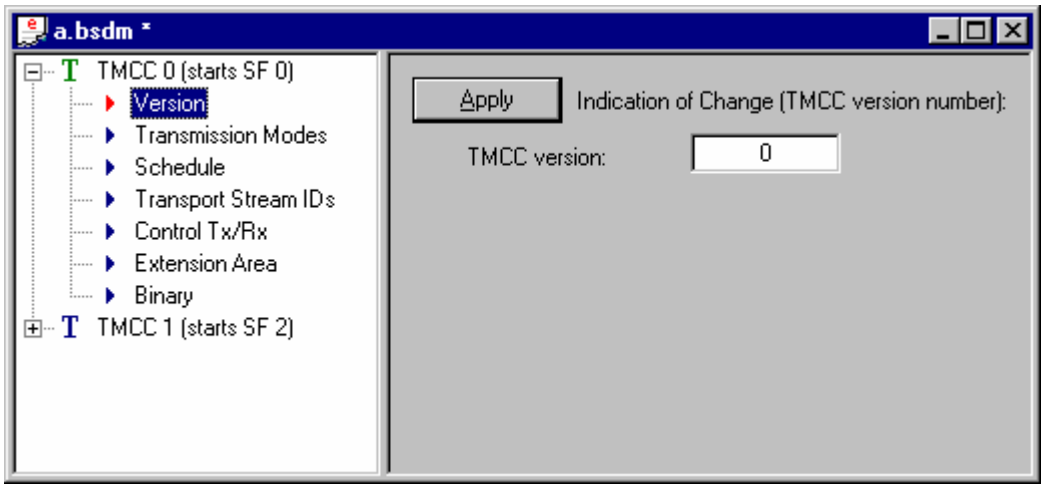
Note that simply highlighting the parameter name is not sufficient to display the details; **View Item…** (or a double-click) must be used to view the details.

Note also, that when an **Apply** button is enabled, changes to parameter details will only be implemented when the button is selected; simply selecting another parameter to view will discard any changes.

TMCC Parameters

TMCCs are labelled with a sequential number and the superframe (SF) number in which the TMCC parameters are to take effect.

Version

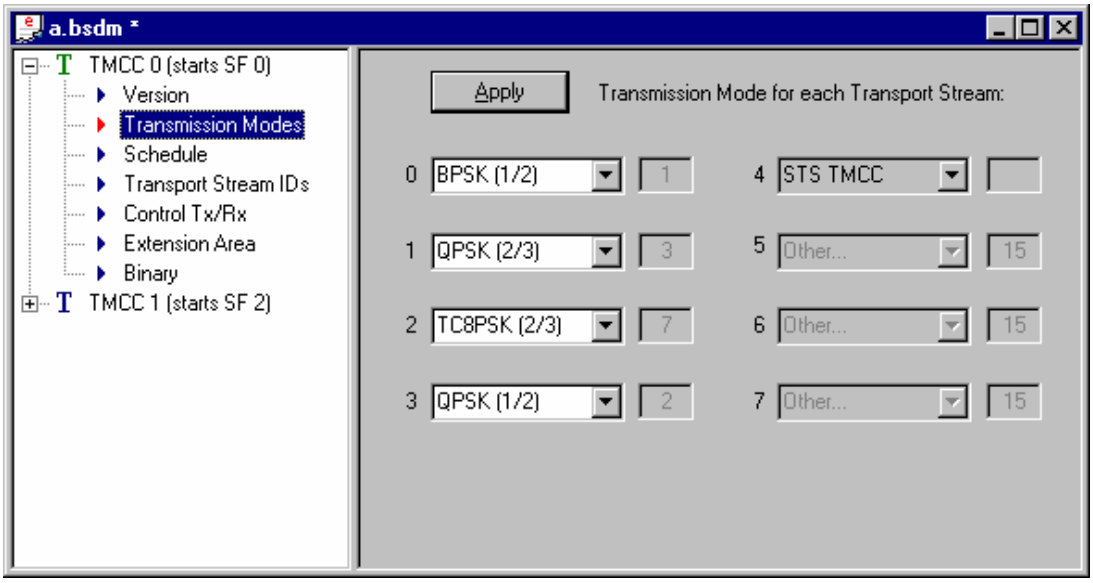


The TMCC version indicates the version of the TMCC. In practical terms the remainder of the TMCC parameters (after the first encounter) are ignored and assumed to remain the same unless the version number changes.

Version numbers are allocated sequentially to each TMCC. A change in version number from one TMCC instance to another is necessary to ensure that the decoder can detect changes in the TMCC.

The Version number cannot be edited unless the Expert mode is enabled.

Transmission Modes



This parameter indicates the transmission mode that is used to carry each of the MPEG files in the project. Each transmission mode selection is prefixed with the relative transport stream number allocated when an MPEG file is added.

The following transmission modes are available:

BPSK 1/2 (1/4)	**QPSK 1/2 (1/2)**	**QPSK 2/3 (2/3)**
QPSK 3/4 (3/4)	**QPSK 5/6 (5/6)**	**QPSK 7/8 (7/8)**
TC8PSK 2/3 (1/1)	**No Allocation**	**Other…**
STS TMCC		

where:
BPSK – Biphase Shift Keying;
QPSK – Quadrature Phase Shift Keying;
TC8PSK – Trellis Coding Eight Phase Shift Keying
STS-TMCC – used when the rTS is an STS file. (To see details select View TMCC for the appropriate STS file.)

The ratios given *in parenthesis* in the table above are of valid MPEG data to unit size; the difference is the amount of error-checking data. For example, if QPSK 7/8 transmission mode is selected, seven packets of MPEG data are transmitted for each single packet of error-checking data giving a unit size of eight.

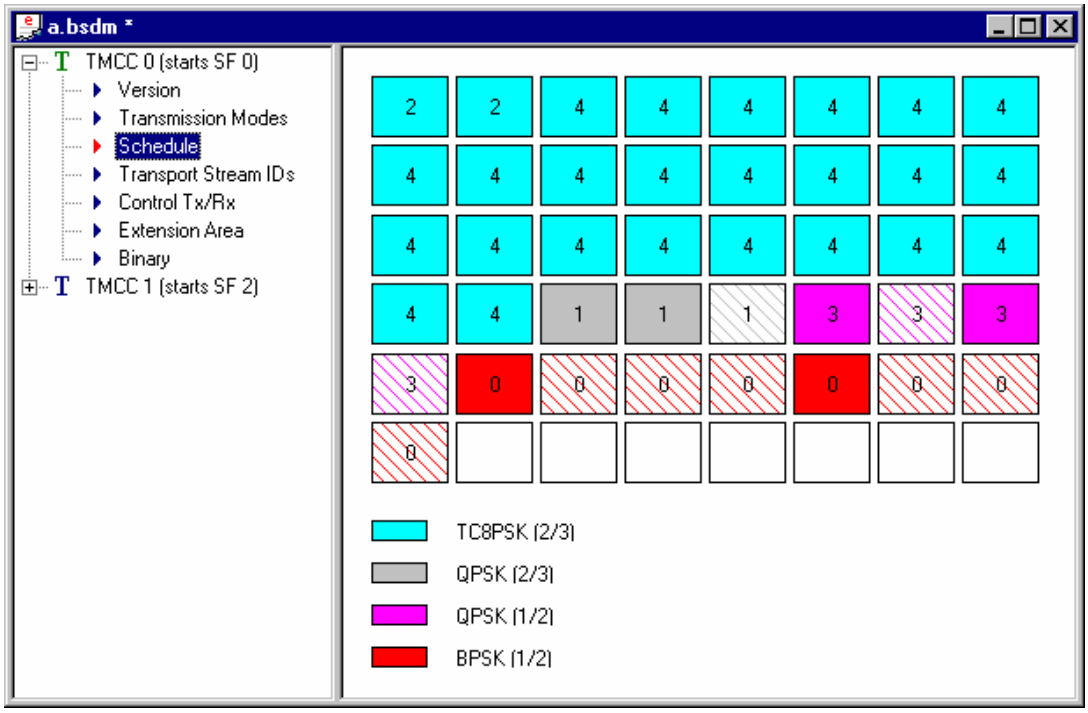
If **No allocation** is selected the MPEG file will not be included in the multiplex for the region specified by the TMCC.

The field immediately to the right of each transmission mode field represents the value that is encoded into the TMCC. This value is fixed (and therefore disabled) for all known modulation modes. The exception is **Other…** for which the field becomes editable and any value up to 15 can be entered. If **Other…** fails the subsequent integrity check, the transmission mode will default to **No Allocation**.

When the **Apply** button is selected, integrity checking will ensure that the TMCC information is compliant. To be compliant, the slots per frame value (shown in parenthesis with the MPEG filename) must be divisible by the valid MPEG data value.

The following parameter, **Schedule**, illustrates the transmission mode allocation graphically.

Schedule



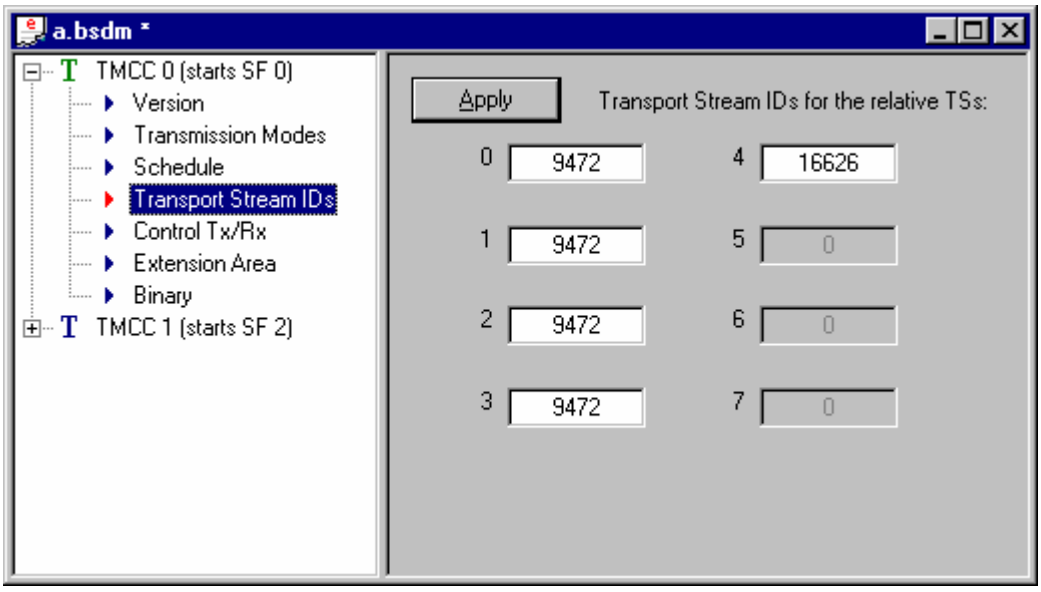
The transmission mode selected for each MPEG file dictates the allocation and distribution of slots in the 48 available in each frame. The schedule parameter display shows graphically the slot layout for a single frame.

The applicable relative transport stream (rTS) number is displayed within each slot. In the example above, the transmission mode selected for rTS 1 is TC8PSK which has an MPEG data to unit size ratio of 1/1 (it has no error-checking data). The transmission mode for rTS2 is QPSK 7/8 which has an MPEG data to unit size ratio of 7/8 (that is seven packets of MPEG data to one packet of error-checking data).

The color coding is not universal; in the example above, the color used for transport stream one and therefore TC8PSK transmission mode may be used for a different transmission mode in the next TMCC.

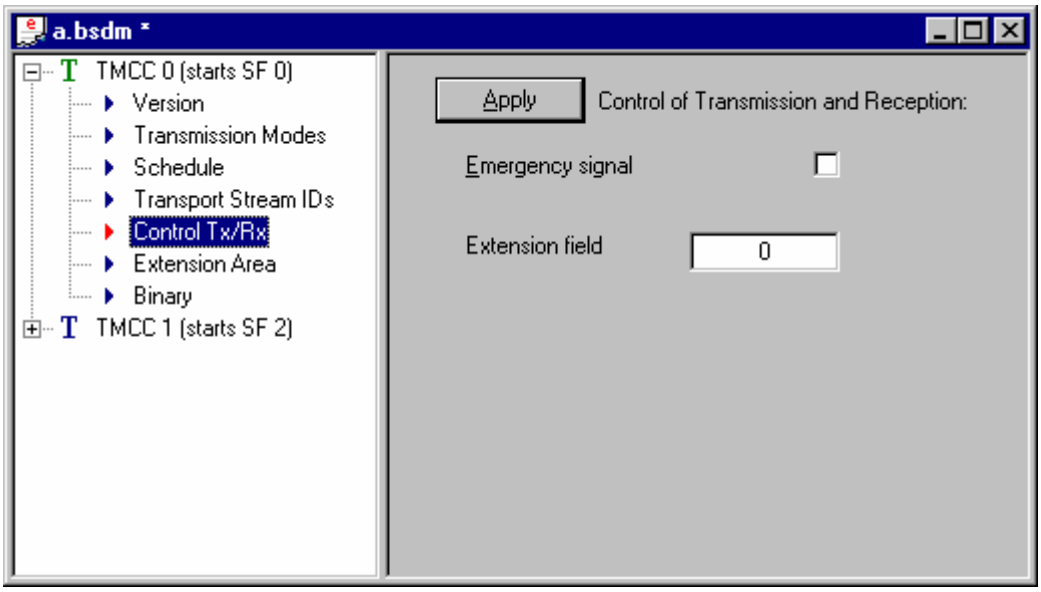
Valid MPEG data is shown in solid color. Error-checking data is shown as hashed lines. STS files are shown in a similar way except that letters correspond to the transmission mode.

Transport Stream IDs



Each transport stream is allocated an identity number that is read from the transport stream identity field within the programme allocation table (PAT), part of the Service Information held by each MPEG file. If this identity field cannot be read, the BSDM will not load the MPEG file. The field is mainly for display purposes, but may be edited in Expert mode. It is quite acceptable to have duplicated identity numbers.
Note that the disabled fields are those for which no MPEG file exists.

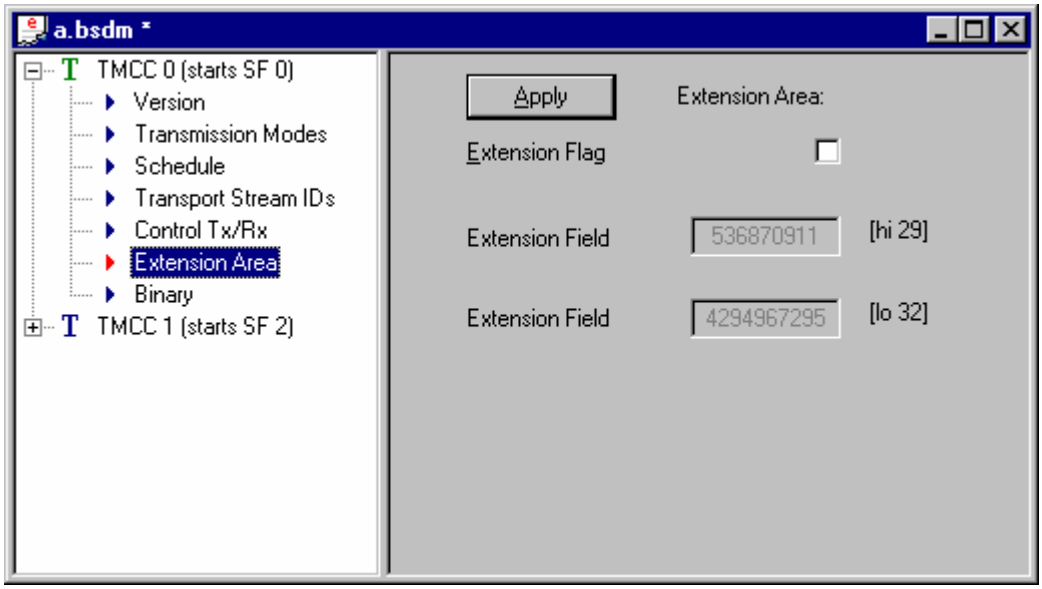
Control Tx/Rx



When enabled, the Emergency signal is intended to boot up the Set-Top box.

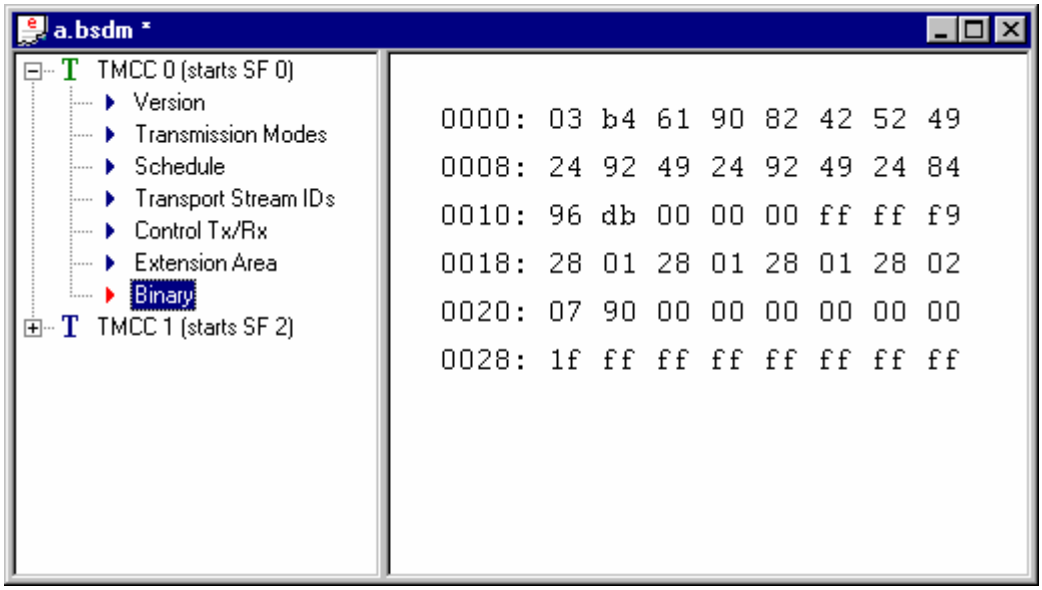
The Extension field (4 bits) is currently undefined.

Extension Area



The Extension Area acts as an extension for TMCC information. The Extension Fields are only valid if the Extension Flag is set. It is recommended that the field values be edited in hex mode to aid ease of use.

Binary

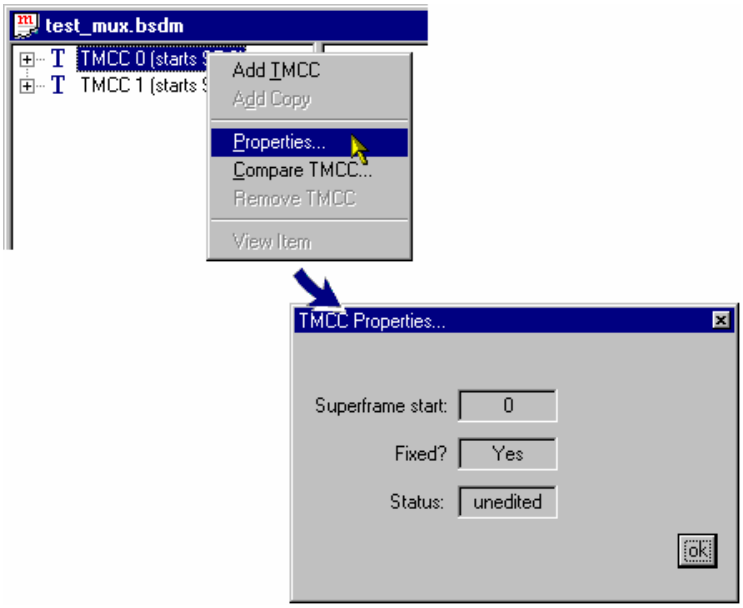


The Binary parameter shows the binary coding of the TMCC. The parameter is non-editable.

TMCC Activities

Viewing TMCC Properties

Each TMCC has an associated properties dialog that shows in which super-frame the TMCC takes effect and the edit status of the TMCC information.



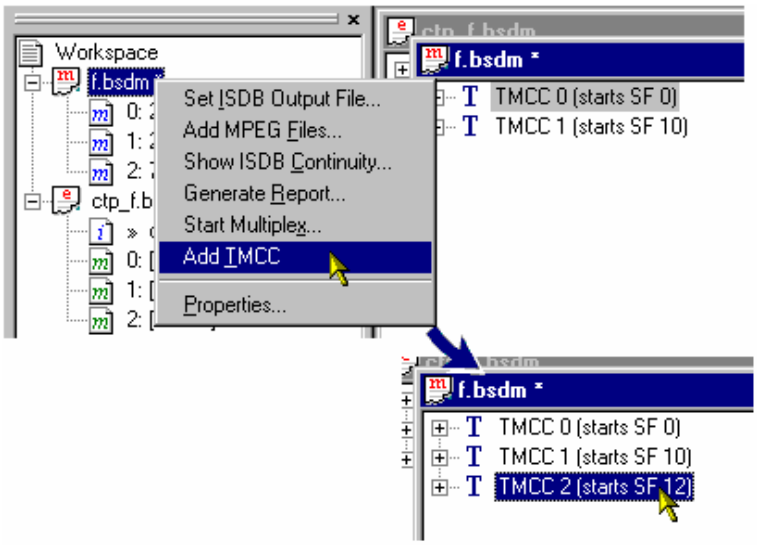
To open the properties dialog, highlight the TMCC label in the TMCC window and select **Properties…** from the right-click menu.

Superframe start: Specifies in which superframe the TMCC is to take effect. This field can only be edited for Mux projects.

Fixed? (green) **Yes** indicates that the TMCC information is internal to the stream; that is it is derived from the multiplexed information and not extracted from the project file.
(blue) **No** indicates that the TMCC information was added by the user and therefore is stored in the project file.

Status: **Added** indicates that it has been added in this session (blue icon).
Edited indicates that it previously existed, but has been edited in this session (green icon).
Unedited indicates that it previously existed and has not been edited (green icon).

Adding TMCCs

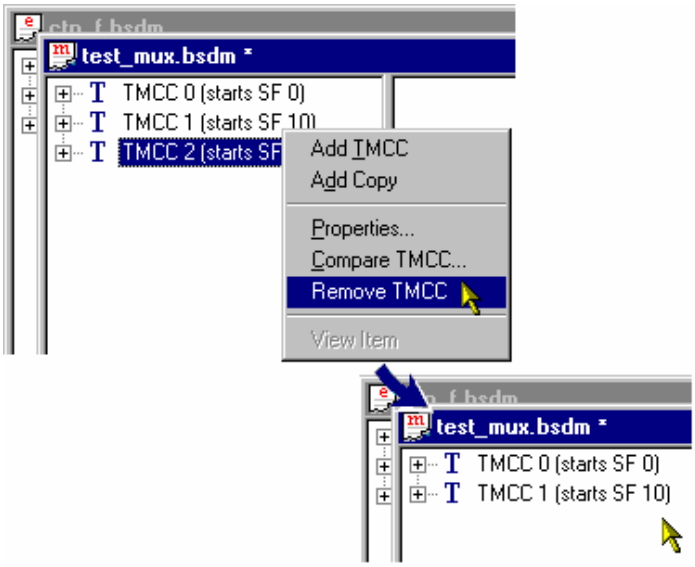


To add a TMCC to a project, highlight the project name in the workspace and select **Add TMCC** from the right-click menu.

Note that the superframe in which the TMCC is to start can be amended from the new TMCC properties dialog.

For the new TMCC to take full effect, the parameters will need to be set (see page 25).

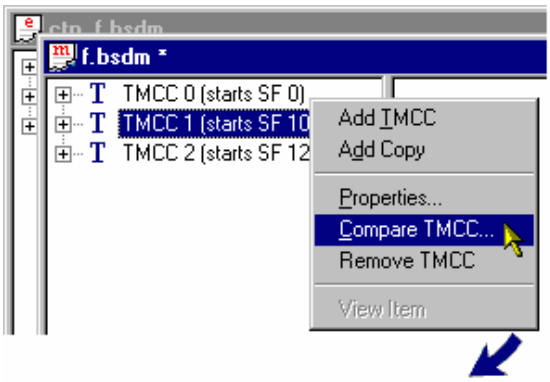
Removing TMCCs



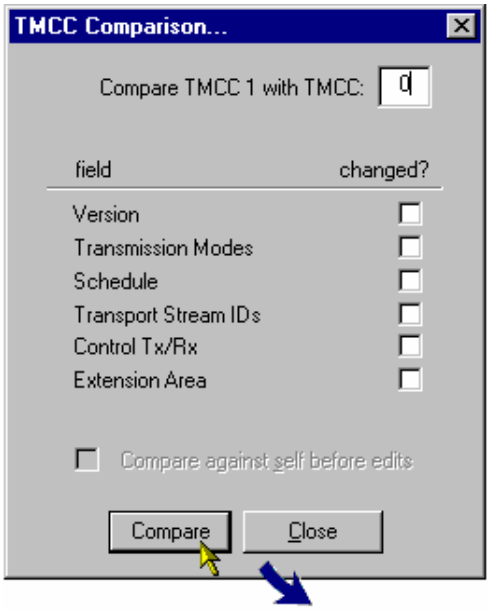
To remove a TMCC from a project, highlight the TMCC label in the TMCC window and select **Remove TMCC...** from the right-click menu.

Note that removing a TMCC may require some adjustment of the remaining TMCCs, e.g. the starting superframes.

Compare TMCCs

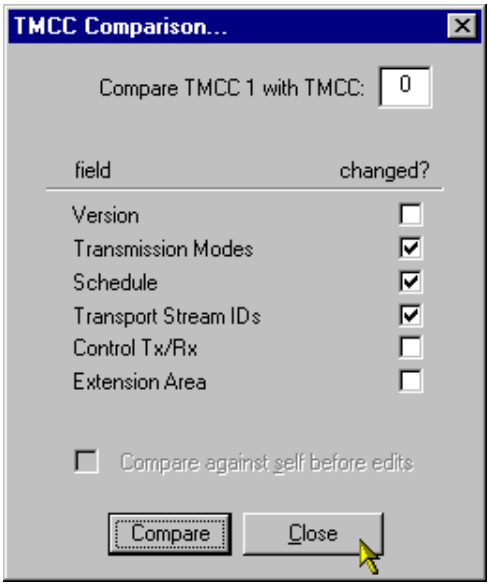


To compare the parameters of TMCCs, highlight the TMCC label in the TMCC window and select **Compare TMCC...** from the right-click menu.



The highlighted TMCC can be compared with any other TMCC.

Enter the number of the TMCC to be compared and select **Compare**.



The parameters of the two TMCC are compared and if any divergence is found a tick is placed adjacent to the relevant parameter.

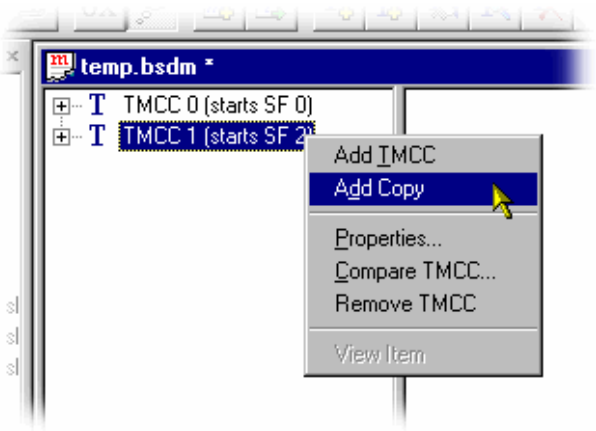
The differences can be verified by closing the dialog and checking the individual parameters.

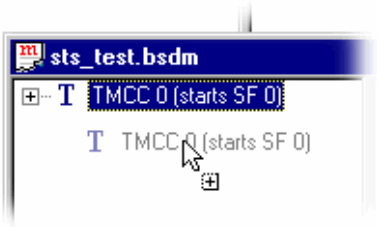
To close the TMCC Comparison dialog, select **Close**.

Copying TMCCs

TMCCs in multiplex projects can be copied using the right-click option provided. This avoids the need for manually copying a TMCC.

TMCCs can also be copied using the Windows technique of right-click drag and drop.

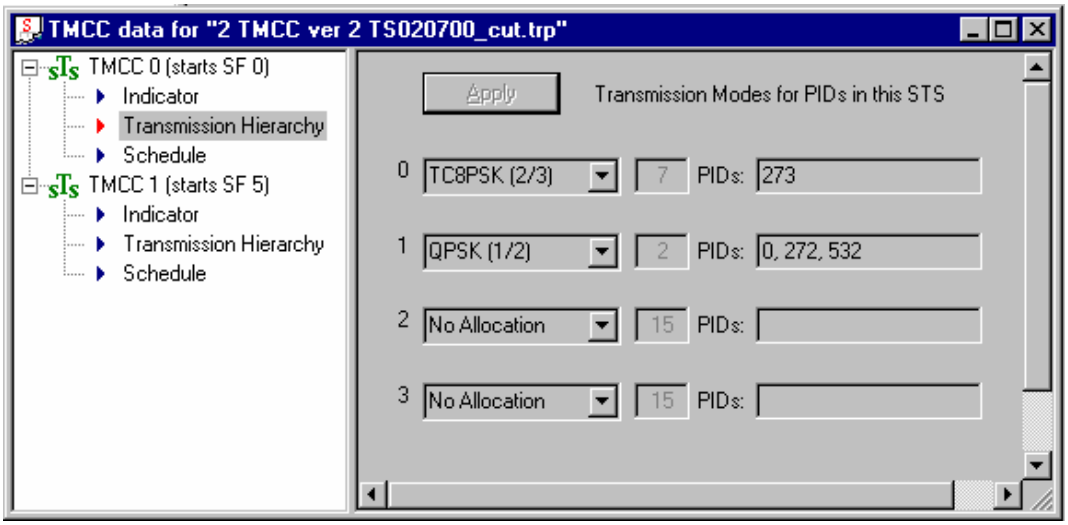




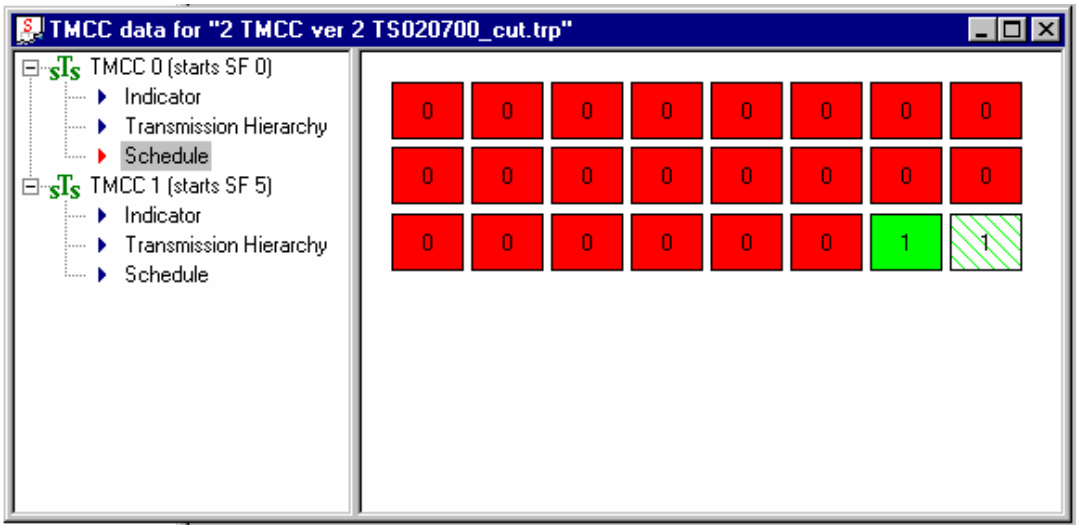
TMCC (STS) Window

STS files are auto-detected when added to the project. They are represented in the project window with the icon .

An STS file contains TMCC information that can be viewed in a separate window. The information shown is similar to the information for the TMCC data in the project. There is a separate set of information for each STS file in the project. The following example shows an STS file that has 2 TMCC and uses hierarchical modulation:



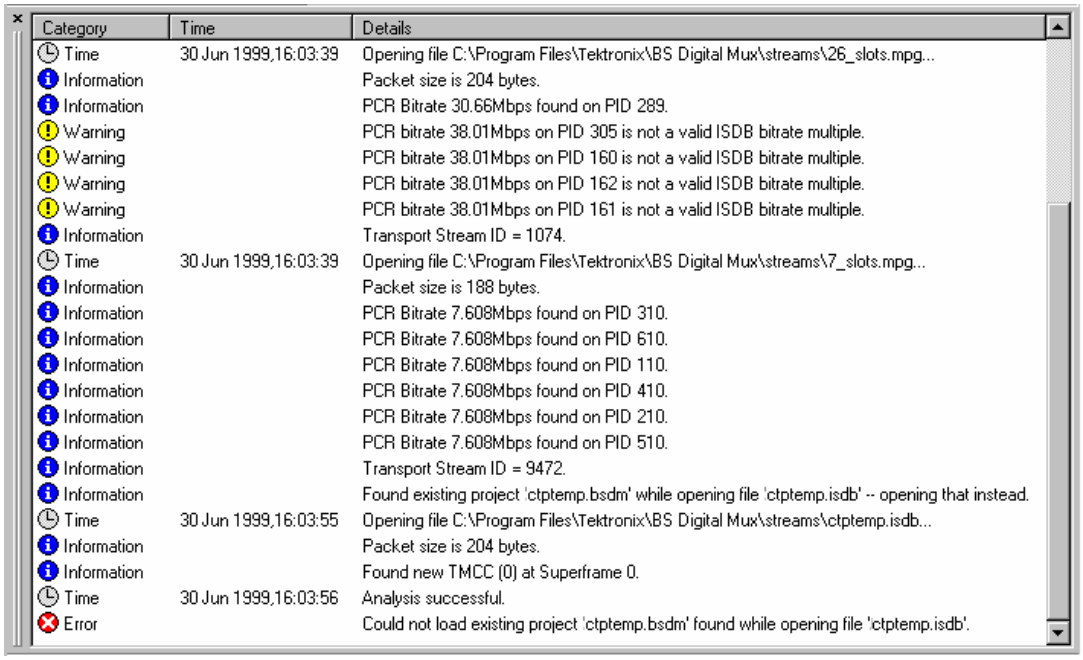
A graphical view of the allocation of packets in the TMCC can be seen under the **Schedule** item:



- Note only 24 packets are displayed. This STS file has 24 packets per frame.
- The colors used represent the different modulation modes used within the STS TMCC match those used in the continuity dialog.
- When a project is closed any STS TMCC views of files contained within the project are also closed.

Log Window

The Log window displays the contents of the log file which reports and logs all BSDM activity.



Category	Time	Details
Time	30 Jun 1999,16:03:39	Opening file C:\Program Files\Tektronix\BS Digital Mux\streams\26_slots.mpg...
Information		Packet size is 204 bytes.
Information		PCR Bitrate 30.66Mbps found on PID 289.
Warning		PCR bitrate 38.01Mbps on PID 305 is not a valid ISDB bitrate multiple.
Warning		PCR bitrate 38.01Mbps on PID 160 is not a valid ISDB bitrate multiple.
Warning		PCR bitrate 38.01Mbps on PID 162 is not a valid ISDB bitrate multiple.
Warning		PCR bitrate 38.01Mbps on PID 161 is not a valid ISDB bitrate multiple.
Information		Transport Stream ID = 1074.
Time	30 Jun 1999,16:03:39	Opening file C:\Program Files\Tektronix\BS Digital Mux\streams\7_slots.mpg...
Information		Packet size is 188 bytes.
Information		PCR Bitrate 7.608Mbps found on PID 310.
Information		PCR Bitrate 7.608Mbps found on PID 610.
Information		PCR Bitrate 7.608Mbps found on PID 110.
Information		PCR Bitrate 7.608Mbps found on PID 410.
Information		PCR Bitrate 7.608Mbps found on PID 210.
Information		PCR Bitrate 7.608Mbps found on PID 510.
Information		Transport Stream ID = 9472.
Information		Found existing project 'ctptemp.bsdm' while opening file 'ctptemp.isdb' -- opening that instead.
Time	30 Jun 1999,16:03:55	Opening file C:\Program Files\Tektronix\BS Digital Mux\streams\ctptemp.isdb...
Information		Packet size is 204 bytes.
Information		Found new TMCC (0) at Superframe 0.
Time	30 Jun 1999,16:03:56	Analysis successful.
Error		Could not load existing project 'ctptemp.bsdm' found while opening file 'ctptemp.isdb'.

The following icons are used to indicate the activity logged:

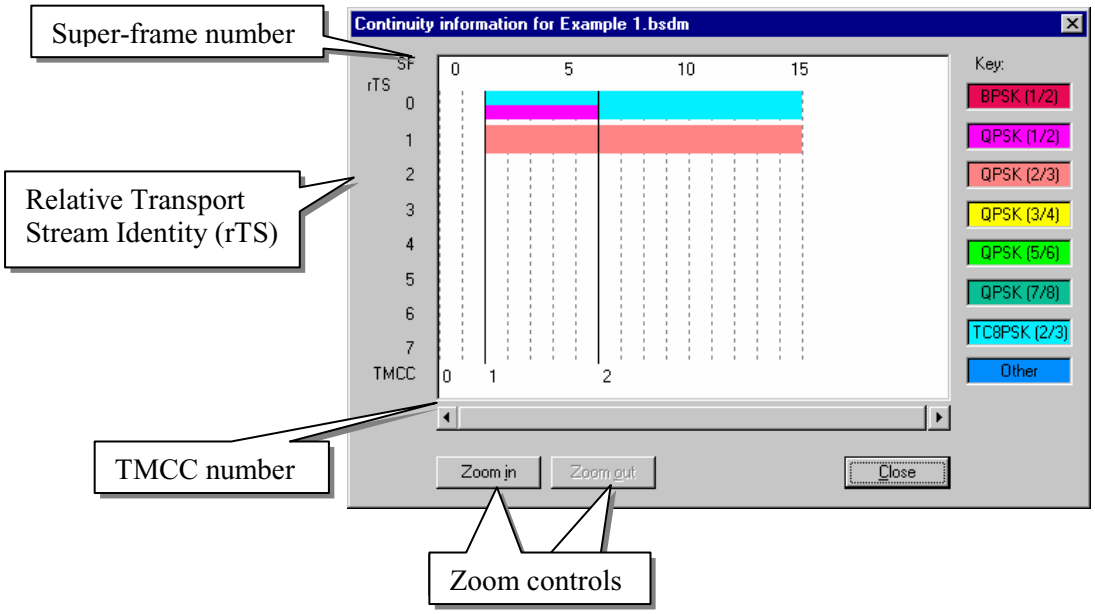
Information	indicates processing activity.
Time	indicates the time of an activity.
Warning	provides information about non-catastrophic events, e.g. events which, while not preventing a stream from being opened, may make the analysis incorrect.
Error	provides information about catastrophic events, e.g. unable to analyze a ISDB-S stream.

Two right-click items are available: **Clear log** clears the current log file and **Copy** copies the contents of the log file to the clipboard, from where it can be pasted into a text editor.

The Log file is discarded when the application is closed.

Continuity Information

The Continuity screen provides a graphic illustration the continuity and modulation type of the files in a project. The screen can be displayed by highlighting the project name in the workspace and selecting **Show ISDB Continuity…** from the right-click menu. It may remain open (and updated) while changes are made to the project.



In the screenshot above, the following is shown:

- This shows the different modulation modes used by for each rTS.
- rTS 0 is an STS stream which has 2 TMCCs. The first TMCC has two modulation modes, i.e. it uses hierarchical modulation. When hierarchical modulation is used, the bar is split into two or more sections. The color of each section represents the different modulation modes used within the hierarchical modulation.
- The colors used for the bars and the key are always the same.

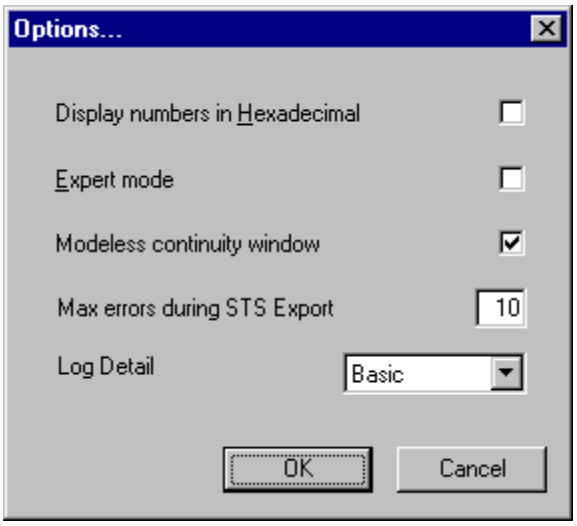
Project Reports

A display of all project properties and parameters formatted for printing out can be selected by highlighting the project name in the workspace and selecting **Generate Report…** form the right-click menu.

The Report screen has two menu options: **Print…** which opens a standard Windows print dialog and **Close** which closes the report screen.

Options…

The **View ➔ Options…** dialog offers the following options:



Display Numbers in Hexadecimal

Toolbar: 0x

When enabled, some numerical displays (e.g. PID numbers) are shown in hexadecimal format, e.g. 0x04A. When disabled, all numerical displays are shown in decimal format.

Expert Mode

Toolbar:

When enabled, more user intervention becomes possible by allowing additional fields to be edited. It also disables some conformance checking.

Modeless Continuity Window

When enabled, the Continuity window (see page 37) can remain open (and will be updated) while changes are made to the project. When disabled, the Continuity window must be closed before changes can be made to the project.

Maximum Errors during STS Export

When exporting an STS file, the program will check the file until the number of errors matches the value set in this field, after which the process will be terminated.

Log Detail

The level of detail to be included in the log file can be selected from this drop-down list.

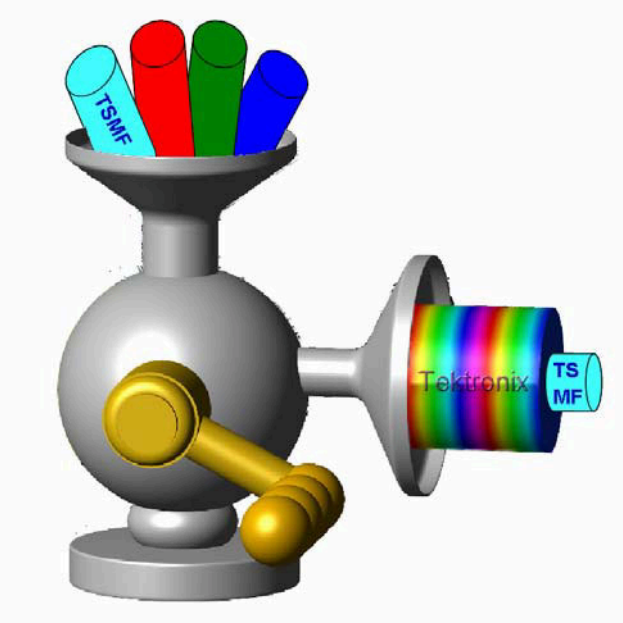
Reference

[1] ARIB STD-B20 Digital Broadcasting System and Related Optional Guidelines for Broadcasting Satellites

Glossary and Abbreviations

ARIB	Association of Radio Industries and Businesses
BSDM	Broadcast Satellite Digital Multiplexer
ISDB-S	Integrated Services Digital Broadcasting - Satellite
MPEG	Moving Picture Experts Group
SI	Service Information
STS	Special Transport Stream
TMCC	Transmission and Multiplexing Configuration Control

Section 13

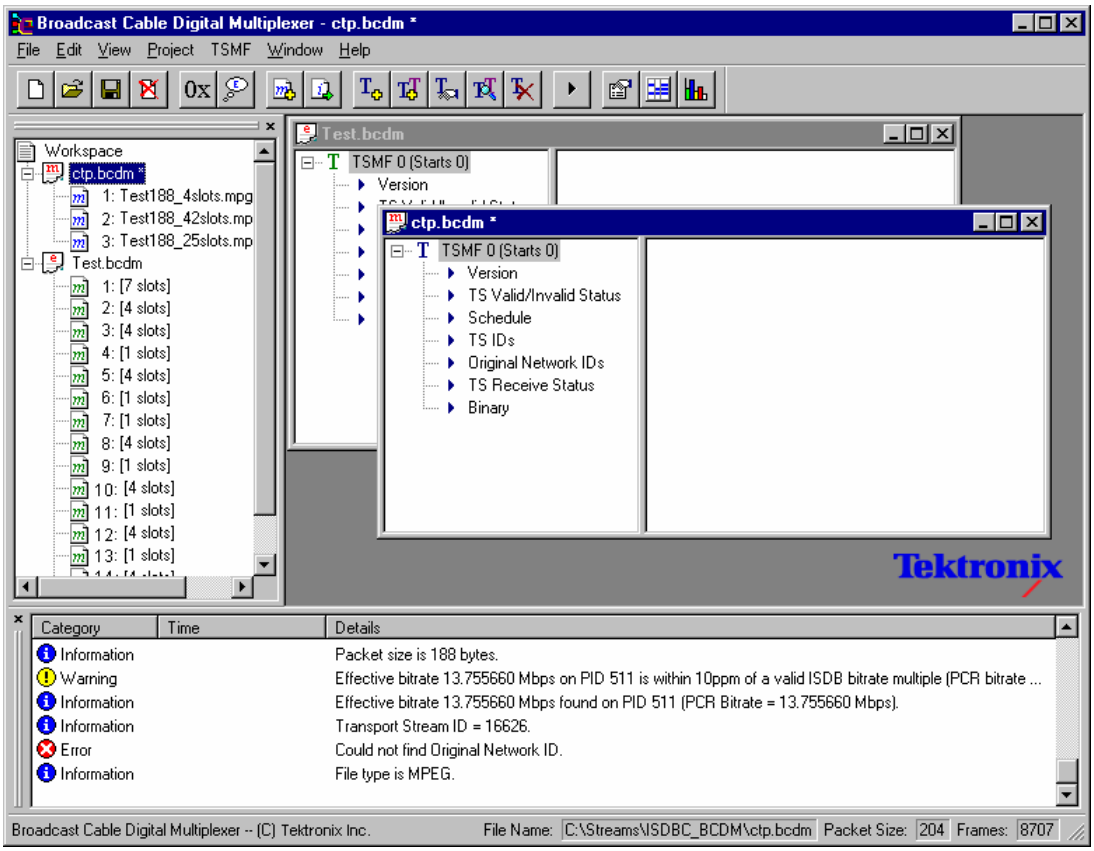


BC Digital Multiplexer

Introduction 3
TSMF Stream Overview 4
Project File 5
Starting the Program 6
Initial Appearance 6
Initial Menu Options 7
Main Window 7
Menus and Options 8
Toolbar 11
Status Bar 12
Workspace Window 12
TSMF Window 20
Log Window 31
Continuity Information 32
Project Reports 32
Options… 33
Reference 34

Introduction

Tektronix Broadcast Cable Digital Multiplexer (BCDM) provides off-line multiplexing of existing transport streams and TSMF (Transport Stream Multiplexing Frame) information in order to produce ISDB-C streams (TSMF streams). It can also be used to demultiplex existing TSMF streams and allow the TSMF information to be edited.



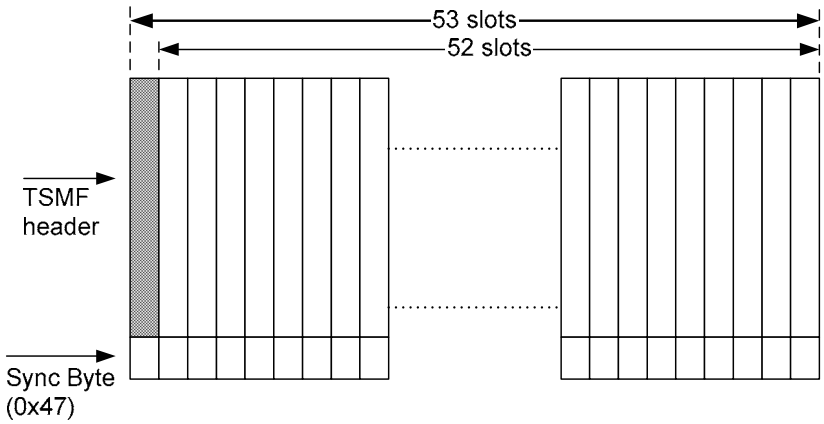
BCDM is a complete multiplexer, demultiplexer, editing and analysis tool for TSMF streams. The application enables the following activities:

- Creation of TSMF streams comprising one or more MPEG files and TSMF information.
- Analysis of TSMF streams, showing TSMF, transport streams and continuity information; a number of conformance checks are also performed.
- Extraction of one or more MPEG transport streams from an TSMF multiplex.
- Editing of TSMF streams, including addition and removal of MPEG files and modification of TSMF information.

TSMF Stream Overview

Up to 15 transport streams can be multiplexed together to form an output stream.

A single TSMF comprises 53 packets (or slots). The TSMF header data is encoded on slot 0 which always corresponds to PID 0x2F (decimal 47) (refer to 34 for a description of the header structure).



Bit Rates

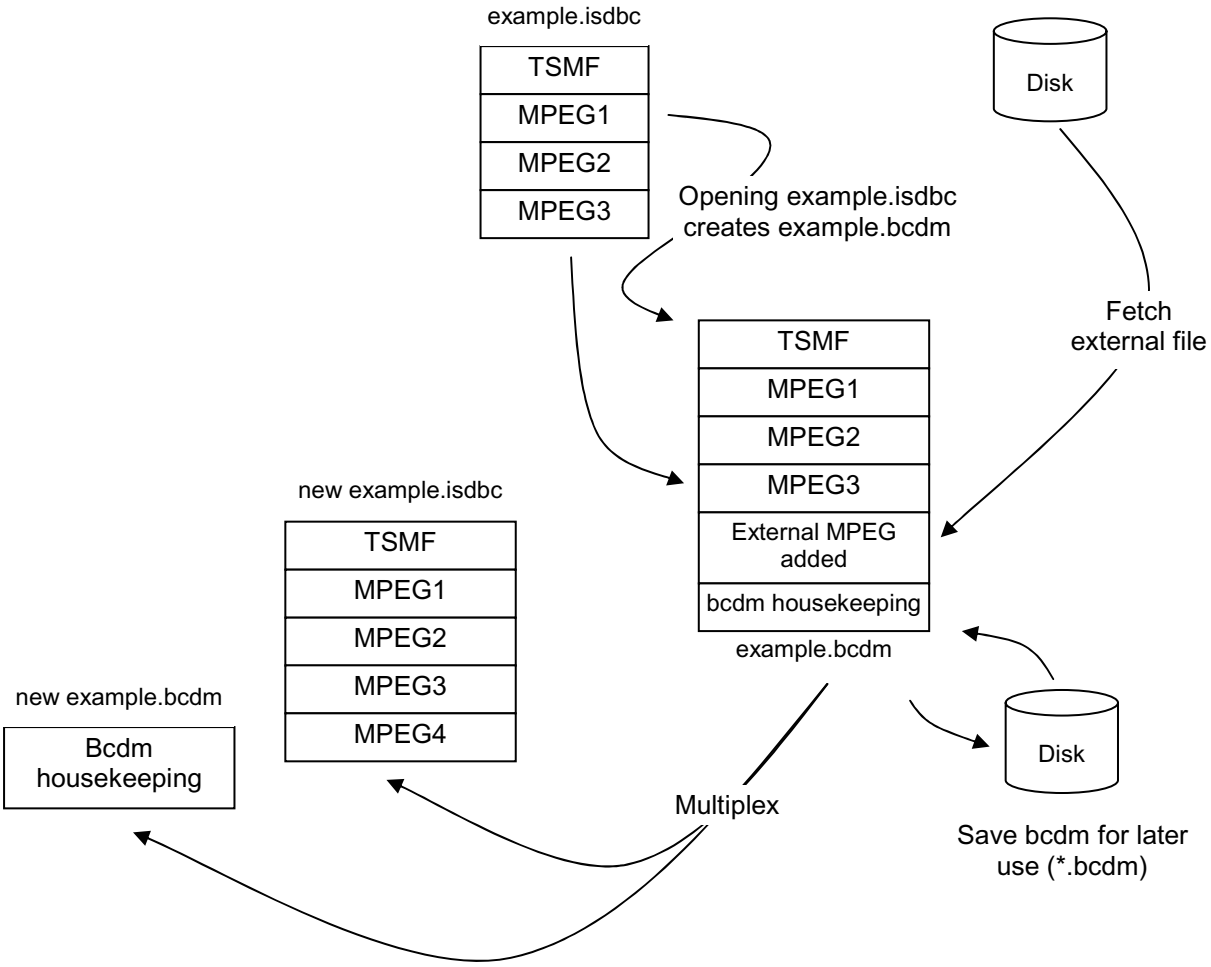
Each TSMF slot has a fixed bandwidth, which is dependent upon the packet size.

TSMF Stream Packet Size	Single Slot Bitrate
188	$\frac{29.1621}{53}$ Mbit/s
204	$\frac{31.644}{53}$ Mbit/s

Each transport stream in the multiplex must occupy a whole number of multiple (or single) slots; so that its bitrate must be a multiple of the single slot bitrate.

Project File

TSMF streams are compiled by the BC Digital Multiplexer with the aid of a project properties file (*.bcdm). The project file contains all the information needed to generate TSMF stream file. This includes references to input MPEG, TSMF information and an output filename (e.g. *.isdbc). A project file is automatically created when a new TSMF stream is created from constituent files.



Multiplex and Edit Projects

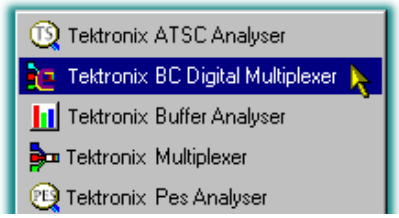
A Multiplex project is one in which the project file (*.bcdm) was created at the same time as the TSMF file (*.isdbc or *.mpg) was first multiplexed; that is, the project file references the constituent MPEG files.

An Edit project is one where no project file (*.bcdm) exists, so it is derived and created from an existing TSMF stream file. In this case the BCDM can only perform further edits; more MPEG files can be added to an Edit project but the existing files in the multiplex cannot be altered.

When the stream is finally multiplexed, the information held in the project properties file is integrated into the output stream. Only housekeeping information is retained in the properties file.

Starting the Program

The program can be started by selecting the **Tektronix BC Digital Multiplexer** option from the **Start ➔ Programs** menu.

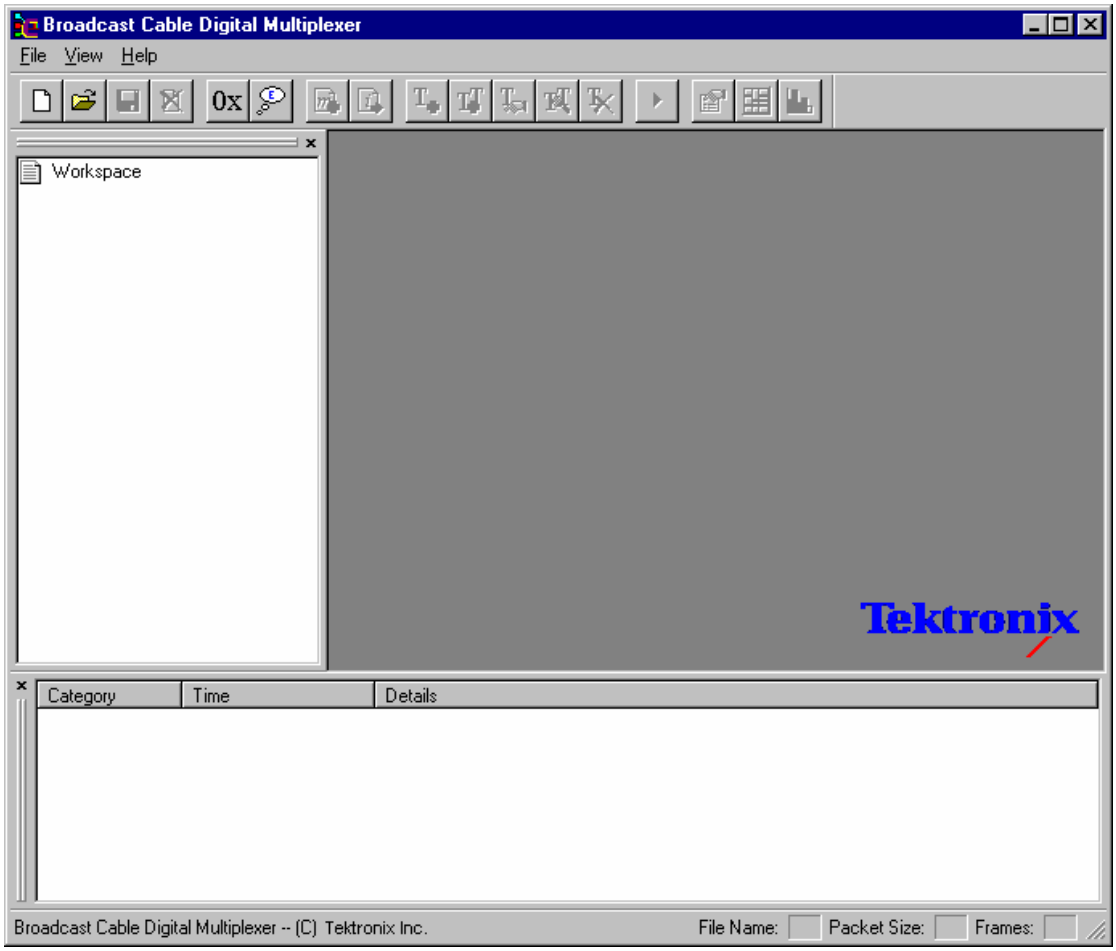


or

by double-clicking on the Tektronix BC Digital Multiplexer shortcut on the desktop.

Initial Appearance

Once the program has started and is ready for use, it will open a window similar to that shown below.



Initial Menu Options

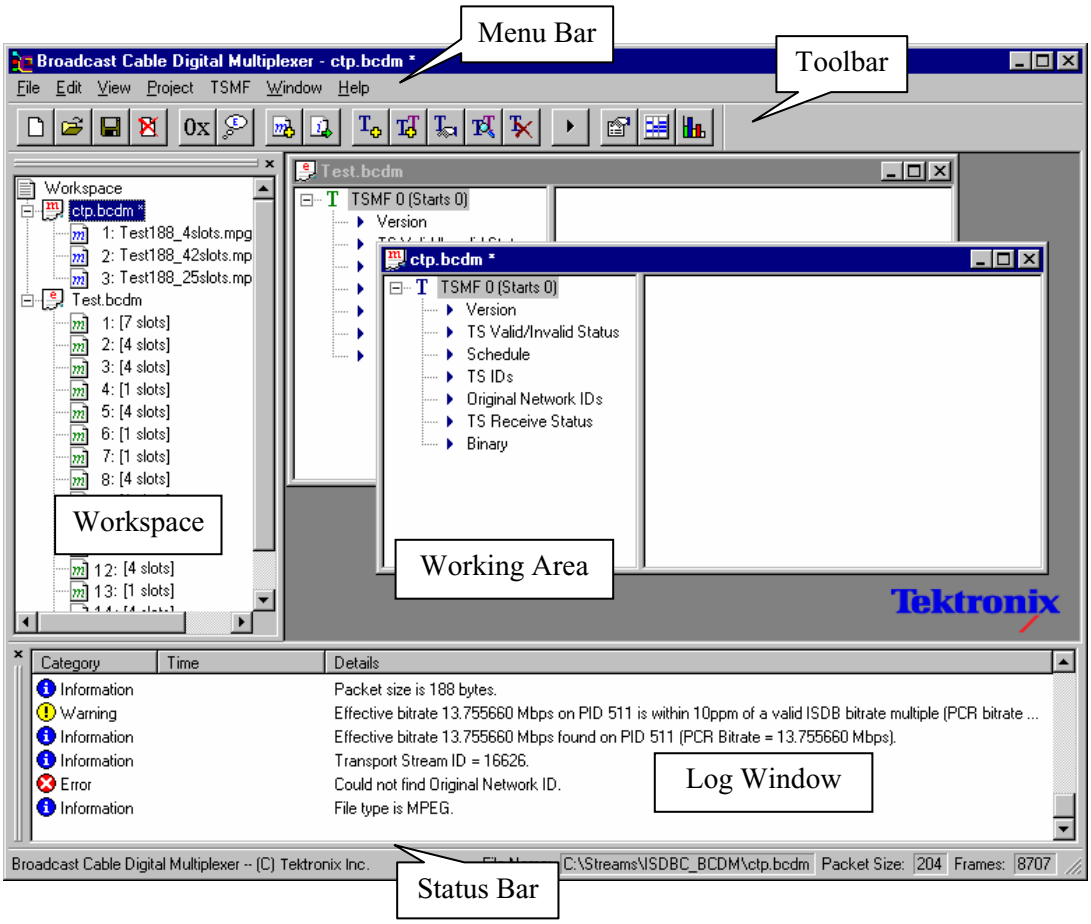
Initially, before any file is opened, BCDM presents only the File, View and Help menus (described in *Menus and Options*, page 8).

Opening a TSMF Stream

When opening an TSMF transport stream the following rules apply:

- If a project file (*.bcdm) of the same name exists, then the information subsequently displayed will have been extracted from the project file.
- If no project file of the same name exists, then the transport stream is analyzed and a project file (of the same name) created.

Main Window



The main window comprises the following items:

- Menu Bar
- Toolbar
- Workspace window
- Working area
- Log window
- Status Bar

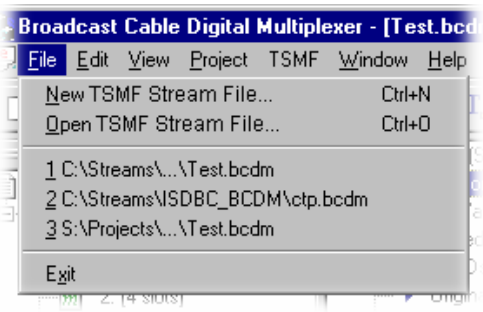
By default, the Workspace and Log windows are displayed; subsequent display selections may change the initial layout. The remainder of the main window (Working Area) remains blank until a project is opened.

Most commands are available via three routes: as a menu option, using a toolbar button or from a context-sensitive right-click menu. All commands are available from the Menu Bar. In describing activities, the following descriptions favour the right-click menu method, but the final choice of working practice rests with the user.

Menus and Options

This section outlines the menu options available.

File Menu Options



New TSMF Stream File… **Ctrl-N**
Creates a new TSMF Stream file.

Open TSMF Stream File… **Ctrl-O**
Opens (and analyzes) an existing TSMF Stream file.

---

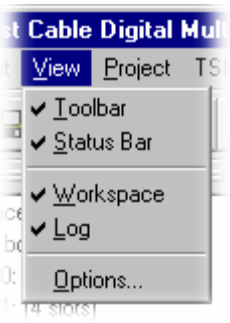
1 <filename>
A list (up to four) of the most recently used files. Selecting a filename opens that file for use.

Exit
Closes the BCDM application.

Edit Menu Options

(None of the Edit menu options are implemented.)

View Menu Options



Toolbar
Toggles the toolbar between being displayed or not. Select the option to change the state.

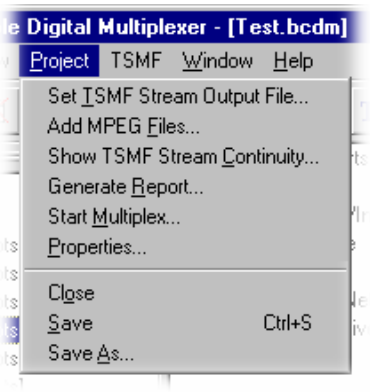
Status Bar
Toggles the status bar between being displayed or not.

Workspace
Toggles the window in which the workspace information is displayed.

Log
Toggles the window in which the log file is displayed.

Options…
Opens the Options dialog (see Options…, page 33).

Project Menu Options



Set TSMF Stream Output File…
Allows the current TSMF stream in a Mux project to be (re)named.

Add MPEG Files…
Adds MPEG files to the current project.

Show TSMF Stream Continuity…
Displays TSMF continuity graphically.

Generate Report…
Displays a text-based report of all project properties and parameters.

Start Multiplex…
Starts the multiplex engine to create a TSMF stream.

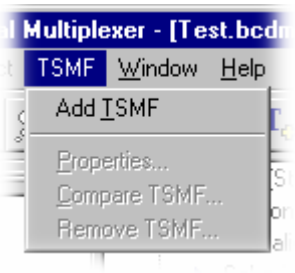
Properties…
Opens the project properties dialog of the currently highlighted project.

Close
Closes currently selected project.

Save **Ctrl+S**
Saves currently selected project.

Save As…
Saves currently selected project under a new/different name.

TSMF Menu Options



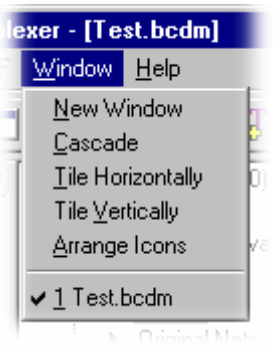
Add TSMF
Adds a new TSMF header to the currently highlighted project.

Properties…
Opens the properties dialog of the currently highlighted TSMF.

Compare TSMF…
Opens the Compare dialog that allows two TSMF headers to be compared.

Remove TSMF…
Removes the currently highlighted TSMF header.

Window Menu Options



New Window
Opens a new TSMF window containing a copy of the current TSMF.

Cascade
Cascades all the open TSMF windows in the workspace.

Tile Horizontally
Tiles all the open TSMF windows horizontally in the workspace.

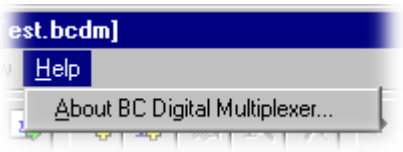
Tile Vertically
Tiles all the open TSMF windows vertically in the workspace.

Arrange Icons
Aligns icons of any minimised TSMF windows at the bottom of the workspace window.

---

1 <window title>
Makes the named TSMF window active, bringing it to the front of any windows that may have been hiding all or part of it.

Help Menu Options



About BC Digital Multiplexer…
Opens the About dialog which gives details of the application's serial number and software version.

Toolbar

The Toolbar provides a set of convenient shortcuts for the more frequently used menu options. Buttons will be greyed out in line with their availability. A tooltip will be displayed briefly if the mouse is rested over a button.

New TSMF Stream File…
Creates a new TSMF Stream file.

Close
Closes currently selected project

Save
Saves currently selected project.

Expert Mode
Toggles Expert/Standard mode. (The **Apply** buttons in the TSMF property dialogs become active in Expert mode.)

Hex Display
Toggles between hexadecimal and decimal numeric display.

Add MPEG Files…
Adds MPEG files to the current project.

Set TSMF Stream File…
Allows the current TSMF Stream in a Mux project to be (re)named.

Add TSMF
Adds a TSMF header to the currently highlighted project.

Add TSMF Copy
Adds copy of currently highlighted TSMF.

Properties…
Opens the properties dialog of the currently highlighted TSMF.

Compare TSMF…
Opens the Compare dialog that allows two TSMF headers to be compared.

Remove TSMF…
Removes the currently highlighted TSMF header.

Start Multiplex…
Starts the multiplex engine to create a TSMF transport stream.

Project Properties…
Opens the project properties dialog of the currently highlighted project.

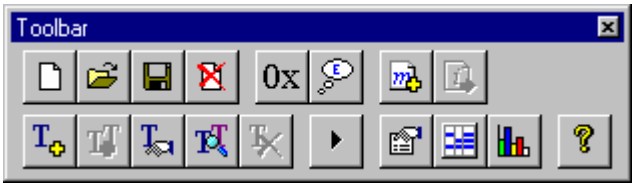
Show Continuity…
Displays TSMF continuity graphically.

Generate Report…
Displays a text-based report of all project properties and parameters.

Open TSMF Stream File…
Opens (and analyzes) an existing TSMF Stream file.

About BCDM…
Opens the About dialog that gives details of the application's serial number and software version.

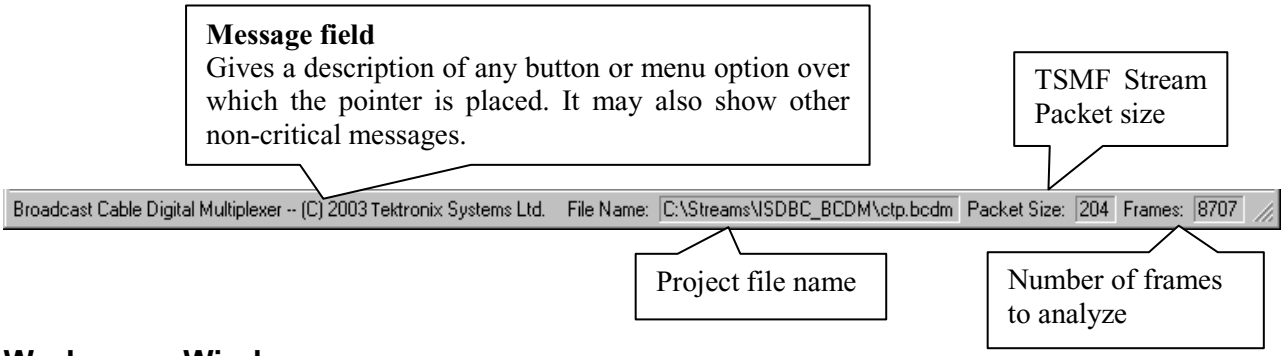
The Toolbar can be dragged off the edge of the main window to create a floating pallet. To do this place the mouse pointer on the background of the Toolbar, i.e. not on one of the buttons, hold the left mouse button down and drag the outline where required. The result will be the Toolbar in a self-contained window, thus:



To re-integrate the Toolbar with the window border, drag the outline over the border until the outline changes shape and then release it. The Toolbar can be placed on any of the four edges.

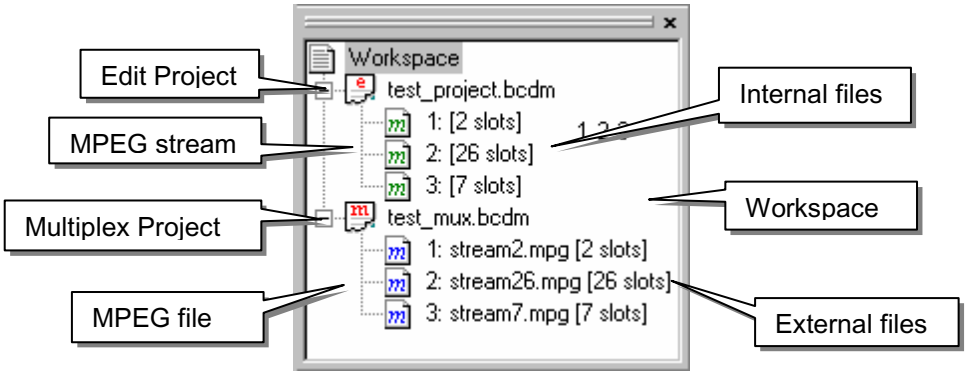
Status Bar

The Status Bar may be hidden from view, but when visible is always at the bottom of the main window.



Workspace Window

The Workspace window shows the MPEG files and/or TSMF stream files contained in each project. Multiple projects can be loaded into the workspace at any one time, as illustrated by the screenshot below.



The screenshot shows the two different project types, namely Multiplex and Edit.

A Multiplex project ( ) (red icon) is one in which the project file was created at the same time as the TSMF Stream file was first multiplexed; that is, the project file references the constituent MPEG files ( ) (blue icon).

An Edit project ( ) (red icon) is one where the project file is created from an existing TSMF Stream file; therefore the BCDM can only perform further edits; more MPEG files ( ) can be added to an Edit project.

The restrictions placed upon an Edit project are:

- The overall TSMF Stream file length may not be altered.
- The TSMF frame start number cannot be edited.
- A TSMF version cannot be removed.

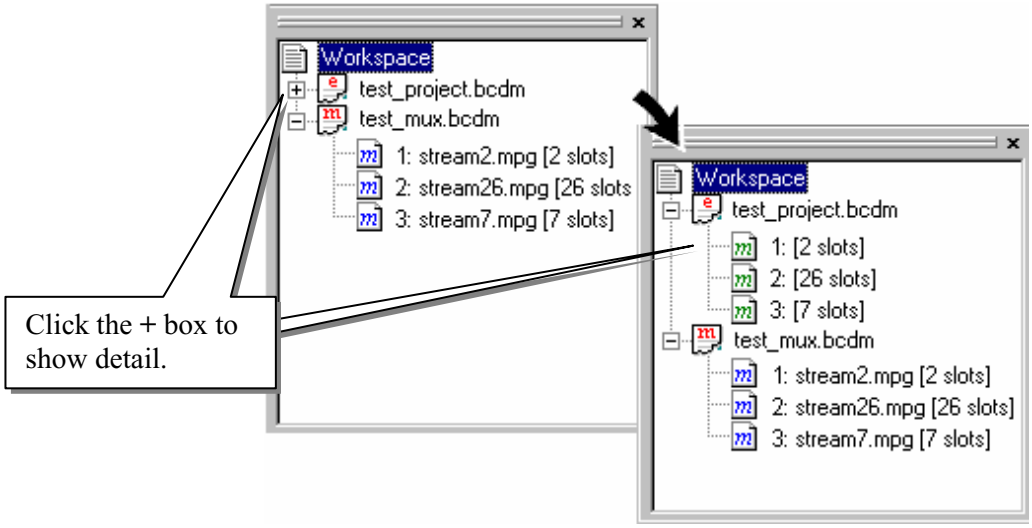
Workspace Icons

The following icons are used in the workspace.

Project Icons		**Color Coding**
Multiplex		Red
Edit		Red
File Icons		
MPEG		Blue – external file Green – internal file

Workspace Control

Projects are represented by a tree structure diagram, with the 'root node' or highest level being the Workspace. Components that contain more information beneath them in the structure are indicated by a square box (/).



Clicking on a box does not select that node, it only shows or hides the level of detail under that node.

If the node has a minus sign ( ) in the box, the level of detail below it is currently displayed. Clicking on the box will hide the detail.

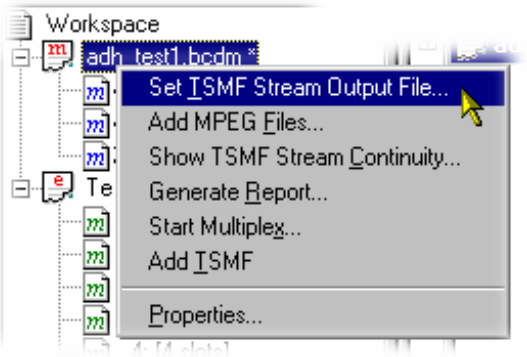
If the box contains a plus sign ( ), there is a hidden level of detail. Clicking on the box will show the detail.

Components which are directly connected to the tree (with out a ⊞ or ⊟ box) are leaf nodes, below which there is no further detail. These correspond to MPEG files or information nodes.

The number preceding the colon before each MPEG file is the relative transport stream identity (**rTS**). The number after the filename (in square brackets) represents the number of slots occupied per frame by the file depending on the bitrate.

Multiplex Project Activities

With a project highlighted in the workspace, the right-click menu is as shown:



Set TSMF Stream Output File…

This command is only enabled for Multiplexed projects.

During the creation of a mux project, the TSMF Stream output file must be named. Note that until the project is multiplexed, the TSMF Stream output file will not be fixed (When the file is multiplexed, a TSMF Stream output file of the same name will be created).

Select **Set TSMF Stream Output File…** from the right-click menu. A standard Windows Save dialog is displayed. Enter the required name of the TSMF Stream file and select the destination.

Add MPEG Files…

MPEG files can be added to Multiplex and Edit projects.

Select **Add MPEG Files…** from the right-click menu. In the dialog displayed highlight one or more MPEG files and select **OK**; up to 15 files can be added. The files will be added to the project (blue icon -); Relative transport stream identity numbers will allocated automatically but can be changed manually.

The bitrate of any 188 byte packet MPEG file selected must be a multiple of 29.1621Mbit/s divided by 53.

Similarly, the bitrate of any 204 byte packet MPEG file selected must be a multiple of 31.644Mbit/s divided by 53.

Show TSMF Stream Continuity…

The Continuity screen provides a graphic illustration of the continuity of the MPEG files in a project.

Select **Show TSMF Stream Continuity…** from the right-click menu. The subsequent display is shown on page 32.

Generate Report…

The report generated displays all of the project properties and parameters.

Select **Generate Report…** from the right-click menu. A text-based report window is opened containing all the project information.

(See Project Reports, page 32)

Start Multiplex…

Starts the multiplex activity using the accumulated project information (MPEG files, and TSMFs) to create a TSMF Stream file.

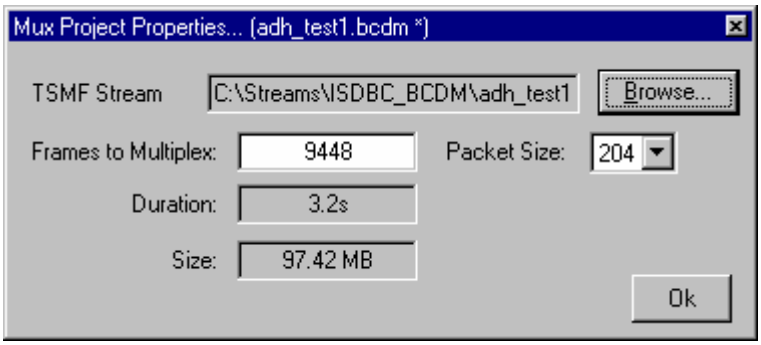
Select **Start Multiplexing…** from the right-click menu. The activity is reported in the Log window.

Add TSMF

(See Adding , page 29)

Project Properties

The properties of an TSMF Stream output file in a Multiplex project are displayed by selecting **Properties…** from the right-click menu. Select **OK** to close the dialog.



TSMF Stream: The TSMF Stream output file name.

Frames to Multiplex: The number of frames to be multiplexed; it is calculated from the available input files.

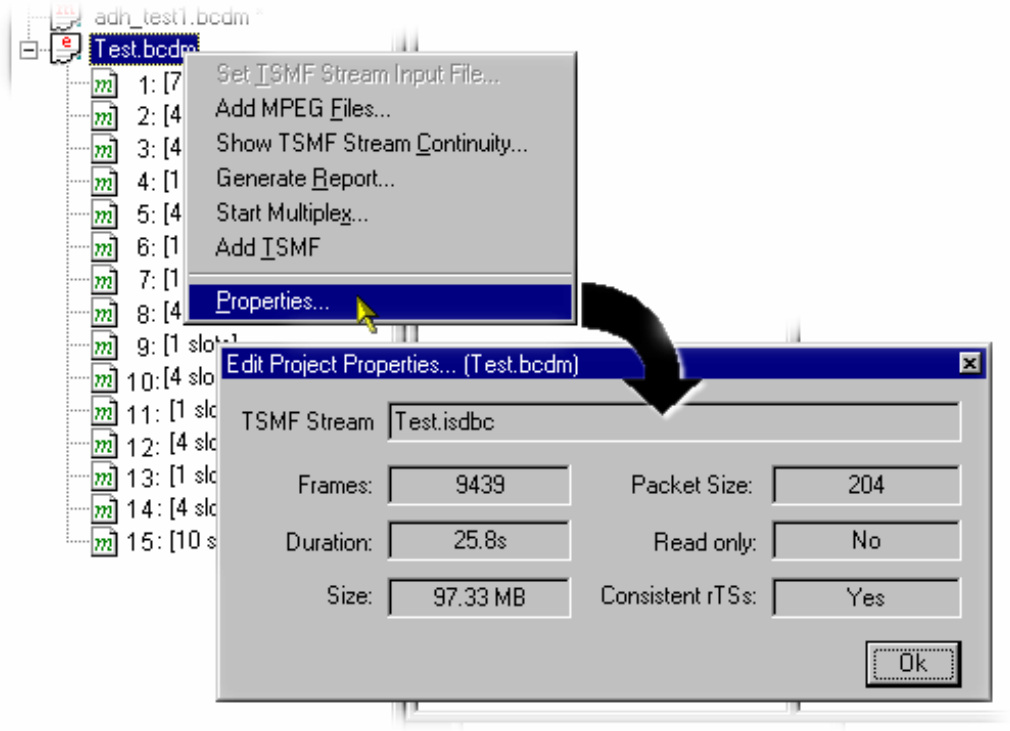
Packet Size: 188/204

Duration: The length of the multiplexed TSMF Stream file.

Size: The size of the multiplexed TSMF Stream file in megabytes.

Edit Project File Properties

The properties of the Edit project file can be displayed by right clicking the filename and selecting **Properties**.



TSMF Stream: Project file name.

Frames: Number of frames.

Packet Size: 188/204

Duration: Duration of project.

Read only: Read/Write status of project file.

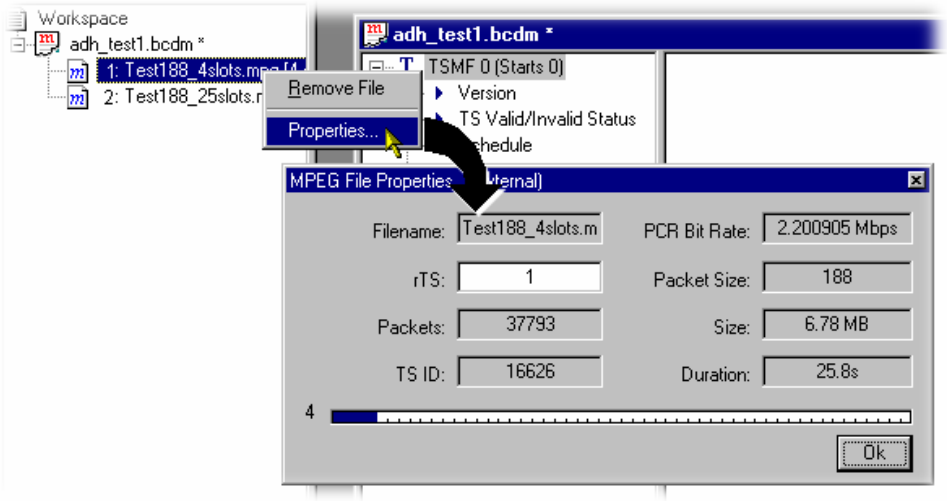
Size: Project file size.

Consistent rTSs: Consistency of relative transport stream identities; that is mapping between the relative transport stream identity and the slots/transport stream identity remains consistent throughout the file.

All fields are read-only. Select **OK** to close the dialog.

External File Properties

The properties of an external MPEG file can be displayed by right clicking on the file name and selecting Properties. The **MPEG File Properties… (external)** dialog is displayed (shown below). The information shown is derived from the stream.



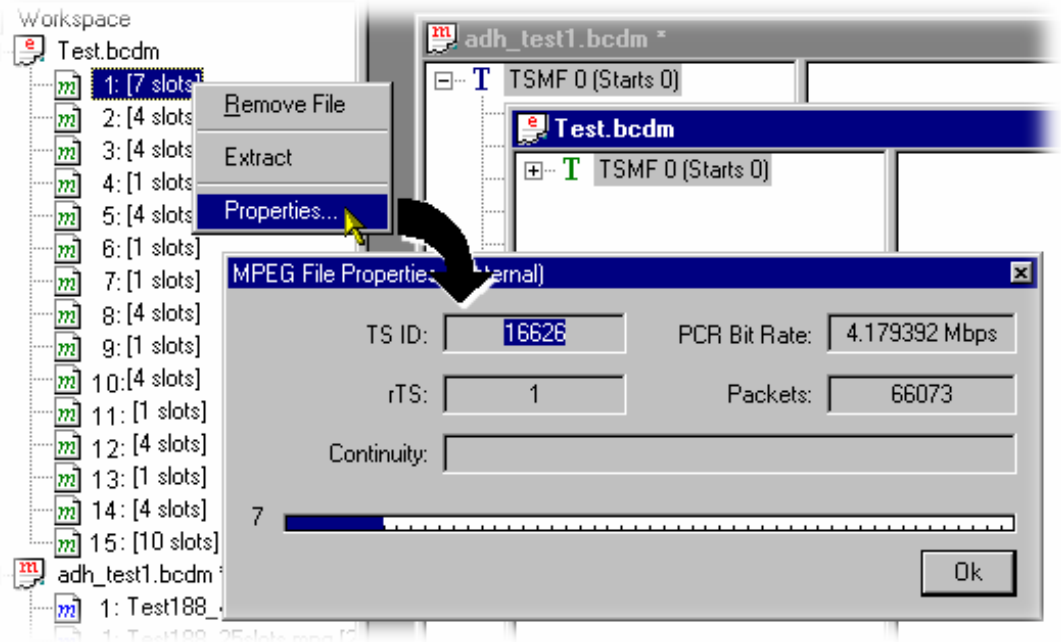
Filename:	MPEG filename.
PCR Bit Rate:	The bitrate of the MPEG stream.
rTS:	Relative Transport Stream – a unique identity for this stream in the overall TSMF stream (range: 1 to 15). This field can be edited as required.
Packet Size:	188 / 204
Packets:	The number of packets in the stream.
Size:	File size.
TS ID:	Transport Stream Identifier.
Duration:	Duration of the file (Size / Bit Rate).

The **Slot Allocation Indicator** at the bottom of the dialog provides a guide as to the number of slots (i.e. 4 in the screenshot above) occupied by the MPEG stream in each frame.

All fields, with the exception of **rTS** are read-only. Select **OK** to close the dialog.

Internal File Properties

Internal file (MPEG stream) properties can be displayed by right clicking on the file name and selecting Properties. The **MPEG File Properties… (internal)** dialog is displayed (shown below). The information shown is derived from the stream. The stream can be extracted (exported) and saved if required.



TS ID: Transport Stream Identifier.

PCR Bit Rate: The bitrate of the MPEG stream.

rTS: Relative Transport Stream – a unique identity for this stream in the overall TSMF stream (range: 1 to 15).

Packets: The number of packets in the MPEG stream.

Continuity: Shows the range of frames occupied by the selected MPEG stream.

The **Slot Allocation Indicator** at the bottom of the dialog provides a guide as to the number of slots (i.e. 7 in the screenshot above) occupied by the MPEG stream in each packet.

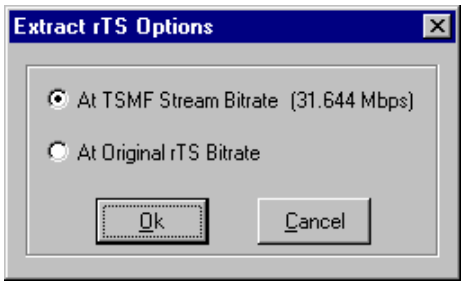
All fields are read-only. Select **OK** to close the dialog.

Extracting the File

An MPEG stream can be saved (or extracted) as an individual stream file.

Highlight the file to be extracted and select **Extract** from the right-click menu.

In the **Extract rTS Options** dialog, select the method of extraction required.



At TSMF Stream Bitrate This method will extract all 53 slots and restamp the PCRs for a fixed bitrate of 29.1621Mbit/s. Any PCR inaccuracies in the original transport stream will be maintained. The TSMF header and streams other than the selected one will be padded with null values. (Method (A) in the diagram below.)

At Original rTS Bitrate This method will extract only slots containing the selected stream. (Method (B) in the diagram below.)

Original TSMF Stream 31.644 Mbit/s

Slot Number	rTS Number
0	Header
1	3
2	3
3	3
4	3
5	3
6	4
7	3
8	3
9	3
10	3
11	3
12	4
13	3
14	3
15	3
16	3
17	4
18	3
19	3
20	3
21	3
22	3
23	4
24	3
25	3
26	3
27	3
28	3
29	4
30	3
31	3
32	3
33	3
34	3
35	4
36	3

Extract rTS3 (A) 31.644 Mbit/s

Slot Number	rTS Number
0	Null
1	3
2	3
3	3
4	3
5	3
6	Null
7	3
8	3
9	3
10	3
11	3
12	Null
13	3
14	3
15	3
16	3
17	Null
18	3
19	3
20	3
21	3
22	3
23	Null
24	3
25	3
26	3
27	3
28	3
29	Null
30	3
31	3
32	3
33	3
34	3
35	Null

Extract rTS3 (B) (31.644*44) Mbit/s 53

Slot Number	rTS Number
1	3
2	3
3	3
4	3
5	3
7	3
8	3
9	3
10	3
11	3
13	3
14	3
15	3
16	3
18	3
19	3
20	3
21	3
22	3
24	3
25	3
26	3
27	3
28	3
30	3
31	3
32	3
33	3
34	3
36	3
37	3
38	3
39	3
40	3

Extract rTS4 (A) 31.644 Mbit/s

Slot Number	rTS Number
0	Null
1	Null
2	Null
3	Null
4	Null
5	Null
6	4
7	Null
8	Null
9	Null
10	Null
11	Null
12	4
13	Null
14	Null
15	Null
16	Null
17	4
18	Null
19	Null
20	Null
21	Null
22	Null
23	4
24	Null
25	Null
26	Null
27	Null
28	Null
29	4
30	Null
31	Null
32	Null
33	Null
34	Null
35	4

Extract rTS4 (B) (31.644*8) Mbit/s 53

Slot Number	rTS Number
6	4
12	4
17	4
23	4
29	4
35	4
41	4
47	4

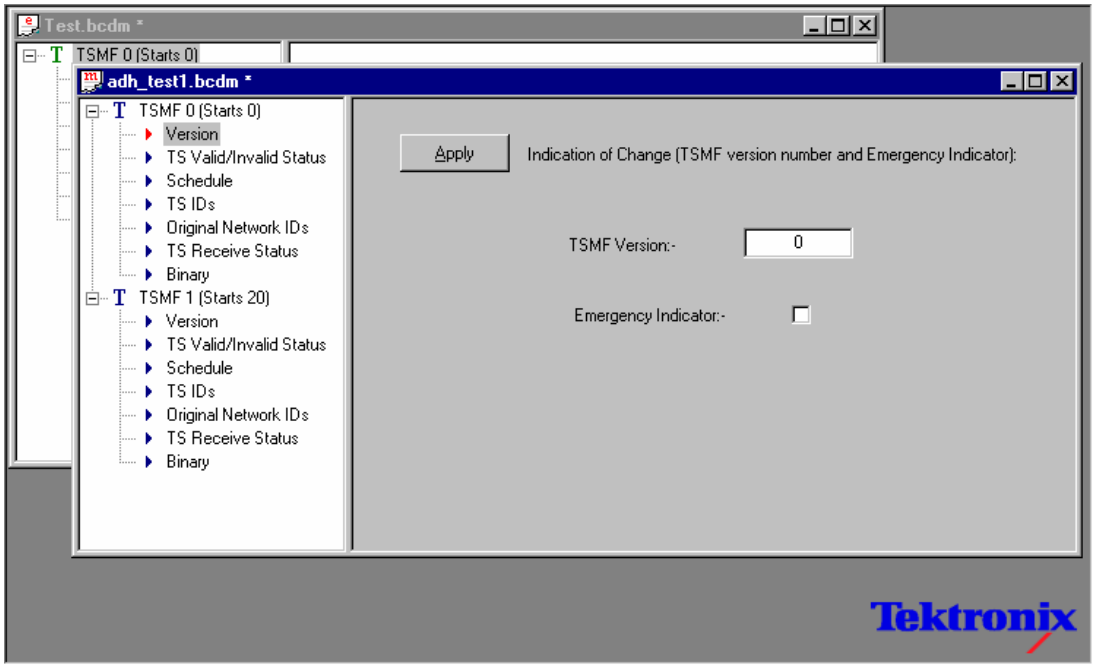
Both methods will enable the user to analyze the PCR inaccuracies of the stream using the Transport Stream Analyzer.

Select **OK** and in the subsequent dialog, allocate the location, file name and file type of the stream to be saved. Select **OK**. The progress of the save action is indicated by a new dialog containing a progress bar.

TSMF Window

The area of the main screen not occupied by the Workspace and Log is given over to TSMF window(s). Each project has a resizable TSMF window associated with it. The active project TSMF window is displayed on top.

Note that the project file in the workspace is not necessarily highlighted when a different TSMF window is selected; conversely, when a different project is selected in the workspace, the corresponding TSMF window *is* activated and brought to the top.

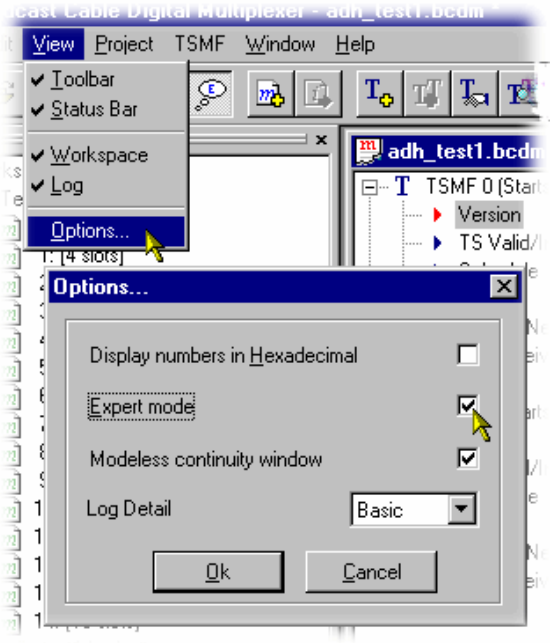


Each TSMF in a project is represented as a tree structure and headed with a **T** icon, the TSMF number and the frame number in which the TSMF becomes active. The color of the TSMF (**T**) icons also has significance. A blue **T** icon indicates that the TSMF was added during this session and therefore is not integrated into the project. A green **T** icon indicates that it is part of (or internal to) an edit project and is therefore fixed and cannot be moved. The TSMF number is simply a sequential number allocated when the TSMF is created.

Each TSMF comprises seven parameters; clicking the ⊞ to the left of the T icon will display a list of the parameter names. Highlighting a parameter name displays the parameter's properties in the right hand pane of the TSMF window. Most of the property windows have an **Apply** button. Where changes are made to the parameter, the **Apply** button must be selected before the change becomes available for use by the multiplex. Simply closing the TSMF window or selecting another parameter will discard any changes.

Note that the **Apply** button (on this and other parameter property screens) is only active when in Expert mode.

Expert mode is selected from the **View** ➔ **Options** dialog

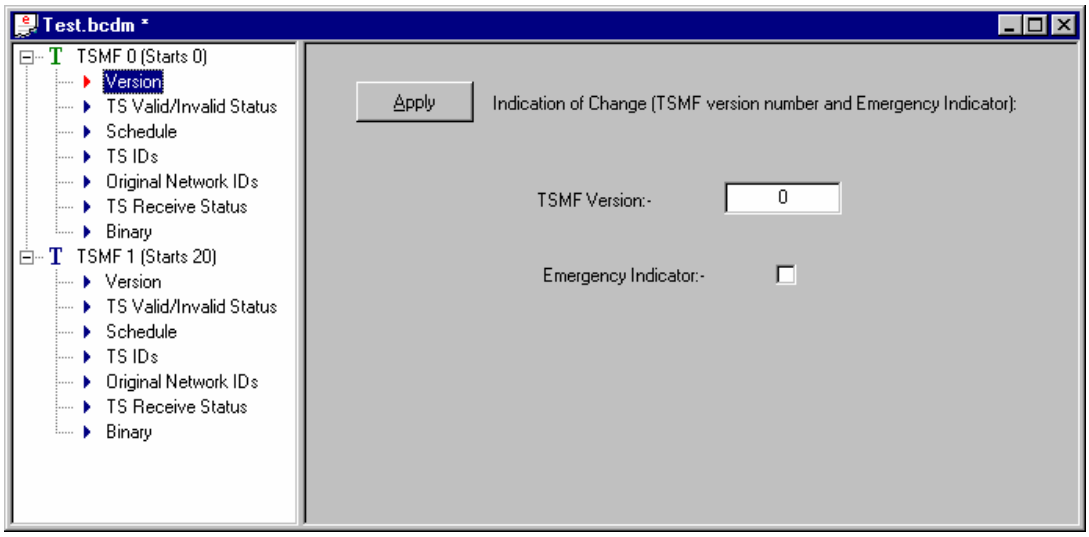


or by selecting the Expert toobar button

TSMF Parameters

TSMFs are labelled with a sequential number and Start number which indicates the frame number in which the TSMF becomes active.

Version



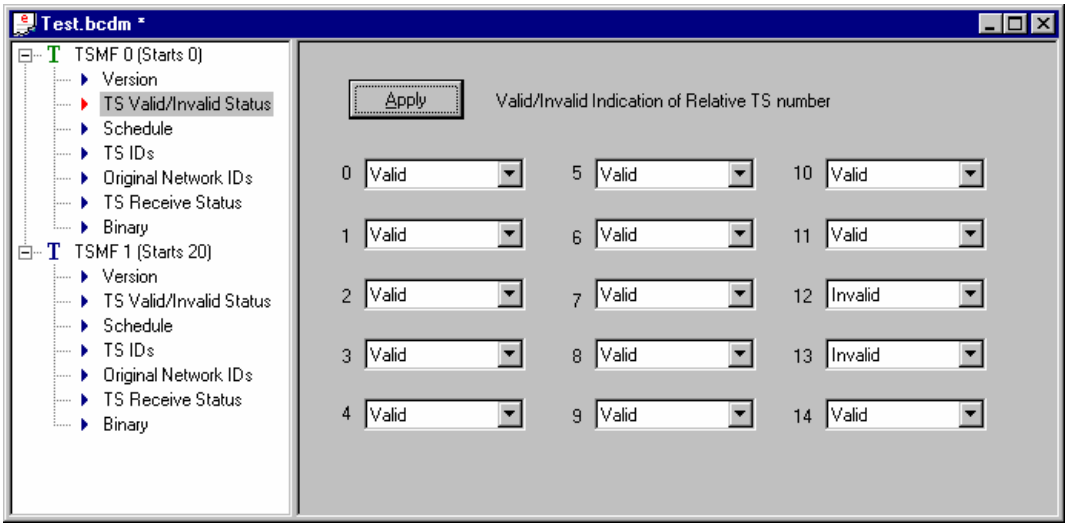
The TSMF version indicates the version of the TSMF. In practical terms the remainder of the TSMF parameters (after the first encounter) are ignored and assumed to remain the same unless the version number changes.

Version numbers (range: 0 to 7) are allocated sequentially to each TSMF. A change in version number from one TSMF instance to another is necessary to ensure that the decoder can detect changes in the TSMF.

The Version number cannot be edited unless the Expert mode is enabled.

When enabled, the Emergency signal is intended to boot up the Set-Top box.

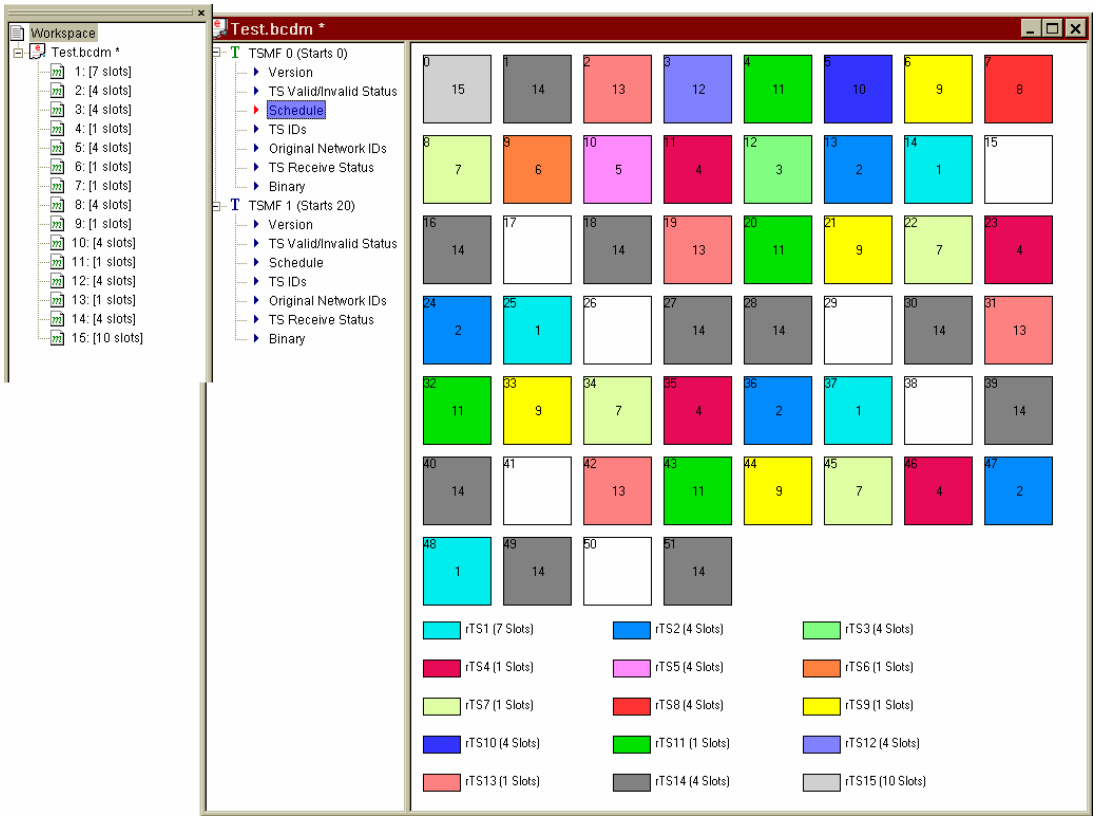
TS Status



This parameter allows streams included in the project file to be enabled/disabled in the final multiplex. Streams designated as **Invalid** will not be included in the multiplex.

When the **Apply** button is selected, integrity checking will ensure that the TSMF information is compliant; To be compliant, total number of slots in a frame should not exceed 52.

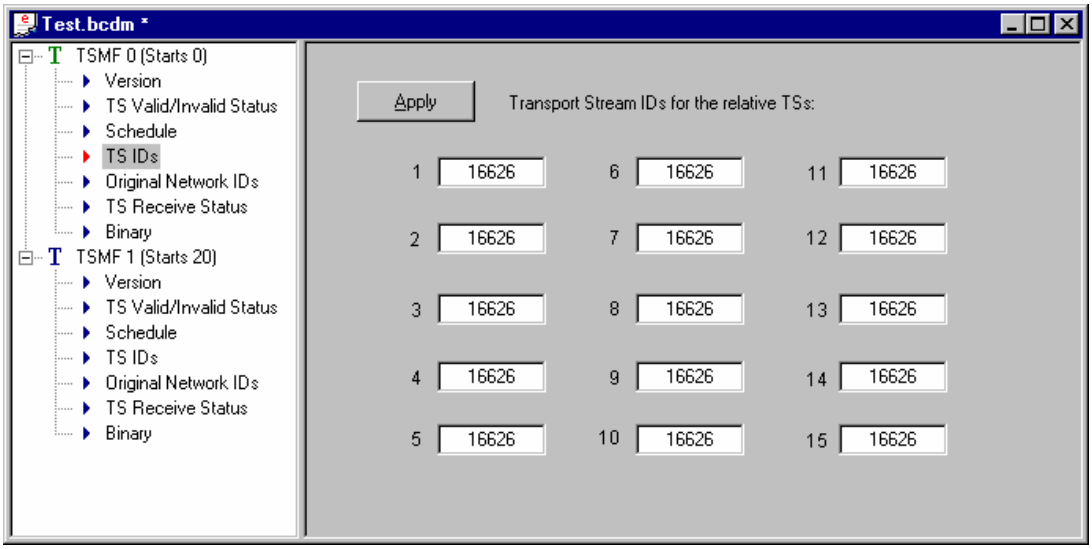
Schedule



Each stream in the project file is allocated an integer number of slots in a frame based on the bitrate of the stream and the packet size of the output stream. Only transport streams marked as **Valid** in the TS Status panel will be included in the allocation. Null slots may be included to balance the allocation of stream slots.

The schedule parameter display shows graphically the slot layout for a single frame. Each relative transport stream (rTS) is color-coded.

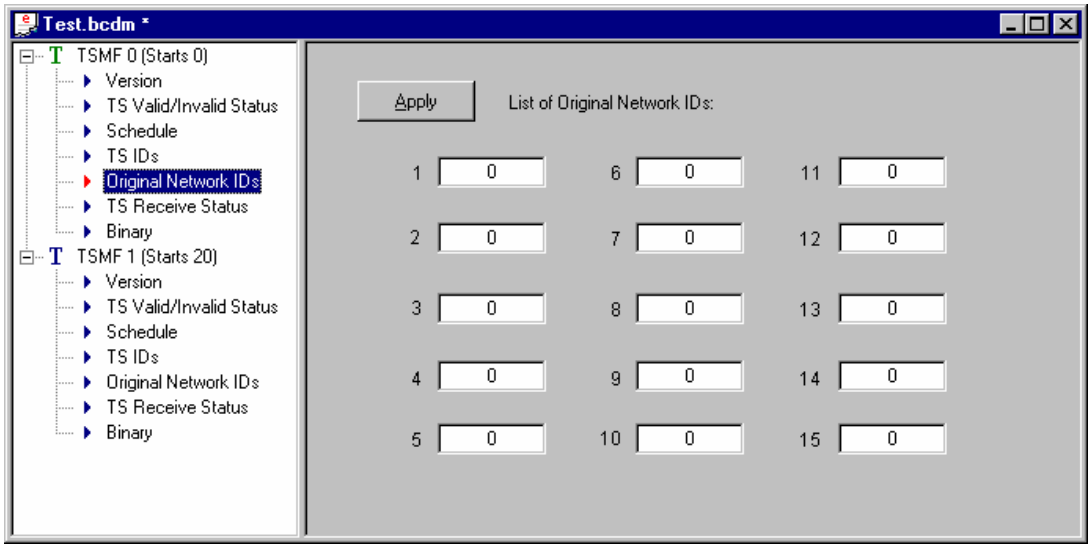
Transport Stream IDs



Each transport stream is allocated an identity number that is read from the transport stream identity field within the programme allocation table (PAT), part of the Service Information held by each MPEG file. If this identity field cannot be read, the BCDM will not load the MPEG file. The field is mainly for display purposes, but may be edited in Expert mode. It is quite acceptable to have duplicated identity numbers.
Note that the disabled fields are those for which no MPEG file exists.

Select the **Apply** button to apply any changes.

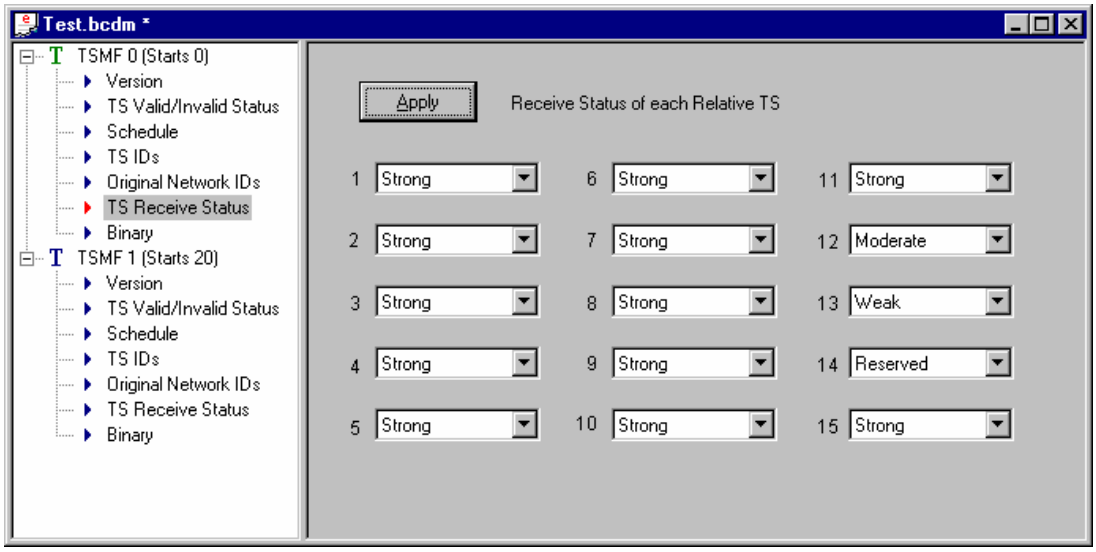
Original Network IDs



Each stream is allocated an identity number that is read from the transport stream identity field within the Event Information Table (EIT), part of the Service Information held by each MPEG file. If this identity field cannot be read, zero will be displayed. The field is mainly for display purposes, but may be edited in Expert mode. It is quite acceptable to have duplicated identity numbers.

Select the **Apply** button to apply any changes.

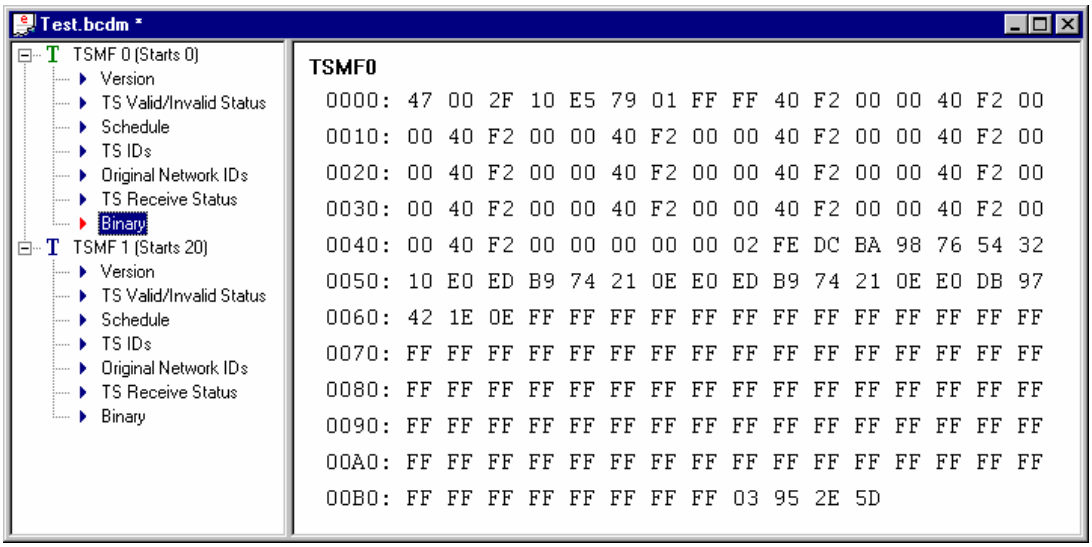
TS Receive Status



The information in this panel indicates the receive status of each stream in the multiplex: **Strong**, **Moderate**, **Weak**, **Reserved**.

Select the **Apply** button to apply any changes.

Binary

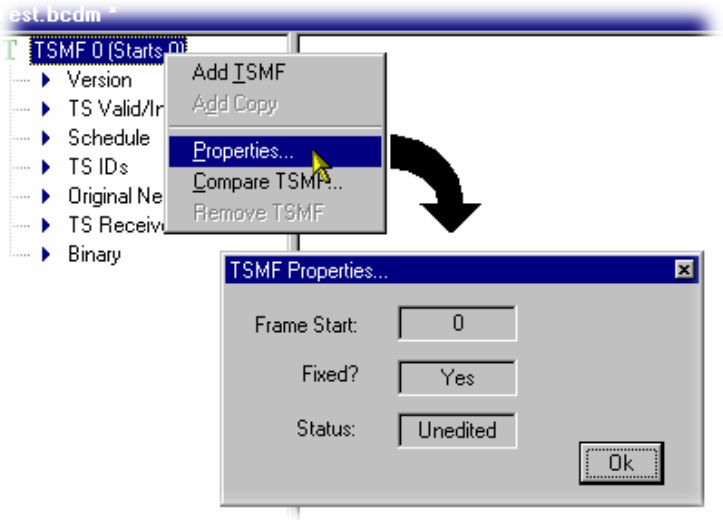


The Binary parameter shows the binary coding of the TSMF. The parameter is read-only.

TSMF Activities

Viewing TSMF Properties

Each TSMF has an associated properties dialog that shows in which frame the TSMF takes effect and the edit status of the TSMF information.



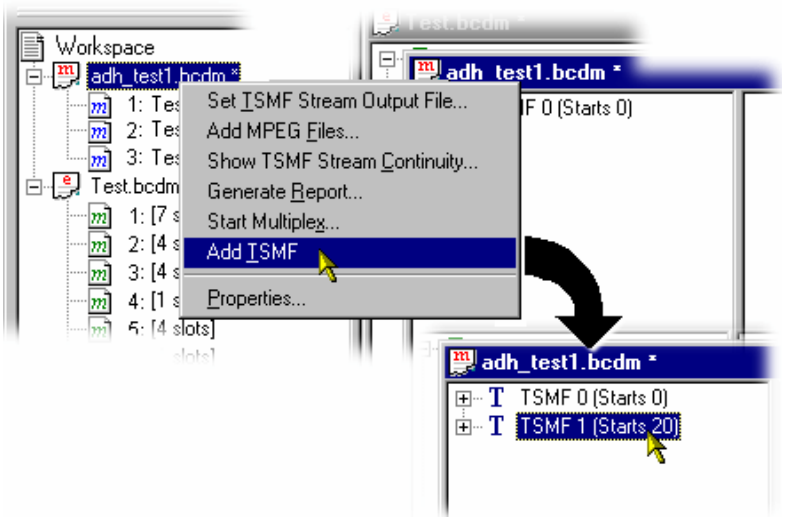
To open the properties dialog, highlight the TSMF label in the TSMF window and select **Properties…** from the right-click menu.

Frame start: Specifies in which frame the TSMF is to take effect. This field can only be edited for Mux projects.

Fixed? (green) **Yes** indicates that the TSMF information is internal to the stream; that is it is derived from the multiplexed information and not extracted from the project file.
(blue) **No** indicates that the TSMF information was added by the user and therefore is stored in the project file.

Status: **Added** indicates that it has been added in this session (blue icon).
Edited indicates that it previously existed, but has been edited in this session (green icon).
Unedited indicates that it previously existed and has not been edited (green icon).

Adding TSMF

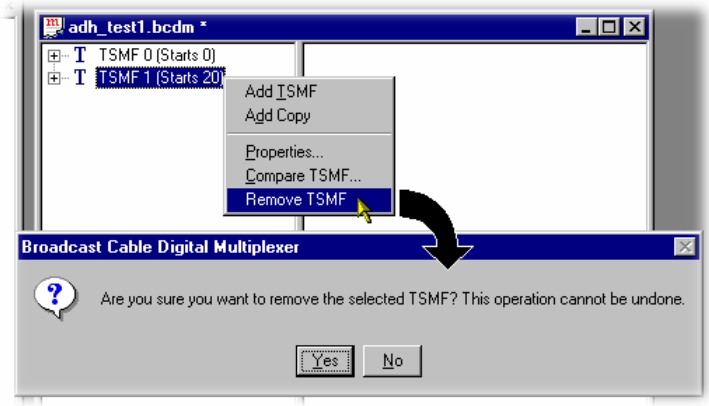


To add a TSMF to a project, highlight the project name in the workspace and select **Add TSMF** from the right-click menu.

Note that the frame in which the TSMF is to start can be amended from the new TSMF properties dialog.

For the new TSMF to take full effect, the parameters will need to be set (see page 22).

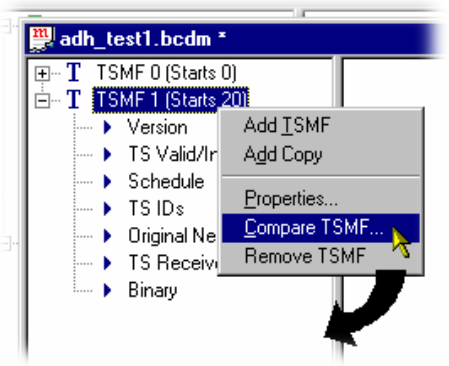
Removing TSMF



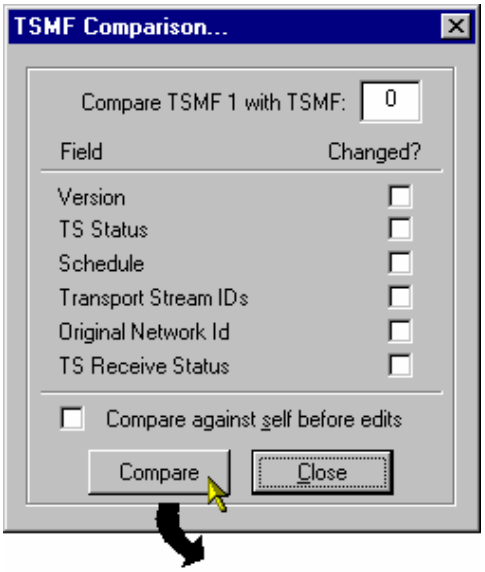
To remove a TSMF from a project, highlight the TSMF label in the TSMF window and select **Remove TSMF** from the right-click menu.

Note that removing a TSMF may require some adjustment of the remaining TSMFs, e.g. the starting frames.

Compare TSMFs



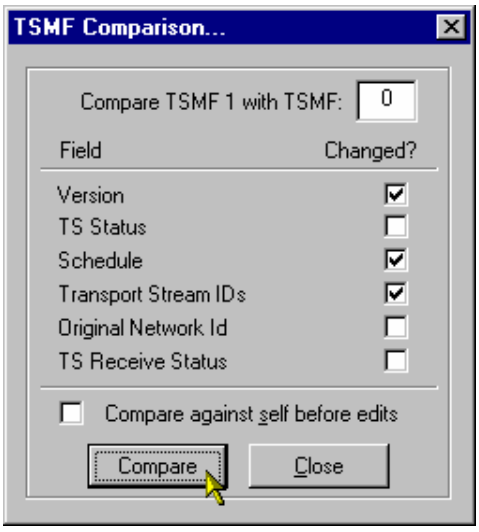
To compare the parameters of TSMFs, highlight the TSMF label in the TSMF window and select **Compare TSMF …** from the right-click menu.



The highlighted TSMF can be compared with any other TSMF.

Enter the number of the TSMF to be compared and select **Compare**.

If the highlighted TSMF has been edited in the current session, it can be compared with its opening status by selecting the **Compare against self before edits** checkbox.



The parameters of the two TSMF are compared and if any divergence is found a tick is placed adjacent to the relevant parameter.

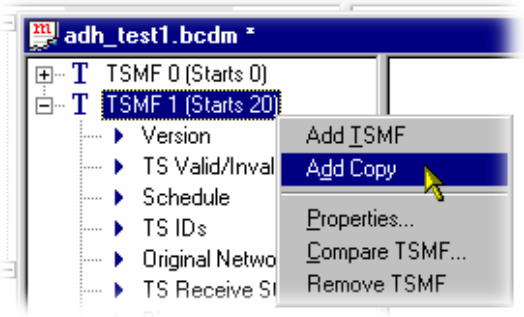
The differences can be verified by closing the dialog and checking the individual parameters.

To close the TSMF Comparison dialog, select **Close**.

Copying TSMFs

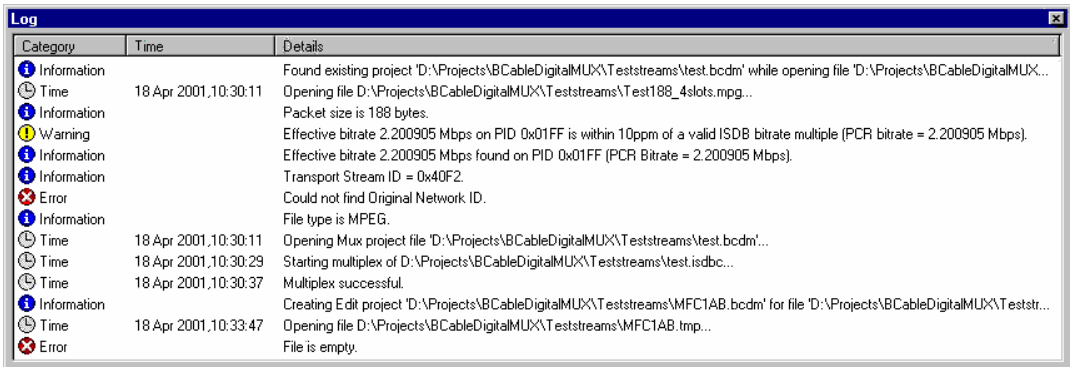
TSMFs in multiplex projects can be copied using the right-click option provided.

A replica of the selected TSMF is copied. The Start frame of the new TSMF is adjusted to follow on from the previous TSMF.



Log Window

The Log window displays the contents of the log file that reports and logs all BCDM activity.



The following icons are used to indicate the activity logged:

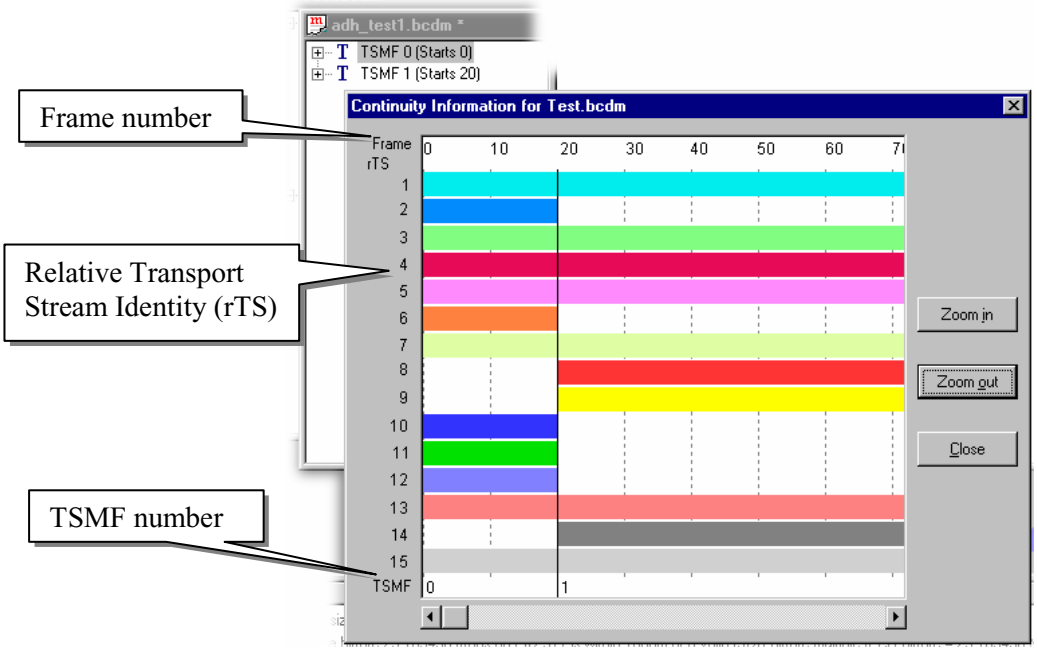
	Information	indicates processing activity.
	Time	indicates the time of an activity.
	Warning	provides information about non-catastrophic events, e.g. events which, while not preventing a stream from being opened, may make the analysis incorrect.
	Error	provides information about catastrophic events, e.g. unable to analyze a TSMF stream stream.

Two right-click items are available: **Clear Log** clears the current log file and **Copy** copies the contents of the log file to the clipboard, from where it can be pasted into a text editor.

The Log file is discarded when the application is closed.

Continuity Information

The Continuity screen provides a graphic illustration the continuity of the files in a project. The screen can be displayed by highlighting the project name in the workspace and selecting **Show Continuity…** from the right-click menu.



In the screenshot above (which has been 'zoomed in' for clarity), the following is shown:

- rTS 1 is active in all TSMFs (frames 0 to end).
- rTS 2 is active in TSMF 0 (frames 0 to 19) only.
- rTS 8 is active in TSMF 2 (frames 20 to end) only.
- The colors used for the bars and in the Schedule are always the same and unique to an rTS for the duration of the session.

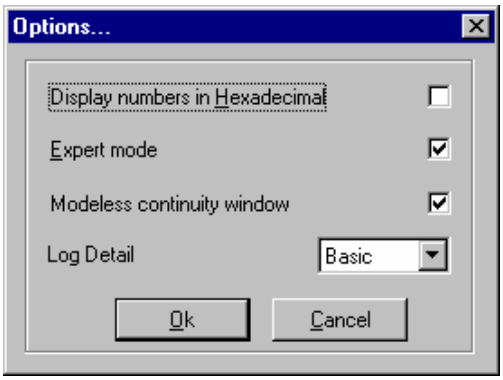
Project Reports

A display of all project properties and parameters formatted for printing out can be selected by highlighting the project name in the workspace and selecting **Generate Report…** form the right-click menu.

The Report screen has two menu options: **Print…** which opens a standard Windows print dialog and **Close** which closes the report screen.

Options…

The **View ➔ Options…** dialog offers the following options:



Display Numbers in Hexadecimal

Toolbar: 

When enabled, numerical displays (e.g. TS Id numbers) are shown in hexadecimal format, e.g. 0x04A. When disabled, numerical displays are shown in decimal format.

Expert Mode

Toolbar: 

When enabled, more user intervention becomes possible by allowing additional fields to be edited.

Modeless Continuity Window

When enabled, the Continuity window (see page 32) can remain open (and will be updated) while changes are made to the project. When disabled, the Continuity window must be closed before changes can be made to the project.

Log Detail

The level of detail to be included in the log file can be selected from this drop-down list.

Reference

[1] JCTEA Standard 002, Version 2.0

[2] JCTEA Standard 003, Version 2.0

[3] JCTEA Standard 007, Version 1.0

TSMF Header Content

Field	Value	Bit	Note
MPEG-2 Systems Header			
sync byte	'01001110' (0x47)	8	
tranport_error_indicator	'0'	1	
payload_unit_start_indicator	'0'	1	
transport_priority	'0'	1	
PID	'0000000101111' (0x002F)	13	
transport_scrambling_control	'00' (No scramble)	2	
adaption_field_control	'01' (Payload only)	2	
continuity_counter		4	
TSMF Information			
Reserved for future use	'111'	3	
frame_sync	'1101010000110' (0x1A86) or '0010101111001' (0x0579	13	Reserved frame by frame
version_number	Increment when TSMF change	3	
relative_ts_number_mode	'0' (Static allocation)	1	Fixed
frame_type	'0001' (0x1)	4	Fixed
For (I=0; I<N; I++){ N=15			
ts_status[I]	Valid/Invalid indication of relative_ts_number	1	
}			
Reserved for future use	'1'	1	
For (I=0; I<N; I++){ N=15			
ts_id[I]	List of ts_id versus relative_ts_number	16	Defined by CATV broadcasters from the related parts of TMCC
original_network_id[I]	List of original_network_id versus relative_ts_number	16	Defined by CATV broadcasters from the related parts of TMCC

}			
For (I=0; I<N; I++){ N=15			
receive_status[I]	receive_status of each Relative ts	2	
}			
Reserved for future use	'1'	1	
emergency_indicator		1	Originated from TMCC
For (I=0; I<N; I++){ N=52			
relative_ts_number[I]	List of slot allocation for each relative_ts_number	4	Defined by CATV broadcasters from the related parts of TMCC
}			
private_data		680	
CRC		32	

Key:

version_number	Incremented every time the TSMF contents change.
relative_ts_number_mode	Indicates the mode of slot allocation. This is fixed as zero.
frame_type	Indicates the number of slots in a frame (53) and maximum number of transport streams. This field is fixed as '0x1'.
ts_status	(1 to 15) Indicates valid/invalid for all relative_ts_number (0 is invalid, 1 is valid).
receive_status	(1 to 15) This field indicates the receive status of all rTSs. The defined receive status' are 'Strong', 'Moderate', 'Weak' and 'Reserved'.
relative_ts_number	(1 to 15) Indicates the slot allocation for each relative_ts_number.

The usage of the private_data (680 bits) remains to be confirmed.

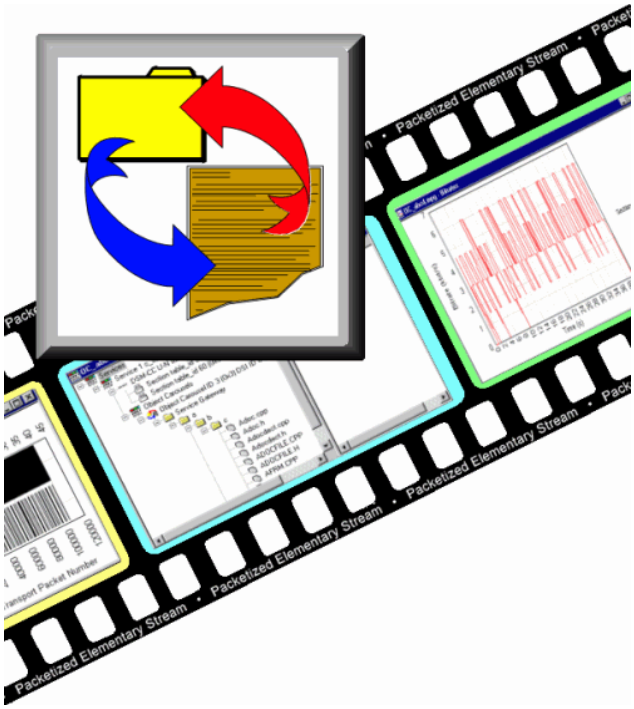
The ts_id and the original_network_id have to be taken from the PAT and the EIT respectively.

Glossary and Abbreviations

ARIB	Association of Radio Industries and Businesses
BCDM	Broadcast Cable Digital Multiplexer
BSDM	Broadcast Satellite Digital Multiplexer
EIT	Event Information Table
ISDB-C	Integrated Services Digital Broadcasting - Cable
	Note: In this user guide, ISDB-C Streams are referred to as TSMF Streams.
ISDB-S	Integrated Services Digital Broadcasting - Satellite
JCTEA	Japan Cable Television Engineering Association
MPEG	Moving Picture Experts Group
NIT	Network Information Table
PAT	Programme Allocation Table
SI	Service Information
TSMF	Transport Stream Multiplexing Frame

Section 14

Carousel Analyzer



Overview 3
Data Broadcasting Overview 4
Starting the Program 5
Initial Appearance 6
Initial Menu Options 7
Stream Interpretation 8
Script Selection and Manipulation 9
Syntax Checking Options 11
Opening a Stream file 13
Menus and Controls 14
Menus and Options 15
Toolbars 19
Workspace 20
Transport Packet Bar 25
Status Bar 26
Views 27
Programs/Services View 29
Object Carousel View 32
UN-Download View 37
Data Carousel (DVB) View 41
Data Carousel (ARIB) View 41
Resource View 45
Structure Views 46
Bitrate View 49
Repetition View 52
PID View 54
Log View 56
Cycle Times View 58
Application Support 61
Application Management 61
Application Definition 63
Application Timing 67
MHP Support 76
Application Lifetimes 77
Reference 78
Script Files 78
Error Checking 79
Acronyms and Abbreviations 79
References 80

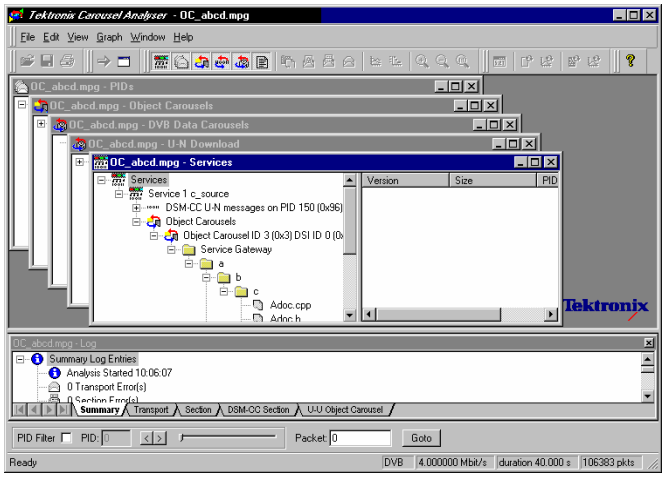
Overview

The Digital Storage Media Command and Control (DSM-CC) protocol was originally developed to provide a VCR-like control mechanism for program material delivered via a MPEG2 transport stream. Since then, the standard has evolved to encompass a wide variety of applications including data broadcasting and interactive television. DSM-CC forms a core part of a variety of both closed and open standards such as the DVB MHP (Multimedia Home Platform) standard for European Interactive Television.

The following DTV standards are supported:

- ISO/IEC 13818-6 Information technology - Generic coding of moving pictures and associated audio information - Part 6: Extension for Digital Storage Media Command and Control [MPEG] (Reference [2])
- EN 301 192 Specification for data broadcasting [DVB] (Reference [4])
- ARIB STD - B24 Data Coding and Transmission Specification for Digital Broadcasting (Reference [11])
- Multimedia Home Platform [DVB] (Reference [12])

A bibliography of DTV standards documentation is given in the *Reference* section.



The Tektronix Carousel Analyzer has been developed to meet the specific need to analyze and display the content and structure of data broadcasts. The tool provides a variety of ways of looking at a transport stream and its contents including displaying the bit rate, repetition rates, structure, syntax and semantics of data items.

The program view shows the various services in the transport stream and their associated PIDs and data streams. Object or data (one or two layer) carousels and UU or UN messages such as DSM-CC Download can also be displayed with options to view associated, sections, carrier modules or transport packets for each version as required.

An object carousel in the stream can be viewed by contents as a directory structure containing the underlying objects such as Java classes, picture or text files. If an object is associated with an installed application then a simple double click will launch that program, providing, for example, an easy and quick way to view the contents of a picture file or read a text file.

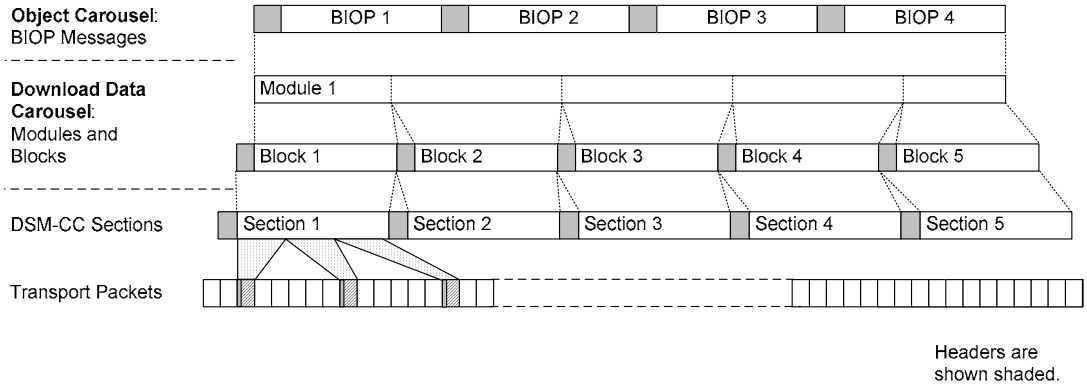
The structure of the U-N download messages can be viewed showing the relationship between DII, modules and blocks. The associated DSI and DII messages contained in the UN-Download tables can also be viewed in interpreted or hex fashion; these indicate where to find and view the BIOPs which contain a required object in the stream.

The timing relationships between the various components can also be easily shown since the bit rates or the repetition rates of blocks, modules, objects, UN messages or SI tables can be shown together in a single graphical display.

Data Broadcasting Overview

In the similar way to which video and audio services are delivered to end users, Data Broadcasting allows data to be transmitted. Object and Data Carousels are intended for the periodic transmission of information in a transport stream. DVB Data Carousels contain modules of data of unspecified content. ARIB Data Carousels and Object Carousels contain identifiable data objects, e.g. JPEG files, text files, application software. Multimedia Home Platform (MHP) is also supported since the Application Information Table (AIT) and Object Carousels (as specified in the MHP standard) can be viewed.

The diagram below shows how information carried by data and object carousels is sub-divided and ultimately carried by the transport stream.



BIOP messages comprise a message header, a message sub-header and the message body which contains data. The message body may contain complete data objects.

BIOP messages are broadcast in Modules. A Module is formed from one or more concatenated, complete BIOP messages.

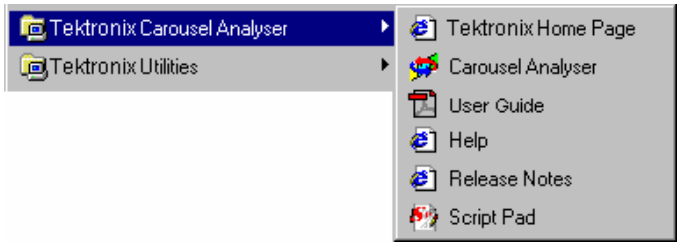
Each Module is fragmented into one or more Download Data Blocks that are in turn transmitted in corresponding DSM-CC Sections.

Sections are transmitted in packets in the Transport Stream.

The Carousel Analyzer enables each layer of the protocol stack to be analyzed and inspected. The following sections provide an overview of how the Carousel Analyzer can be used to locate messages and packets of interest.

Starting the Program

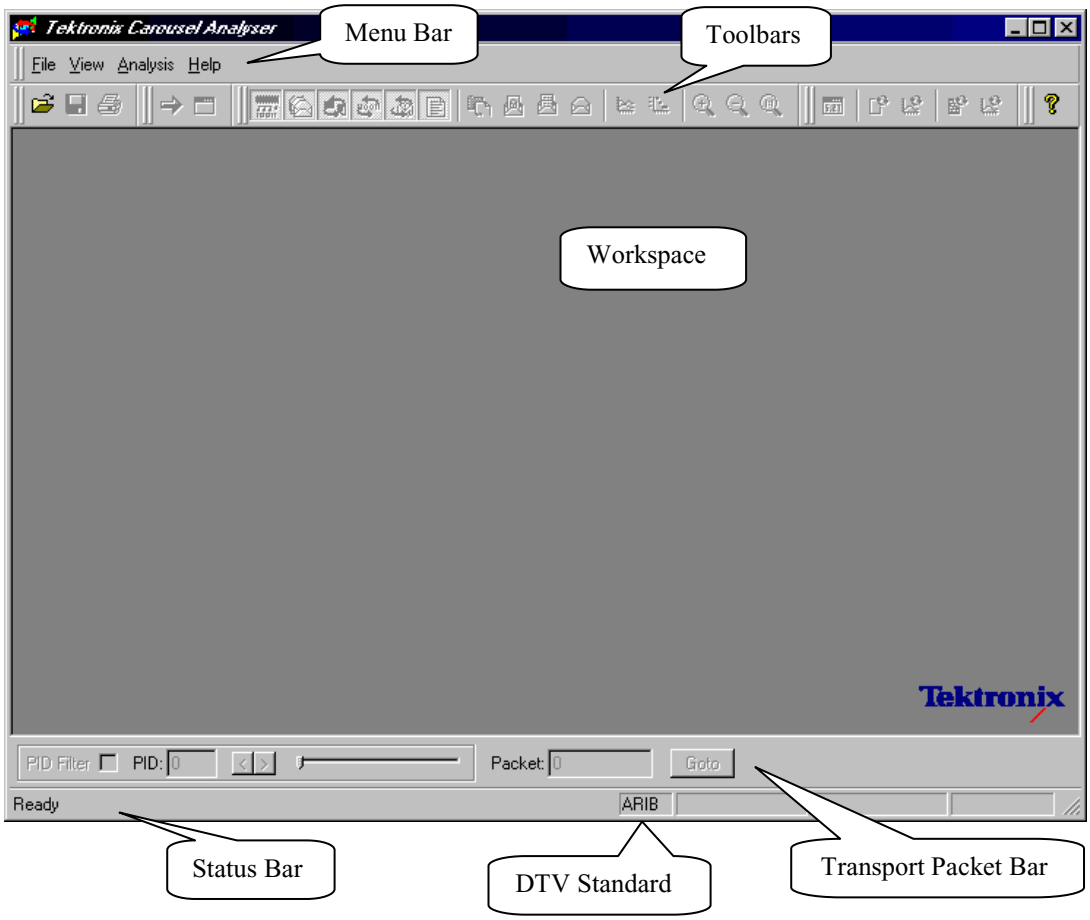
The program can be started by selecting the **Tektronix Carousel Analyser** option from the **Start ➔ Programs ➔ Tektronix Data Applications V2.0** menu:



or by double clicking on the **Tektronix Carousel Analyser** shortcut on the desktop.

Initial Appearance

When the program has started and is ready for use, it will open the Main window, as shown below:



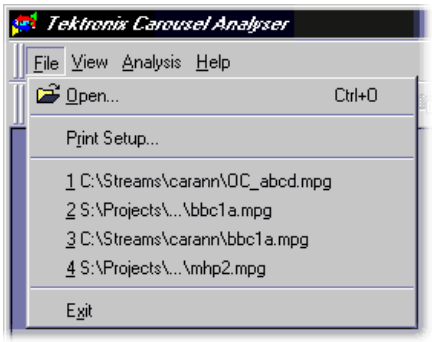
Elements of the main window can be hidden during a session, but will be restored at start-up.

The Menu Bar contains all options available to the application; disabled options are visible but greyed out. The Toolbars provide shortcuts to the more important menu options; similarly, disabled buttons are visible but greyed out. The Transport Packet Bar provides controls to locate and jump to transport packets. The Status Bar shows stream information and the cursor message field.

Initial Menu Options

The Carousel Analyzer presents different menus and options depending upon whether or not a stream is open for analysis. The menu options available when no stream is open are as follows:

File Menu Options



Open… an MPEG transport stream for analysis. The program opens the file selection dialogue allowing the user to choose the required file.

Print Setup… opens a dialogue for selecting which printer and associated options to use.

---

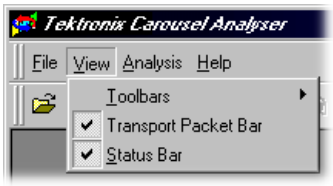
1 *<filename>*
2 *<filename>*
3 *<filename>*
4 *<filename>*

A list of the four most recently analyzed files. If the program has recently been installed the list may be empty or hold less than four files.

Selecting a filename opens that file for analysis.

Exit Finishes running the program.

View Menu Options

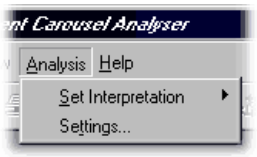


Toolbars ► Opens a sub-menu which allows toolbars to be toggled between being displayed or not. Select the sub-menu option to change the state.

Transport Packet Bar Toggles the Transport Packet Bar between being displayed or not. Select the option to change the state.

Status Bar Toggles the Status Bar between being displayed or not. Select the option to change the state.

Analysis Menu Options

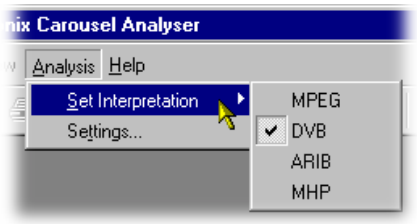


Set Interpretation ► Select the Digital TV standard to be used for stream analysis.

Settings… Displays a dialog for selecting scripts to be used during analysis.

Stream Interpretation

Selection of the DTV standard to be used for analysis can only be done before any streams are opened.



Select the required standard from the sub-menu.

(a check mark ✓ next to an option indicates that the option is enabled; no ✓ means that it is disabled.)

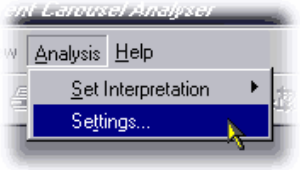
Script Selection and Manipulation

Scripts are available to the Carousel Analyzer to enable structures to be analyzed successfully.

If any script is not selected or enabled, the stream will not fail to be analyzed, but any data normally interpreted by that script would be ignored.

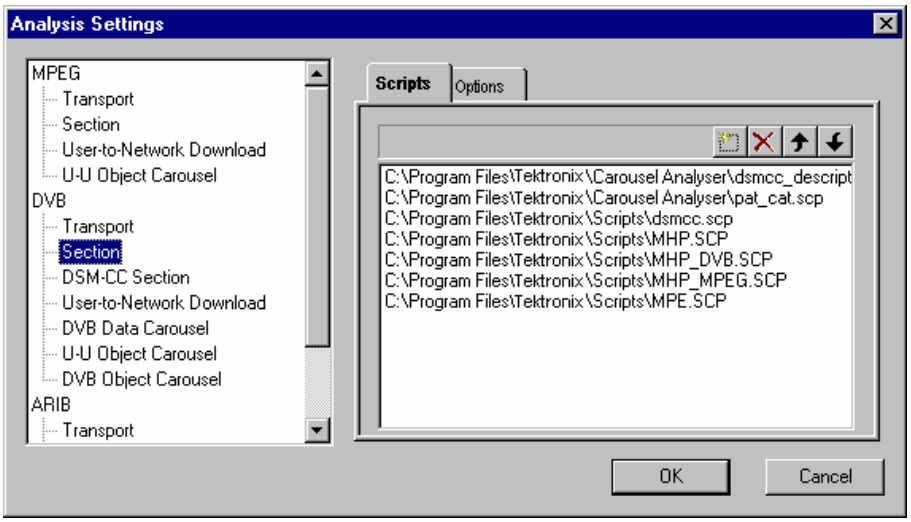
Scripts can only be selected and enabled when no files are open. The option is not available when a file is open.

Handling Script Files



To open the Analysis Settings dialog select **Settings…** from the **Analysis** menu.

The dialog shown below is displayed:



In the Analysis Settings dialog, the left-hand window shows a tree structure of the test protocols available. The right-hand window shows the scripts currently allocated to the test protocol; in the example, the scripts listed are associated with the **DVB - Section** protocol. The right-hand also contains the controls needed to manipulate the scripts.

Note that across the standards, the scripts are not hierarchical; that is, each DTV standard must be self-contained in terms of the scripts that it uses.

The script files currently available are listed in the *Reference* section of this User Guide.

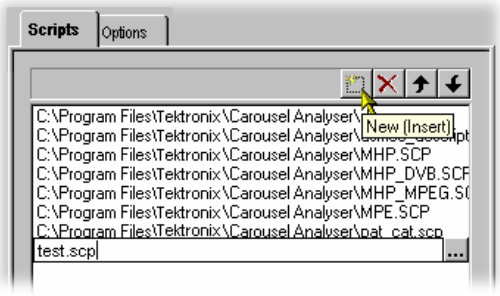
The following paragraphs describe the script manipulation activities available. The activities are applied to the test protocol currently selected.

Adding a Script file

a) With the required test protocol highlighted, select the Add **New** Script button (Shortcut key: **Insert**).

b) If the script path/name is known, enter it into the blank field now displayed.

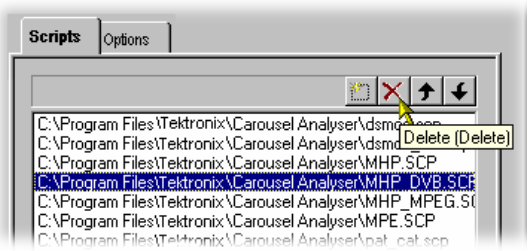
If the script name is unknown, use the browse button (...) at the right-hand side of the blank field to display a standard windows file **Open** dialog.



c) The new script file name will be added at the bottom of the script list. Note that script files are parsed in the order that they are listed and hence the file may require moving up in the list – see below.

Removing a Script file

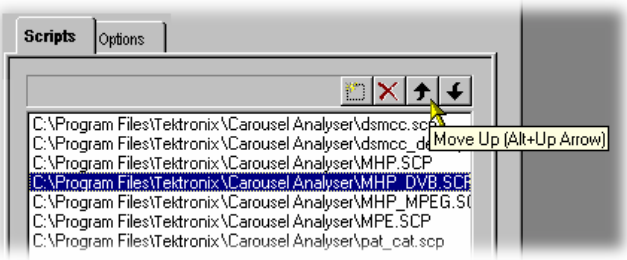
a) Highlight the file to be deleted and select the **Delete** Script button (Shortcut key: **Delete**).



Moving Script files in the List

Script files are parsed in the order that they are listed and hence the file may require moving up in the list

a) Highlight the file to be moved and select either the **Move Up** or **Move Down** button (Shortcut keys: **Alt-**↑ and **Alt-**↓ respectively). The file will move up or down one place for each press of the button.



Syntax Checking Options

A number of options are available from the Analysis Settings dialog that allow strict syntax checking to be enabled and disabled.

If any option is not enabled, the relevant syntax will not fail to be checked, but will be interpreted more loosely.

Syntax Checking Options can only be selected and enabled when no files are open. The option is not available when a file is open.

Currently, three syntax checking options are available:

Strict private data length/Message length checking

Object: UU Object Carousel
Disabling this option allows the privateDataLength field where it exists in the DSI to be set to zero. The application will calculate it when required using the total message length and the position of the private data in the message.
(See reference [2], sections 2 and 7.3.6.)

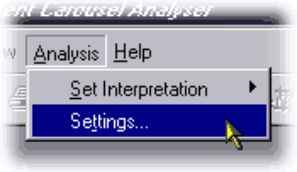
Strict association tag checking

Object: UU Object Carousel
The association tag field in the stream_identifier_descriptor is an 8-bit value, while the same field in an object carousel is a 16-bit value. When comparing these two values, the MSB of the 16-bit value should be zero. Disabling this option allows it to take other values.
(See reference [4], 9.3 paragraph 3 and [6], paragraph 4.7.7.3.)

Strict CRC/Checksum checking

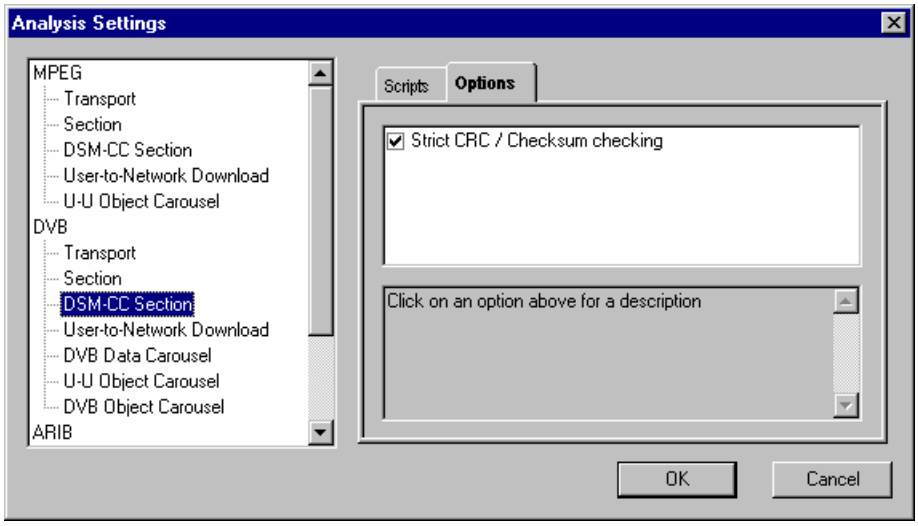
Object: DSM-CC Section
section_syntax_indicator and private_indicator fields should be the complement of each other to determine whether a CRC or checksum is in use. Disabling this option allows them to be the same and the application work out which should be applied.
(See reference [2], section 9.2.2 paragraphs 3 and 4.)

Enabling a Syntax Checking Option



To open the Analysis Settings dialog select **Settings…** from the **Analysis** menu.

Select the **Options** tab. The dialog shown below is displayed:

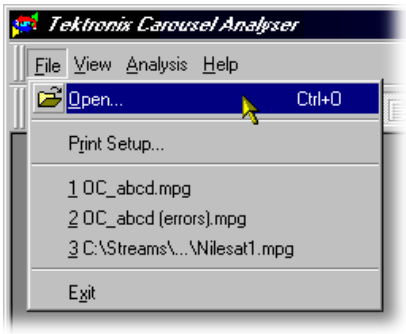


In the Analysis Settings dialog, the left-hand window shows a tree structure of the test protocols available. The right-hand window shows the options currently allocated to the test protocol; note that currently, options are only applicable to DSM-CC Sections and U-U Object Carousels. Available options are applicable to all standards, e.g. an option set in the DVB DSM-CC Section will be applied in the MPEG and ARIB protocols.

Opening a Stream file

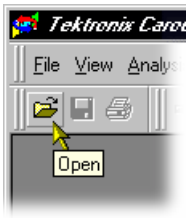
Any Transport Stream file can be opened for browsing by the Carousel Analyzer. However, only those streams containing Data and/or Carousel Objects will provide meaningful results. **Tektronix**'s Transport Stream Analyzer should be used for normal stream analysis. Only one file may be opened at a time.

To open a file select the **Open…** option from the **File** menu. If the required file is in the list of recently analyzed files, then it can be opened from the list to save using the open file dialogue.

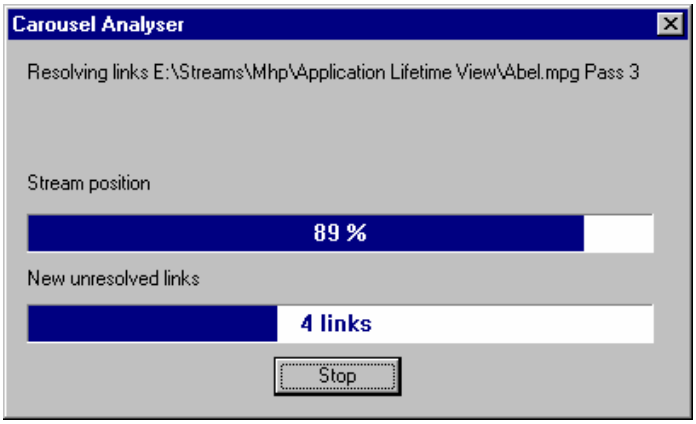


Alternatively use the **Ctrl+O** keyboard shortcut.

There is a shortcut button available on the Toolbar for opening a file, which uses the standard file open symbol:



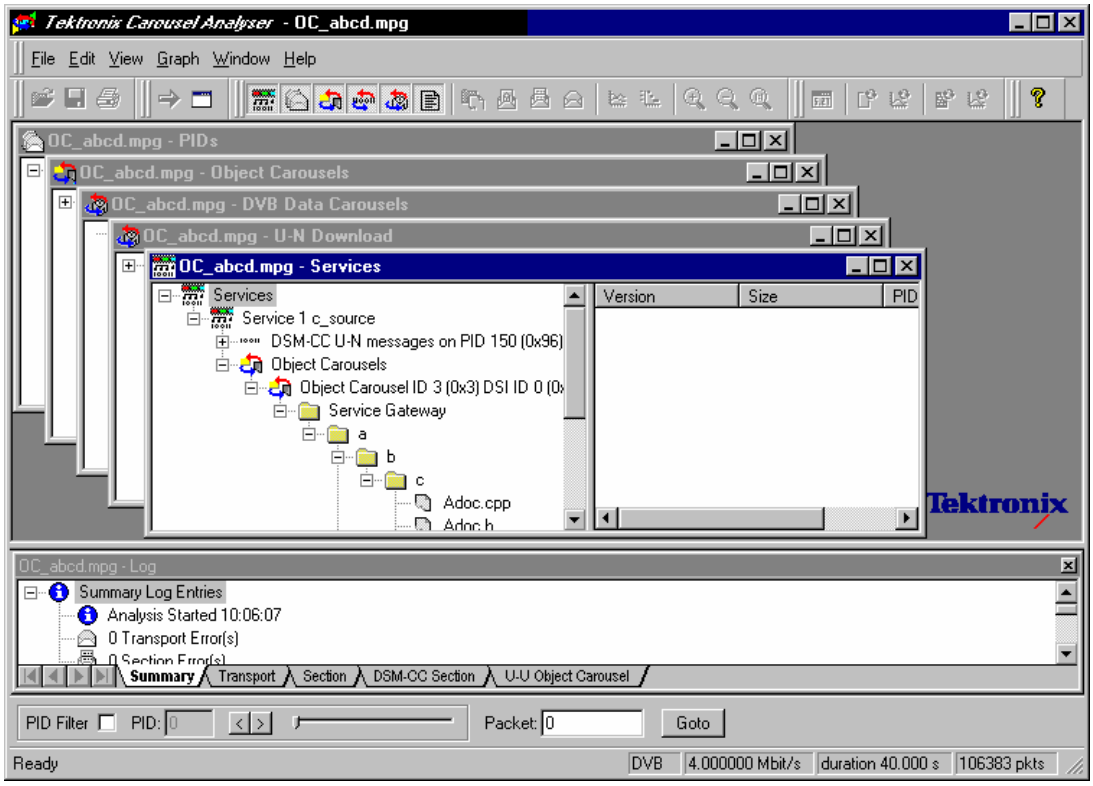
As the file is opened, a progress bar is displayed; analysis may require more than one pass through the transport stream file. The current pass number is shown in the title line. After the first pass, a second progress bar (**New unresolved links**) is displayed showing the number of unresolved links at each pass.



Analysis can be halted at any time by selecting the **Stop** button in the dialog; the stream is still opened, but only the elements so far analyzed will be displayed.

By default, the Services and the Log window are opened as soon as a stream file is opened. Further windows can be via the View Menu or the Toolbar. Note that whilst the options on the View menu remain the same, they are enable or disabled according to which protocol element is highlighted at the time.

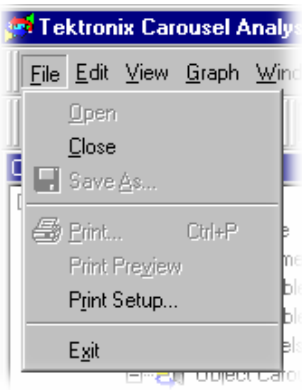
Menus and Controls



Menus and Options

In the Menus and Options described below, a number of the options are context sensitive; which window is open and which element is highlighted will dictate which options are enabled and disabled.

File Menu Options



Open an MPEG transport stream for analysis. The program opens the file selection dialogue allowing the user to choose the required file.

Close Closes the current file.

Save As…

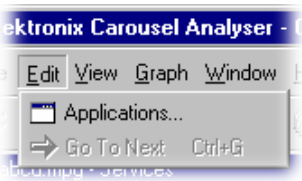
Print Opens the Print dialog.

Print Preview Opens the Print Preview dialog.

Print Setup… Opens the Print Setup dialog.

Exit Closes any file that is open and terminates execution of the program.

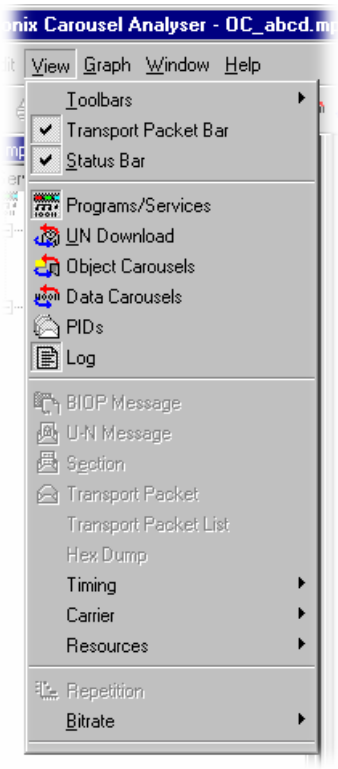
Edit Menu Options



Applications Opens the Application Management dialog.

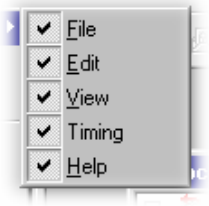
Go To Next Jumps to next occurrence of the structure being viewed. The **Packet** field in the Transport Packet bar will reflect the change of packet.

View Menu Options



(an active (depressed) button next to an option indicates that the window or toolbar is currently visible; an inactive button means that it is hidden.)

Toolbars ► opens a sub-menu which allows the toolbars to be toggled on and off.



Transport Packet Bar allows the Transport packet bar to be toggled on and off.

Status Bar allows the Status Bar to be toggled on and off.

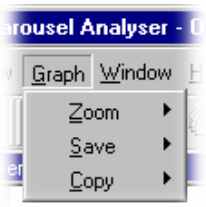
The remaining options in this menu open and close the associated window. The options and windows are described elsewhere in this User Guide.

Program/Services	**UN Download**
Object Carousels	**Data Carousels**
PIDs	**Log**

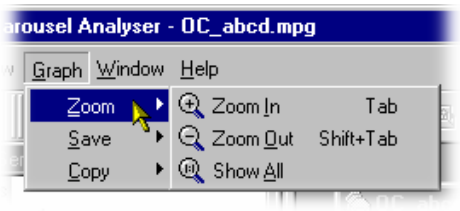
BIOP Message	**U-N Message**
Section	**Transport Packet**
Transport Packet List	**Hex Dump**
Timing	**Carrier**
Resources	

Repetition	**Bitrate**

Graph Menu Options



Zoom Applies to Bitrate and Repetition views only.

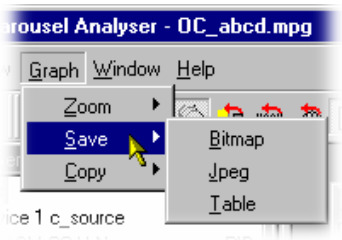


Zoom In Maximises the central 50% (x-axis) of the current graph.

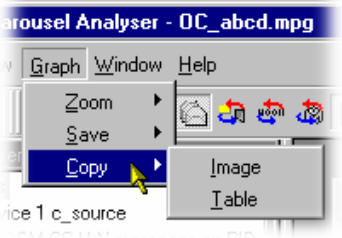
Zoom Out Takes one step back in the Zoom sequence.

Show All Resets the graph to show all points.

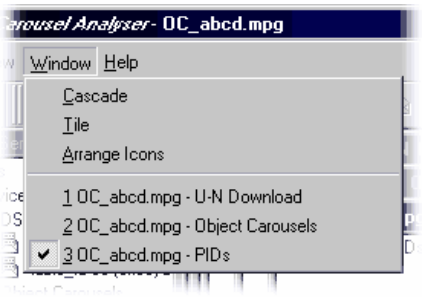
Save Save the graph in the selected format.



Copy Copy the graph to the clipboard in the selected format.

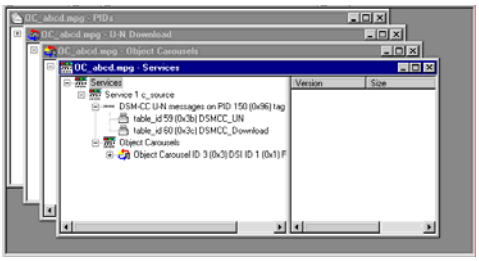


Window Menu Options

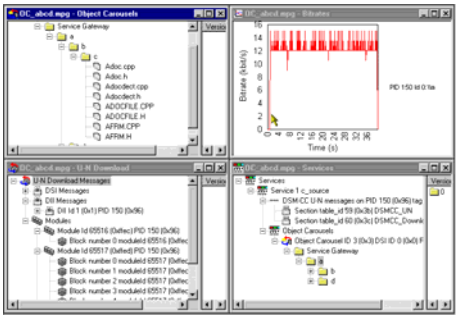


(a check mark ✓ next to an option indicates that the window or toolbar is currently active, no ✓ means that it is inactive.)

Cascade Re-arranges the windows like this:



Tile Tiles the windows. For example, four windows would be tiled like this:

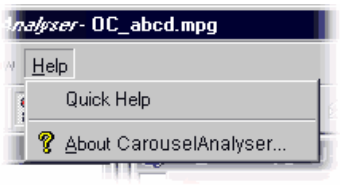


Arrange Icons Aligns icons of any minimised windows at the bottom of the program's main window.

---

1 <*window title*> Makes the named window
2 <*window title*> active, putting it on top
3 ... etc. of any windows which had been hiding all or part of it.

Help Menu Options



Quick Help Opens the Quick Help browser window.

About CarouselAnalyser… Opens a dialogue which displays the program version number and license number. This information will be required if **Tektronix** Technical Support is contacted.

Toolbars

Quick access buttons are divided between several toolbars: File, Edit, View and Help.

As for the Menu Options, a number of the tollbar functions are context sensitive; which window is open and which element is highlighted will dictate which buttons are enabled and disabled.

File Toolbar

Open a file. This button is disabled when a file is open.

Save As… - BIOP file messages can be saved to separate files. Structures can also be saved to a separate file.

Print – only available for bitrate and repetition views.

Edit Toolbar

Jumps to next occurrence of the structure being viewed.

View Toolbar

The buttons in this toolbar open and close the associated windows. The windows are described elsewhere in this User Guide.

View Programs/Services

View PIDs

View Object Carousels

View Data Carousels

View U-N Download Messages

View Log

View BIOP Message

View U-N Message

View Section

View Transport Packet

View Bitrate

View Repetition Rate

View Lifetime

Zoom In

Zoom Out

Show All

Timing Toolbar

Edit Application Timing

View Entity Cycle Time

View Entity Cycle Time Graph

View Carousel Cycle Time

View Carousel Cycle Time Graph

Help Toolbar

About CarouselAnalyser… Opens a dialogue which displays the program version number and license number. This information will be required if a **Tektronix** Technical Support is contacted.

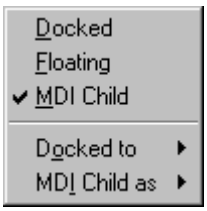
Workspace

Window Management

In addition to the generic **Cascade** and **Tile** options available from the window menu, management of individual windows is provided via a sub-menu available by right-clicking the title bar of the individual window.

Right-click window title bar:

(The checkmark ✔ indicates the current selection.)

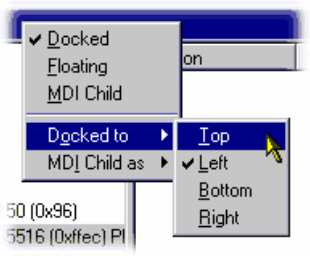


Each window within the workspace can be designated as **Docked**, **Floating** or as an **MDI** (Multiple Document Interface) **Child**.

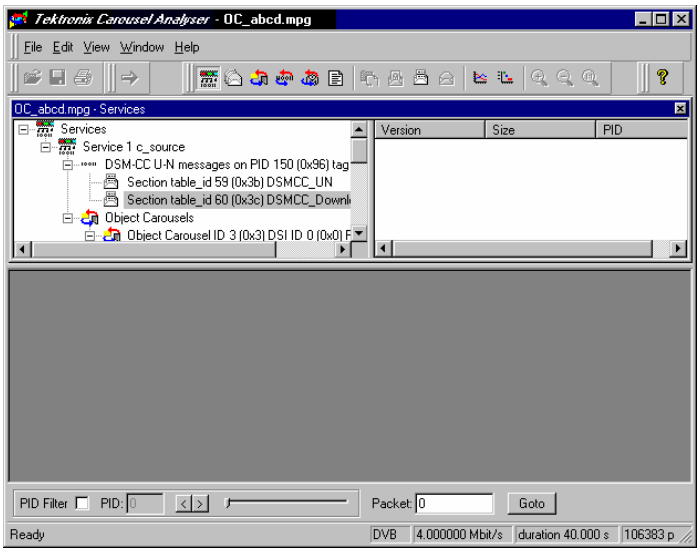
Docked

When docked, a window will be automatically placed against one of the four sides of the workspace.

For example, selecting **Docked ➔ Top** thus:



will dock the selected window at the top of the workspace:

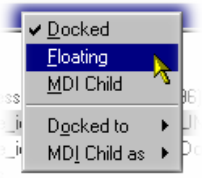


If multiple windows are docked at the same edge, they will stack in selection order.

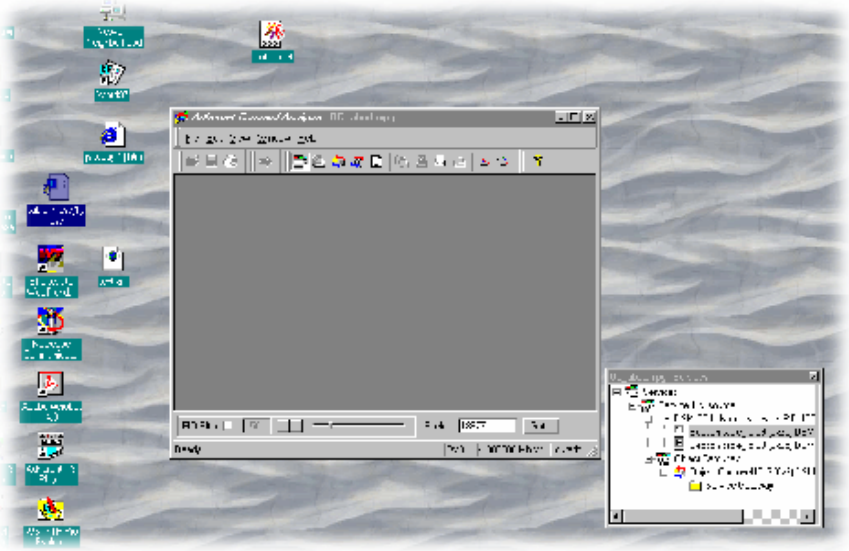
Floating

Designating a window as floating allows it to be moved around on the monitor desktop independently of the Carousel Analyzer interface

For example, selecting **Floating** thus:



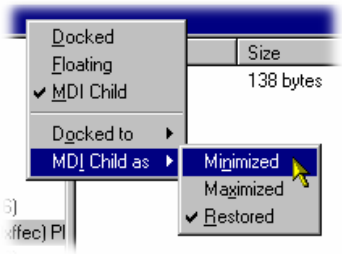
will allow the window to be moved anywhere on the desktop:



MDI Child

Designating a window as an MDI Child allows it to be moved anywhere within the workspace.

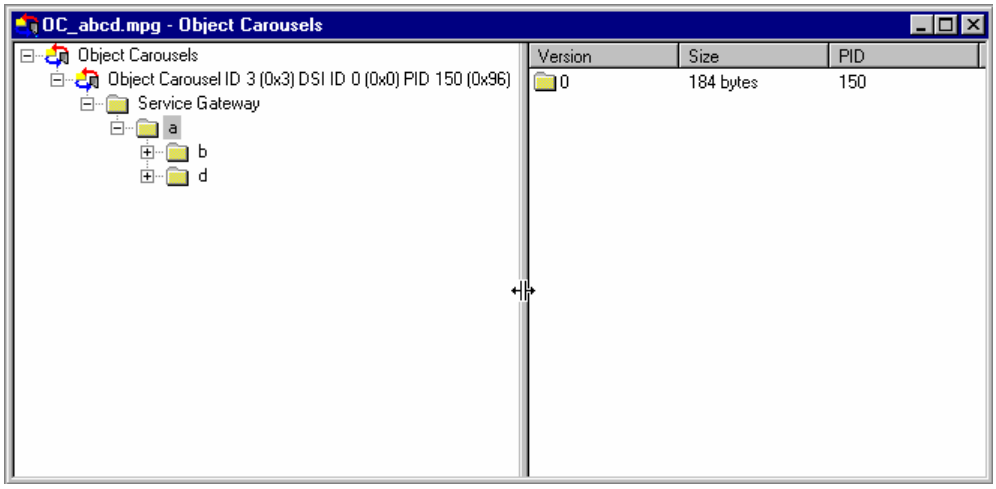
The MDI Child sub-menu allows the window to be designated as **Restored**, **Minimized** or **Maximized**.



When a window is 'docked' it can be dragged (and dropped) around the workspace; when it is at an edge it will adopt a docked position. MDI Children do not attempt to dock with the edges of the workspace.

Version/Size Pane Display

Most of the views described later use a split pane arrangement to display the view data and related version, file size and PID information. The information is displayed in the right-hand pane. However, the default arrangement when opening the view is that the right-hand pane is 'closed'. To open the pane, pass the cursor over the right-hand edge of the view until it changes to the split pane cursor (⇹), then move the dividing bar to the desired position.

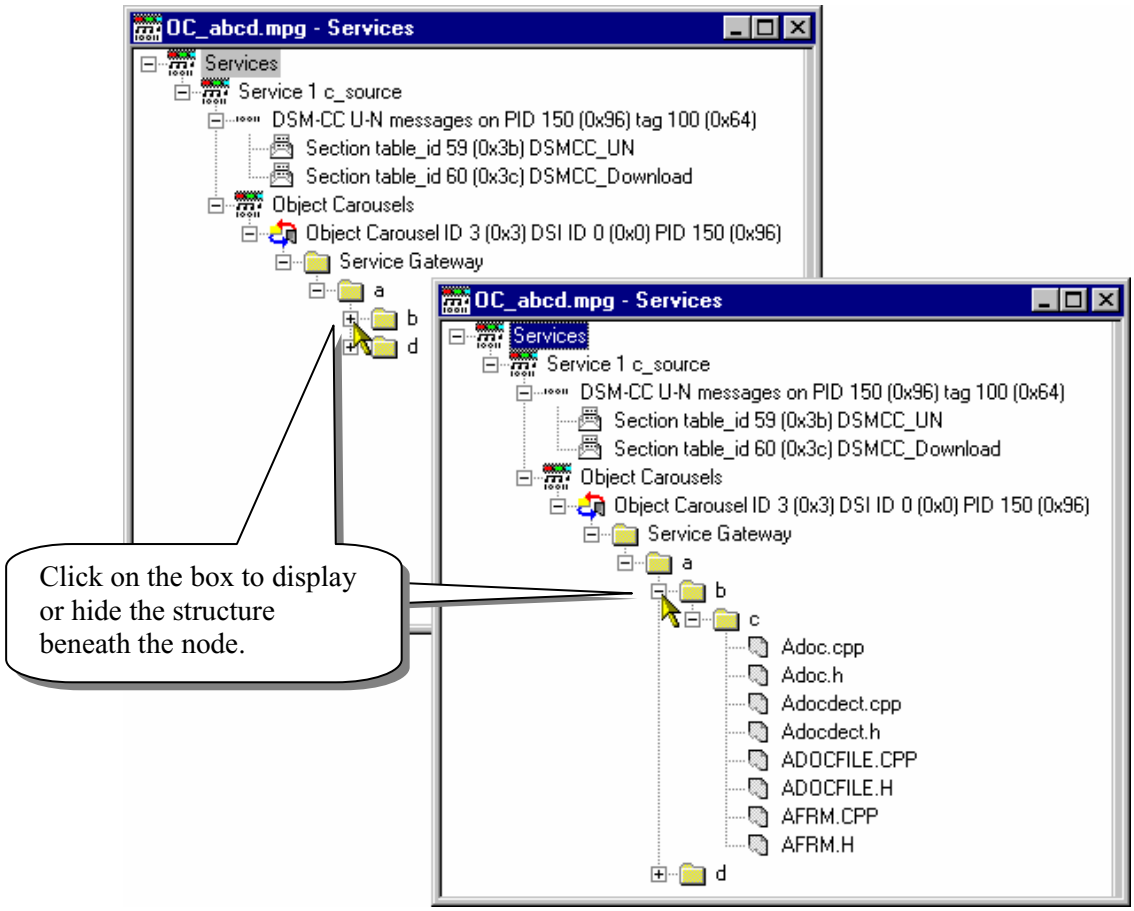


Content Management

The principles employed in displaying the information in each workspace window are applicable to all windows, although the content will vary from window to window.

Tree Structure

Structures are represented by tree diagrams, with the 'root node' or highest level component at the top. Components which contain more information beneath them in the structure are indicated by a [+] box. Clicking on the [+] box will display the structure beneath the node. Similarly, if a [-] box is adjacent to the node, the level of detail immediately below it is already displayed; this detail can be hidden by clicking on the [-] box. Components which are connected to a branch of the tree without a square box are leaf nodes; they display the lowest and finest level of detail.



Right-clicking on a tree node may open a context sensitive menu.

Component Selection

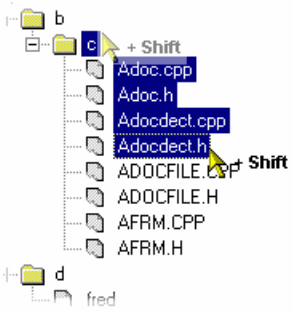
Components can be selected (or highlighted) either singly or in groups. When selected, the views available from the View menu (or a right-click menu) will be those that can be applied to all of the selected components.

Single component selection

Selected by clicking on a component.

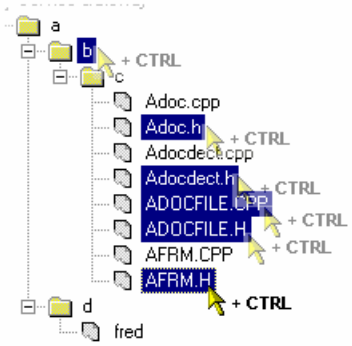
Range selection

Selected by clicking on and thus highlighting the first component in the selection required and, while holding the **Shift** key on the keyboard, clicking on the last component. The range selected will be highlighted.



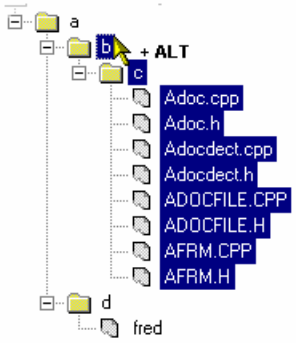
Multiple component selection

Selected by holding the Control key (**CTRL**) on the keyboard and clicking on the required components.



Node selection

Selected by holding the **Alt** key on the keyboard and clicking on the required node; all sub-components will be selected.



Saving Components

Selected (or highlighted) components can be saved via the right-click menu. However, the manner in which the components were selected (see previous paragraphs) will affect the file structure of the saved components.

If a Node Selection has been made, the directory structure is re-created at the specified location and the sub-components are saved to their equivalent directories.

If a Range or Multiple selection has been made, all files will be duplicated in the root directory at the specified location in addition to re-creating the directory structure and saving the sub-components to their equivalent directories.

Hex Displays

Hex displays follow a common format.

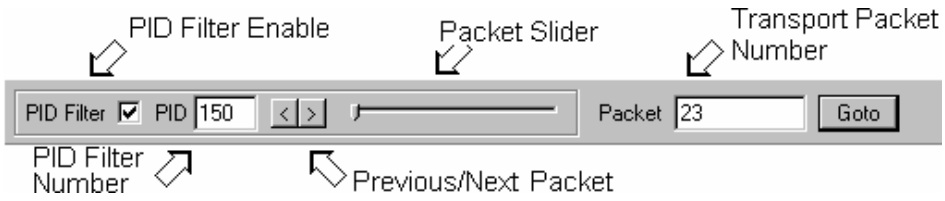
The eight-digit number in the left-hand column is the address of the first (i.e. left-hand) byte in the row. The addresses themselves are shown in hexadecimal format.

The center column displays the contents of the structure in hex format.

The right-hand column displays the contents of the structure in ASCII format.

Transport Packet Bar

The Transport Packet bar provides a quick method of locating and navigating to transport packets PIDs.



Packet — To locate a particular Transport Packet, enter the Transport **Packet** number and select **Goto**.

PID Filter enable — The PID navigation feature can be enabled by selecting the checkbox (as shown).

To navigate to a specific packet: With the PID Filter disabled, enter the packet number and select either the Previous or Next Packet button. If a PID structure view is now requested from a View, the search for the PID will commence with the transport packet number displayed.

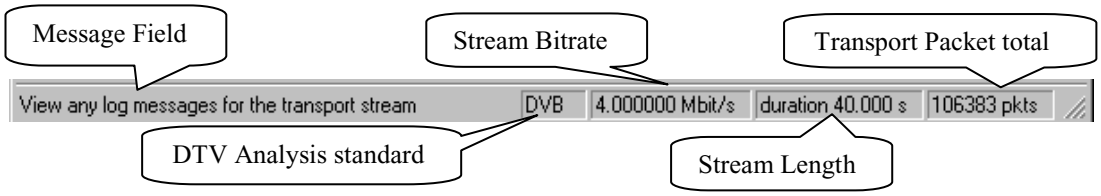
Similarly, with the PID Filter enabled, each press of either the Previous/Next button will display the previous/next transport packet containing the PID number displayed in the PID Number field. If a PID structure view is now requested from a View, the search for the PID will commence with the transport packet number displayed.

Note that when a Transport Packet is viewed, the number in the **Packet** field will increment by one.

The Transport Packet bar can be hidden from view via the **View** menu **Toolbars** option.

Status Bar

The Status bar provides information about the stream that is currently being displayed. A message field gives a description of the button, menu or option that the cursor is resting on; other non-critical messages may also be shown.



Views

Broadly speaking, Carousel Analyzer provides three types of view as a means to inspecting and analysing information carried in a transport stream.

- Static Views
  (Programs/Services, Object Carousel, U-N Download, Data Carousel, PID, Log)
- Structure Views
  (Transport Packet, U-N Messages, Module, Section, BIOP Messages)
- Chart Views
  (Bitrate, Repetition Rate)

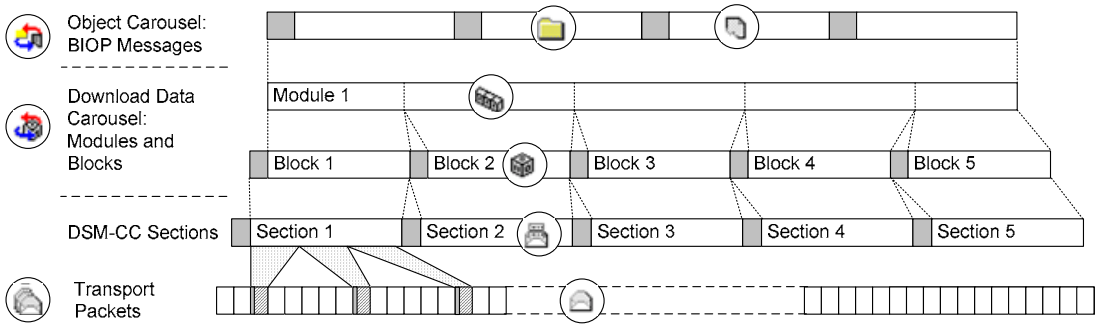
View	Page	View	Page
Programs/Services View	29	Structure Views	46
Object Carousel View	32	Bitrate View	49
	37	Repetition View	52
UN-Download View			
Data Carousel (DVB) View	41	PID View	54
Data Carousel (ARIB) View	41	Log View	56
		Cycle Times View	58

Static views display information derived from the transport stream when it is opened.

Structure views use **Tektronix** scripting technology to analyze structures that appear in the transport stream, e.g. tp, BIOP messages, etc. For repeated structures, this view allows all occurrences to be visited.

Chart views present timing information in graphical form about one or more structure in the stream.

The nodes displayed in the views relate to the protocol layers as shown in the diagram below:



Key to Tree Nodes

	Service/Program		Active PIDs/PIDs
	Download Block		BIOP Object Directory / ARIB Directory
	U-N Message		BIOP Object / ARIB Resource
	Download Module		Table
	Compressed Download Module		Transport Packet
	Data Carousel		Audio Stream
	Object Carousel		Video Stream
	Stream Object		Data/Other Stream
	Stream Event Object		MHP Applications
	Java Application		HTML Application

Key to Node Overlays

Overlays are used to signify additional information about nodes; the overlays may be used individually or in combination.

Absent Objects:
Objects referenced but not found, e.g. directory object not found.

The path in which the absent object is recognised is also marked.

Unresolved Objects:
When an object is found during analysis, but its key is not referred to in the Service Gateway, it is displayed under an Unresolved Objects node.

Boot Class Objects:
Boot class items are identified. The path in which the boot class resides is also indicated.

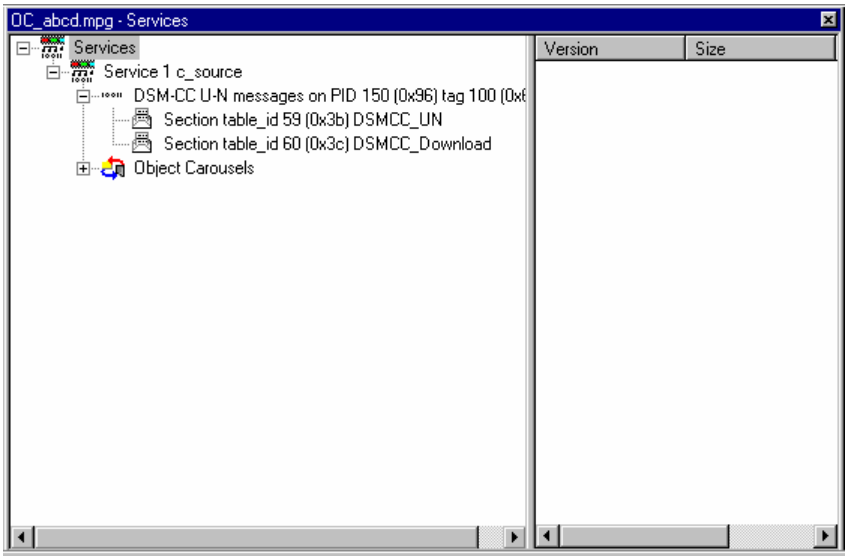
Manual Signalling:
Indicates that a PID has been subjected to the manual signalling process; used in the carousel and PID views only

In the following sections, each view is described together with the information accessible from that view.

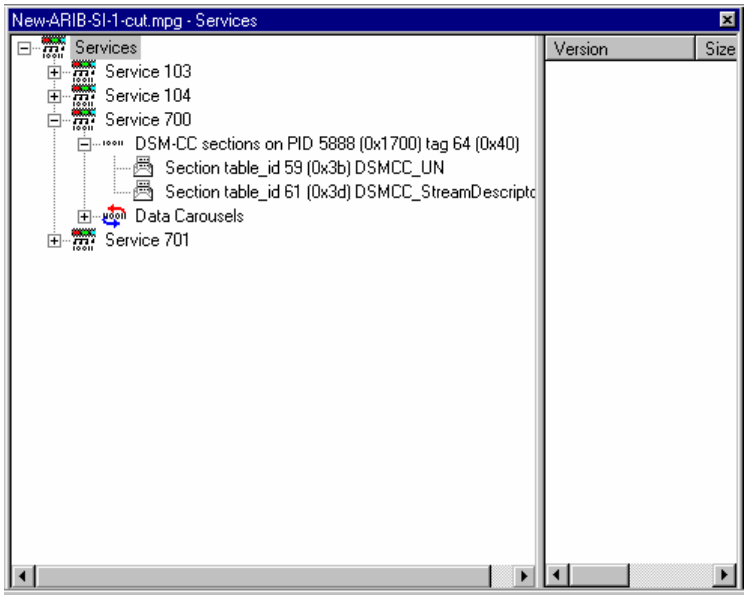
Programs/Services View

Menu Bar: View ➔ Programs/Services **Toolbar:** 

The Programs/Services view gives a static, DVB/ARIB service (or MPEG program) centric view of the transport stream contents. Each program is listed together with the service name (for DVB/ARIB). Expanding a program item will reveal its elemental PIDs and any object (or data) carousels associated with it.

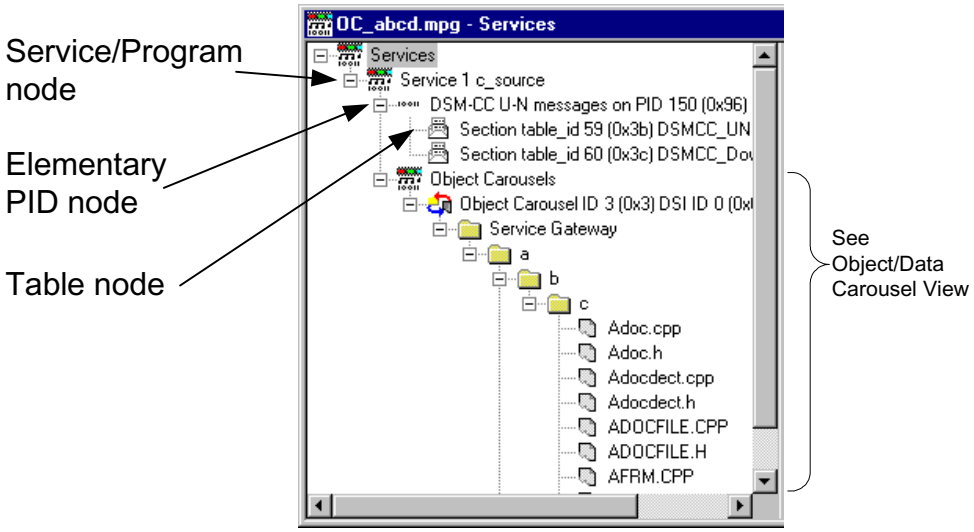


DVB Programs/Services View (Typical)



ARIB Programs/Services View (Typical)

The diagram below indicates the primary nodes accessible from the Program/Services view.



Service/Program node

This node represents a specific program or service (DVB or ARIB) in a transport stream. If a name for the program is available in the SDT (Service Description Table) it is displayed. Each Elementary PID listed in the PMT (Program Map Table) will have a corresponding node displayed as a child node of the Services/Program node. Similarly, any Object or Data Carousels associated with the Services/Program node are listed as child nodes.

Right-Click Menu Options

View PMT Opens the Section Table view for the PMT.

View Bitrate Activates or creates a bitrate view of the sum of the elementary streams that are listed in the PMT for this program.

Elementary PID node

This node represents a PID referenced by a program. If the PID carries Sections, these are represented as Table nodes.

Right-Click Menu Options

View Transport Packet Displays a structure view of the next transport packet encountered on this PID from the current stream position (as indicated by the Transport Packet number displayed in the Transport Packet Bar).

View Cycle Time ► Allows either cycle time statistics or graphical view to be selected.

View Repetition Activates or creates a view of the repetition rate of this PID in the transport stream.

View Bitrate Activates or creates a bitrate view of this PID.

Table node

This node represents the stream of sections present on a specific PID with a specific table identity.

Right-Click Menu Options

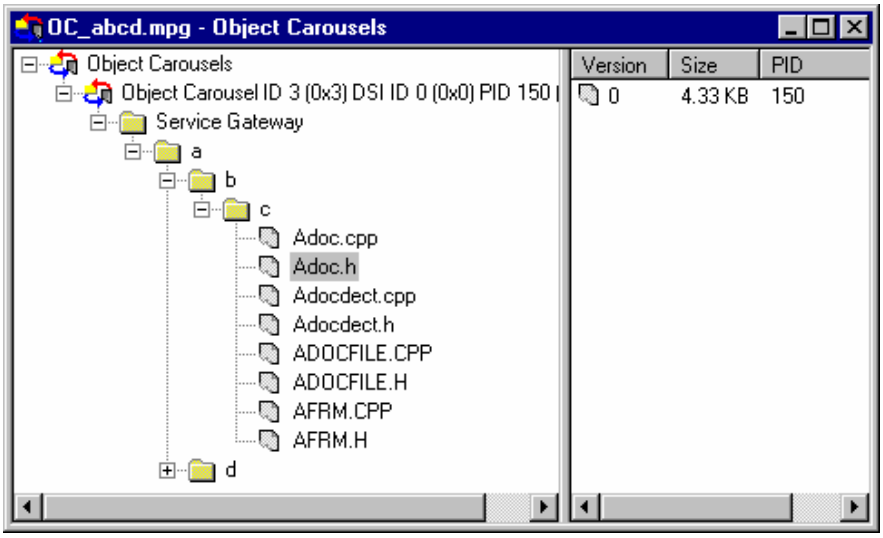
View Section	Displays a structure view of the next section with this PID and table identity that can be formed from the current stream position onwards (as indicated by the Transport Packet number displayed in the Transport Packet Bar).
View Cycle Time ►	Allows either cycle time statistics or graphical view to be selected.
View Repetition	Activates or creates a view of the repetition rate of this PID with this PID and table identity.
View Bitrate	Activates or creates a bitrate view of sections with this PID and table identity.

Object Carousel View

Menu Bar: View ➔ Object Carousels **Toolbar:** 

The Object Carousel view shows a static view of every object carousel in the transport stream.

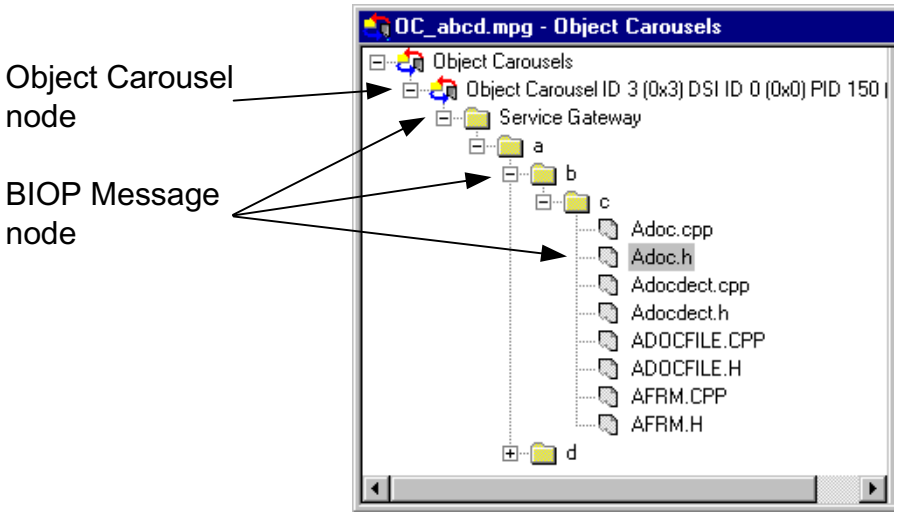
The view is in the style of Windows Explorer. The left-hand pane shows the directory structure of the object carousels, and the right-hand pane lists the versions of the BIOP message currently selected in the left-hand pane.



Double clicking on a file BIOP message can bring up an appropriate viewer application if the operating system can find one (File associations can be set via the Windows Explorer Options). File BIOP messages can also be saved to disk by selecting the **Save As…** option from the **File** menu.

The version number of the BIOP messages represents the version number of the module that carries the BIOP message.

The diagram below indicates the nodes accessible from the Object Carousels view:



Object Carousel node

This node indicates that an object carousel has been signalled in the PSI/SI.

Right-Click Menu Options

View Application Timing	Opens the Application Management dialog.
View DSI Carrying Carousel IOR	Displays a structure view showing the U-N DSI message that carries the service gateway IOR for this carousel.

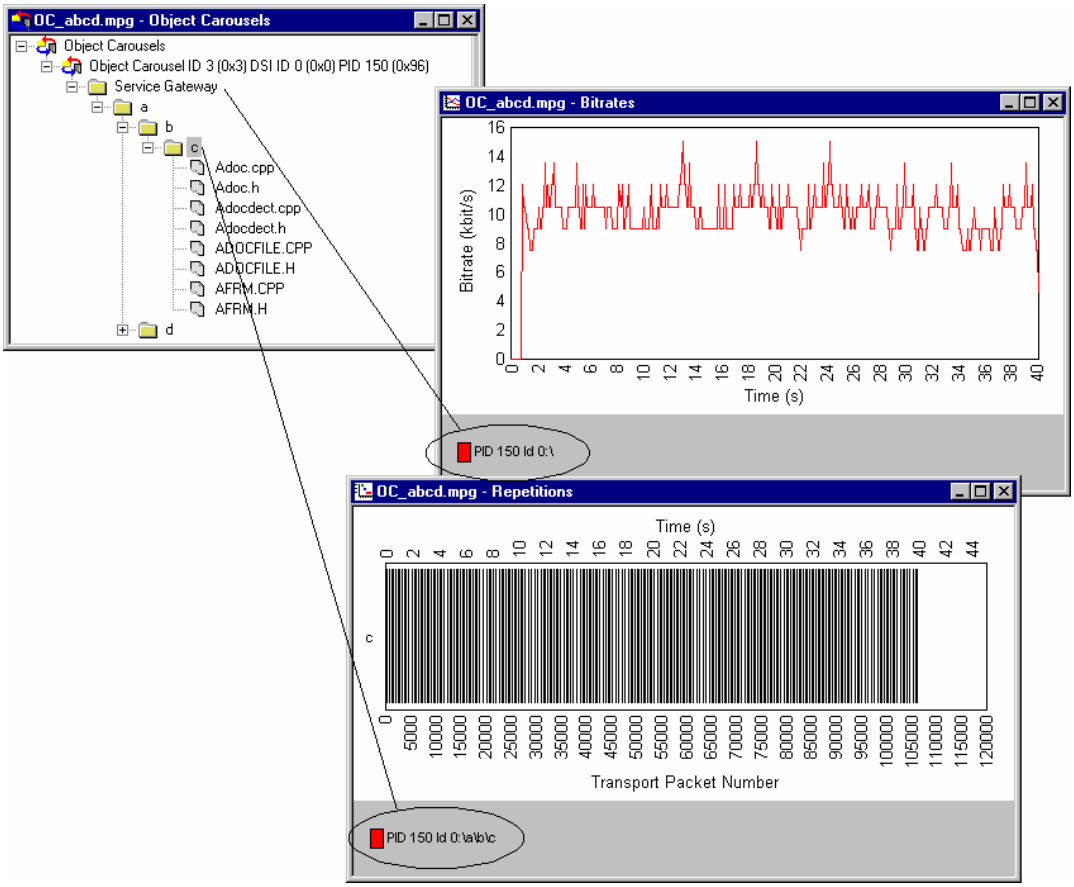
BIOP Message node

This node represents a specific BIOP Message. If the node represents a BIOP directory, the directory entries appear as child nodes.

Right-Click Menu Options

Open	View the message in its native format. This only works for file messages that have an associated viewer application on the PC.
Save As…	Save the BIOP message to a separate file.
View BIOP Message	Displays a structure view of the next appearance of this BIOP message that can be formed from the current stream position onwards (as indicated by the Transport Packet number displayed in the Transport Packet Bar).
View Carrier Module	Activates or creates the U-N download view and highlights the module that carries this BIOP message.
View Cycle Time ►	Allows either cycle time statistics or graphical view of the carousel to be selected.
View Repetition	Activates or creates a view of the repetition of this BIOP message.
View Bitrate	➔ **This BIOP message**: Activates or creates a view of the bitrate of this BIOP message. ➔ **Including nested messages**: View the sum of the bitrates for this BIOP message and all descendant messages (i.e. all children and their children). These options are only available for BIOP directory messages.

If a Service Gateway is viewed in the Bitrate, Repetition or Structure view, its name in these views reflects the DSI transaction ID and PID in which it was carried.

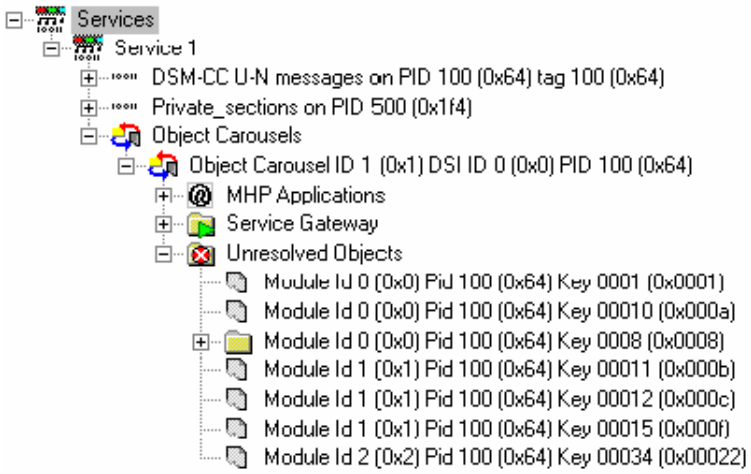


MHP Applications

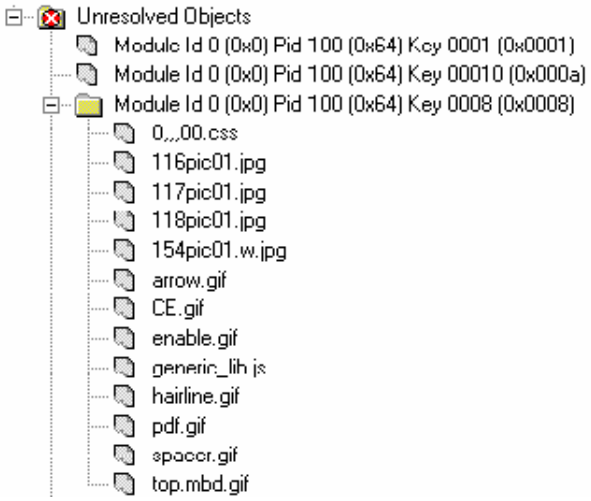
(See MHP Support, page 76.)

Unresolved Objects

When an object is found during analysis, but its key is not referred to in the Service Gateway, it is displayed under an Unresolved Objects node.

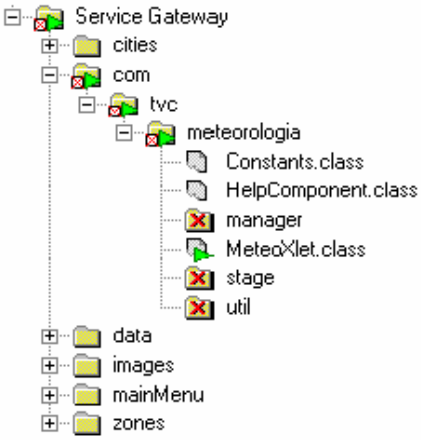


However, when a directory object is found, the keys of its child nodes can be resolved and its tree structure built correctly, even though the directory object itself may still be unresolved.



Absent Objects

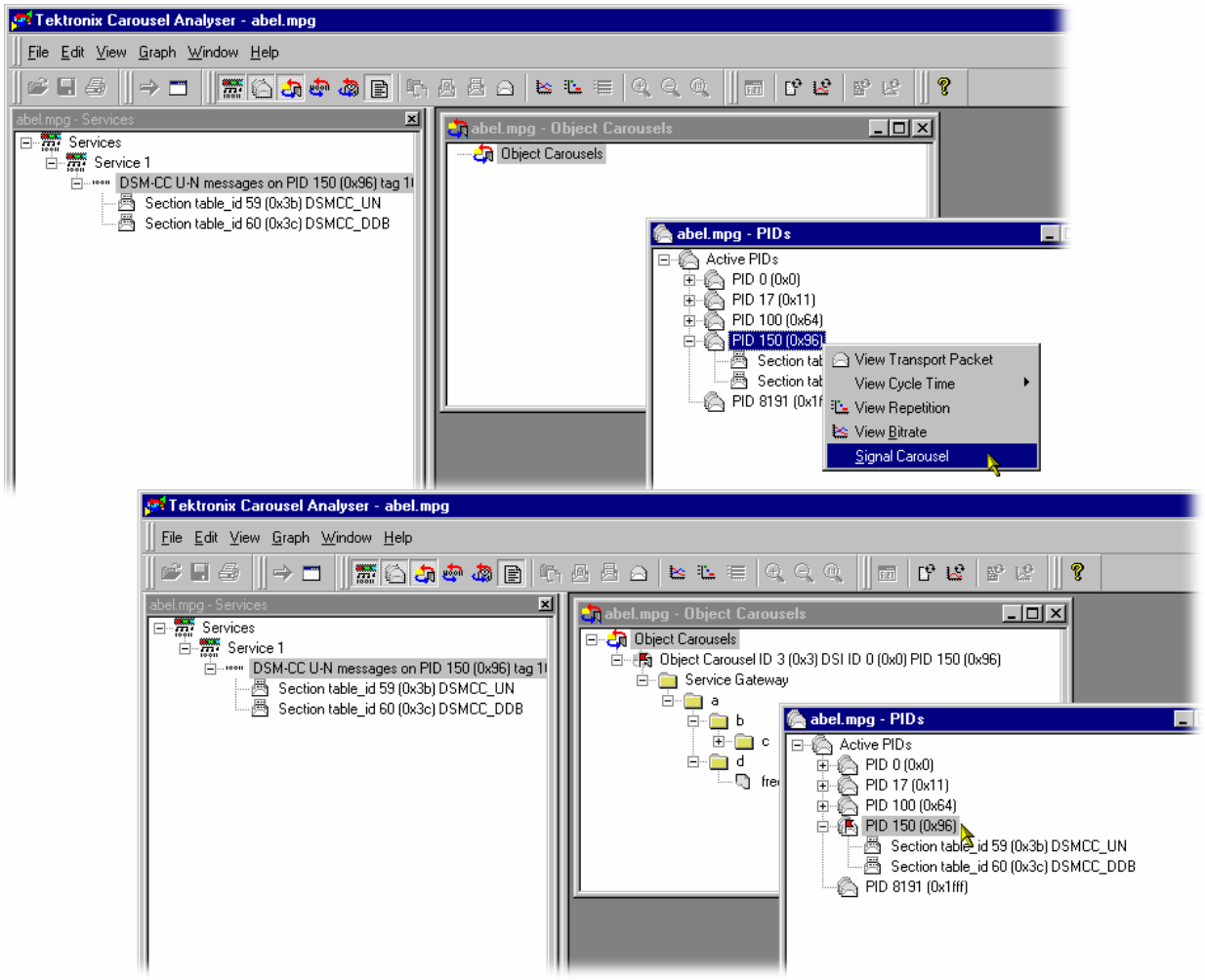
Objects referenced but not found are identified, e.g. - directory object not found. The path in which the absent object is recognised is also marked ( ).



Manual Signalling

If a carousel is present in a stream, but has not been found during analysis, it can be identified with Manual Signalling from the related PID node.

The command Signal Carousel can be found on the right-click menu associated with each PID node. When selected the stream will be reprocessed. During processing, only the DSM-CC tables on the selected PID will be analyzed.



The user interface is updated when the stream has been processed. Any carousels that have been identified are added to the Carousel view. The signal icon ( ), used in the carousel and PID views only, indicates that the PID has been subjected to the manual signalling process.

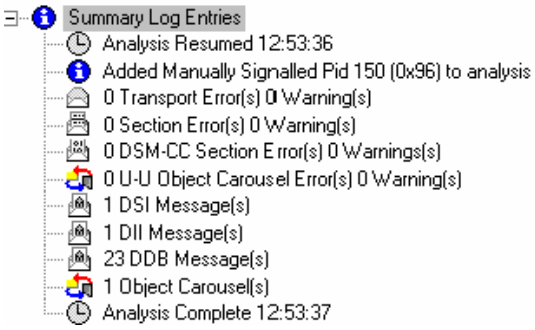
The PID view will display a list of the table types that were detected during processing.

Carousels that span multiple PIDs will be only partially analyzed.

The PID must contain a Service Gateway for any Object Carousel view to be displayed.

The Log view is refreshed by describing the most recent action, e.g. **Added Manually Signalled PID150….**

Any feedback from the Manual Signalling will be displayed in the Summary log.

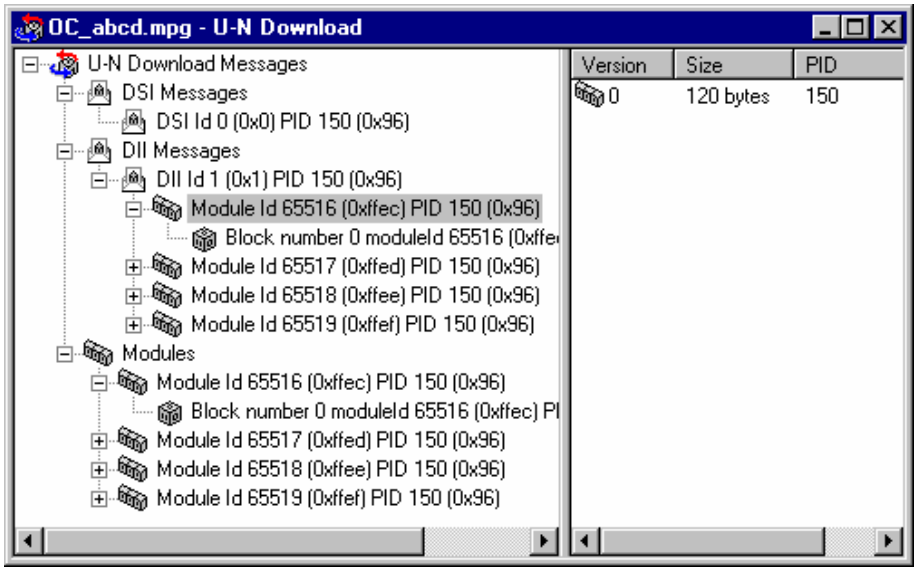


UN-Download View

Menu Bar: View ➔ UN Download **Toolbar:** 

This static view shows all the UN-download (DSM-CC data carousel scenario) messages in the transport stream.

The view is in the style of Windows Explorer. The left-hand pane contains a hierarchical pane on the left and a version pane on the right. The version pane will list the versions of the U-N download message selected in the left-hand pane.

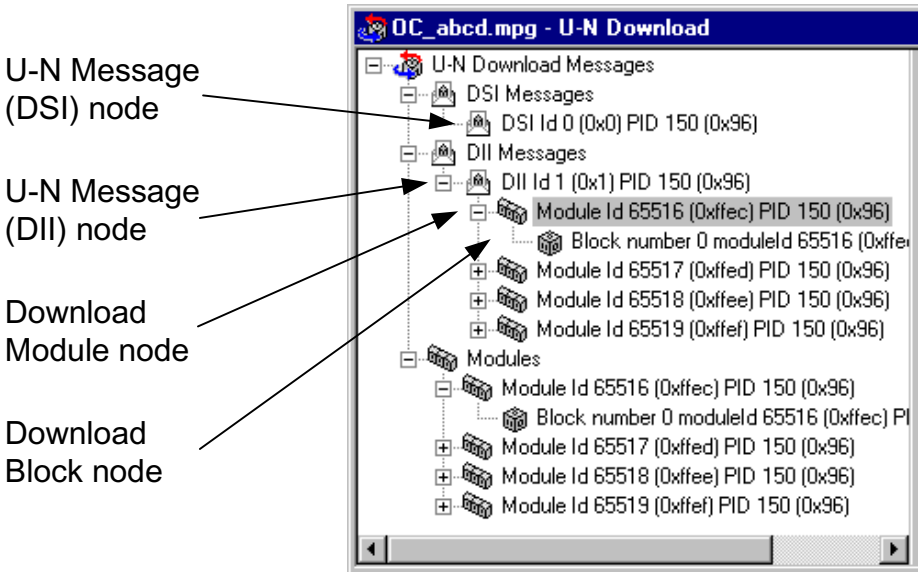


DII items contain module items that the DII message references. All modules are also listed under the 'Modules' item.

Modules may be in compressed form; the version of the compressed icon is displayed in the Version column of the right-hand pane. 

Modules are listed independently of DII messages in case the DII does not reference the module correctly. Hence, for a compliant stream, each module is listed as a child of the DII node and within the Modules node.

The diagram below indicates the nodes accessible from the U-N Download view.



U-N Message (DSI) node

This node represents a Download Server Initiate message.

Right-Click Menu Options

View U-N Message Displays a structure view of the next appearance of this DSI message that can be formed from the current stream position onwards (as indicated by the Transport Packet number displayed in the Transport Packet Bar).

View Carrier Section Displays a structure view of the next appearance of the section that carries this DSI message.

View Cycle Time ➔ Allows either cycle time statistics or graphical view of the object to be selected.

View Repetition Activates or creates a repetition view of the DSI message.

View Bitrate Activates or creates a bitrate view of the DSI message.

U-N Message (DII) node

This node represents a Download Information Indication message. A DII message may reference modules. If the module reference can be resolved then the DII tree node will contain child Module nodes.

Right-Click Menu Options

View U-N Message Displays a structure view of the next appearance of this DII message that can be formed from the current stream position onwards (as indicated by the Transport Packet number displayed in the Transport Packet Bar).

View Carrier Section Displays a structure view of the next appearance of the section that carries this DII message.

View Cycle Time ➔ Allows either cycle time statistics or graphical view of the object to be selected.

View Repetition Activates or creates a repetition view of the DII message.

View Bitrate Activates or creates a bitrate view of the DII message.

Download Module node

This node represents a U-N Download Module. The download blocks that constitute the module are listed as child nodes.

Right-Click Menu Options

View Hex Dump Displays a data view of the next appearance of this module that can be formed from the current stream position onwards (as indicated by the Transport Packet number displayed in the Transport Packet Bar).

View Cycle Time ➔ Allows either cycle time statistics or graphical view of the object to be selected.

View Repetition Activates or creates a repetition view of the module.

View Bitrate Activates or creates a bitrate view of the module.

Block node

This node represents a U-N Download Data Block (DDB).

Right-Click Menu Options

View U-N Message Displays a structure view of the next appearance of this DDB message that can be formed from the current stream position onwards (as indicated by the Transport Packet number displayed in the Transport Packet Bar).

View Carrier Section Displays a structure view of the next appearance of the section that carries this DDB message.

View Cycle Time ► Allows either cycle time statistics or graphical view of the object to be selected.

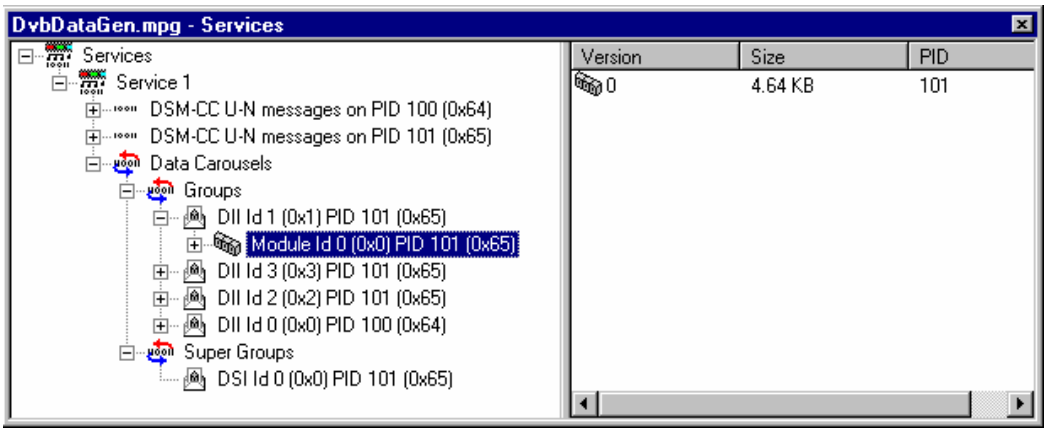
View Repetition Activates or creates a repetition view of the DDB message.

View Bitrate Activates or creates a bitrate view of the DDB message.

Data Carousel (DVB) View

Menu Bar: View ➔ Data Carousel **Toolbar:** 

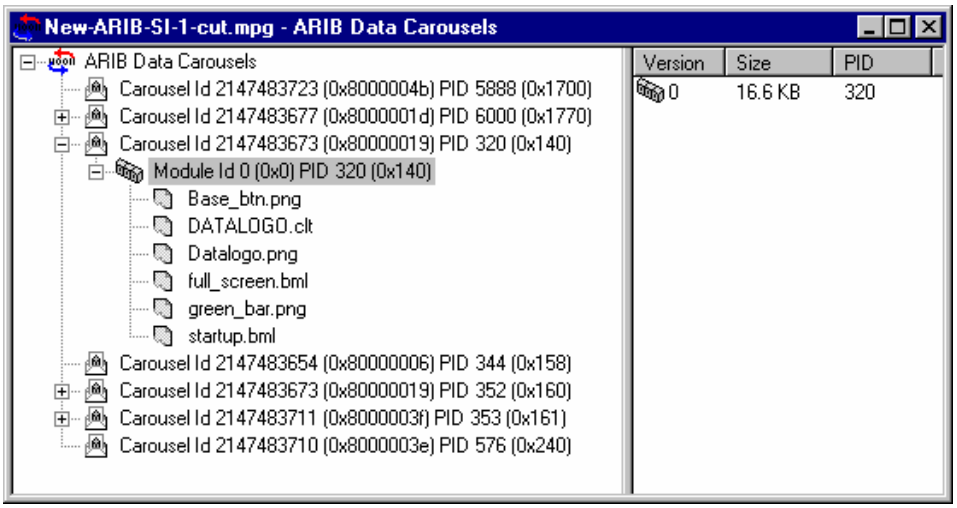
This static view shows all the data carousels in the DVB transport stream. The view is in the explorer style with a hierarchical view in the left pane and a version view in the right.



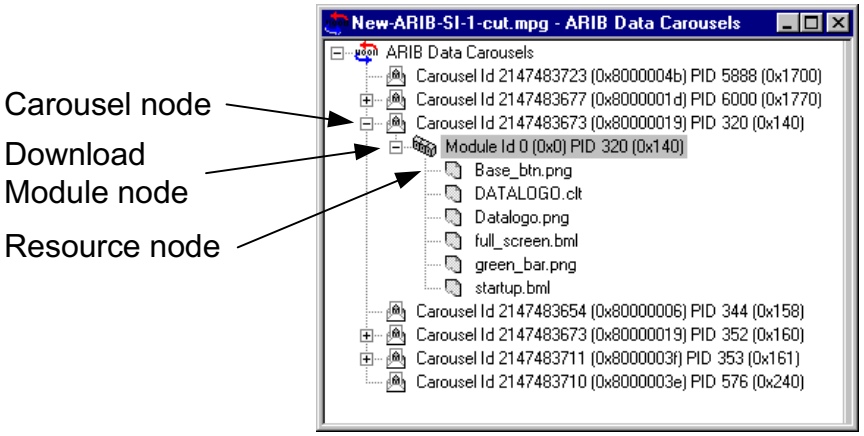
Data Carousel (ARIB) View

Menu Bar: View ➔ Data Carousel **Toolbar:** 

This static view shows all the data carousels in the ARIB transport stream. The view is in the explorer style with a hierarchical view in the left pane and a version view in the right.



The diagram below indicates the nodes accessible from the Data Carousel (ARIB) view.



Carousel node

This node represents a single Data Carousel in the ARIB data carousel structure.

Right-Click Menu Options

View U-N Message Displays a structure view of the next appearance of this DII message that can be formed from the current stream position onwards (as indicated by the Transport Packet number displayed in the Transport Packet Bar).

View Carrier Section Displays a structure view of the next appearance of the section that carries this DII message.

View Cycle Time ► Allows either cycle time statistics or graphical view of the object to be selected.

View Repetition Activates or creates a repetition view of the DII message.

View Bitrate Activates or creates a bitrate view of the DII message.

Download Module node

This node contains all of the resources available to a module.

Right-Click Menu Options

View Resources Displays the Resource view of the selected module.

Save Resources Saves the resource files to a selected location. The header information is not saved.

View Cycle Time ► Allows either cycle time statistics or graphical view of the object to be selected.

View Repetition Activates or creates a repetition view of the module.

View Bitrate Activates or creates a bitrate view of the module.

(See also ARIB Module Versions, page 44.)

Resource node

Each Resource node is a leaf node containing one resource file.

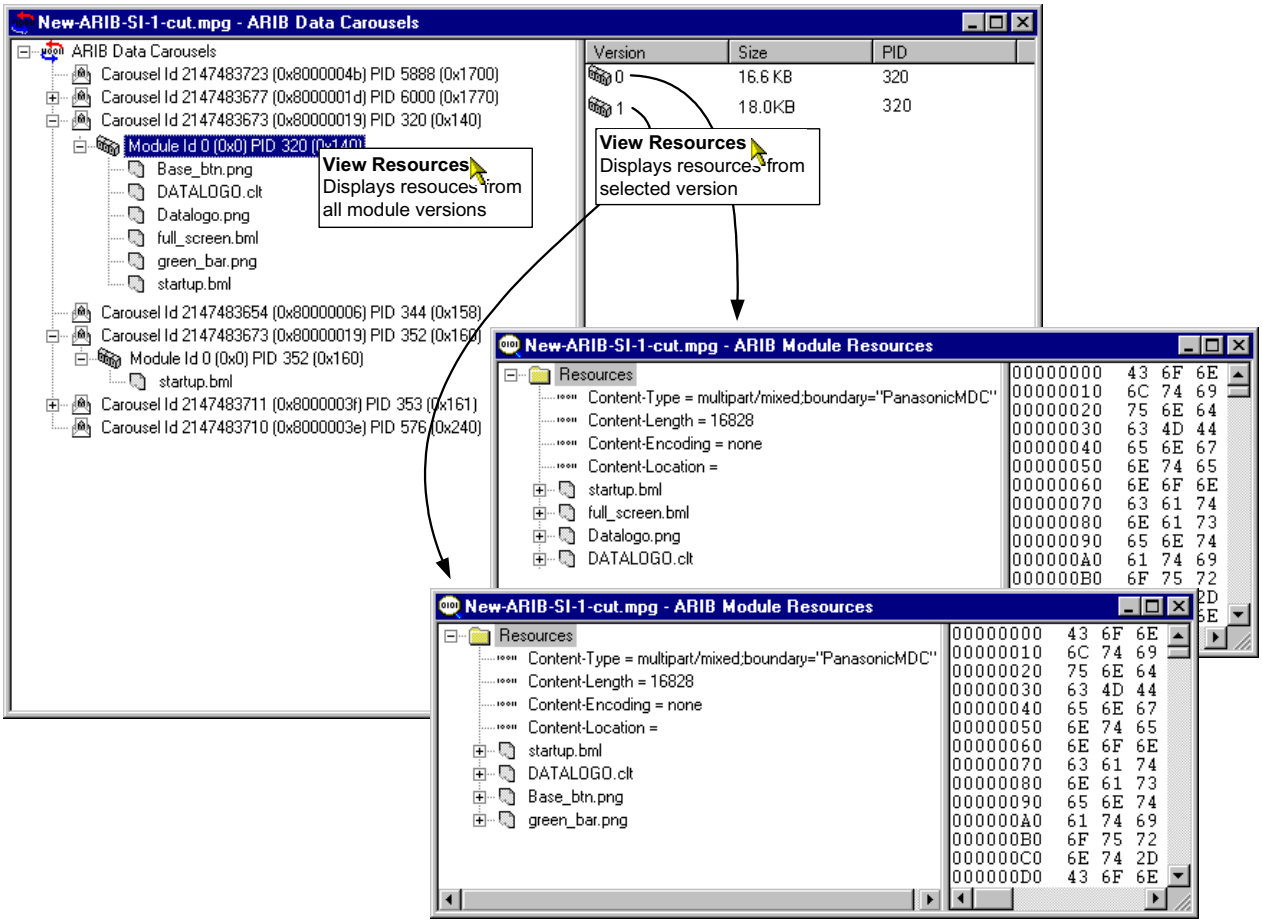
Right-Click Menu Options

Open	Opens the resource in an associated application to allow it to be viewed. If no association has been made with the file type on the host computer, a message is displayed.
Save	Saves the resource file to a selected location. The header information is not saved.
View	Displays the Resource view. The selected resource is highlighted in the Resource view.

ARIB Module Versions

Note that there may be multiple versions of a single ARIB module. Each version of the same module can potentially contain different resources,
e.g. Version 1 may contain resources A, B and C and Version 2 may contain resources C, D and E.

When viewing the resources in Data Carousel and Service/Program views, the resources listed under the Module node will be all resources across all versions, e.g. A, B, C, D and E. When opening or saving any of these resources from Data Carousel or Service/Program views, the operation will work on the first version encountered in the stream (A, B and C will come from Version 1 and D and E will come from Version 2). Basically, these two views contain a summary of all the resources encountered in that module regardless of version.

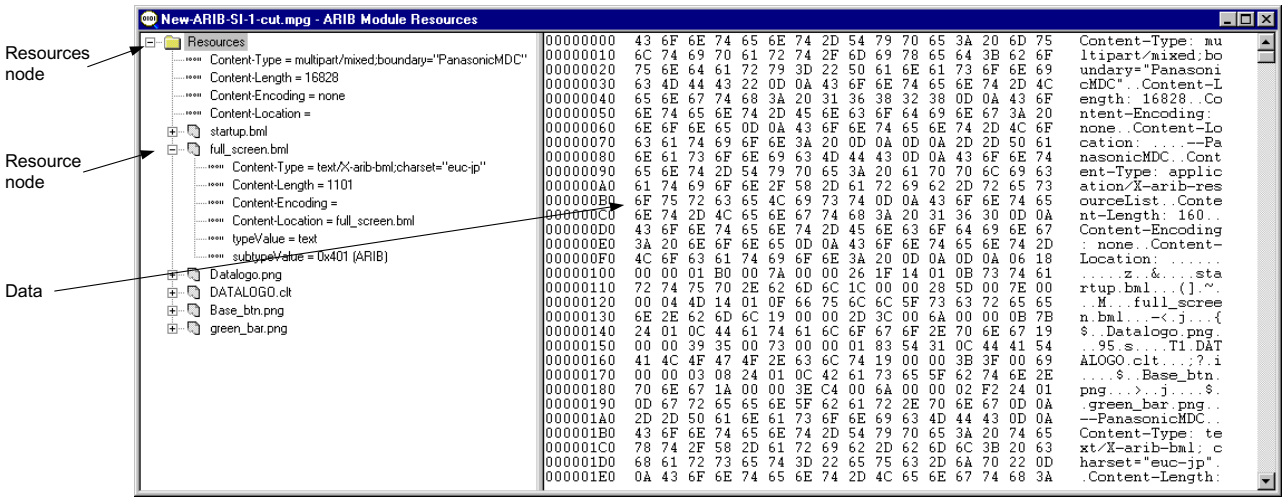


The ARIB Resource view will show only the resources contained in an individual module version - to view resources from different module versions, the user must use the **Go To Next** command or open a different version in ARIB Resource view.

Resource View

Menu Bar: View ➔ Resources

The ARIB Resources view displays a hierarchical and raw data interpretation of the resource structure in Data Carousels. The raw data is presented in hexadecimal and ASCII form in the adjacent pane.



Resources node

This Resources node displays a header and the resources associated with one Module.

Right-Click Menu Options

Go To Next — Displays the next occurrence of the Resource node in the transport stream (Note the change of **Packet** number in the Status bar).

Save — Saves the resource files to a selected location. The header information is not saved.

Resource node

Each Resource node displays header information and a resource.

Right-Click Menu Options

Open — Opens the resource in an associated application to allow it to be viewed. If no association has been made with the file type on the host computer, a message is displayed.

Save — Saves the resource file to a selected location. The header information is not saved.

Data

Represents the currently selected tree node

Right-Click Menu Options

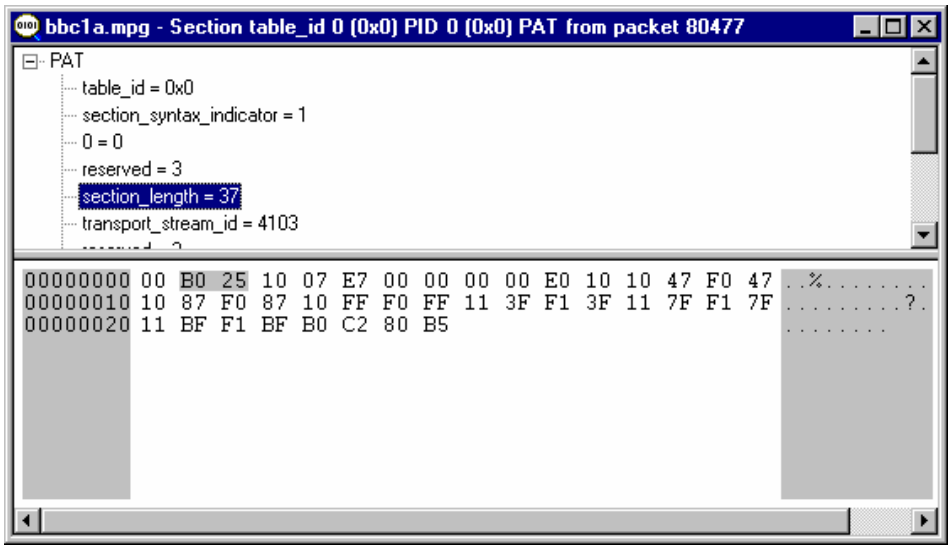
 **Save As…** Saves the Module Resource data to a selected location.

 **Go To Next** Displays the next occurrence of the Resource node in the transport stream (Note the change of **Packet** number in the Status bar).

View Transport Packet List Displays the **Transport Packet Contributions** view which list the transport packets that have contributed to the resources in the module (See Structure Views, page 46).

Structure Views

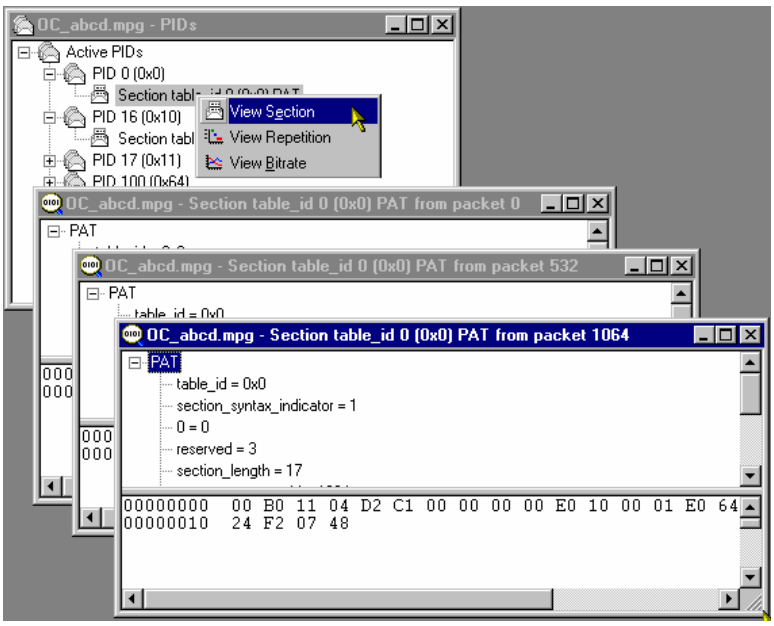
Structure views display a hierarchical and raw data interpretation of a structure (i.e. BIOP Message, U-N Message, Module, Section, Transport Packet). The hierarchical view is based on a script from the script files that are loaded (see Script Selection, page 9). Raw data is presented in hexadecimal and ASCII format in the lower pane.



Highlighting an element in the table window will automatically highlight the section of the hexadecimal code which contains the selected information.

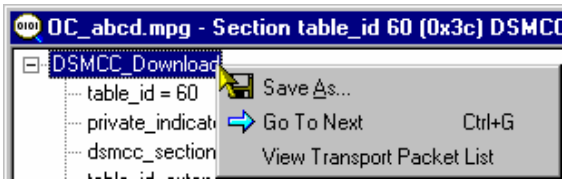
The view will bring up the first appearance of a particular message in the transport stream reading from the current packet position. To view the next appearance, select the **Go to Next** option from the **Edit** menu or the toolbar button  . This will display the next repetition of the message in the open structure view window; if necessary, it will wrap to the first occurrence.

For example, in the screenshot below, the PAT first appears in transport packet 0. Selecting **Go to Next** and viewing the section again will show the next repetition of the PAT on transport packet 532 and so on.



Since the structure view is based on a script, the script can be edited and the presentation of the packet or message changed.

Right-clicking on the any item in the structure view will pop up this menu:



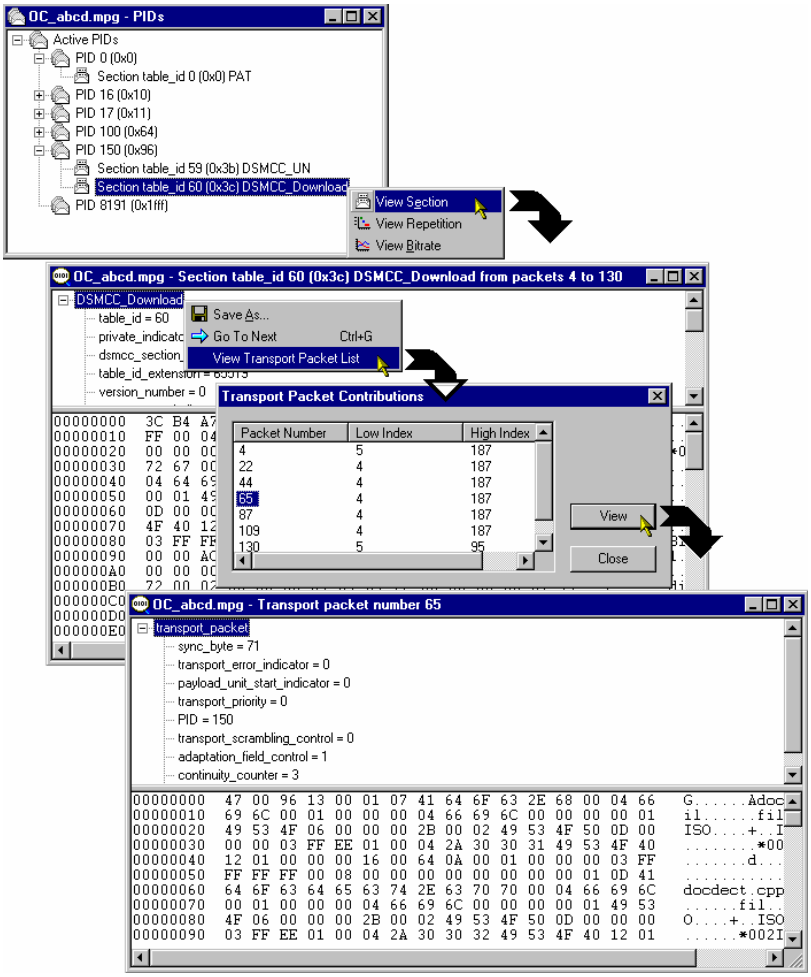
Using the **Save As…** option, the structure can be saved to a separate file.

The **Go To Next** option moves the structure view to the next repetition of the same item. If the current view is the last in the stream, the option will loop back to the first repetition in the stream.

The information displayed by the structure view may be carried in one or more transport packets. By right-clicking the item and selecting **View Transport Packet List**, a list of the transport packets carrying the information will be displayed. Highlighting a **Packet Number** and selecting **View** will display the selected transport packet structure. Several structure views can be opened in this way but the views are not enabled until the **Transport Packet Contributions** dialog is closed.

The Low and High Index entries in the **Transport Packet Contributions** dialog indicate the first and last byte respectively of the packet that contributes to the structure.

The screenshots below illustrate an example of this sequence of actions:



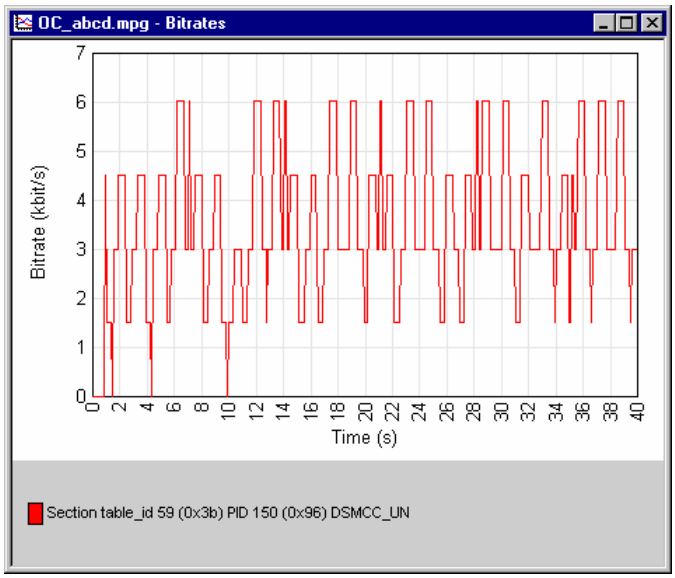
Bitrate View

Menu Bar: View ➔ Bitrate **Toolbar:** 

This structure view charts the bitrate of a set of transport entities (e.g BIOP message, PID, module). The bitrate calculation is a rolling average. For any transport entity the sum of the transport packets that contribute to that entity in each 100ms time-slice are summed. The average is calculated every 100ms using the last 10 time-slices (i.e. the bitrate is the average over the last second).

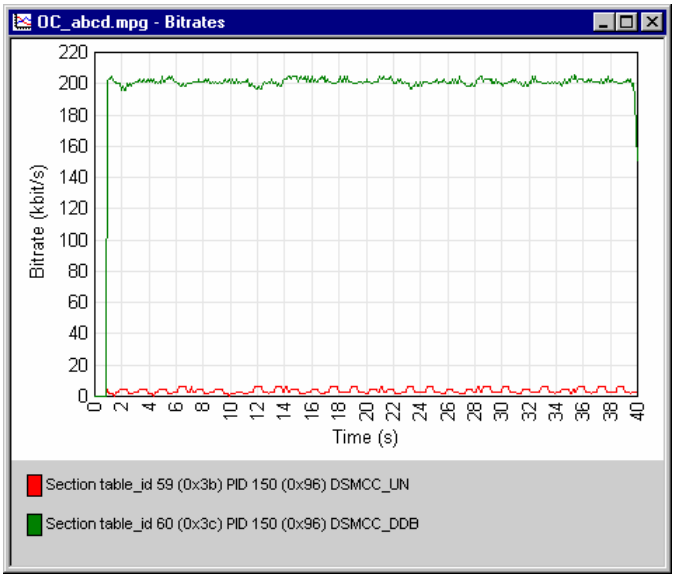
In some cases a choice is offered between displaying the bitrate of the selected element or a composite bitrate of the selected element and its subsidiary (nested) elements.

In calculating bitrates, Carousel Analyzer returns to the stream file. For large files, the calculation may take an appreciable amount of time.



The y-axis is automatically scaled to accommodate the maximum bitrate. The name of the element from which the bitrate is derived and the related graph are linked by color; a line (of the same color) is displayed to the right of the element name.

If the bitrate for a second element is requested, it is displayed on the same graph, thus:



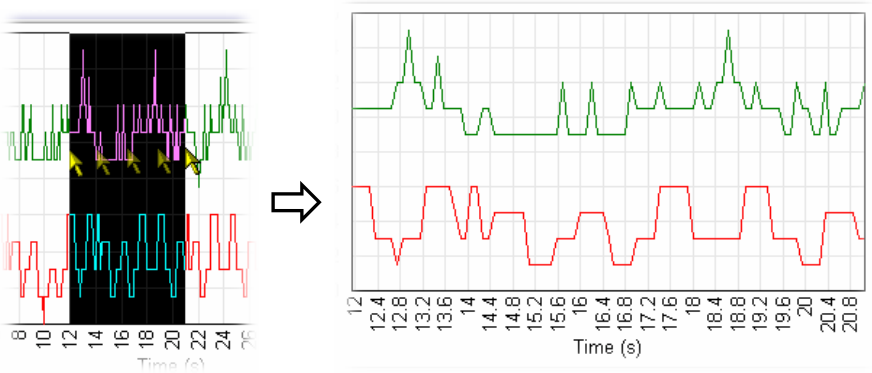
Any number of element bitrates can be displayed; each will be a separate color.

Inspecting Bitrates

It is possible to zoom in on an area of the graph in order to inspect the bitrate in detail.

To zoom in on the central 50% of the displayed graph, use the menu option **Graph ➔ Zoom ➔ Zoom In** (or the Toolbar button:  ; or tab key). This action can be repeated.

To zoom in on any area of the bitrate graph, drag the mouse while holding the left-button, to highlight the area required. When the mouse button is released, the highlighted area will be displayed to fill the graph area.



The menu option **Graph ➔ Zoom ➔ Zoom Out** (Toolbar:  ; or shift-tab key) will zoom out one step at a time; a step being the previous zoom in actions.

The menu option **Graph ➔ Zoom ➔ Show All** (Toolbar: ) will redisplay the graph with no zoom factor applied.

Saving/Copying

The graph can be saved or copied in text format or as a picture file (JPEG or bitmap).

Menu Option	Description
Graph ➔ Save	Save the graph to a user defined location.
➔ Bitmap	Size the graph window before saving.
➔ JPEG	Size the graph window before saving.
➔ Table	Tab delimited format.
Graph ➔ Copy	Copy to clipboard, from where it can be pasted into a suitable application:
➔ Image	
➔ Table	Tab delimited format.

Repetition View

Menu Bar: View ➔ Repetition **Toolbar:**

This structure view charts the repetition of a set of data broadcast entities. This Gantt style graph displays a row for each transport entity (e.g. BIOP message, U-N message etc) selected. A colored block on the row indicates the presence of the message at that point in the transport stream.

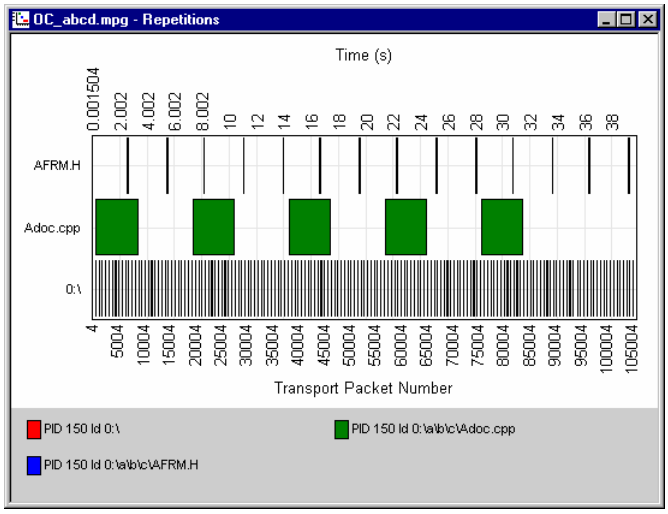
In calculating repetition rates, Carousel Analyzer returns to the stream file. For large files, the calculation may take an appreciable amount of time.

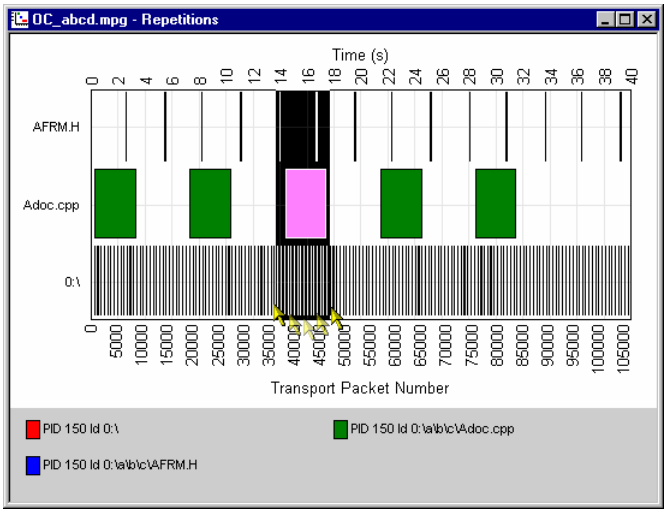
Inspecting Repetition Rates

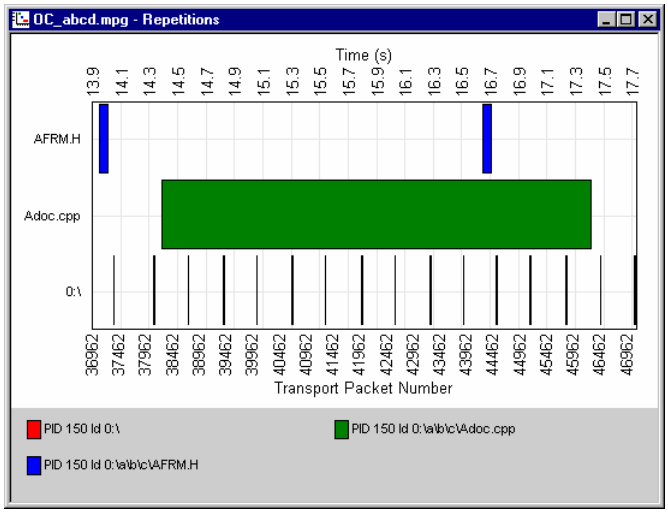
It is possible to zoom in on an area of the graph in order to inspect the repetition rate in detail.

To zoom in on the central 50% of the displayed graph, use the menu option **View ➔ Zoom ➔ Zoom In** (or the Toolbar button: ; or tab key). This action can be repeated.

To zoom in on any area of the repetition rate graph, drag the mouse while holding the left-button, to highlight the area required. When the mouse button is released, the highlighted area will be displayed to fill the graph area.







The menu option **View ➔ Zoom ➔ Zoom Out** (Toolbar:  ; or shift-tab key) will zoom out one step at a time; a step being the previous zoom in actions.

The menu option **View ➔ Zoom ➔ Show All** (Toolbar: ) will redisplay the graph with no zoom factor applied.

Tooltips: When the cursor is placed over a block, a tooltip is displayed giving the PID, time and packet number.

Saving/Copying

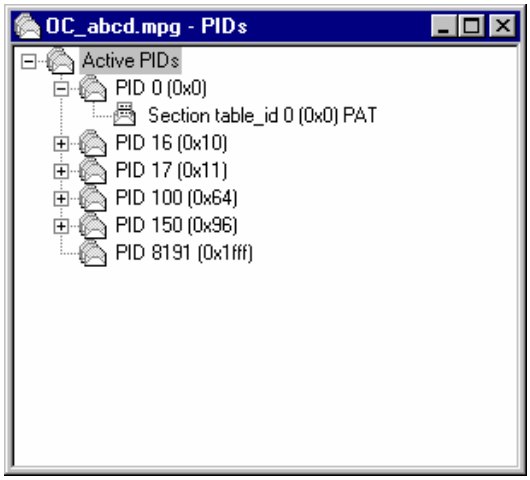
The graph can be saved or copied in text format or as a picture file (JPEG or bitmap).

Menu Option	Description
Graph ➔ Save	Save the graph to a user defined location.
➔ Bitmap	Size the graph window before saving.
➔ JPEG	Size the graph window before saving.
➔ Table	Tab delimited format.
Graph ➔ Copy	Copy to clipboard, from where it can be pasted into a suitable application:
➔ Image	
➔ Table	Tab delimited format.

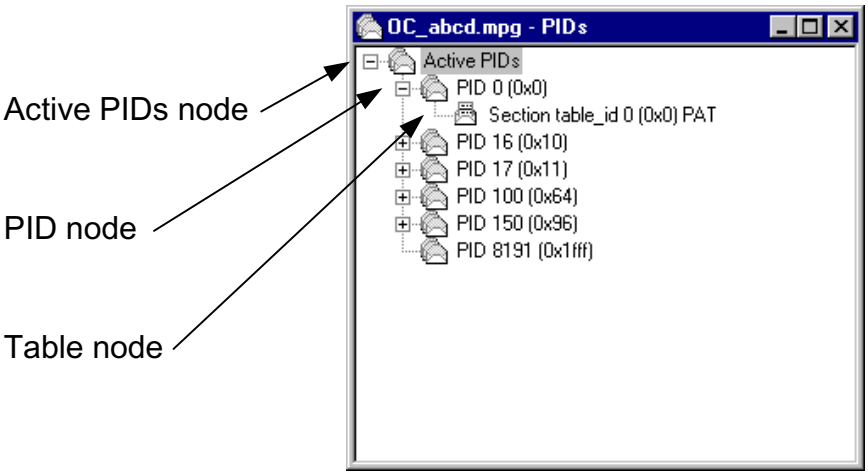
PID View

Menu Bar: View ➔ PIDs **Toolbar:** 

This static view displays all the active PIDs within the transport stream. A PID carrying sections will have nested items which detail the table types on that PID. The structure, bitrate and repetition of transport packets and sections are available from this view.



The diagram below indicates the nodes accessible from the PIDs view.



Active PIDs node

This node represents all the PIDs found in the current transport stream; the PIDs are listed as child items.

Right-Click Menu Options

View Transport Packet Displays a structure view of the packet at the current stream position (as indicated by the Transport Packet number displayed in the Transport Packet Bar).

PID node

Represents all the transport packets with a particular PID. If the PID carries sections then the PID tree node will have child table tree nodes.

Right-Click Menu Options

View Transport Packet Displays a structure view of the next transport packet encountered on this PID from the current stream position (as indicated by the Transport Packet number displayed in the Transport Packet Bar).

View Cycle Time ► Allows either cycle time statistics or graphical view to be selected.

View Repetition Activates or creates a view of the repetition of this PID in the transport stream.

View Bitrate Activates or creates a view of the bitrate of this PID.

Table node

This node represents the stream of sections present on a specific PID with a specific table identity.

Right-Click Menu Options

View Section Displays a structure view of the next section with this PID and table identity that can be formed from the current stream position onwards (as indicated by the Transport Packet number displayed in the Transport Packet Bar).

View Cycle Time ► Allows either cycle time statistics or graphical view to be selected.

View Repetition Activates or creates a view of the repetition rate of this PID with this PID and table identity.

View Bitrate Activates or creates a bitrate view of sections with this PID and table identity.

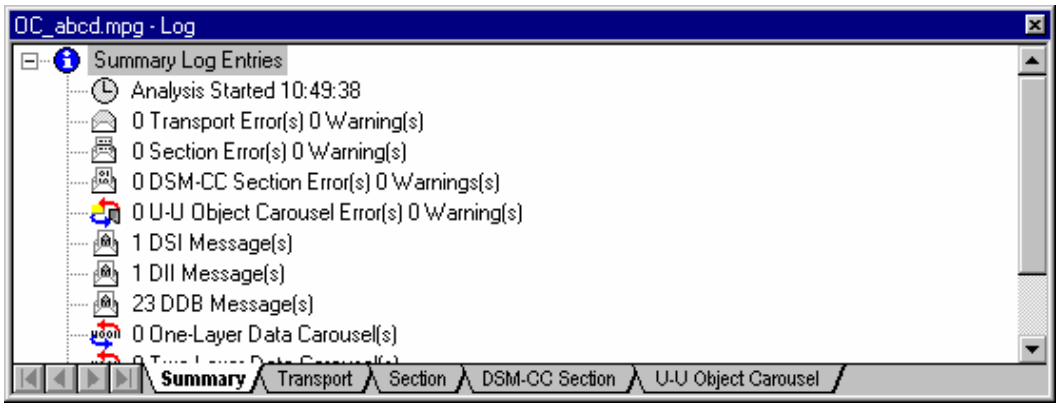
Signal Carousel (See Manual Signalling, page 36)

Log View

Menu Bar: View ➔ Log **Toolbar:** 

The log view is a tabbed window with each tab representing information about a particular MPEG-2 layer. Each tab contains any miscellaneous information about the transport stream that has been analyzed. E.g. packets that have the transport_error_bit set will have an entry in the transport log tab.

The diagram below indicates the information accessible from the Log view.



Summary

This view provides a summary of the transport stream analysis.

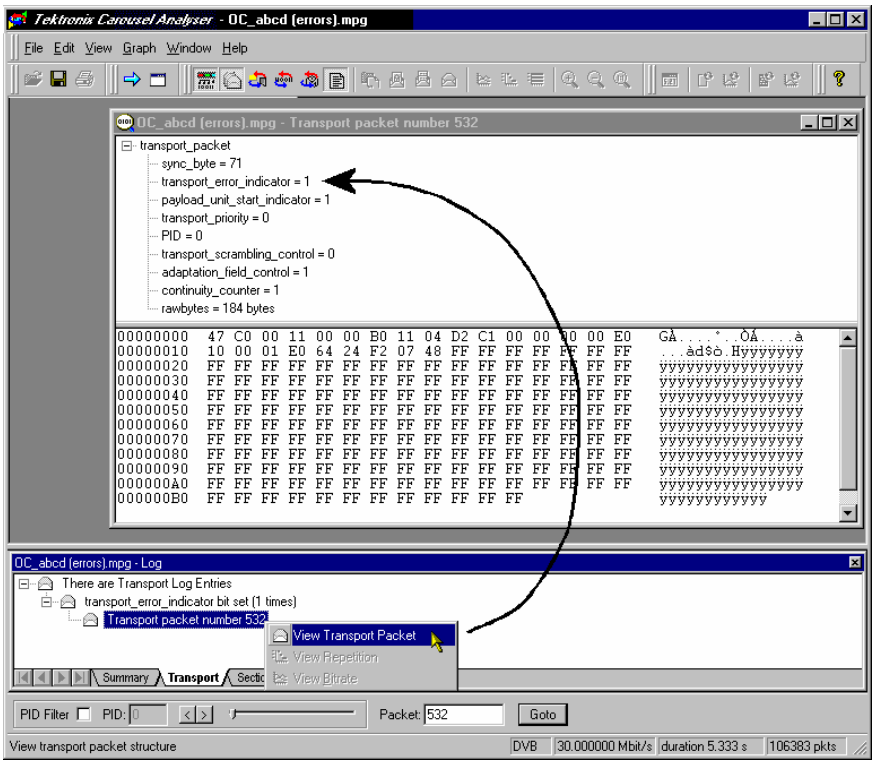
Transport Packet Log view

This view displays the errors that have been logged in transport packets during analysis of the stream.

Right-Click Menu Options

View Transport Packet Displays a structure view of the highlighted transport packet.

E.g.



Section Log view

This view displays the errors that have been logged in sections during analysis of the stream.

Right-Click Menu Options

View Section Displays a view of the highlighted section.

DSM-CC Section Log view

This view displays the errors that have been logged in DSM-CC sections during analysis of the stream.

Right-Click Menu Options

View Section Displays a view of the highlighted DSM-CC section.

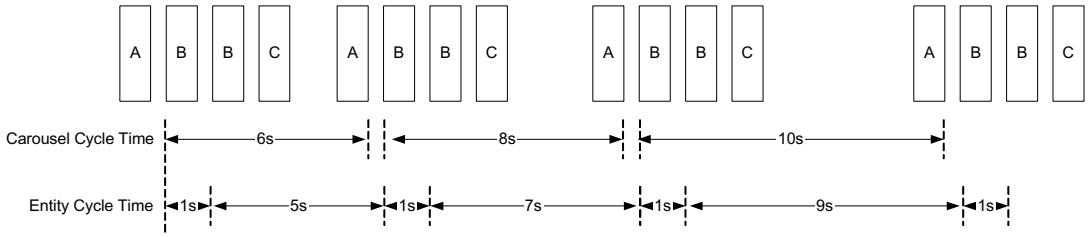
U-U Object Carousel

This view displays the warnings that have been logged in U-U Object sections during analysis of the stream.

Cycle Times View

Cycle times can be calculated for either a carousel (given a starting point) or an entity in the transport stream.

In the diagram below, a carousel is shown carrying objects A, B and C.



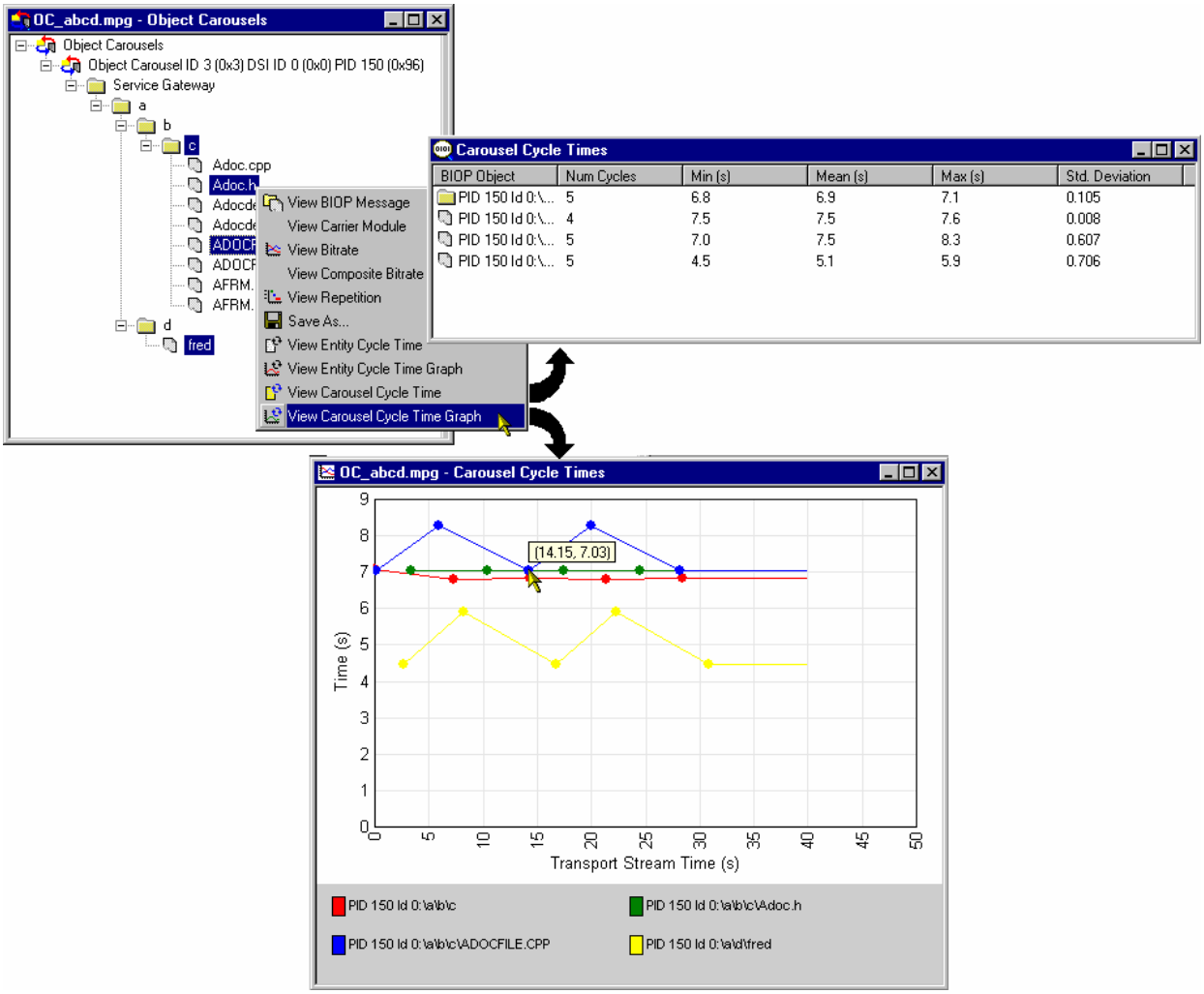
In this example, object B is identified as the starting point for both carousel and entity cycle timing. The cycle time of a carousel is the time taken to receive all of the objects within the carousel given a specified starting point in the carousel. The cycle time of any given entity in the transport stream (including Section, BIOP Object, PID and UN Message) is the time taken from the start of an instance to the start of the next instance.

The cycle times calculated give the maximum, minimum and mean times for the occurrences of an object in a transport stream in seconds; standard deviation and number of cycles found will also be displayed. The statistics can also displayed in graphical format.

Carousel Cycle Times Statistics

The cycle time of an object carousel is the time taken for all components of the carousel to be received starting with a selected component of the carousel.

Selecting one or more BIOP objects from a carousel and **View Carousel Cycle Time** from the right-click menu generates the **Carousel Cycle Times** statistics window. The information can also be displayed in graphical form by selecting **View Carousel Cycle Time Graph**.



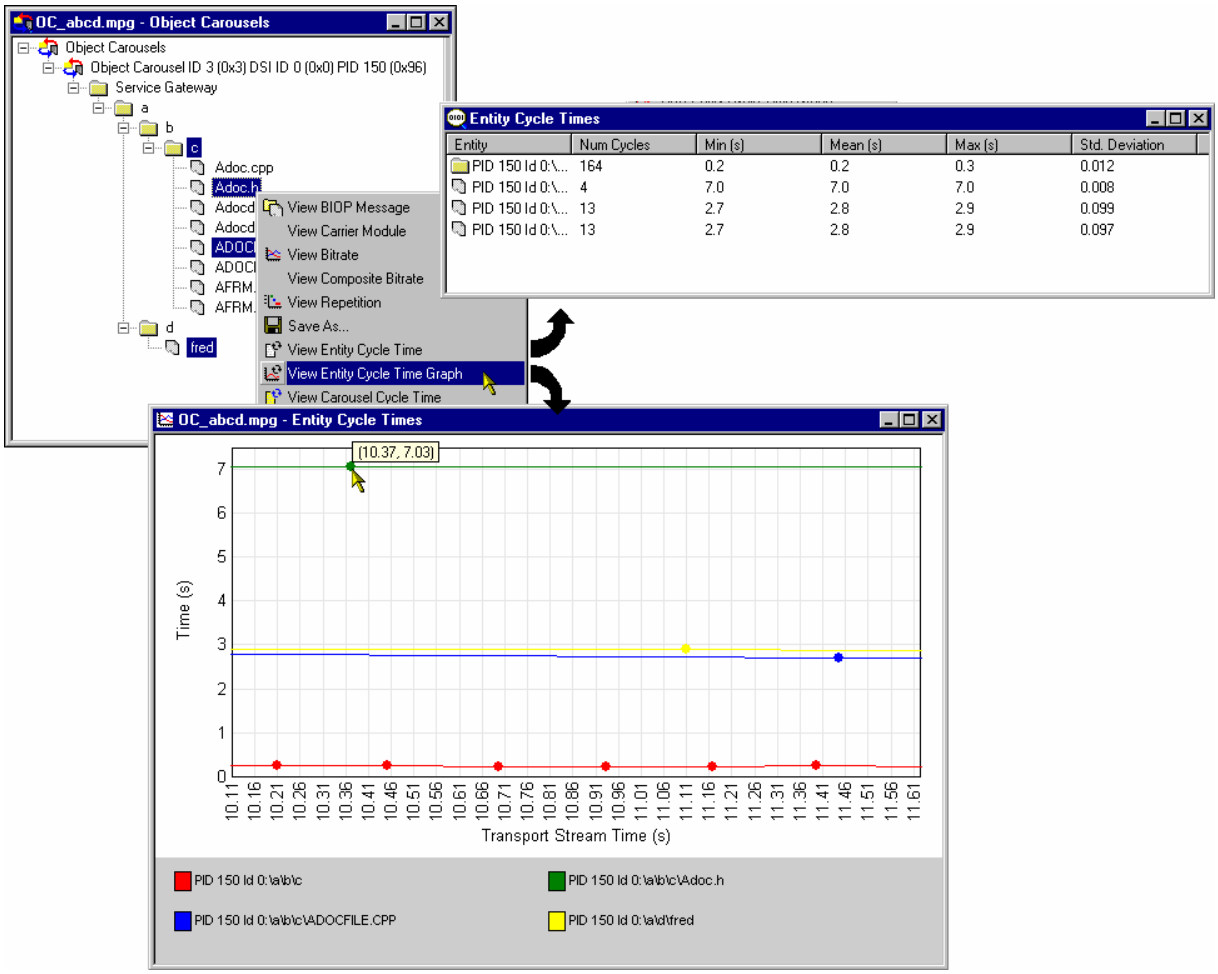
In the Carousel Cycle Times window, the BIOP Object column identifies the PID, Carousel ID and Object that the user identified as a starting point for the test.

The information can also be displayed in graphical form.

Entity Cycle Times Statistics

Similarly, the cycle time of any entity (object) in the transport stream is the time between the start of an instance of the entity and the start of the next instance.

Selecting one or more entities in any view and **View Entity Cycle Time** from the right-click menu generates the **Entity Cycle Times** statistics window. The information can also be displayed in graphical form by selecting **View Entity Cycle Time Graph**.



The Entity column identifies the PID, Carousel ID and Object that the user identified as a starting point for the test.

In both Carousel and Entity statistics windows, further cycle time statistics will be added to the bottom of the list while the window remains active.

Similarly, with one or more entries in a **Cycle Times** window selected, the right-click menu allows the user to display a graph of the cycle times or export cycle time statistics to a text file.

Application Support

Carousel Analyzer provides a means of testing the effects of associating applications with Object Carousels. An application comprises a 'boot class' and 'assets'. Typically, a boot class will comprise a Java or HTML class while assets may be images or text required by the boot class.

A comprehensive range of tests and measurements is provided in addition to application management tools.

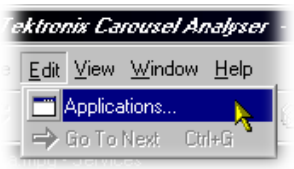
A single Object Carousel may be timed with several applications in the Carousel Analyzer.

Application Management

The Application management dialog shows the applications currently defined and allows the user to manage them. The user can also create new applications.

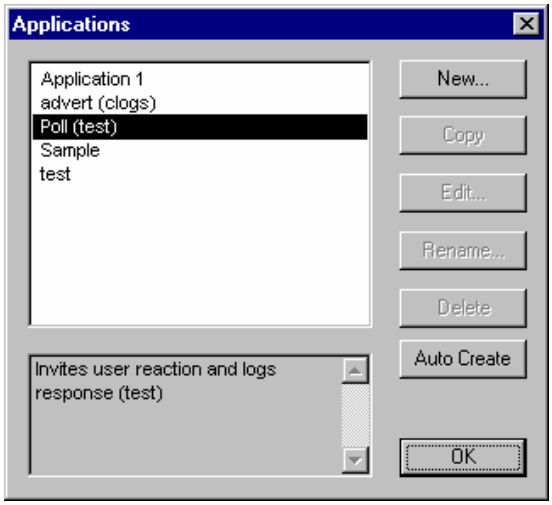
When defining an application, it may be done by adding application tree nodes manually using context menus, or by moving parts of currently available object carousels over to the application. It is also possible to move over sub-trees from the hard disk to the application definition.

If an asset is specified as a wildcard, the timing will wait for that asset and all child assets that are found in the transport stream. This means that a directory can be specified as a wildcard asset and any content found underneath it in the transport stream will be treated as an asset, e.g. specify `\bin\startup.class` as the boot class, and `\images\` as a wildcard directory asset. Any content in the `\images\` directory in the carousel will be treated as an asset.



To open the **Applications** management dialog, select **Applications…** from the **Edit** menu.

The dialog shown below is displayed:



In the **Applications** management dialog, the main list displays those applications that have already been created. Application data is stored locally in the file `C:\Program Files\Tektronix\DataTestSystem\applications.dat`; this is the installation directory but it may have been modified by the user. This data file can be copied to other Carousel Analyzer installations if required.

A summary of the highlighted application is displayed below the list; the user should enter this summary when the application is created.

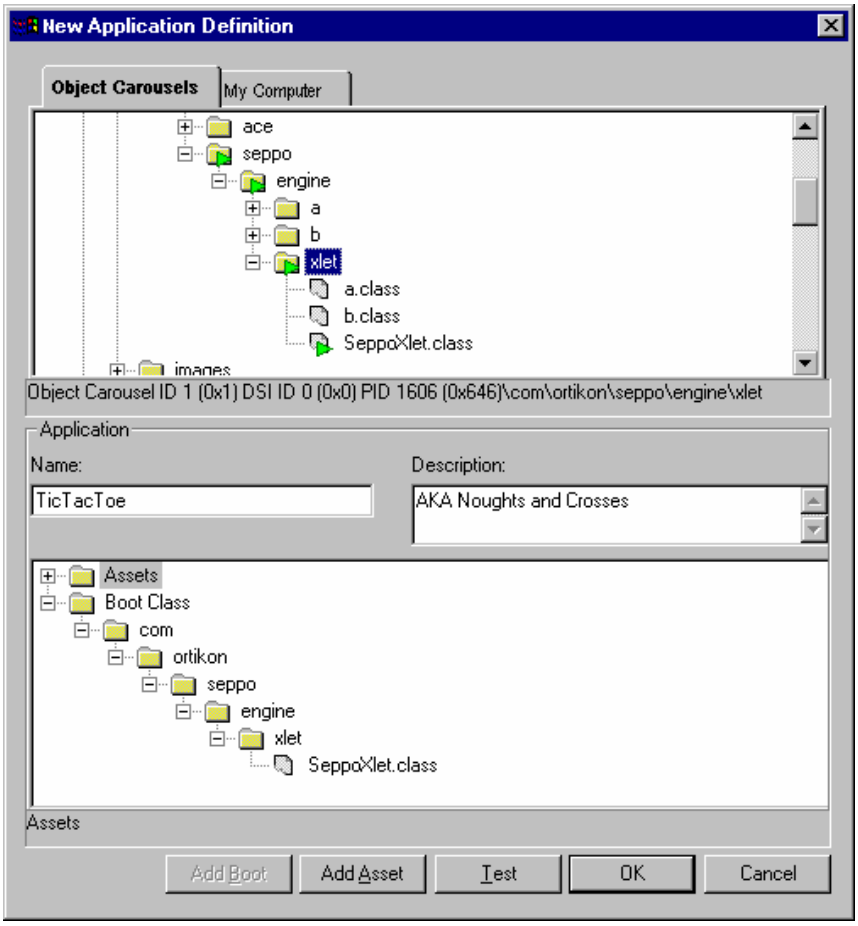
The dialog button functions are described below:

New	Allows a new application to be defined via the **New Application Definition** dialog. Keyboard shortcut: **Insert**.
Copy	Creates a copy of the highlighted application. The new application is allocated a modified name (**Copy of** …).
Edit…	Allows the highlighted application to be edited via the **Edit Application Definition** dialog. Shortcut: Double-click application name.
Rename…	Allows the highlighted application to be renamed. Keyboard shortcut: **F2**.
Delete	Deletes the highlighted application after receiving confirmation from the user. Keyboard shortcut: **Delete**.
Auto Create	Creates an application definition for each MHP application found in the stream. The boot class for each application is also set up.

Select **OK** to close the dialog. All of the buttons, except **New**, are disabled unless an application is highlighted; **New** is always enabled.

Application Definition

Applications are defined using the **New Application Definition** dialog as shown below:

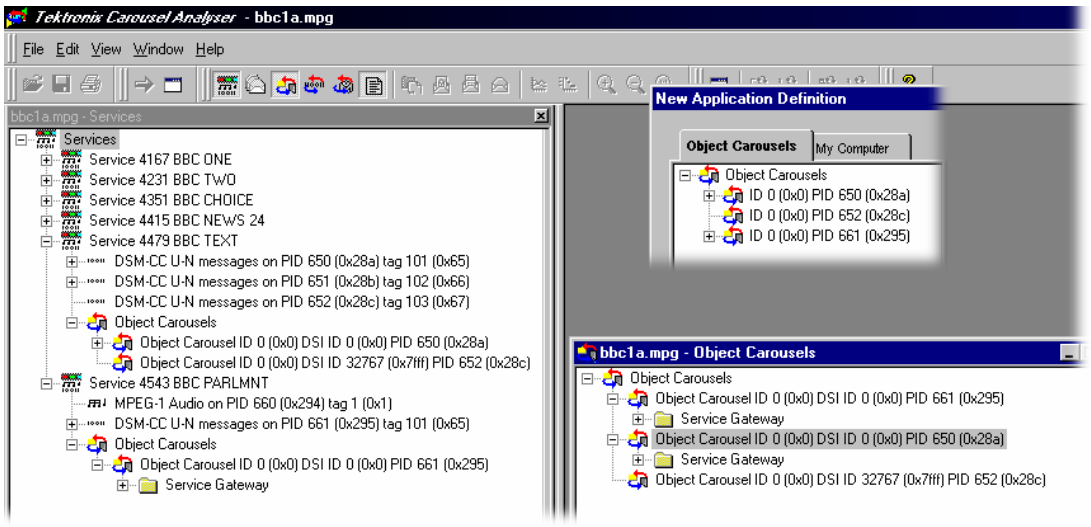


(Initially the Application panes will be empty apart from the root nodes (**Boot Class** and **Assets**).)

The elements of the **New Application Definition** dialog are as follows:

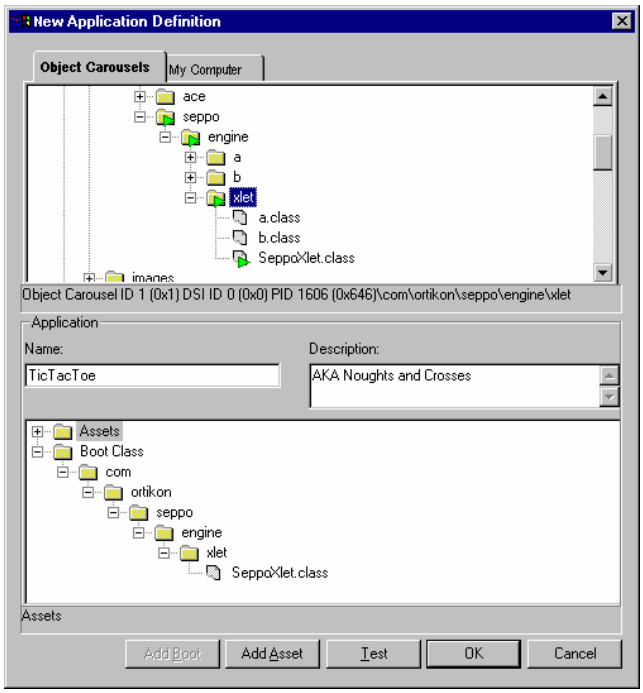
Object Carousels tab: This displays all of the object carousels in the current transport stream: Note that if the current transport stream carries no object carousels, then none will be displayed here.

The example screenshot below shows the Object Carousels displayed in the **New Application Definition** dialog overlaid onto the standard Object Carousel views.



Name Enter the name of the application.

Description An optional field which allows a brief description of the application to be entered.



The boot class and the assets are displayed as parts of a tree structure in the lower pane.

The boot class is the object that must be loaded first in an application (i.e. an executable image).

Assets are data objects to be used by the Boot Class in the same carousel (e.g. picture files, text files).

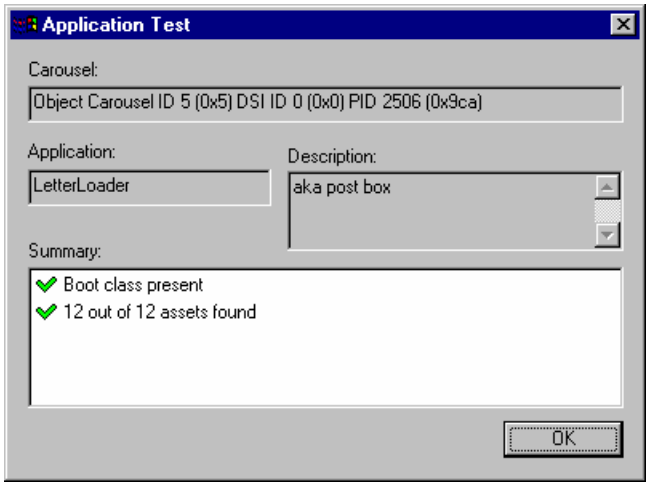
Selecting the **OK** button closes the dialog and stores the new application data. The action will be refused if a boot class object has not been specified. If a duplicate application name has been entered, it must be renamed.

The boot class must be in the associated carousel; if it is not, the timing test cannot be performed. An asset is a BIOP object in the carousel that is used by the boot class. If the asset is not in the associated carousel, the user will be warned that the assets could not be found and the tests will be performed as if those assets had not been defined.

Selecting the **Cancel** button closes the dialog and discards the new application data.

Testing an Application

The **Test** button at the bottom of the application dialog allows items in the application to be tested against the currently selected carousel. This can be used to ensure that the correct carousel has been selected for the application and that all of the objects are present. The results of the test are displayed in the **Application Test** dialog.

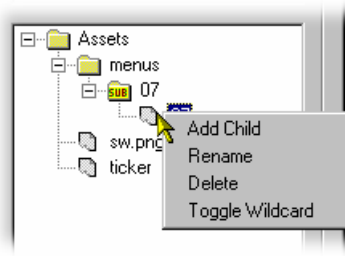


Adding Objects to the Application

Objects are moved from the Object Carousel pane to the Boot Class or Asset panes using the **Add Asset** button; viz. highlight the object in the Object Carousel pane, select **Add Asset** and note that the object is added to the adjacent application structure.

- Making a node that has children an asset will automatically include all the children as assets. To include every object in a carousel, add the carousel root node to the application.
- The boot class can only contain one object; it may be at any depth in the directory structure.
- Adding an object to the Boot Class will displace any existing object.
- Moving assets from the Object Carousel will automatically recreate the directory structure from the object carousel.
- Moving assets from the hard disk directory tree will only recreate the structure below the source tree node. When moving assets from the directory tree, highlight a node in the asset tree as a target.

- A right-click context menu is available at all nodes in the application structure; available options will depend on the node type.



The context menu options operate on the currently highlighted node in the application structure as follows:

Add Child	Adds a child node. It can be subsequently renamed to indicate an object.
Rename	Allows a node to be renamed.
Delete	Deletes the node.
Toggle Wildcard	Asset directory nodes can be identified as wildcard entries. A wildcard directory indicates that the directory and all of its children at the time of analysis are defined as assets.

Editing an Application

Application editing is similar to creating a new application.

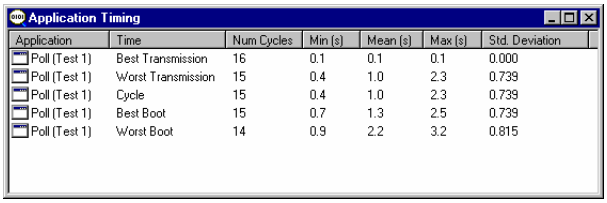
Application Timing

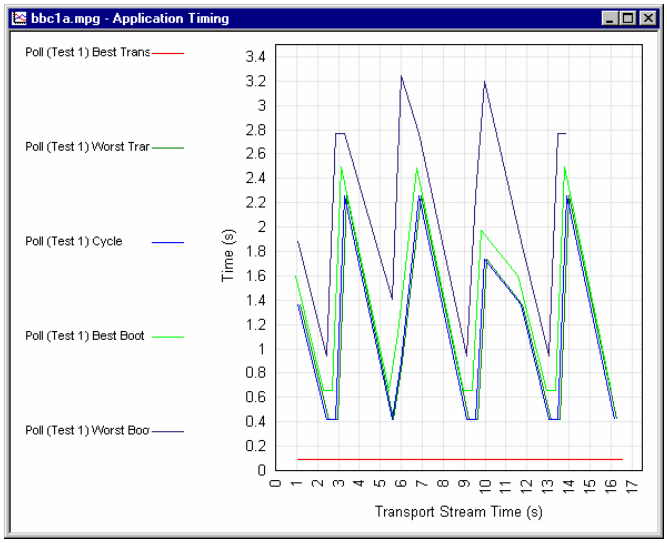
The Application Timing feature allows the user to observe the effect in terms of download time of one or more applications being timed with an object carousel.

In practice, an object carousel is identified and one or more applications are selected from the current application list to be timed with it. As each application is selected, the software will check the availability of the Boot Class and Assets. If the Boot Class cannot be found, the timing operation will fail. If Assets cannot be found, the timing tests can still be performed, but they will not represent the true effect of the application on a particular carousel.

Progress bars are displayed while the tests are being performed.

The results of the application timing tests are presented in tabular form.





Data displayed in tabular form can be displayed in graphical form (see left) or exported to a tab separated file.

Explanation of Timing Tests

This section gives a graphical explanation of each of the application timing tests.

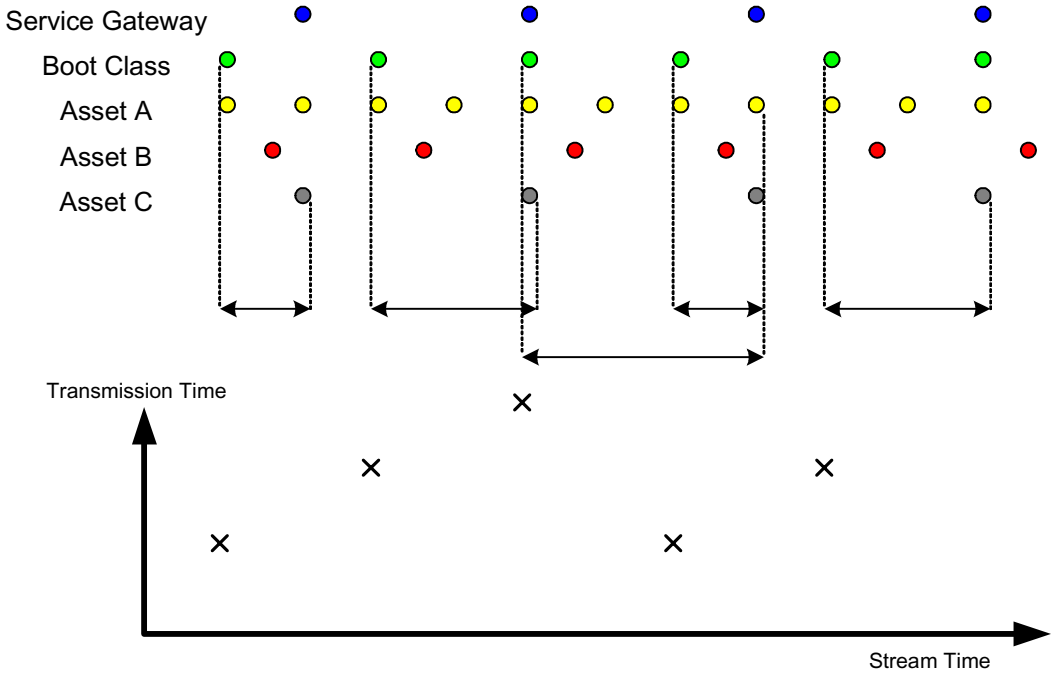
The calculations assume that control information (DSI/DII) (i.e. SI/PSI information, e.g. PAT, PMT) has been cached.

The boot class must be received before any of the assets can be received. This simulates the STB not knowing which carousel objects the boot class depends on until it has completely received and processed it.

Best Transmission Time

From the start of a boot class to the end of the last asset.

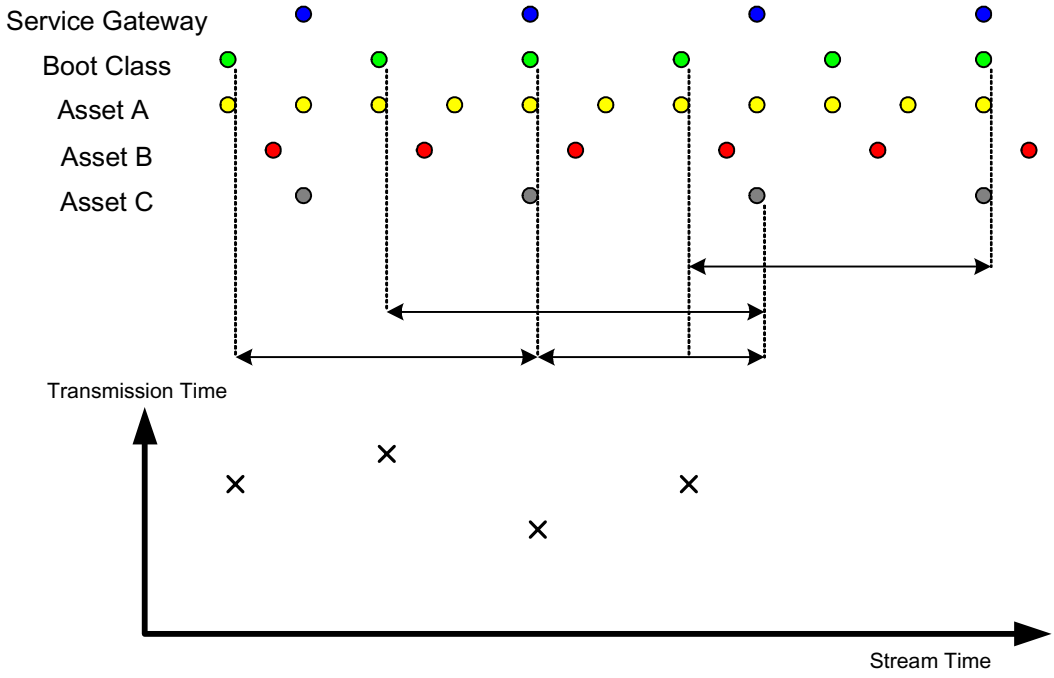
The true application load time is the transmission time plus the time taken by the set-top box (STB) to load the application. The time taken by the STB to load the application is not included in these tests.



Worst Transmission Time

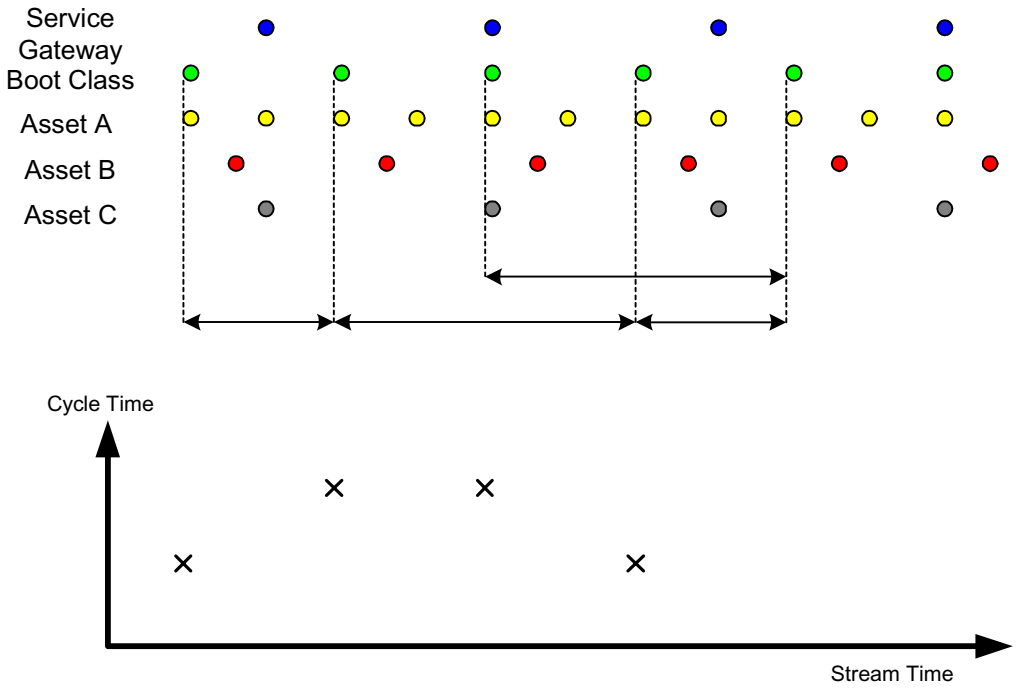
From the end of a boot class, through the next boot class, to the end of the last asset.

The true application load time is the transmission time plus the time taken by the set-top box (STB) to load the application. The time taken by the STB to load the application is not included in these tests.



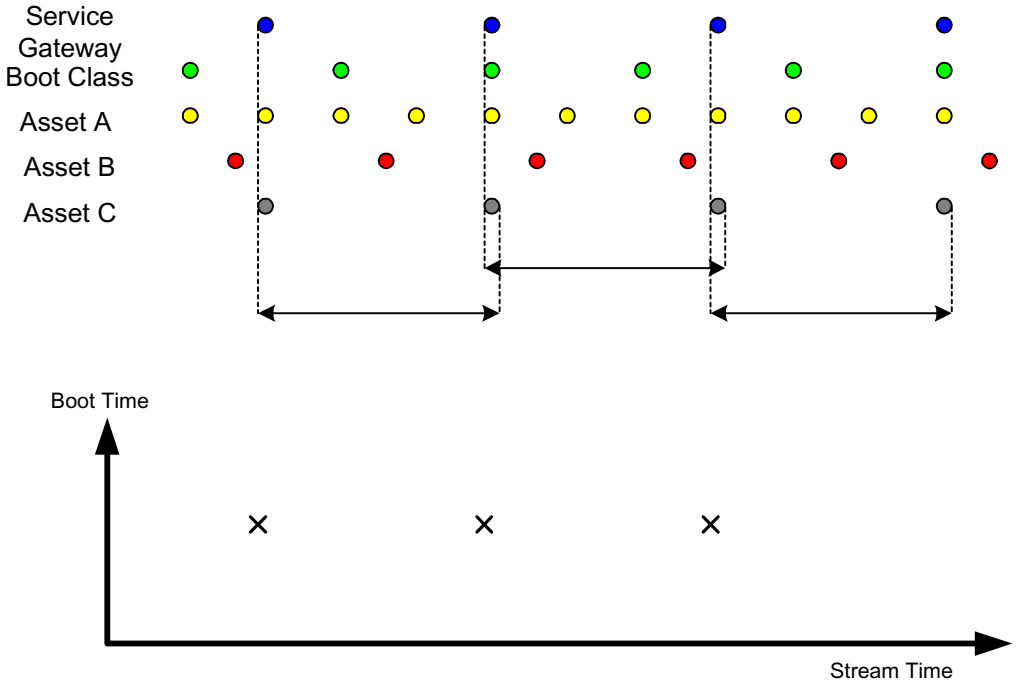
Cycle Time

From the start of a boot class, through the last asset, to the start of the next boot class.



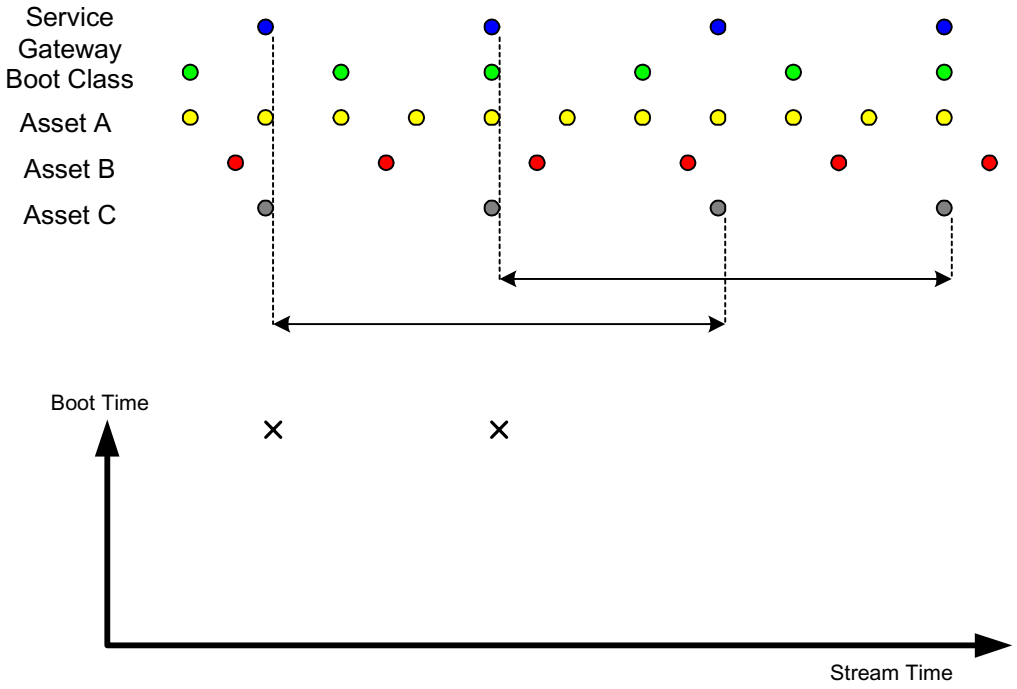
Best Boot Time

From the start of a service gateway, through the next boot class, to the end of the last asset.



Worst boot time

From the end of a service gateway, through the next service gateway, through the next boot class, to the end of the last asset.



Cold boot time

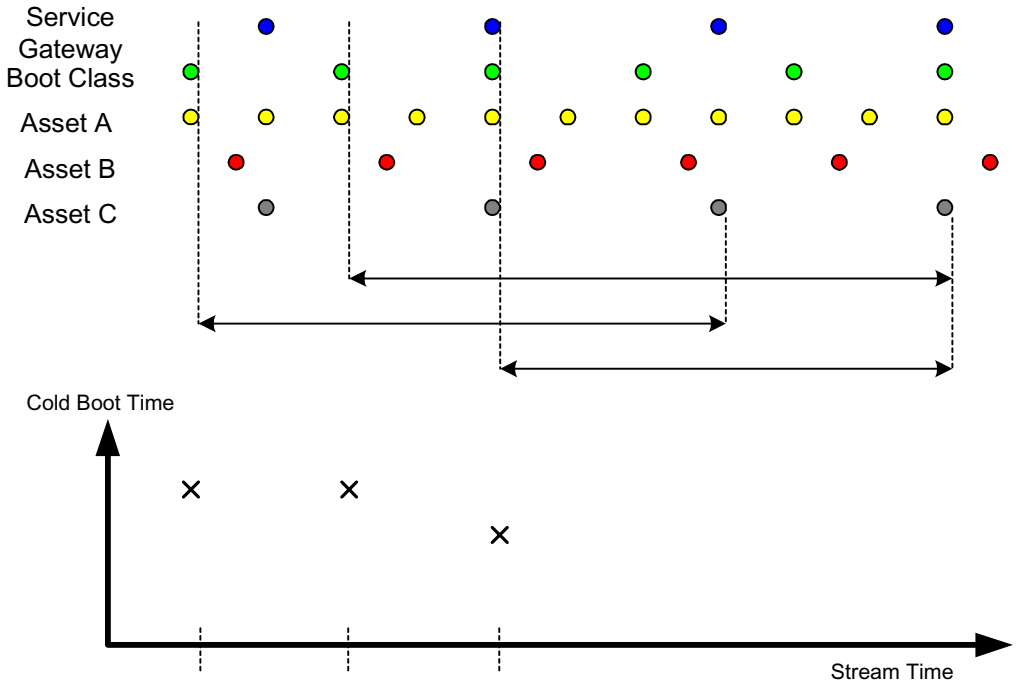
Whereas the other timing methods assume that control information (PAT, PMT, DSM-CC section, etc.) has been cached, this method does not.

The user defines a 'sampling' frequency; that is times to start the download and observe how long it takes to signal the carousel and download the service gateway, the boot class and all of the assets. For example, in a 60 second stream, a **Start Point** (on the **Cold Boot Time Settings** dialog) of five seconds will sample the download time twelve times. The result is added to the Application Timing results table and graph.

The boot class must be received before any of the assets can be received. This simulates the STB not knowing which carousel objects the boot class depends on until it has completely received and processed it.

Directories must be received before any child objects can be in this case. This is because this timing method assumes no signalling caching.

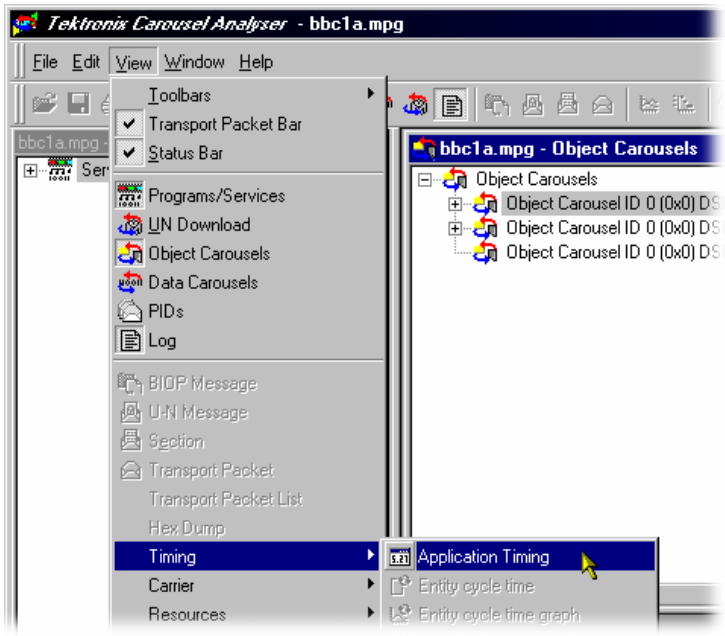
The end of each cycle will be the end of the module containing the last asset - this is an important distinction as an asset may not be the only one in that module.



Setting up a Timing Test

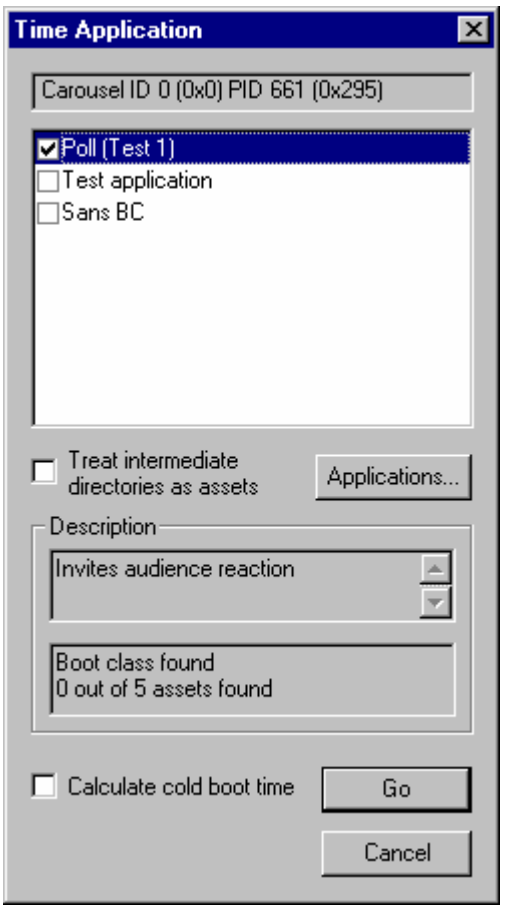
It is assumed that applications have been created as described in the previous section.

1.) With the Object Carousel view active, select **View ➔ Timing ➔ Application Timing**,



or highlight an object carousel and select **View Application Timing** from the right-click menu (not shown).

2.) The **Timing Application** dialog is displayed:



The dialog displays the selected object carousel identity and the applications already defined.

Applications to be associated with the object carousel are selected by enabling the adjacent checkbox.

Highlighting an application name will display its description and a brief report on the availability of the boot class and assets. If the boot class is reported as being not present, the timing operation will be aborted after the first test pass.

Select **Applications…** to open the **Applications** management dialog (see page 61).

On first opening this dialog, a simple test is performed to detect the presence of the boot classes required. Applications for which the boot class is found will be enabled.

Subsequently, user selections will be remembered.

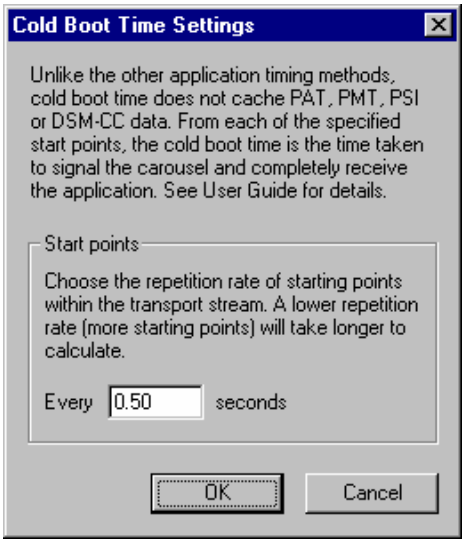
Treat Intermediate Directories as Assets: If this checkbox is enabled, all directories which form part of the asset path are also treated as assets. That is, they must be downloaded as part of the timing test. This will not usually have any significant impact on the results since directories are generally much smaller and transmitted at a higher frequency than files.

Calculate Cold Boot Time: If this checkbox is enabled, the Cold Boot timing test will be applied (see page 71); this may take some time.

In MHP mode, if the Cold Boot time is to include the AIT acquisition time, the **Application Timing** selection must be made from an MHP application node (Java or HTML). By selecting an MHP application, the application's AIT will be automatically included in the Cold Boot timing.

3.) Select **Go** to start the timing tests.

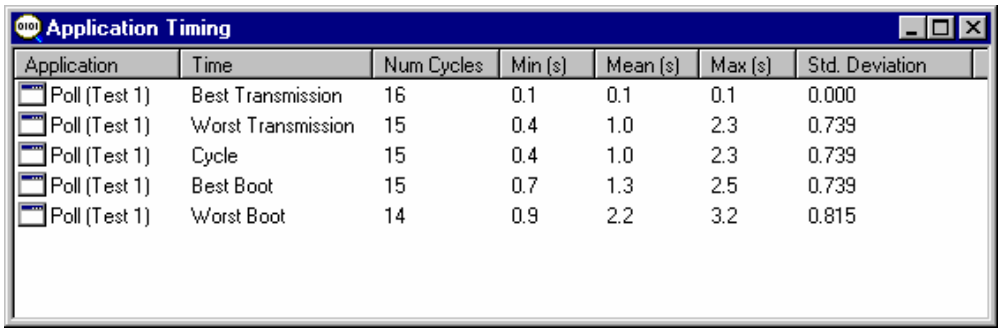
If the Calculate cold boot time checkbox was enabled, the Cold Boot Time Settings dialog is displayed. Enter the starting point repetition rate required.



Select **OK** to continue with the tests.

Progress bars will be displayed while the test is being carried out.

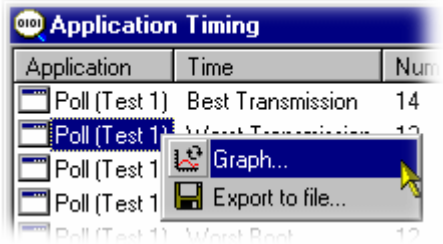
4.) On completion of the test, the **Application Timing** results table is displayed.



Application	Time	Num Cycles	Min (s)	Mean (s)	Max (s)	Std. Deviation
Poll (Test 1)	Best Transmission	16	0.1	0.1	0.1	0.000
Poll (Test 1)	Worst Transmission	15	0.4	1.0	2.3	0.739
Poll (Test 1)	Cycle	15	0.4	1.0	2.3	0.739
Poll (Test 1)	Best Boot	15	0.7	1.3	2.5	0.739
Poll (Test 1)	Worst Boot	14	0.9	2.2	3.2	0.815

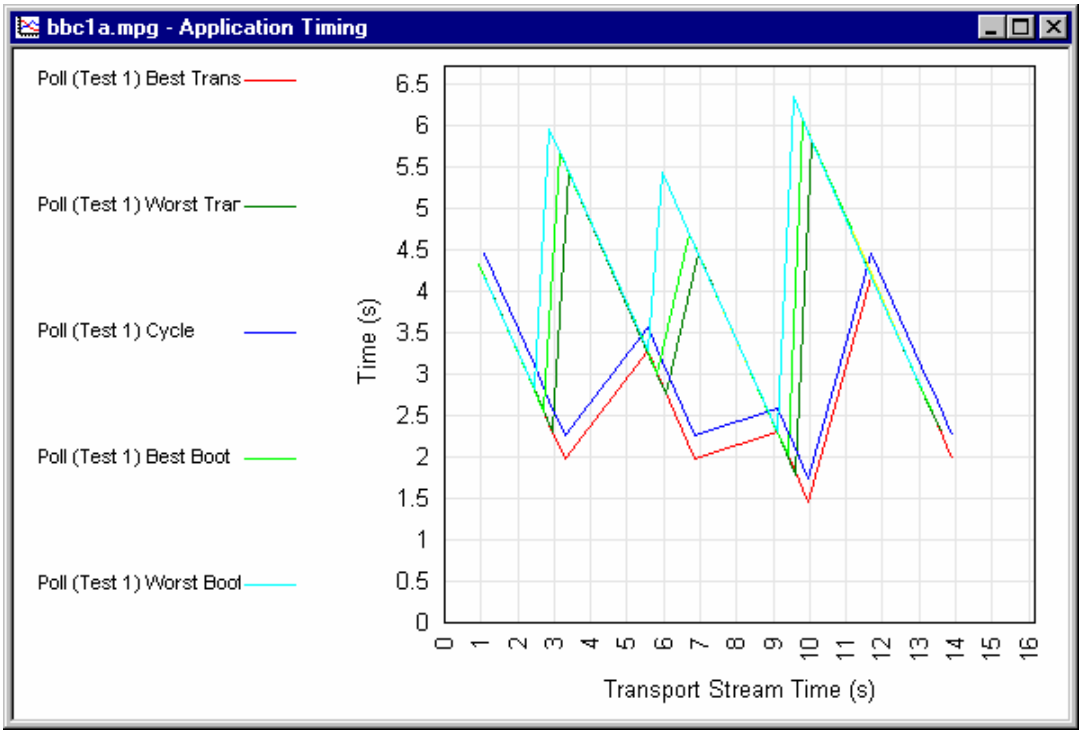
The column headings are largely self-explanatory. **Number of Cycles** shows the number of times that the test could be calculated for the stream.

5.) To display the results in graphical form, highlight a test name and select **Graph…** from the right-click menu.



If another test is selected, the results are overlaid. Color coding is used to identify each result.

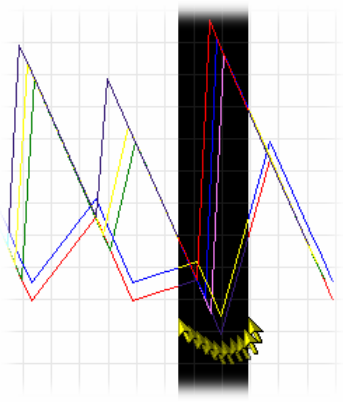
The screenshot below illustrates a graph showing all five test results (Cold Boot not shown).

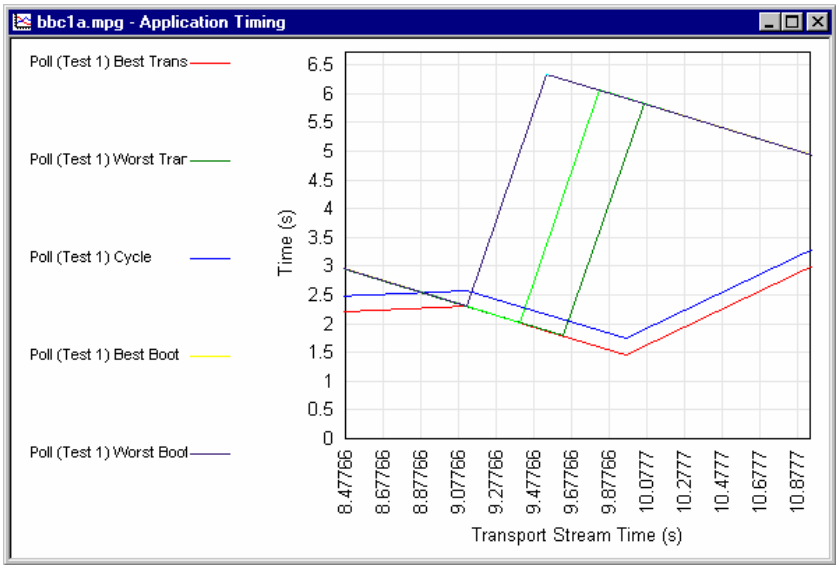


Zoom in and zoom out buttons are provided on the toolbar(or use the tab and shift-tab keys on the keyboard).

Alternatively a precise area can be selected by dragging the mouse over the range required (hold the left-button, move the mouse, release the button).

When the mouse button is release, the zoomed area of the graph will be displayed immediately (as shown below),

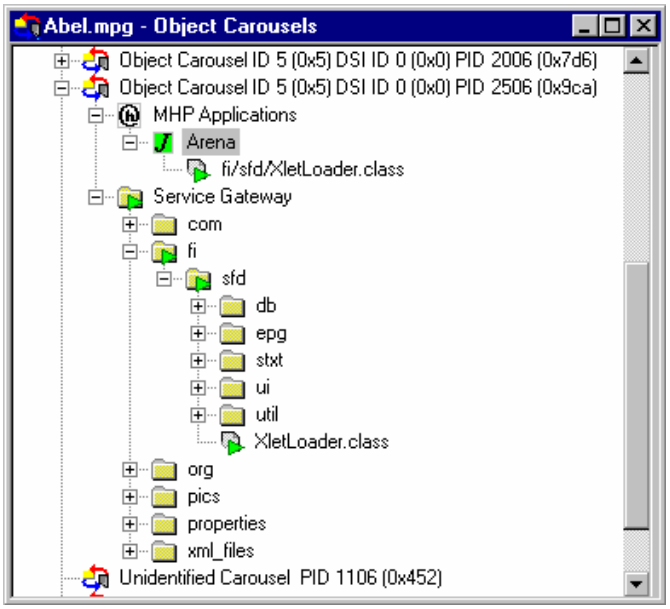




MHP Support

Although described separately here, MHP Object Carousel support is fully integrated into Carousel Analyzer. MHP applications are displayed in the Services and Object Carousel views. The features described here can be accessed from menu options and right-click context menus.

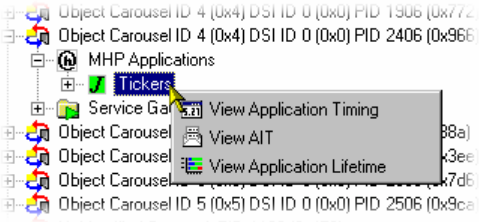
The MHP application ( ) is identified by its name in the AIT. If the boot class is found in the Service Gateway, it is attached as a child of the MHP application. As a visual aid, boot class items are identified in the Service Gateway by green triangles ( ). The path in which the boot class resides is also indicated by green triangles.



Applications are designated as Java ( ) or HTML ( ). The color of the icon represents the running status of the application when the carousel was recorded; green indicates running, yellow indicates ready and red indicates not running.

Right-Click Menu Options

Right-clicking on an MHP application node will display the following menu:



View Application Timing
(See Application Timing, page 67)

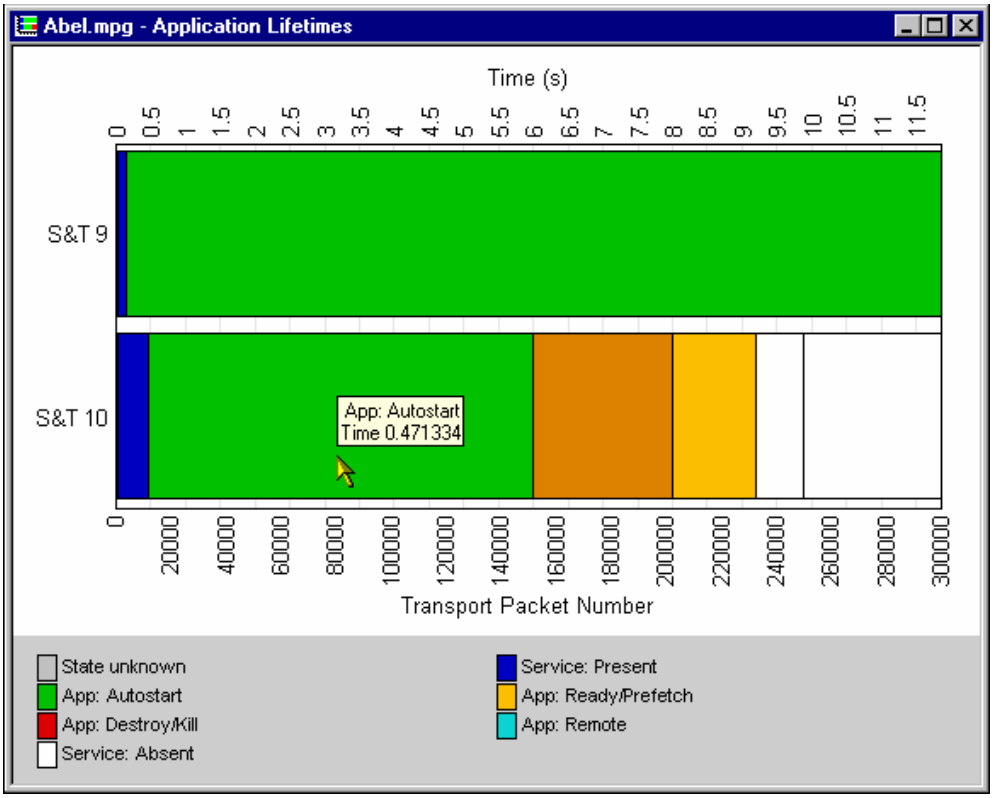
View AIT
Opens the AIT structure view (see also Structure Views, page 46)

View Application Lifetime
(See Application Lifetimes, page 77)

Application Lifetimes

This Gantt style graph displays an analysis of the lifetime of an MHP application. Multiple applications can be displayed; each application is subdivided and color-coded to indicate the changing state of the application.

The Applications Lifetimes view can be opened by highlighting an MHP application node and selecting either the toolbar icon  or **View Application Lifetime** from the right-click menu.



A key to the color-codes is displayed at the bottom of the view. Each application is labelled. By placing the cursor over a color-block, a tooltip can be displayed which provides details of the block. The time given in the tooltip is the block start time.

Reference

Script Files

The following scripts are shared between the Carousel Analyzer and other Tektronix products. They exist in the Tektronix\Scripts directory.

Script File Name	Purpose
MPEG.scp	Scripts for MPEG sections and descriptors.
DVB.scp	Scripts for DVB sections and descriptors.
ISDB-T.scp	Script for ISDB-T sections and descriptors.
ISDB-S.scp	Script for ISDB-S sections and descriptors.
MHP.scp	Script for AIT table.
MPE.scp	Scripts for DVB datagrams.
DSMCCv2.scp	General purpose DSMCC structures.
DSMCC.scp	Scripts for (DVB) DSM-CC sections.
ISDB_DSMCC.scp	ISDB version of the DSM-CC script.

The following scripts are used only by the Carousel Analyzer. They exist in the Tektronix\DataTestSystem\Scripts directory.

Script File Name	Purpose
Transport.scp	Script for transport packets.
Pat_Cat.scp	Script for PAT and CAT sections.
Biop.scp	Scripts for BIOP messages.
DSMCC_DataCarouselObject.scp	Script for DSM-CC objects, which relate a Data Carousel.
DSMCC_DataCarouselSection.scp	Script for DSM-CC sections, which relate a Data Carousel.
DSMCC_ObjectCarouselObject.scp	Script for DSM-CC objects, which relate an Object Carousel.
DSMCC_ObjectCarouselSection.scp	Script for DSM-CC sections, which relate an Object Carousel.
DSMCC_Object	Script for DSM-CC objects, whose content is not assumed to be either data or objects.

Error Checking

DSM-CC sections have two bit fields called section_syntax_indicator and private_indicator (Ref 13818-6 section 9.2.2). If the section_syntax_indicator field is 1, there is a CRC32 at the end of the section; if set to 0, there is a checksum at the end of the section. The private_data field should always be the complement of the section_syntax_indicator field.

If both these fields are set to the same value, the application cannot be absolutely sure whether a CRC or a checksum is being used. It therefore attempts to guess which is used, trying the CRC method first and then the checksum. If either method works it is used, if not the section is rejected.

Currently nothing will be reported in the error logs if these bits are set incorrectly. This issue will be addressed in a future release of Carousel Analyzer.

Acronyms and Abbreviations

AIT	Application Information Table
ARIB	Association of Radio Industries and Businesses
BIOP	Broadcast Inter-ORB (Object Request Broker) Protocol
DDB	Download Data Block
DII	DownloadInfoIndication message
DSI	DownloadServerInitiate message
DSM-CC	Digital Storage Media - Command and Control
DTV	Digital Television
DVB	Digital Video Broadcasting
ID	Identity
IOR	Interoperable Object Reference
JPEG	Joint Photographic Experts Group
MHP	Multimedia Home Platform
MPEG	Moving Picture Experts Group
PID	Packet IDentifier
PMT	Program Map Table
PSI	Program Specific Information
SDT	Service Description Table
SI	Service Information
U-N	User to Network
U-U	User to User

References

[1] ISO/IEC 13818-1 Information technology - Generic coding of moving pictures and associated audio information: Systems [MPEG]

[2] ISO/IEC 13818-6 Information technology - Generic coding of moving pictures and associated audio information - Part 6: Extension for Digital Storage Media Command and Control [MPEG]

[3] ETS 300 468 Digital broadcasting systems for television, sound and data services; Specification of Service Information in Digital Video Broadcasting [DVB]

[4] EN 301 192 Specification for data broadcasting [DVB]

[5] A027 Specification for the transmission of data services in DVB bitstreams [DVB]

[6] A047 Implementation guidelines for Data Broadcasting [DVB]

[7] SI-DAT 382 Rev.4 Implementation guidelines for data broadcasting [DVB]

[8] Digital terrestrial television MHEG5 specification [DTG]

[9] ISO/IEC 13522-5:1996(E) MHEG-5 IS [MHEG]

[10] A tutorial introduction to MHEG-5 [Authors: Strategy and Technology Ltd]

[11] ARIB STD - B24 Data Coding and Transmission Specification for Digital Broadcasting

[12] Multimedia Home Platform, ETSI TS 101 812 v1.1.1 [DVB]

Section 15

Carousel Generator

Overview 3
Data Broadcasting Overview 3
Carousel Generator Overview 4
Starting the Application 7
Carousel Wizard 10
Step 1: Select Carousel 11
Step 2: Carousel Properties 12
Step 3: Carousel Contents 13
Step 4: Collection Contents 15
Step 5: Imported Elementary Streams 17
Step 6: Program Entry 18
Step 7: Output Stream Properties 19
Step 8: Congratulations 20
Menus and Controls 21
Menus and Options 21
Toolbars 27
Log Window 30
Status Bar 30
Properties Window (List Control) 30
Carousel Generation 32
Setting Overall Carousel Generator Properties 32
Creating a Session 38
Selecting the Carousel Type 41
Modifying the Carousel Properties 41
Carousel Contents 49
Collections 60
Programs 64
Output Stream Generation 70
Carousel Definition File 70
References 71
Glossary and Abbreviations 71
Bibliography 71
Appendix A: PSI and SI in the Carousel Generator Output Stream 73
PSI/SI Mode Settings 73
MPEG PSI tables 74
DVB SI Tables 81
Summary 95

Overview

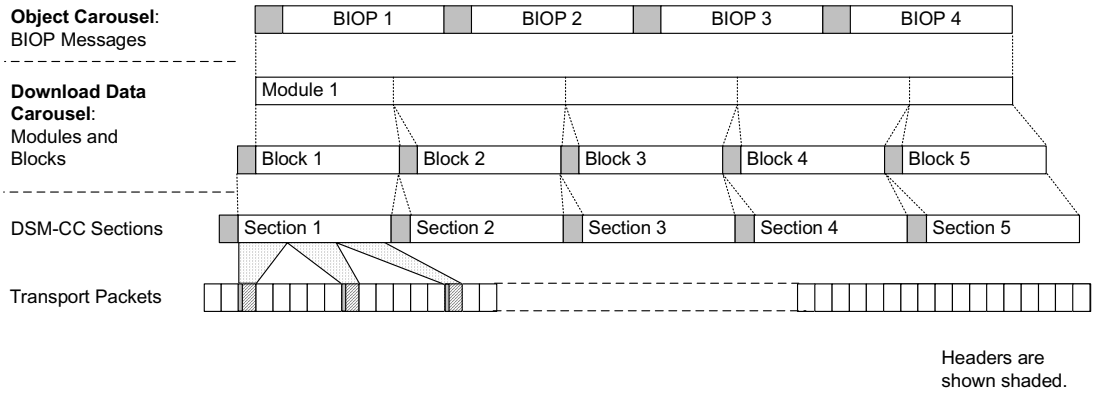
The Carousel Generator is aimed principally at the content provider user who simply wants to create a carousel to deliver content to a set top box quickly and efficiently. The product also aims to support the more experienced MPEG user who wants to modify a carousel to test the effects on equipment along the broadcast chain. Similarly the more experienced MPEG user can incorporate a carousel into a transport stream alongside video and audio content.

The assembled transport stream can be played out directly or saved to an MPEG file.

Data Broadcasting Overview

In a similar way to which video and audio services are delivered to end users, Data Broadcasting allows data to be transmitted. Object and Data Carousels are intended for the periodic transmission of information in a transport stream. Data Carousels contain modules of data of unspecified content, whereas Object Carousels contain identifiable data objects, e.g. JPEG files, text files, application software. Multimedia Home Platform (MHP) builds on object carousels by defining parameters such as the boot class and application life cycle in the Application Information Table (AIT).

The diagram below shows how information carried by data and object carousels is sub-divided and ultimately carried by the transport stream.



BIOP messages comprise a message header, a message sub-header and the message body which contains data. The message body may contain complete data objects.

BIOP messages are broadcast in Modules. A Module is formed from one or more concatenated, complete BIOP messages.

Each Module is fragmented into one or more Download Data Blocks that are in turn transmitted in corresponding DSM-CC Sections.

Sections are transmitted in packets in the Transport Stream.

Carousel Generator Overview

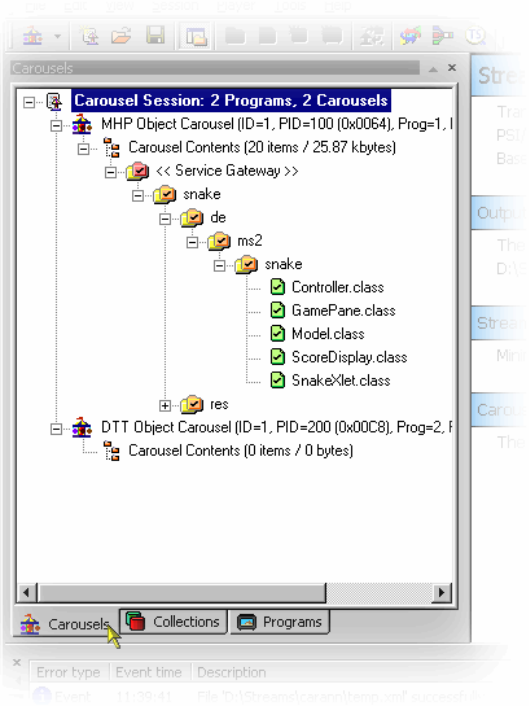
Activity in the Carousel Generator is referred to as a 'session'. During a session, data objects are assembled into one or more carousels.Video and audio content can also be added. Mandatory SI tables are added automatically. The structure of the carousel can be saved in XML format; this definition file can be subsequently re-opened in a new session for further edits.

The end result of a session is the creation of a transport stream which can be played out via the MIC (MPEG-2 Interface Card) or saved to a file.

One of the main advantages of Carousel Generator is that many of the more complex concepts in the various Object Carousel standards are hidden from the user for the sake of clarity and user friendliness.

Three views of the assembled stream are offered: Carousels, Collections and Programs. Each view displays aspects of the stream from a single perspective. The three screenshots following show the same stream in each of the views.

Carousels View



The Carousels view lists the carousels and the associated objects that are included in the session.

Carousel Types

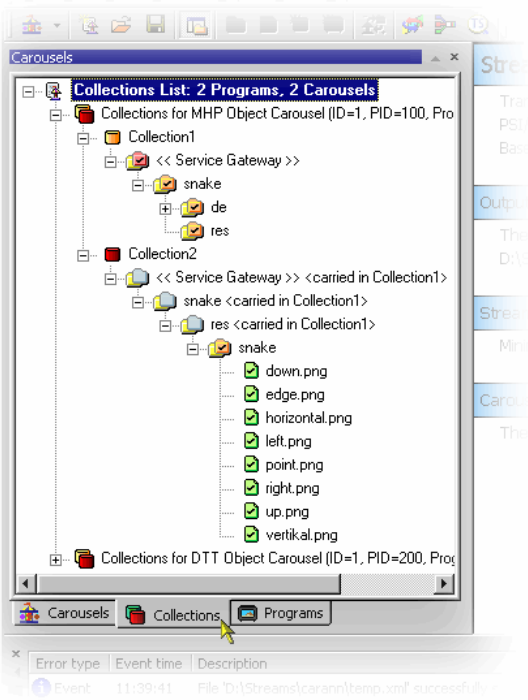
The carousel types currently supported are as follows:

Object Carousels: DSMCC, DVB, DTT, MHP

Object Carousels	Reference Specification
DSM-CC	Digital Storage Media - Command and Control (MPEG only)
DVB	Digital Video Broadcast
DTT	Digital Terrestrial Television
MHP	Multimedia Home Platform

The type of carousel being edited dictates the options and user interface elements available.

Collections View

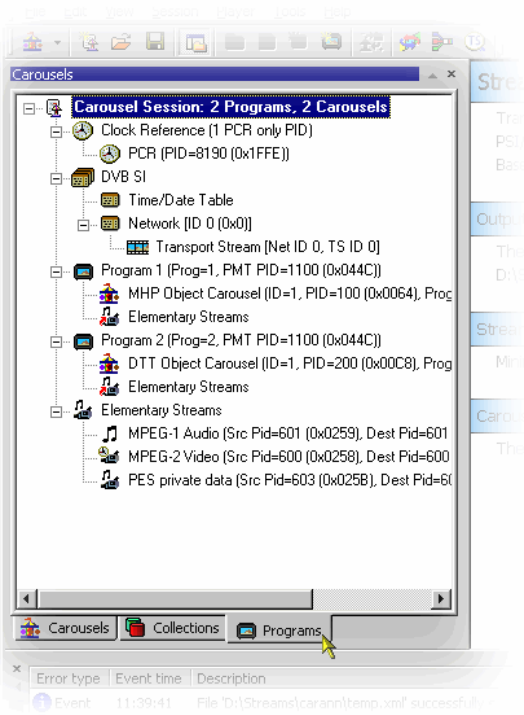


Objects associated with a carousel can be grouped together in collections. The properties of each collection can be adjusted to give the most efficient delivery in the transport stream.

The way that individual objects in a carousel are to be transmitted often varies. Each object in the carousel has properties including its minimum repetition rate (i.e. maximum cycle time) and whether it is compressed. Files that need to be transmitted with similar properties or which are logically related can be grouped into a module. As the DSMCC module is a limited size, the process of adding an object to a module would require calculating whether the object would fit into the module's available space (possibly after compression) and if no space is available, generating a new module and feeding this back to the user. This would slow this aspect of the user interface down appreciably.

Consequently, the concept of a Collection is used to replace the size limited DSMCC module, with a 'module of unlimited size'. Any number of objects can be added to a Collection; during stream generation this may translate to many modules with the same properties.

Programs View



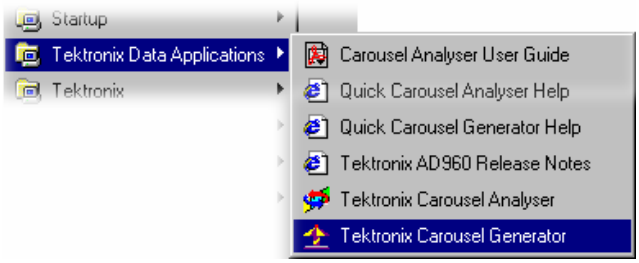
In the Program view, the root is the Carousel Session (as in the other views). Immediately below this are nodes giving access to the supported (i.e. mandatory) SI/PSI tables and a listing of PCR PIDs. There is also an Elementary Streams node which lists all of the imported elementary streams included in the stream and the Program nodes which show the allocation of carousels and elementary streams to programs.

Carousel Definition File

The current state of the Carousel Generator session can be saved to disk at any time during the creation process using the carousel definition file. The format of the saved file is standard XML and can be viewed in any XML compatible viewer (for example, Internet Explorer 5 onwards); editing the XML file directly is not recommended.

Starting the Application

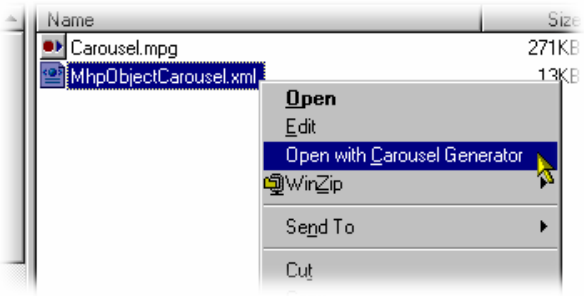
The application can be started by selecting the **Tektronix Carousel Generator** option from the **Start ➔ Programs** menu,



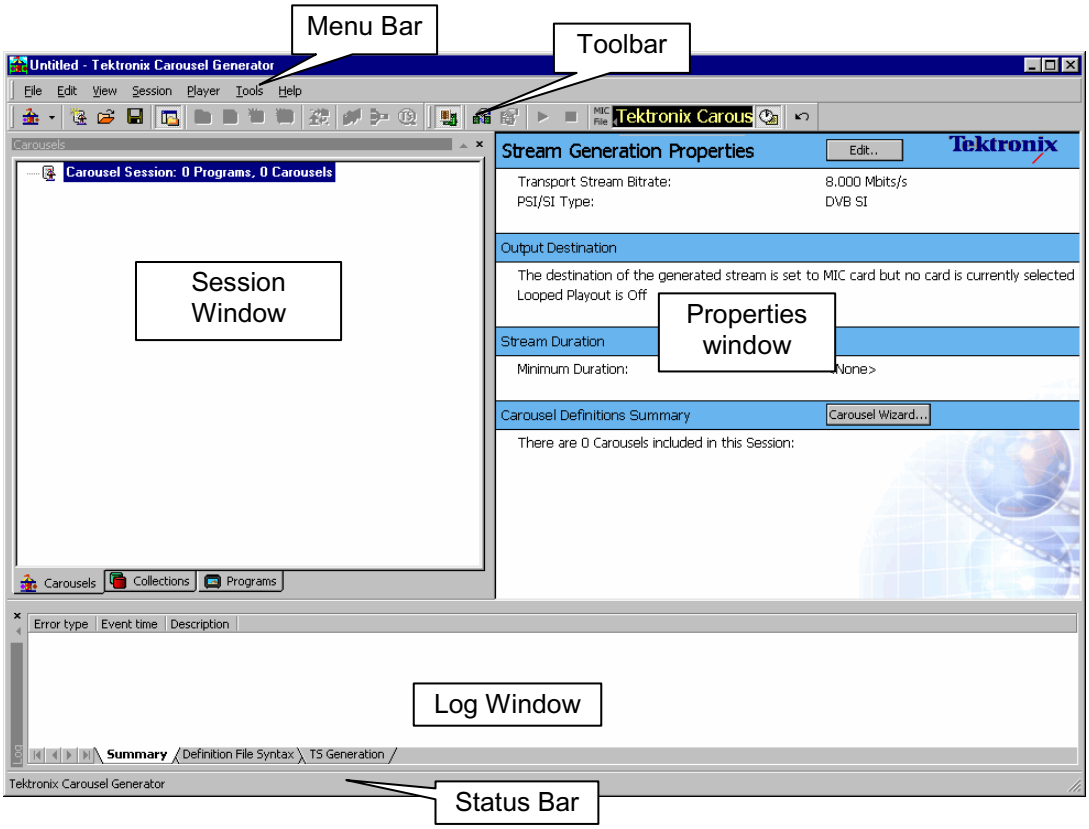
or

by double clicking on the **Tektronix Carousel Generator** shortcut on the desktop.

In addition, files with an XML extension have an additional option in the right-click menu, i.e. **Open with Carousel Generator**. When this option is selected, Carousel Generator opens and attempts to use the file as a Carousel Definition file (see page 6).



Initial Appearance



The full range of options available to the Carousel Generator can be accessed via the Menu Bar. However, the selection of options displayed varies during the stages of carousel creation; options not available are normally greyed out. The Toolbar provides shortcuts to the more commonly used options.

The working area of the Carousel Generator screen comprises three windows: the Session window, the Properties window and the Log window. The Session window and the Log window can each be either floated (moved to anywhere on the desktop) or docked to one of the four sides of the application window. The content of the Properties window is context sensitive; it will provide a summary of the properties of the node highlighted in the Session window.

A full description of the Carousel Generator screen components can be found in the Menus and Controls, page 21.

Session Window

The Session window is the workspace in which carousels and collections are built and manipulated. The window has three tabs: **Carousels**, **Collections** and **Programs**. Each window displays different aspects of the current session in the form of a tree structure.

Carousel Tab

The Carousels Session window displays all of the carousels in the current session and the directories and files associated with each carousel. It is in this window that carousels are built and manipulated.

Collections Tab

The Collections Session window displays the collections associated with each carousel and the allocation of files and directories within them.

Programs Tab

The Program session window displays the contents of the stream from the program or service point of view.

Properties Window

The Properties window provides an immediate view of the parameters and values associated with each node in the Carousels and Collections Session windows. The values displayed are those of the currently selected node.

Log Window

The Log window displays errors and warnings as the carousel building and stream generation progresses.

A full description of the Carousel Generator screen components can be found in the Menus and Controls, page 21.

Carousel Wizard

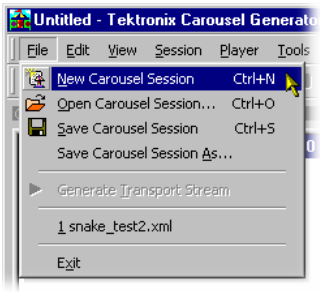
The Carousel Wizard makes the process of creating a single carousel easier. The carousel is added to the current session. The final step of the wizard allows a transport stream to be created using the information in the current session.

Default parameters are provided at all stages of the wizard, but the user can change them either via the wizard screens or subsequently via the various property dialogs.

The description in this section provides an overview of the wizard and carousel creation. Individual properties and activities are described in more detail in the Reference section of this guide. Extensive tooltips are provided with the wizard screens. Place the cursor over any element of a screen to reveal the tooltip.

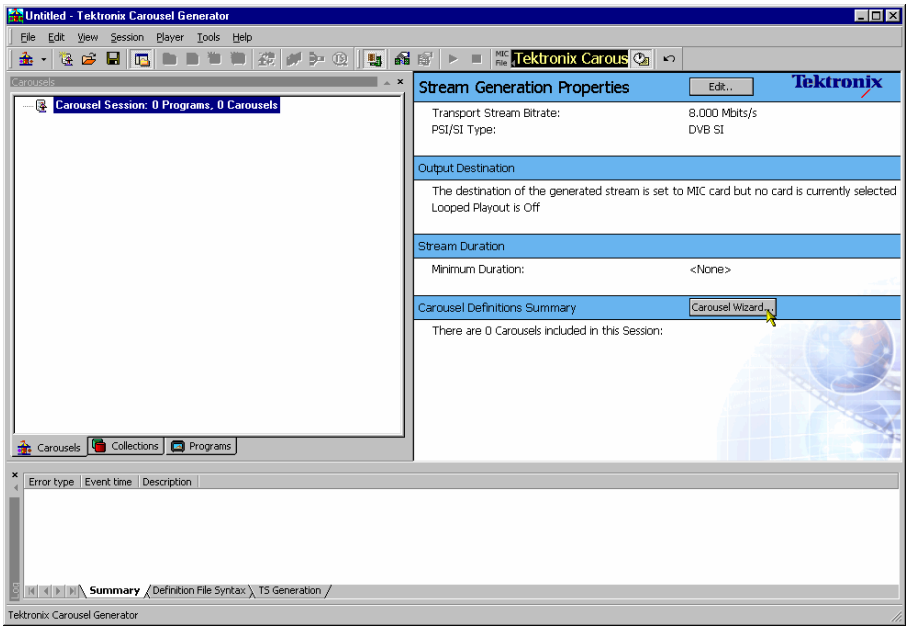
If a carousel session is in progress, the user must decide whether a new session is required or a new carousel is to be added to an existing session.

If a new carousel session is to be started, select **File ➔ New Carousel Session**.



Any carousel session currently open will be closed with an option to save.

The following screen is displayed:

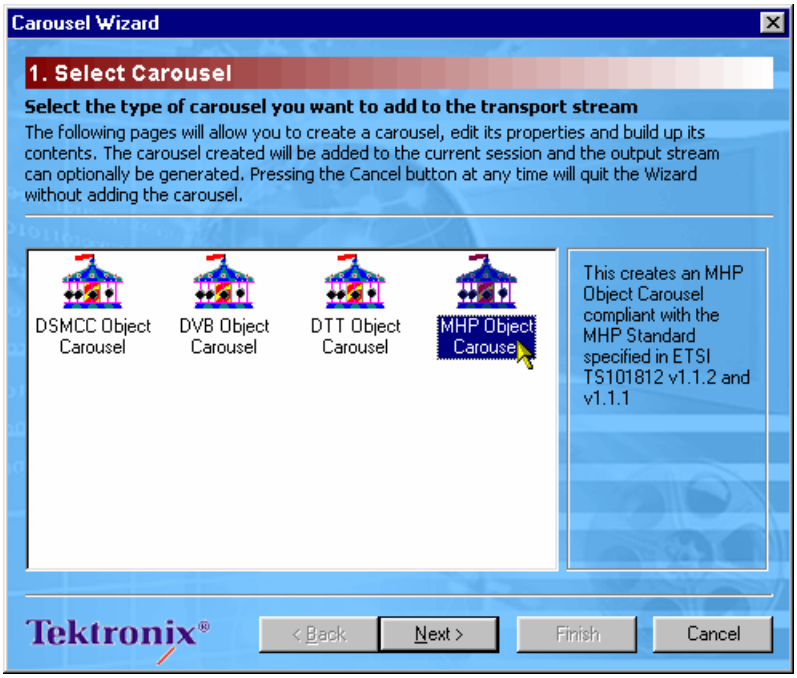


For a new session or adding a carousel to an existing session, the wizard can now be invoked.

Step 1: Select Carousel

1.) In the work area select **Carousel Wizard…** or select **Session ➔ Carousel Wizard**.

Step 1: Select Carousel of the Carousel Wizard is displayed.

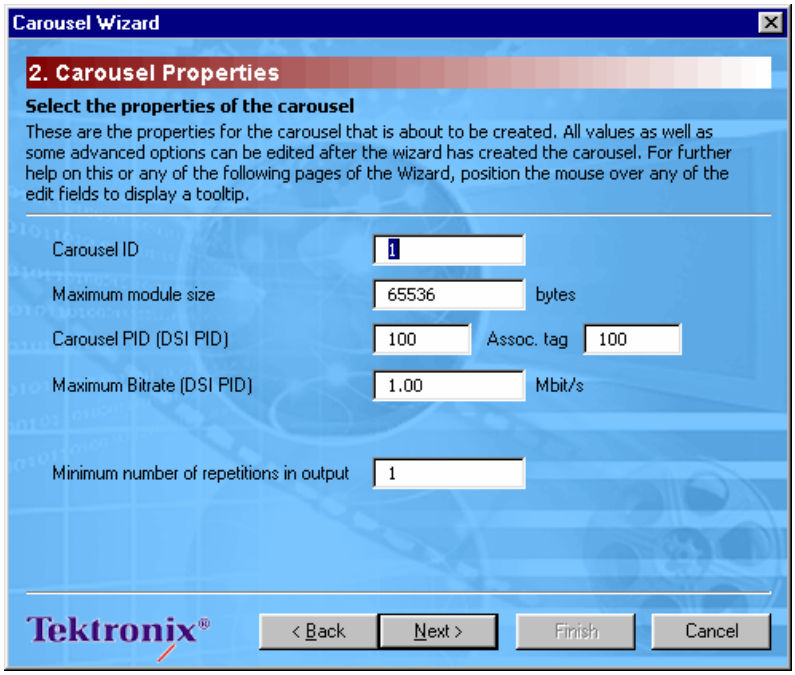


2.) Highlight the required Carousel type.

Note that depending on the type selected, some of the subsequent wizard screens will vary in content. The content is dictated by the carousel type selected.

3.) Select **Next** to display Step 2: Carousel Properties.

Step 2: Carousel Properties



In Step 2, the Carousel Properties are selected. Defaults are supplied but all properties can be edited. Properties can also be edited after the carousel has been created from the main window.

4.) Make any required adjustments to the Carousel properties.

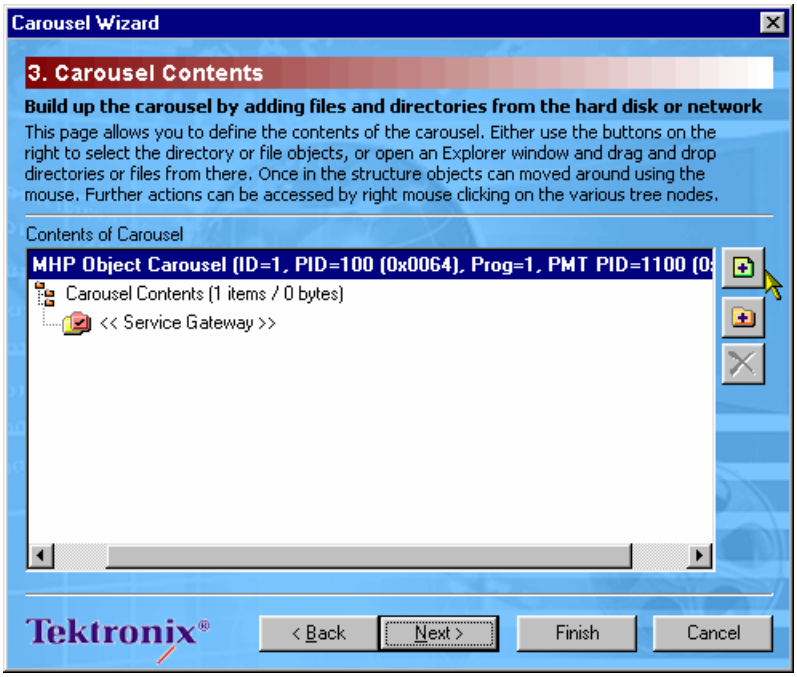
5.) Select how many times the carousel should appear in the output stream.

NOTE. When using the wizard, only a single carousel is being assembled. However, more than one carousel may be created within a session.

The number of repetitions can be specified for each carousel. The length of the transport stream will be dictated by the carousel which requires the longest time by virtue of its size or the number of repetions requested. Carousels in the same session requiring less time to fulfil their size/repition criteria will be repeated.

6.) Select **Next** to display Step 3: Carousel Contents.

Step 3: Carousel Contents



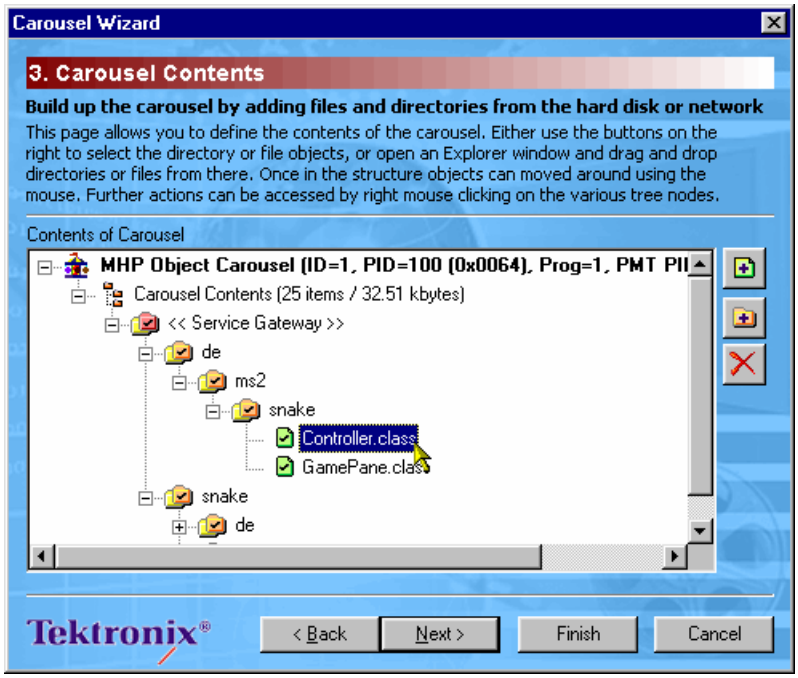
Files and directories containing applications and resources are added to the carousel during this step.

The buttons on the right-hand side of the window allow individual files or complete directory structures to be added to highlighted nodes of the carousel. Files and directories can also be dragged and dropped from Windows Explorer.

Files and directories can be dragged and dropped within the wizard window, to allow final adjustments to be made.

Highlighted files and directories can be also be deleted.

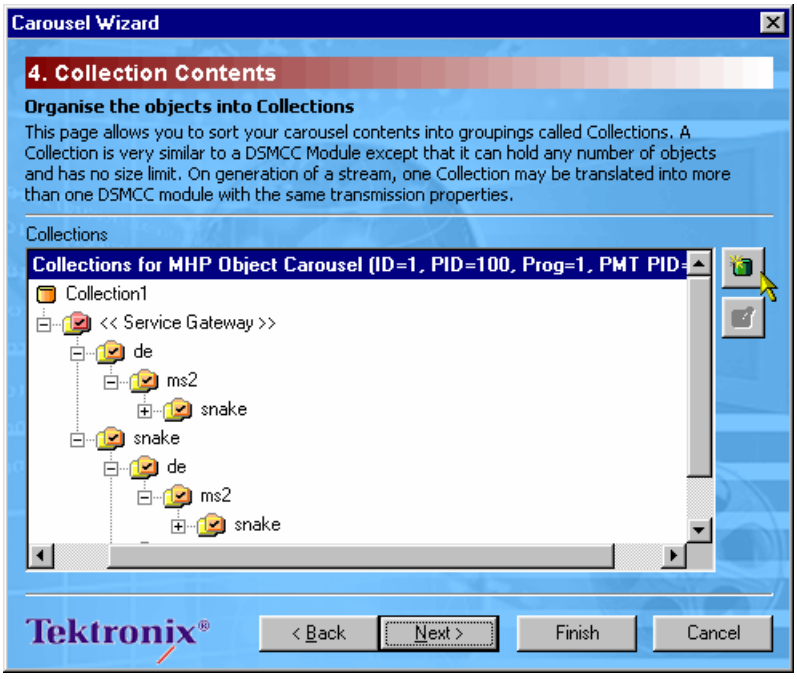
7.) Build the carousel structure as required.



Highlighting an object and selecting **Properties** from the right-click menu allows access to the object properties.

8.) Select **Next** to display Step 4: Collection Contents.

Step 4: Collection Contents

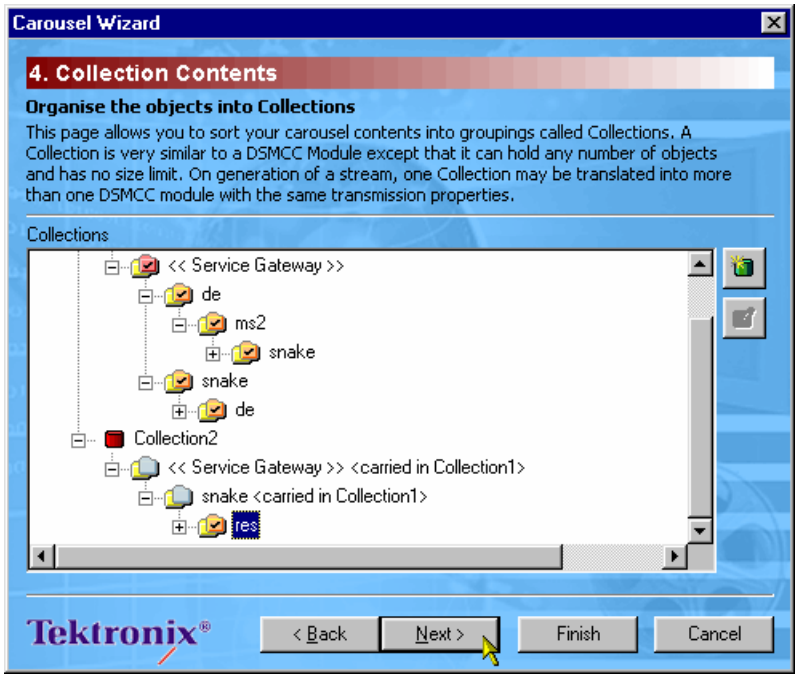


The files added in the previous step are automatically placed in a single default Collection (as shown above). Collections allow objects to share transmission properties including minimum repetition rate (i.e. maximum cycle time) and compression. This step allows the user to change the properties of the default Collection, create new Collections and move files between the various collections.

9.) Select  to create a new collection header.

10.) Highlight a collection node and select to modify the collection's properties.

NOTE. If the previous wizard step is reselected (**Back**) and more files added or removed, the Collection assignment is maintained for existing files and new files are placed in the parent directory's collection by default.

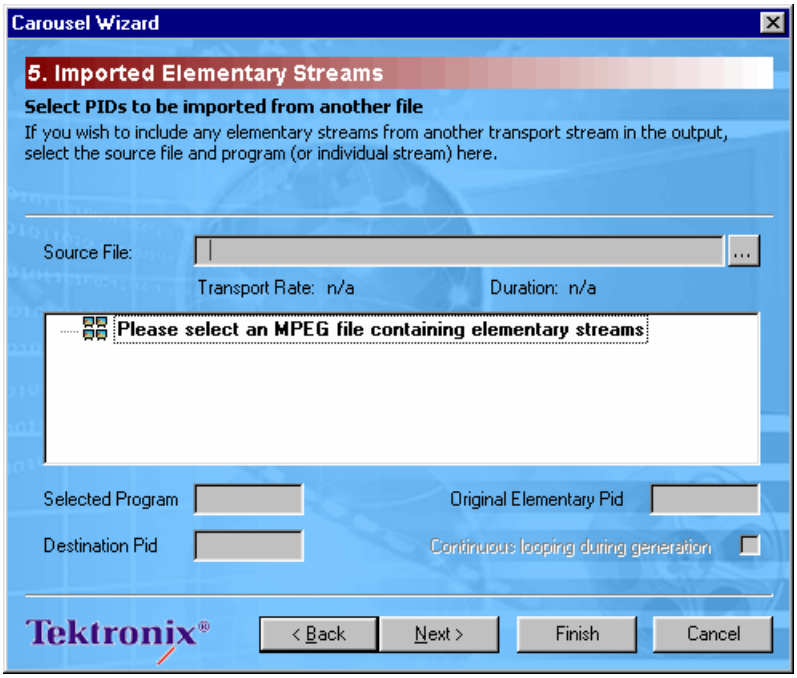


To modify the collection properties, highlight the required Collection node and select Properties from the right-click menu.

11.) Select **Next** to display Step 5: Imported Elementary Streams.

Step 5: Imported Elementary Streams

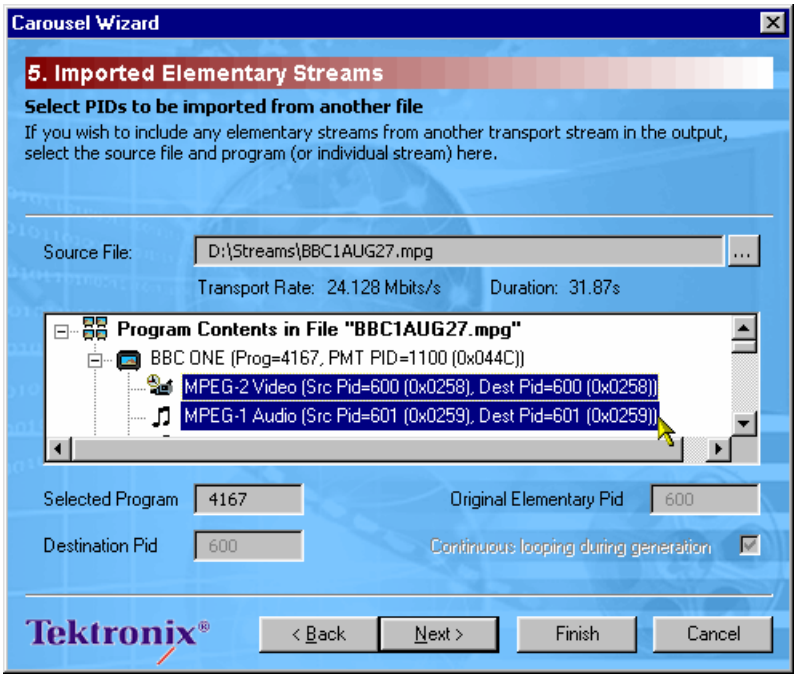
In addition to the carousel objects, elementary streams from a transport stream can be included in the session.



12.) Use the **Source File:** ... button to identify and select the transport stream.

The contents of the source file are displayed.

13.) Select one or more elements from this tree to import into the current session, or select a program node to import every element contained by the program.



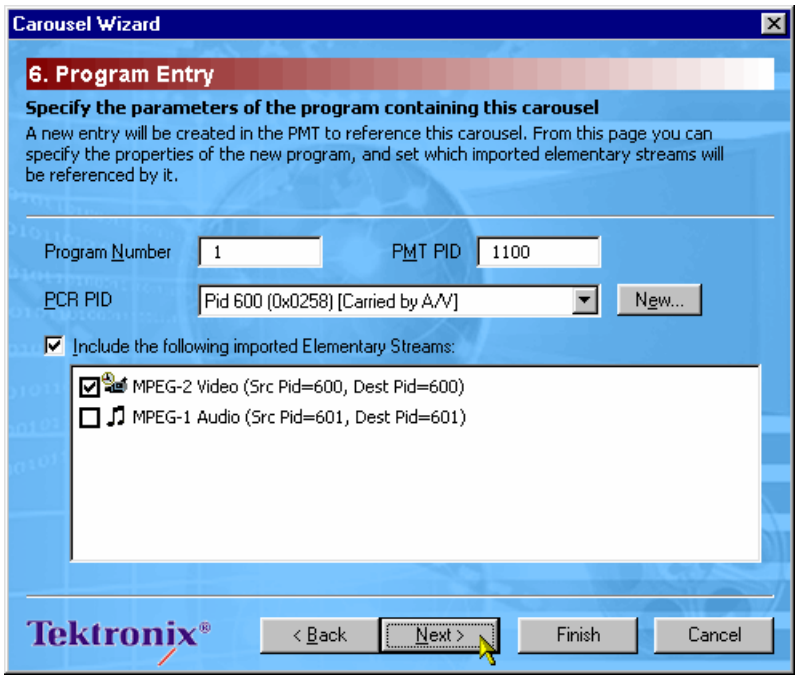
Note that only elements from the same source program can be selected. All elements included in the session will be included in the output stream, whether they are referenced by a program or not.

Where possible, elementary streams will be carried on the same PID used in the source stream; where a conflict within the session occurs, a new PID will be automatically allocated or can be allocated manually.

14.) Having identified the source stream and the individual elementary streams to be included in the session, select **Next** to display Step 6: Program Entry.

Step 6: Program Entry

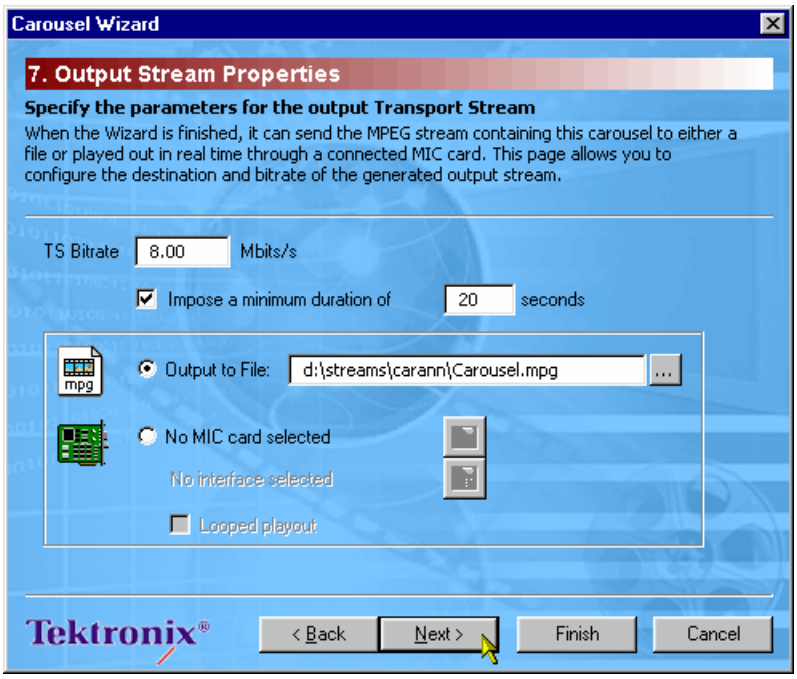
At this step, a new entry will be created in the PMT referencing this carousel. Also the elementary streams identified in the previous steps can be associated with a new program.



15.) Select the elementary streams to be included in the new program.

16.) Select **Next** to display Step 7: Output Stream Properties.

Step 7: Output Stream Properties



Use this screen to specify the name and properties of the transport stream that is to be created.

17.) Enter the **TS Bitrate**.

18.) Enter minimum duration for the output transport stream if required.

The transport stream can be output to a file or played out via a MIC card and interface.

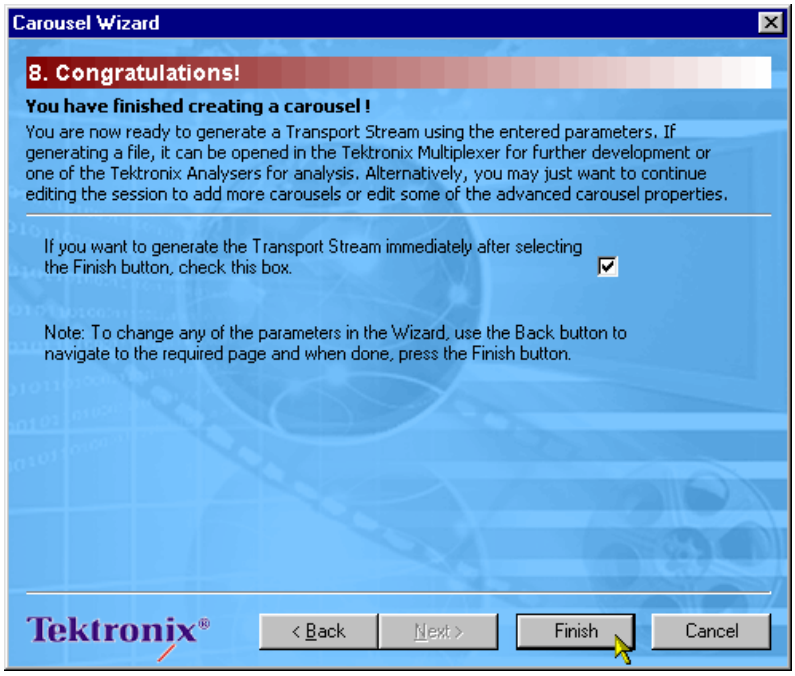
19.) Enable either **Output to File:** or MIC card output.

20.) For file output, enter or select (...) an **Output Filename**.

21.) To set up the MIC card and interface (where fitted), refer to the *MPEG Interface Card* chapter in the *Installation* section of this manual.

22.) Select **Next** to display Step 8: Congratulations.

Step 8: Congratulations



The carousel is now prepared. If the option to create the transport stream is enabled then all carousels in the current session will be included. The carousel created with the wizard will be added to the session screen.

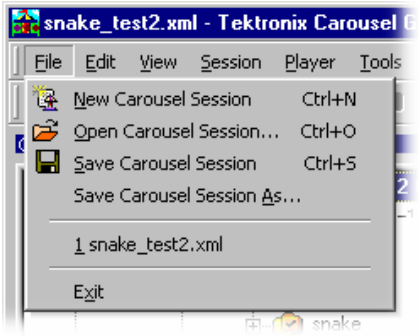
23.) Select **Finish** to exit the wizard.

Menus and Controls

Menus and Options

In the Menus and Options described below, a number of the options are context sensitive; which window is open and which element is highlighted will dictate which options are enabled and disabled.

File Menu Options



New Carousel Session
Opens a new carousel session. An opportunity to save the current session is offered, if relevant.

Open Carousel Session…
Opens an existing carousel session using a previously saved carousel definition file.

Save Carousel Session
Saves the current carousel session in the form of a carousel definition file. If the file has not been previously saved, an opportunity is offered to name it.

Save Carousel Session As…
Allows the current carousel session to be named and saved in the form of a carousel definition file.

Most Recently Used List
Lists the most recently used carousel session files. Click on a file name to re-open it.
The number of files displayed is set in the Carousel Generator Options dialog (**Tools ➔ Options**)

Exit Closes the application. An opportunity is offered to save the session if it has not been previously saved.

Edit Menu Options

Cut Cuts the currently highlighted item. The item is stored on the Windows clipboard.

Copy Copies the currently highlighted item. The item is stored on the Windows clipboard.

Paste Paste the item currently on the Windows clipboard.

Empty Carousel

(Carousel contents node highlighted) Deletes the carousel contents.

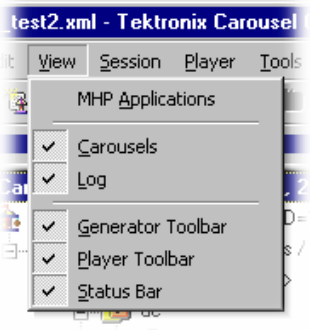
Delete Collections

(Collection node highlighted) Deletes the selected collection (The Collection must be empty; the contents must be moved to another collection first).

Delete Program

(Program node highlighted) Deletes the selected program and the carousel(s) it contains.

View Options



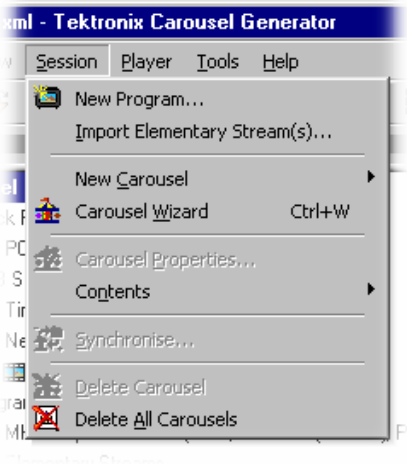
MHP Applications

List MHP applications where they are included in a session.

Carousels; Log; Generator Toolbar; Player Toolbar; Status Bar

Allows the screen elements listed to be shown or hidden.

Session Menu Options



New Program…

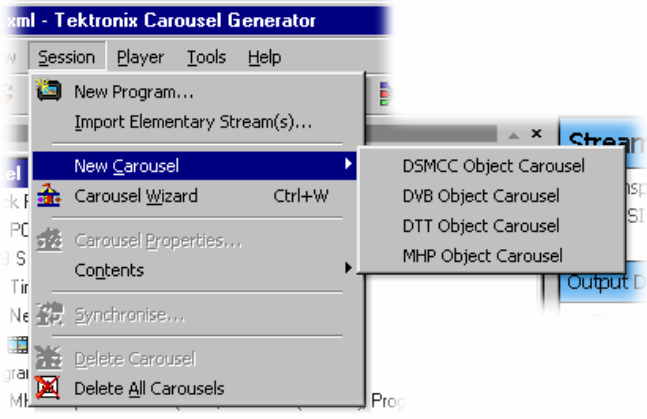
(Program view) Adds a new program node.

Import Elementary Stream(s)…

(Program view) Allows elementary streams to be added to the Elementary Streams node.

New Carousel

(Carousel view or Program node) Allows a new carousel type to be created.



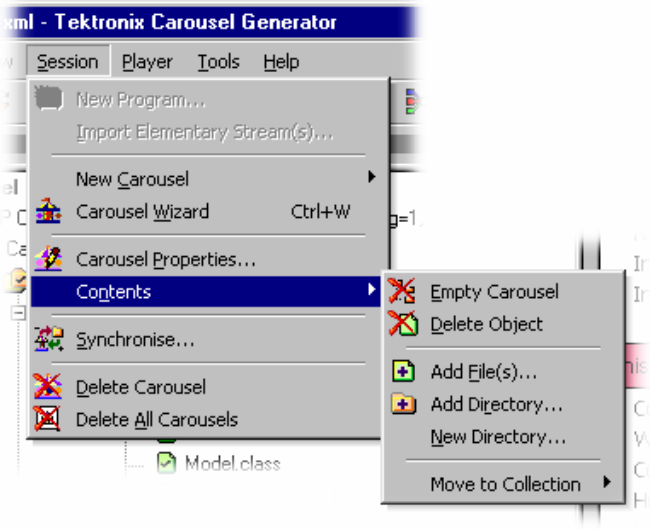
Carousel Wizard

Opens the Carousel Wizard which takes the user through carousel and stream generation step-by-step.

Carousel Properties…

Opens the Carousel Properties dialog.

Contents Facilitates the file activities listed below (the menu content is context sensitive):



Empty Carousel
Empty currently highlighted carousel.

Delete Object
Delete currently highlighted object (and dependant objects).

Add File(s)… Adds one or more files to the selected carousel.

Add Directory… Adds a directory to the selected carousel.

New Directory…
Creates a new directory at the selected node.

Move to Collection
Moves the selected objects to another collection.

HTML Application commands Make, Remove and Edit HTML applications.

Java Application commands Make, Remove and Edit Java applications.

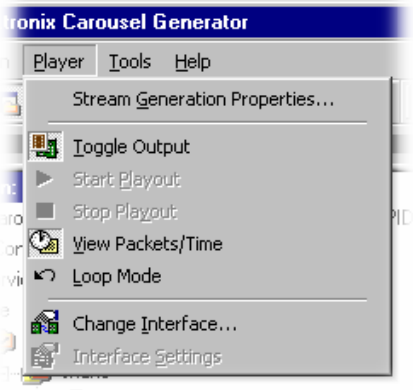
These HTML and Java Application commands are only applicable to file objects, i.e. when a file is selected.

Synchronise
Synchronise the carousel contents with the source files.

Delete Carousel
Deletes the selected carousel.

Delete All Carousels
Deletes all carousels in the current session.

Player Menu Options



Stream Generation Properties…
Opens the Stream Generation Properties dialog.

Toggle Output
Switches output between MIC card and playout to file.

Start Playout
Initiates output stream generation using information in the current session.

Stop Playout
Stops output generation.

View Packets/Time
Switches between Packet count and time display during playout

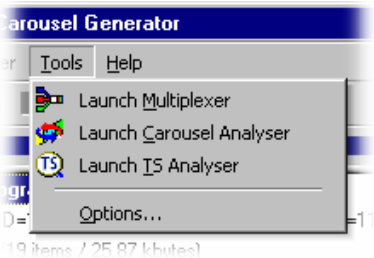
Loop Mode Enables loop mode.

Change Interface…
(MIC card selected) Allows the interface to be changed.

Interface Settings…
Allows the interface card settings to be adjusted.

Generate Transport Stream

Tools Menu Options



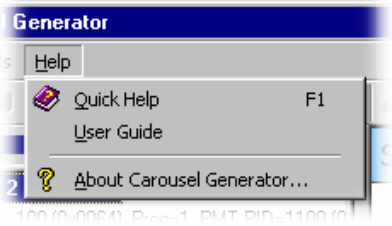
Launch Multiplexer
Opens the Multiplexer application.

Launch Carousel Analyser
Opens the Carousel Analyzer application.

Launch TS Analyser
Opens the Transport Stream Analyzer application.

Options… Opens the Carousel Generator options dialog. This is used to set the basic Carousel Generator and session defaults.

Help Menu Options



Quick Help Opens an HTML help page containing summarised help information.

User Guide Opens the Carousel Generator User Guide in Adobe Acrobat™ (PDF) format.

About Carousel Generator…
Displays information about Carousel Generator, including Software Version and Serial Number. This information will be required if Tektronix support is required.

Toolbars

Two toolbars can be displayed: Generator and Player. The toolbars can be shown or hidden using the View menu or by right-clicking in the toolbar area.

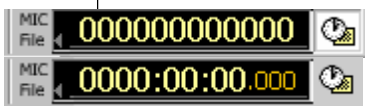
Toolbars provide a set of convenient shortcuts for the more frequently used menu options. The buttons are context sensitive and are enabled or disabled dependent upon the currently highlighted view or the action being performed.

Generator Toolbar

Icon	Function	Equivalent Menu Bar Command
	Carousel wizard	**Session ➔ Carousel Wizard (Ctrl+W)**
	New carousel session	**File ➔ New Carousel Session (Ctrl+N)**
	Open carousel session	**File ➔ Open Carousel Session (Ctrl+O)**
	Save carousel session	**File ➔ Save Carousel Session (Ctrl+S)**
	Toggle workspace view	**View ➔ Carousels**
	Add directory	**Session ➔ Contents ➔ Add Directory…**
	Add files	**Session ➔ Contents ➔ Add Files…**
	New collection	(Right-click on Collection node) ➔ **New Collection**
	Insert program	**Session ➔ New Program…**
	Synchronise carousel	**Session ➔ Synchronise…**
	Launch Carousel Analyzer	**Tools ➔ Launch Carousel Analyser**
	Launch Multiplexer	**Tools ➔ Launch Multiplexer**
	Launch Transport Stream Analyzer	**Tools ➔ Launch TS Analyser**

The toolbar functions are described elsewhere.

Player Toolbar

Icon	Function	Equivalent Menu Bar Command
	Toggle Output Device	**Player ➔ Toggle Output**
	Change Interface	**Player ➔ Change Interface…**
	Interface Settings	**Player ➔ Interface Settings…**
	Playout Carousel	**Player ➔ Start Playout**
	Stop playout	**Player ➔ Stop Playout**
	Toggle Packet/Time display	**Player ➔ View Packets/Time**

NOTE: The **MIC** / **File** pointer indicates the **Output Setting** (see page 34).

	Toggle Loop Mode	**Player ➔ Loop Mode**

Toolbars can be dragged off the edge of the main window into a floating pallet. To do this place the mouse pointer on the background inside the Toolbar, i.e. not on one of the buttons, hold the left button down and drag into the main window area. The result is a self-contained window that looks like this:

To replace the Toolbar on the window border drag it over the border until the outline changes shape. It can be placed on the top, bottom, left or right hand edges.

The Toolbar may be hidden from view - **View ➔ Toolbar**.

Icons

The icons in Session windows are used to provide the user with a graphical indication of status.


Collections node


Collection node containing the Service Gateway.

At least one collection must exist during any session. The collection containing the Service Gateway cannot be deleted.


Ordinary collection node.

Not containing Service Gateway.


Compressed collection.


Directory object
Included in Carousel; Included in Synchronisation.


Directory object
Included in Carousel; Not included in Synchronisation.


Directory object
Not included in Carousel; Included in Synchronisation.


Directory object
shared.


File object
Included in Carousel.


File object
Not included in Carousel.


PCR node


DVB SI / MPEG PSI


Table node


Transport Stream node


Program node


Carousel object


Elementary Stream - Audio


Elementary Stream - Video


Elementary Stream - Private data

Icons incorporating an arrow indicate a shortcut function, e.g. elementary streams displayed in a Program node in the Programs view indicate a shortcut to the elementary stream in the Elementary Streams node.

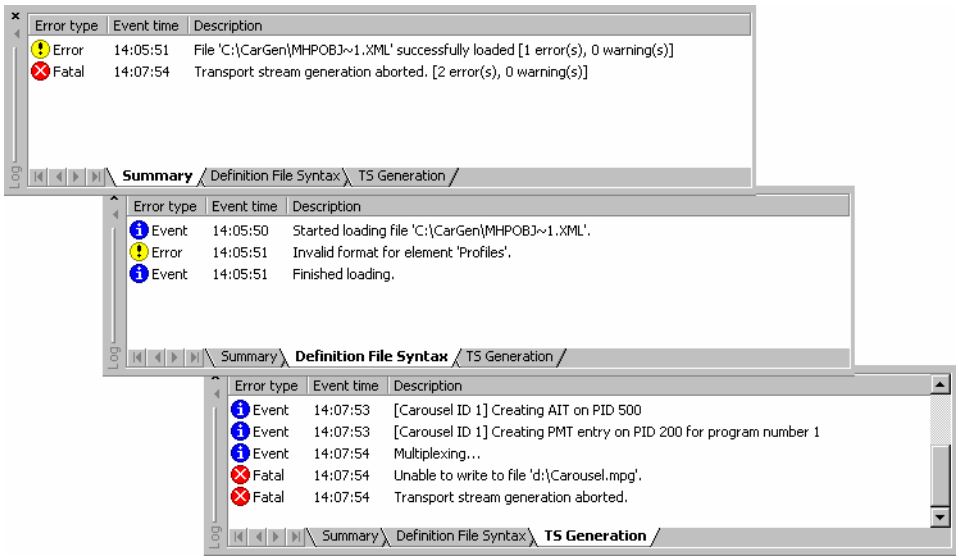
Log Window

The Log Window comprises three tabbed views:

The **Summary** log records information on the general activities in the Carousel Generator.

The **Definition File Syntax** log records information on activities concerning the definition file.

The **TS Generation** log records information during stream generation activities.



During file loading and saving and the generation of transport streams, error messages are routed to the appropriate Log window tab. More information about each error can be accessed by clicking on the error entry or selecting the **Details…** option from the right-click menu.

The following icons are used to indicate the severity of the error:

	Event	indicates normal processing activity
	Warning	indicates that information was not available or was invalid. The operation will often be completed.
	Error	indicates that a sub-operation could not be completed; the overall task may still be completed.
	Fatal	indicates that a fatal error has occurred; an activity has failed to reach completion.

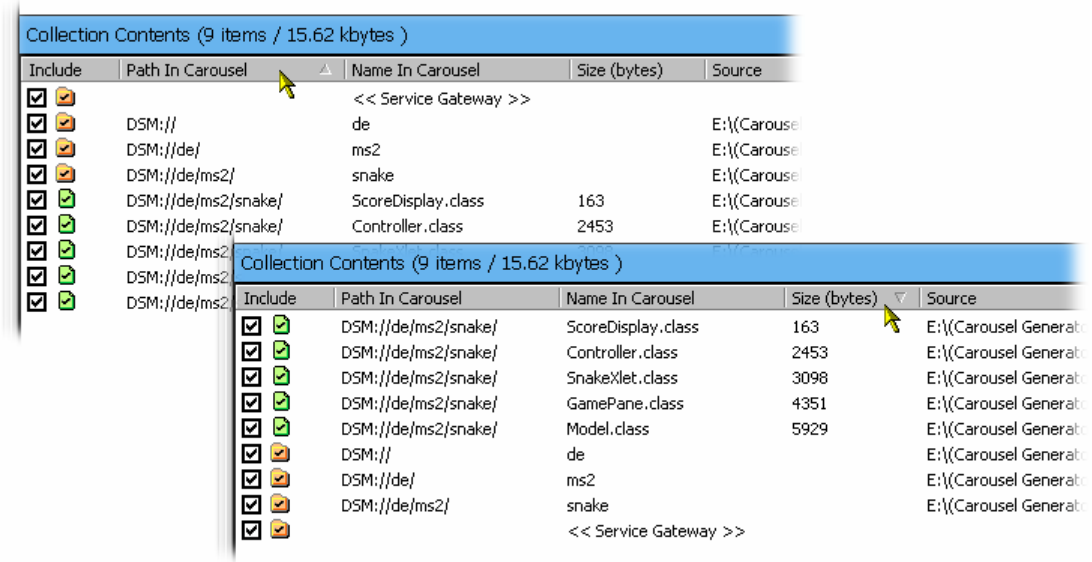
A right-click menu allows the user to clear the log currently being viewed or all logs.

Status Bar

The Status Bar displays tool-tips when the mouse pointer is over active elements of the window, e.g. toolbar buttons and menu options.

Properties Window (List Control)

In those properties windows that display lists, e.g. contents lists, one column can be selected to sort the list into ascending or descending order.



To sort a list, click on the key column header. If the same column needs to be sorted in reverse order, click on the header again; note that the arrow icon (▲) in the header bar indications the sort direction.

Carousel Generation

This section describes the processes required to create a transport stream containing one or more carousels. In broad terms it echoes the steps outlined in the Wizard, but more background information is provided.

Setting Overall Carousel Generator Properties

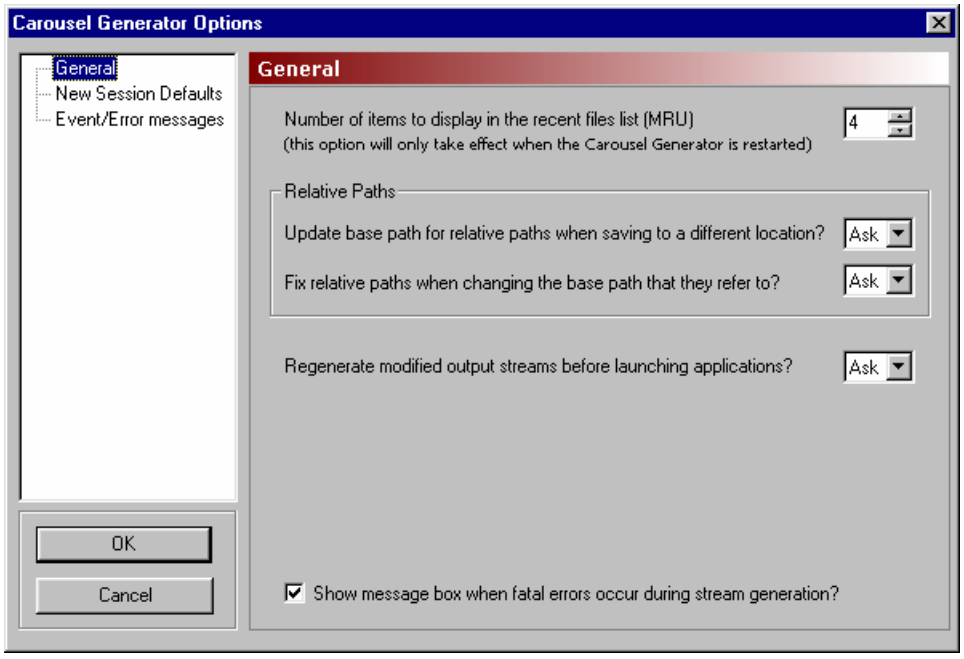
Although not usually essential during every session, the general properties of the Carousel Generator can be set using the Carousel Generator Options dialog. Note that settings such as the Output Filename can be overridden in the current session; however, the settings made here will be used as the defaults in any new session.

Select **Tools ➔ Options…** to open the Carousel Generator Options dialog.

Carousel Generator Options

The following screens are available in this dialog: **General**, **New Session Defaults** and **Event/Error messages**. To view a screen, click on the name in the left-hand panel.

General screen



Number of items… A list of the most recently used carousel definition files is displayed in the **File** menu. Use this parameter to select how many file names should be displayed.
Range: 0 to 15

Relative Paths The paths of source components associated with a carousel file can be stored in relative or absolute format.

Update base path… When a carousel definition is saved to a different (new) location, components stored with paths relative to the original carousel definition may no longer be found at the same (relative) location. If **Yes** is selected from the drop-down list, the base path will be modified so that the components can still be found. Select **Ask** to allow the user to make a decision when the carousel definition is saved. If **No** is selected, no modification will be made to the base path; carousel components may no longer be accessible to the definition file.

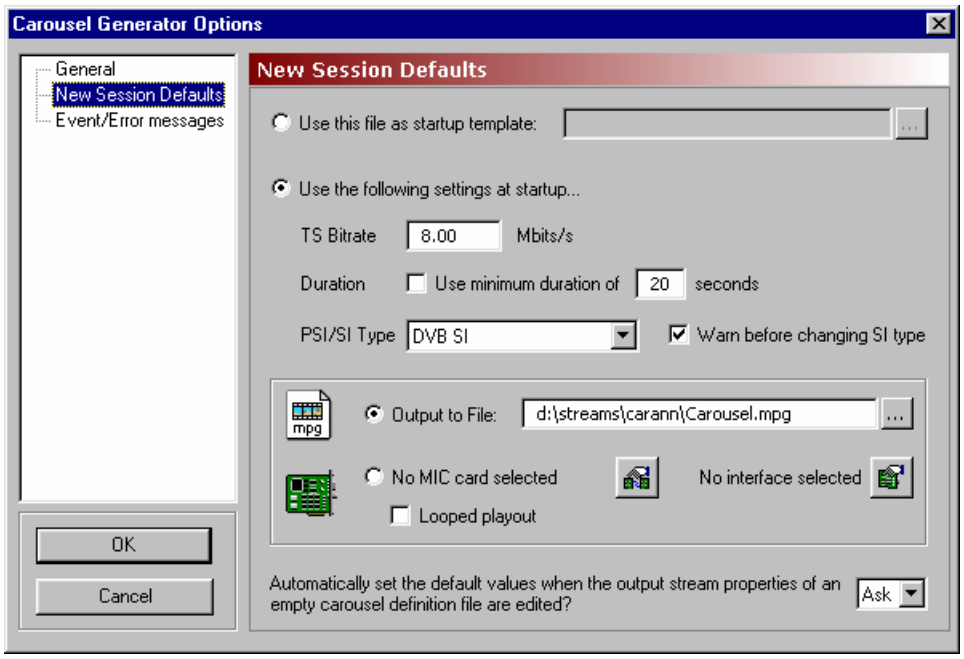
Fix relative paths… When the base path for components referenced by a carousel definition file is changed, the existing relative paths may not refer to the correct locations. If **Yes** is selected from the drop-down list, the relative paths will be adjusted so that they are referenced correctly to the new base path.

Regenerate… When enabled, launching Carousel Analyzer, Transport Analyzer or Multiplexer causes the output stream to be regenerated using the *current* session properties. This ensures that the properties that have been entered in the Carousel Generator are the same as those shown in the Carousel Analyzer, Transport Analyzer or Multiplexer.

Show message… When enabled, a message will be displayed during stream generation if an error occurs which causes the stream generation to terminate. The error will always be reported in the TS Generation tab of the Log window.

New Session Defaults screen

This screen provides default values to be used for all new sessions and consequently in the carousel definition files and generated transport streams. The default values can originate from a template or be set individually. The values can be overridden in individual carousel sessions.



Startup Template Select this option and identify a file to be used as a startup template.

Any carousel session file (XML format) can be used as a template. It can be used primarily to retain settings which are required from session to session, e.g. network settings.

Startup Settings:

Select the **Use the following settings…** option to set the session defaults locally.

TS Bitrate: The bitrate of the output transport stream.
Range: 0.25 Mbit/s to 90 Mbit/s

Duration: The duration value (in seconds) available when this feature is enabled will dictate the minimum length of the transport stream.

PSI/SI Type: This selection will dictate the tables that are automatically created at startup.

If **MPEG PSI** is selected, only the PAT and PMT will be generated. If **DVB SI** is selected, the mandatory DVB tables (NIT actual, TDT, SDT actual and EIT P/F actual) will also be generated.

Select the **Warn before…** checkbox to display a message when a change to the Stream Generation PSI/SI Type property is attempted (see page 39).

Output Settings:

The generated stream can be played out either to a file or via a MIC card.

Output to File: Select this option if you want to send the generated stream to a file. Enter the filename to be used in generating an output transport stream or browse (...) to find an existing filename.

MIC Card: Select this option (when available) to play the generated stream.

A MIC card supports a DVB Parallel interface and one of the following optional interfaces: ASI and GPSI.

If no MIC card is present, this option is disabled.

Use this button to open the MIC Card Manager dialog.

Use this button to open the Interface Settings dialog.

Looped playout Select this checkbox to ensure that the generation process continues until the stop button is selected. This option is only available when writing to the MIC card.

NOTE. MIC and Interface Card settings are described in the *Installation* section of this manual.

The output setting (and status) is indicated on the Player toolbar as follows:

File output selected (not playing).

File output selected (playing).

MIC output selected (not playing).

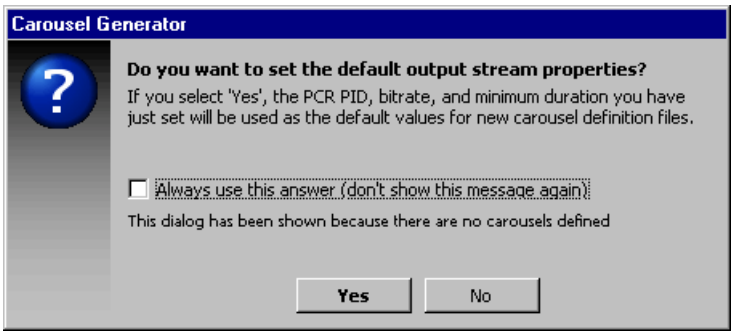
MIC output selected (playing).

Automatically set the default values…

If at the start of a session (with no carousels defined), changes are made to the Stream Generation Properties (see page 39), whether or not the changes are saved as Carousel Generator defaults is dictated by this setting.

The options operate as follows:

Ask: The dialog shown below will allow the user to choose between using the revised settings as future defaults or to only use them for this session.

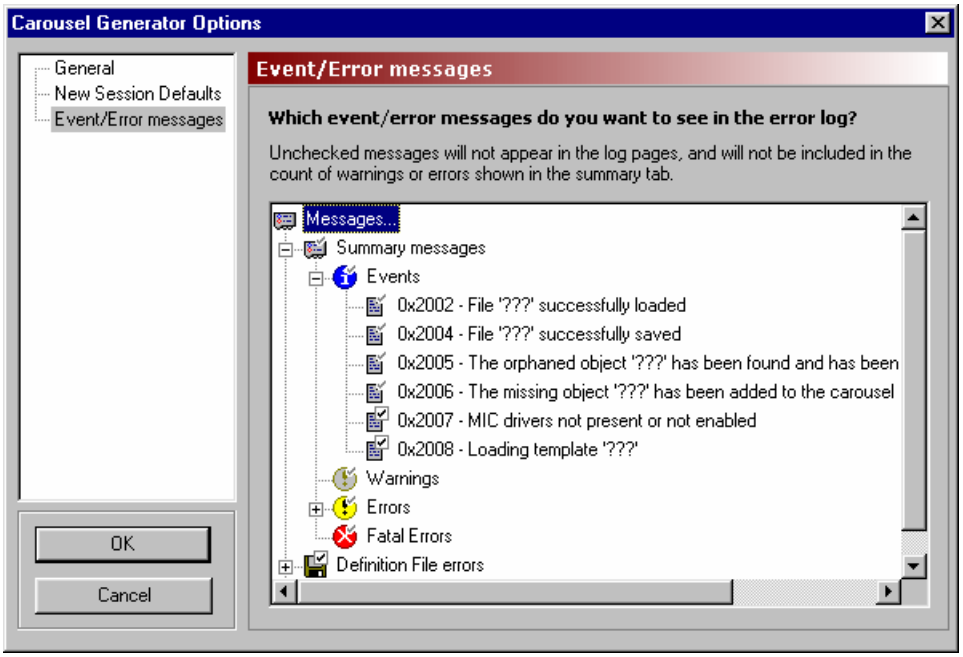


If the **Always use…** checkbox in the dialog is enabled, the **Automatically set…** option in this screen will be reset to concur.

No: The revised settings will not be used as future defaults.

Yes: The revised settings will be used as future defaults.

Event/Error Messages screen



The Log view which can be displayed as part of the main application, displays a series of status and error messages which advise the user of the progress of carousel and stream generation.

This screen allows the user to indicate which messages should be displayed. The Log view comprises three tabbed screens: **Summary**, **Definition File Syntax** and **TS Generation**. These correspond to the message categories **Summary messages**, **Definition File errors** and **TS Generation errors** in this screen.

Each message category contains four levels of severity: Events, Warnings, Errors and Fatal Errors. Individual messages that can be displayed in the Log view are listed at each level.

Message Selection

The checkmarks associated with each message icon indicate the reporting status of the message.

Enabled (permanent): this message type will always be reported in the log view.

Enabled / disabled (toggle): this message type is enabled/disabled by the user. It will only be reported in the log view when enabled.

If one or more of the subsidiary message types in a category (Events, Warnings Errors) is disabled, this icon is displayed.

All messages in the **Summary** category and **Fatal Error** messages in all categories are all permanently enabled; they cannot be disabled. The remaining messages in the **Carousel Definition File** and **Stream Generation** categories can be enabled and disabled as required by clicking on the message icon.

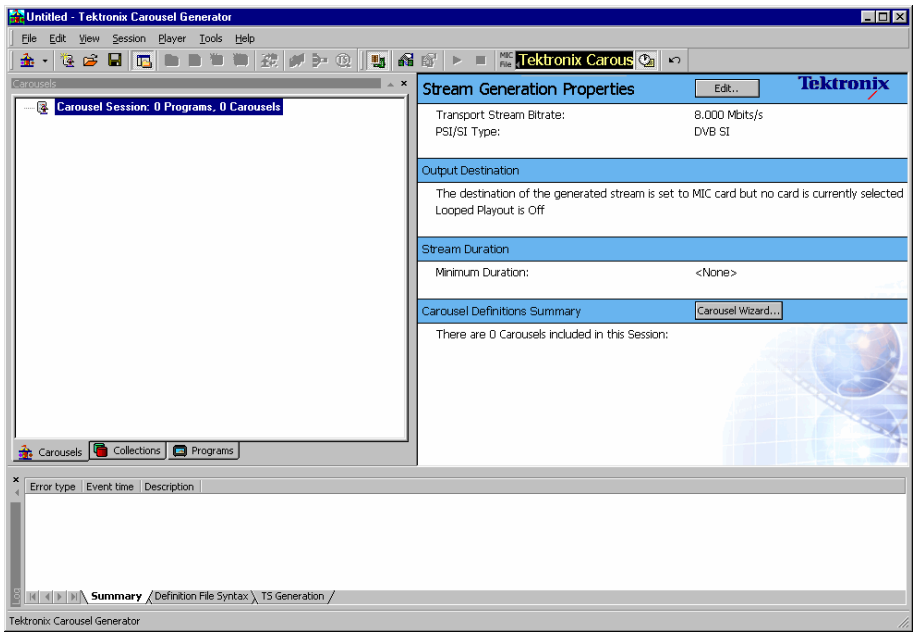
A brief description of a message can be displayed by clicking on the message name.

(See also Log Window, page 30)

Creating a Session

A session in Carousel Generator is the activity during which objects are assembled in one or more carousels with a transport stream being the end result.

The initial activity when starting a session is to note the defaults already displayed in the Stream Generation Properties screen; these are derived from the Carousel Generator Options. If required, the values can be modified for the current session.

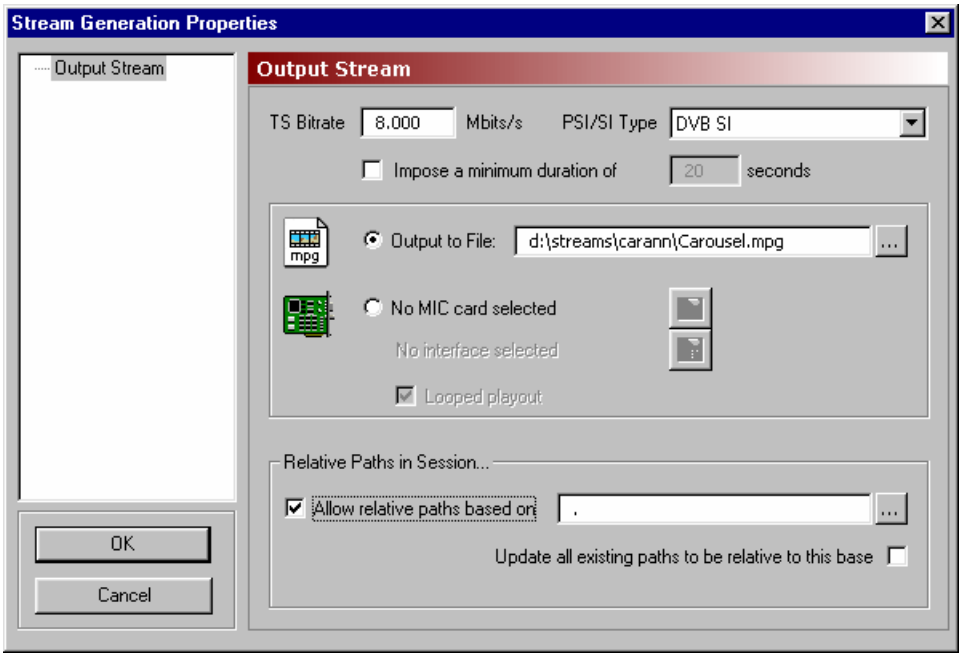


The values may be changed at any time in the session; it may be useful to review these settings at the end of a session, before the transport stream is created.

Select **Player ➔ Stream Generation Properties…** to open the Stream Generation Properties dialog or select **Edit…** in the properties window or double-click in the properties window.

Stream Generation Properties

This screen provides stream generation values to be used in the current session.



TS Bitrate: The bitrate of the output transport stream.
Range: 0.25 Mbit/s to 90 Mbit/s.

PSI/SI Type: This selection will dictate the tables that are created in the generated stream. If **MPEG PSI** is selected, only the PAT and PMT will be present. If **DVB SI** is selected, the mandatory DVB tables (NIT actual, TDT, SDT actual, and EIT p/f actual) will also be generated.

A warning may be issued noting that SI settings may be lost (see New Session Defaults screen, page 34).

Streams can be output to a file or played out via the MIC card and/or an interface.

Output to File: Select this option if you want to send the generated stream to a file.
Select ... to specify a location on local or network drives.

MIC Card: Select this option (when available) to play the generated stream.

A MIC card supports a DVB Parallel interface and one of the following optional interfaces: ASI and GPSI.

If no MIC card is present, this option is disabled.

The output setting (and status) is indicated on the Player toolbar as follows:

File output selected (not playing).

File output selected (playing

MIC output selected (not playing).

MIC output selected (playing).

Use this button to open the MIC Card Manager dialog.

Use this button to open the Interface Settings dialog.

Looped playout Select this checkbox to ensure that the generation process continues until the stop button is selected. This option is only available when writing to the MIC card.

NOTE: MIC and Interface Card settings are described in the *Installation* section of this manual.

Relative Paths in Session…

The paths of source components associated with a carousel file can be stored in relative or absolute format.

Allow relative paths based on

When enabled, Carousel Generator will interpret all incomplete paths as being relative to the base path specified in the adjacent text box.

The base path specified can be an absolute path (e.g. c:\data) or it can be relative to the current location of the carousel definition file. Note that if '.' is entered in the box, all relative paths are referenced to the current location of the carousel definition file.

Any paths automatically created will also be made relative to the base path, if possible.

If the checkbox is cleared (disabled), only absolute paths will be used.

Update all existing…

When enabled, Carousel Generator will attempt to convert all paths used in the session to be relative to the specified base path (where possible).

If the checkbox is cleared (disabled), existing absolute paths will be left unchanged.

Selecting the Carousel Type

There are a number of carousel types available from the various standards authorities. Carousel Generator makes available the types listed in the following table:

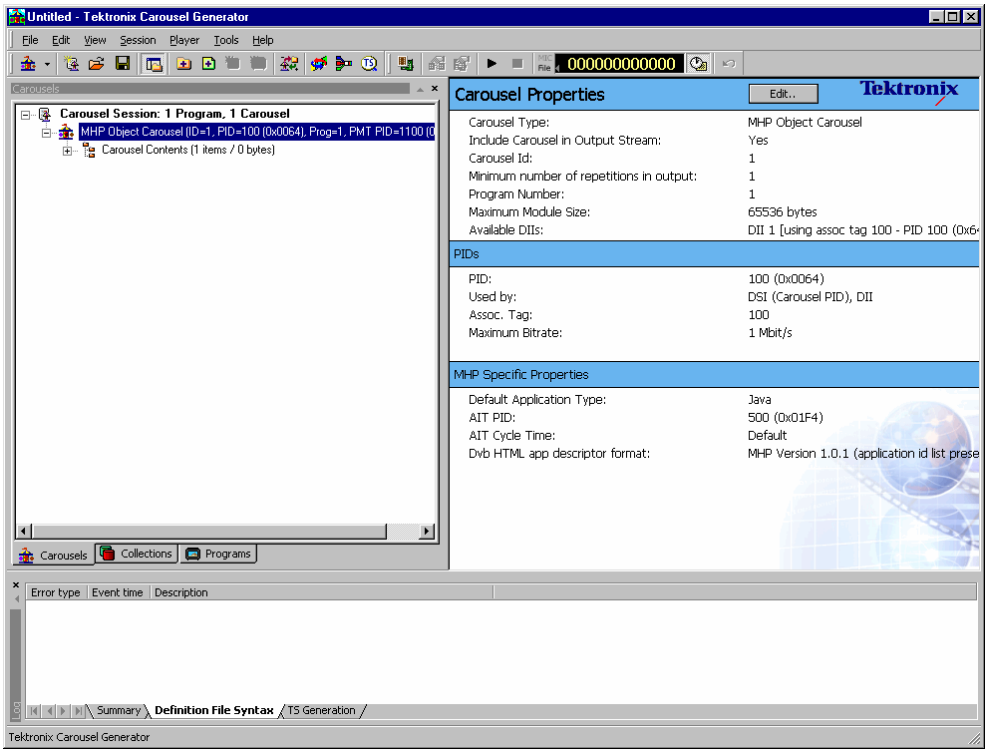
Carousel Type	Guiding Standard
DSMCC Object	ISO/IEC 13818-6: 1998 (MPEG)
DVB Object	DVB EN301 192 V1.2.1
DTT Object	DTG DTT Requirements for Interoperability V3.1
MHP Object	ETSI TS101 812 V1.1.2 & V1.1.1

Select **Session ➔ New Carousel ►** and click on the carousel type required. A new (empty) carousel of the type required will be added to the session. The carousel will be assigned an identity number (ID) and allocated to a PID automatically.

Additional carousels can be added; successive IDs and PIDs will be allocated.

Modifying the Carousel Properties

The properties of individual carousel can be modified as required. A summary of the carousel properties is displayed in the Properties window.



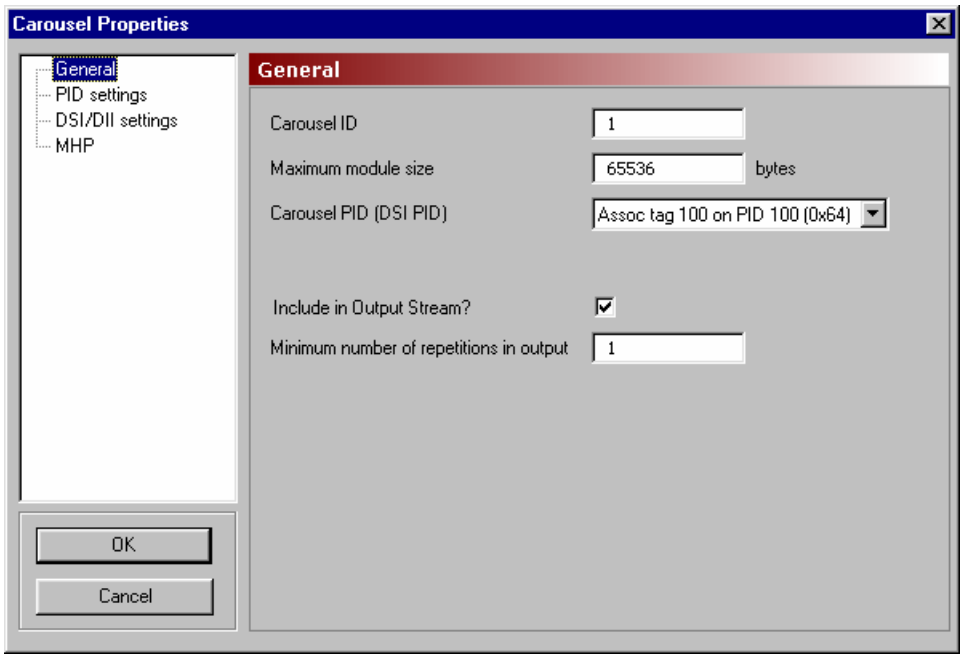
The contents of the carousel are displayed when the **Carousel Contents** node is highlighted.

To edit individual carousel properties, in the Carousels tab of the Sessions window and with the carousel node highlighted, select **Session ➔ Carousel Properties…** or select **Edit…** in the Properties window. The Carousel Properties dialog is displayed.

The number of screens available in the Carousel Properties dialog is dependent on the carousel type selected. In the following notes, screens dedicated to only a single carousel type are identified; all other screens are common to all types.

The Carousel Properties dialog can display up to four screens: General, PID Settings, DSI/DII settings, DTT Applications (DTT only) and MHP (MHP only)

General screen



Carousel ID: Unique carousel identity. The Carousel ID is normally generated automatically but can be changed by the user.
Range: 0 to 4294967295

Maximum module size:
The maximum size of the modules used to carry the carousel objects. During output stream generation, if a module has one or more objects and does not have enough space for the next object, a new module will be created. If a module is empty and the object added will exceed the maximum size, the object is still added, but no more objects will be placed in that module.
Range: 0 to 4294967295 Default: 65536

Carousel PID (DSI PID):
Select the required Association Tag from the drop-down list.
On carousel creation a default Association is generated to carry the Carousel/DSI PID. This cannot be removed.

Include in Output… This flag allows the carousel to be included in or excluded from the output stream. If the checkbox is disabled, no reference to this carousel or its contents will appear in the generated output stream.

Minimum number… Enter the minimum number of times that the carousel is to appear in the output stream; this can be repeated for each carousel in the session. The resulting output stream will be long enough to accommodate at least the minimum number of repetitions requested for each carousel.

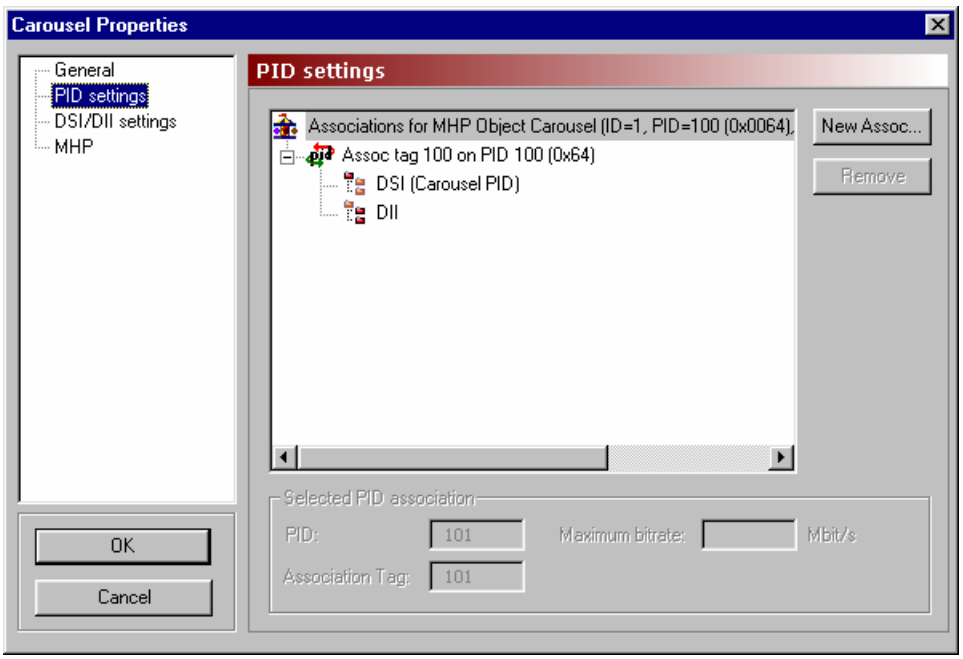
PID settings screen

The tree structure in the PID Settings screen shows the PID usage for the selected carousel's program. The DSI and DII messages carried in the carousel use an Association tag, which allows the BIOP messages in the carousel to be linked to a PID in the stream (see Reference 2).

To place the DII and DSI messages on different Association Tags, use the **DSI/DII settings** screen (see page 45).

During stream generation, each Association Tag specified will result in the following:

- An elementary stream (ES) with a stream type of 11 (DSMCC U-N messages) and the entered PID being added to the PMT ES loop.
- The Association Tag value will be inserted into an association_tag_descriptor inside this ES's descriptor loop.



Highlighting any of the association nodes will display the PID associations in the **Selected PID association** panel.

Select **New Assoc...** to create a new association node in the tree. The PID and Association Tag will be automatically allocated, but they can be changed in the **Selected PID association** panel.

Selected PID association

PID: This is the PID of the elementary stream (ES) carrying the DII and/or DSI messages.
Range: 0 to 8191 (see PID Values, page 44)

Association Tag: This is the 16 bit value carried in the association_tag_descriptor which is inserted in the ES descriptor loop of the PMT signalling this carousel.
Range: 0 to 65535.

Maximum bitrate… This is the maximum bitrate allocated in the stream for this PID. If there is not enough bandwidth to support this rate, the actual bitrate will be less.
Range: 0.25Mbit/s to 90Mbit/s

PID Values

As stated, the valid range for PIDs is 0 to 8191. However, there are a number of restrictions on the actual values that can be used, since some are reserved or may be used in other carousels. The following table shows the elements which can and cannot share PID values. Unless otherwise noted, a cross (✖) indicates the entities in the row and column headers may not share a PID value in any carousel in a single session. A tick (✔) indicates that the PID value may be shared with other entities in the same session; unless otherwise indicated in the Notes below.

	Reserved	PCR	PMT	AIT	DSI	DII
DII	✖	✖	✖	✖	✔ (Same Carousel)	✔ (Same Carousel)
DSI	✖	✖	✖	✖	✖	
AIT	✖	✖	✖	✖		
PMT	✖	✖	✔			
PCR	✖	✖				
Reserved	✖	The Reserved PIDs are PIDs 0 to 31 (0x00 to 0x1F) and the Null PID 8191 (0x1FFF)				

Note 1 PIDs 0 to 15 (0x0000 to 0x000F) are reserved by MPEG; PIDs 16 to 31 (0x0010-0x001F) are additionally reserved by DVB.

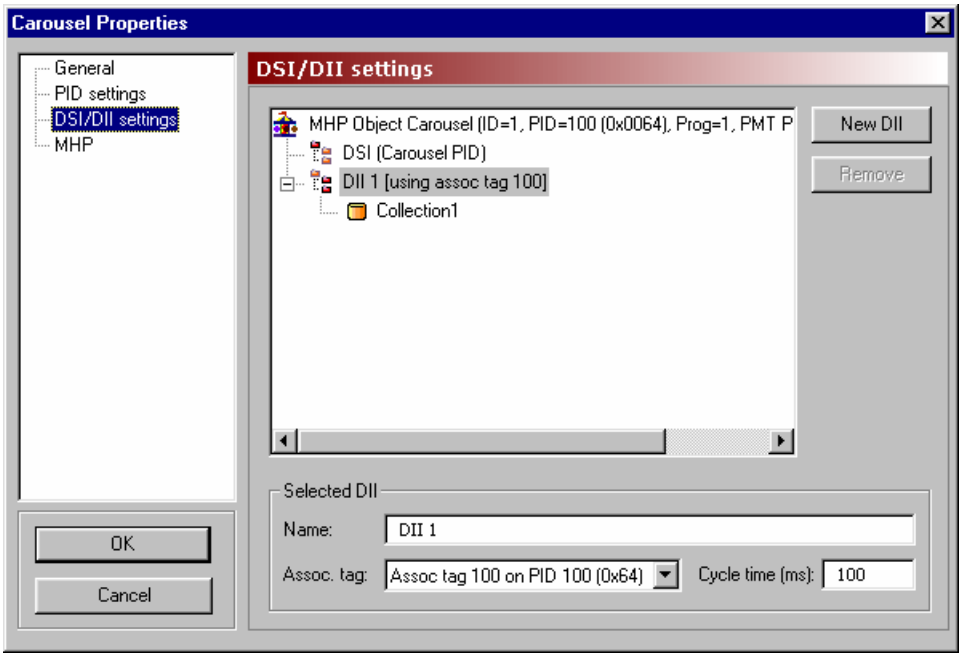
Note 2 PMTs cannot share PIDs with anything but other PMTs. Multiple PMT sections can be on the same PID, so, if required, every carousel could have its PMT entry on the same PID (usually not done that way, but it can be).

Note 3 The DIIs belonging to a single carousel can be on the same PID as its DSI or its other DIIs, but not on the same PID as DSIs or DIIs belonging to other carousels.

For example, the ticks and crosses in the PMT row/column indicate that the value of the PID carrying a PMT may not be shared with any other entities in the session. However, in the case of the PMT, see Note 2 attached to the table.

DSI/DII settings screen

The tree structure in the DSI/DII Settings screen shows the DSI and DIIs that will be generated in the stream for the selected carousel. Each DSI/DII has an Association Tag and a cycle time, and DIIs have a user definable name.



Highlighting any of the DII nodes will display the PID associations in the **Selected DII** panel.

Select **New DII** to create a new DII using default values. The default Association Tag to use is decided by first checking if an existing DII uses the DSI tag. If so, this tag is used, otherwise the tag of the first DII in the list is used.

Selected DII

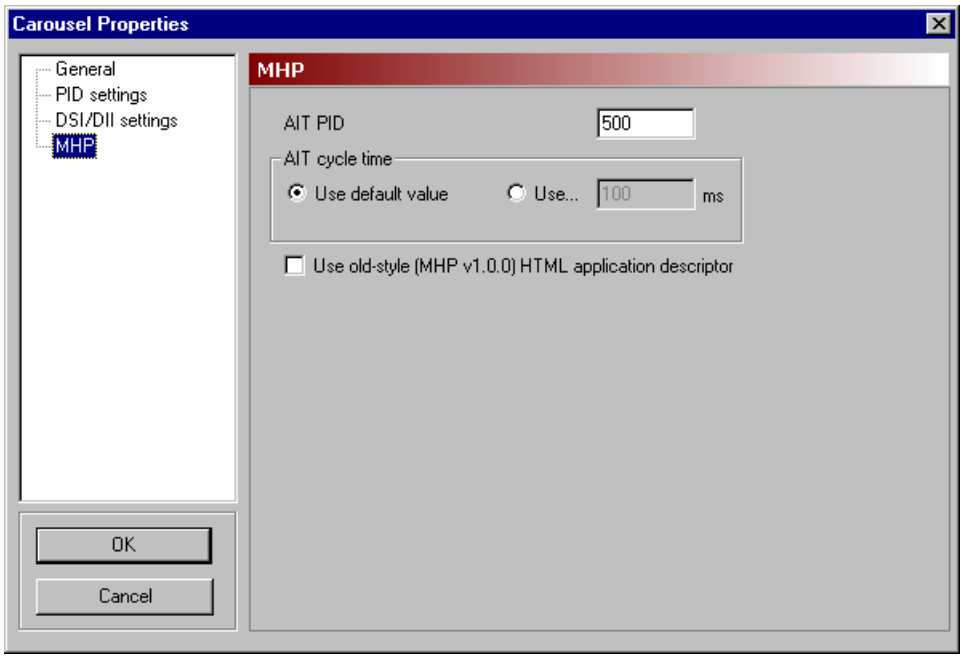
Name: This is a user allocated name for this DII. The name does not appear anywhere in the generated stream, only within the Carousel Generator.

Assoc. tag: This is the list of all the currently defined Association tags listed for this carousel. Assigning a different Association Tag to the DII effectively changes the PID the DII messages will be carried on. (Association tags can be added from the PID Settings screen.)

Cycle time (ms): This option sets the time taken for this DII to be repeated. For example, DIIs referencing boot classes may be given shorter cycle times to speed up the boot process.
Range: 1ms to 3600s.

To associate a Collection with a DII, first create the DII, giving it a meaningful name, set the Association tag and Cycle time of the DII and close this dialog. On the Collections tab of the Session window, edit the Collection's Properties to set the field **Using DII** to the new DII.

MHP



AIT PID This is the PID that carries the Application Information Table (AIT). Range: 0 to 8191 (see PID Values, page 44).

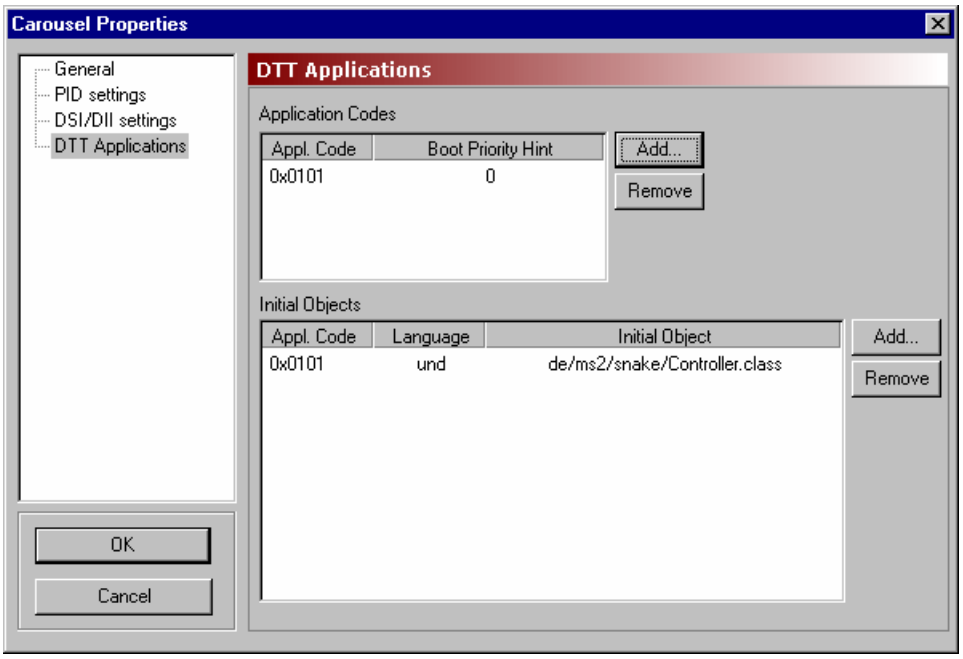
AIT cycle time: Set the time to be taken for the selected Carousel's AIT to be repeated. Default: 100ms.

Use… Select this option to allow the AIT cycle time to be set manually. Range: 1ms to 3600s.

Use old-style… If this box is checked, the DVB-HTML application descriptor format as defined by MHP v1.0.0 (Reference 1) will be used.

If this box is not checked, the new format as defined in MHP v1.1.2 (Ref: [1]) will be used. This will cause the DVB-HTML Application Descriptor to be properly formed and include an empty set of application IDs. To add application IDs to this descriptor, use the HTML Properties page on the MHP File Properties dialog.

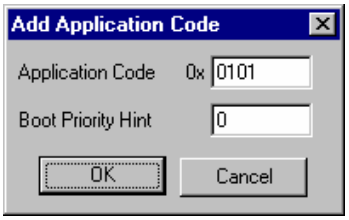
DTT Applications



Application Codes

The entries in this list will be added to the data_broadcast_id_descriptor in the elementary stream descriptor loop of the PMT. This descriptor lists the application types that can be booted from the elementary stream with which it is associated. The Boot Priority Hint is an indication of which application that should be booted in the case of more than one in the list being supported. The application with the highest Boot Priority Hint, in the range 0 to 255, will be booted first.

Add Displays the **Add Application Code** dialog.

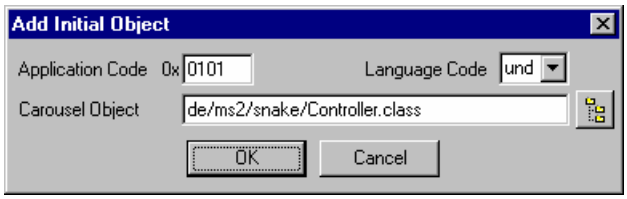


Remove Removes the highlighted Application Code.

Initial Objects

The Initial Object list allows different languages to have different boot objects. On stream generation, entries here will appear in the ServiceContextList part of the Service Gateway object.

Add Displays the **Add Initial Object** dialog.

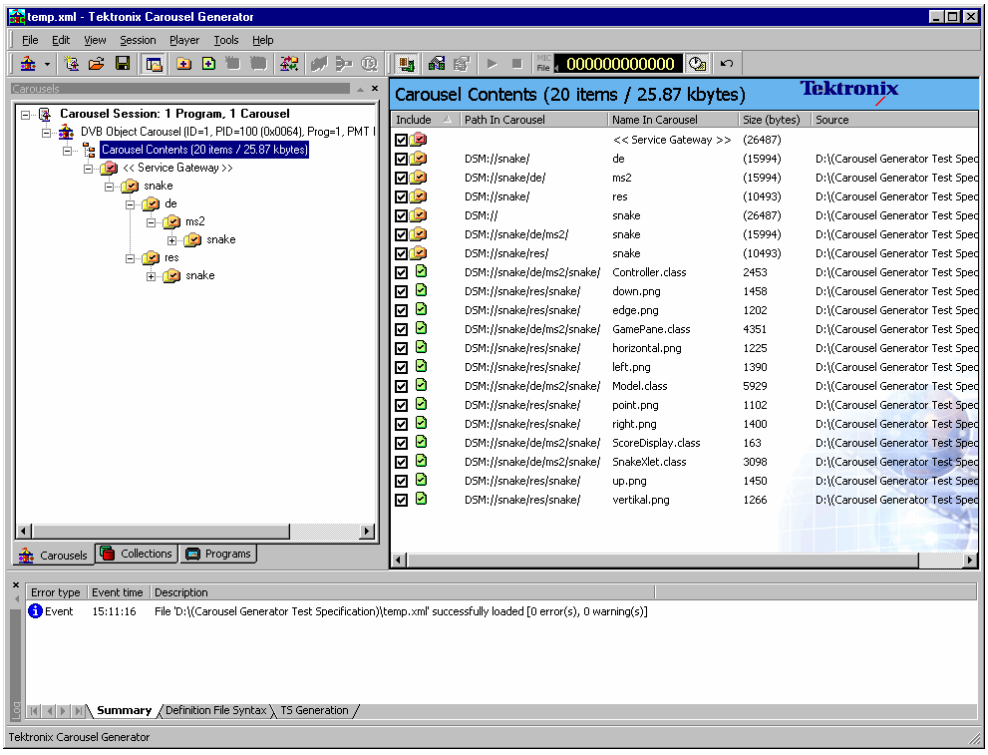


The **Application Code** should correspond to one already listed in the **Application Codes** panel. A **Language Code** can be selected from the drop-down list. The object can be given a name in the **Carousel Object** field. If objects have already been associated with the carousel, the adjacent button will display the contents of the carousel, from which an object can be selected.

Remove Removes the highlighted Initial Object

Carousel Contents

Each carousel initially contains two sub-nodes: Carousel Contents and Service Gateway. The carousel will eventually contain all of the objects associated with a particular function or feature. These objects can be arranged in a hierarchy of directories and files all displayed beneath the Service Gateway node.



Files and directories can be manipulated in a variety of ways:

- All commands are accessible via the Menu Bar or context sensitive right-click menus.
- Files and directories can be dragged and dropped within Carousel Generator.
- Files and directories can be dragged from Windows Explorer.

The properties of files and directories can be edited after they have been incorporated into a carousel.

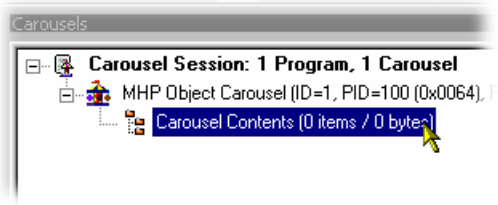
Adding an Object (File/Directory)

Individual files or complete directory structures can be added to a carousel. New directories can be created.

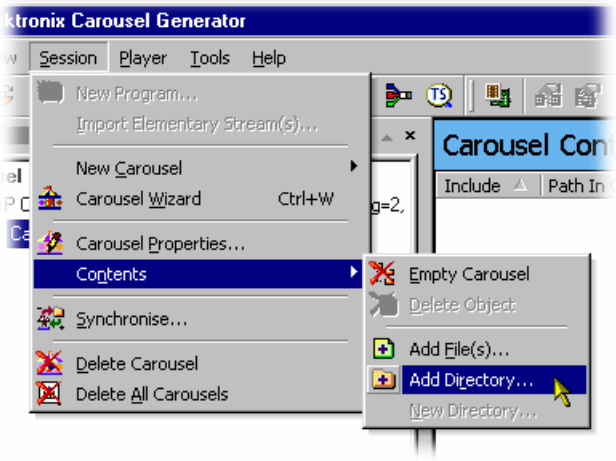
The location that an object is to be added to should be highlighted.

Adding Directories

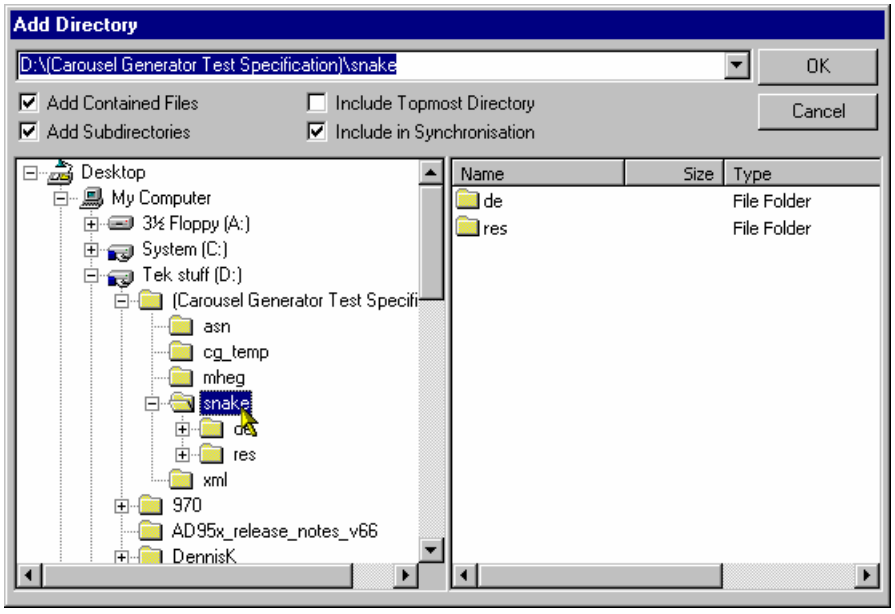
1.) Highlight the node in the carousel where the directory is to be added.



2.) Select **Carousel ➔ Contents ➔ Add Directory…**



The **Add Directory** dialog is displayed.



The **Add Directory** allows the user to select any available directory. The directory path is shown in the top field; the most recently accessed directories are available in the drop-down list. The adjacent checkboxes have the following functions:

Add Contained Files: All files contained in the selected directory (and any subdirectories if **Add Subdirectories** is enabled) will be added to the carousel.

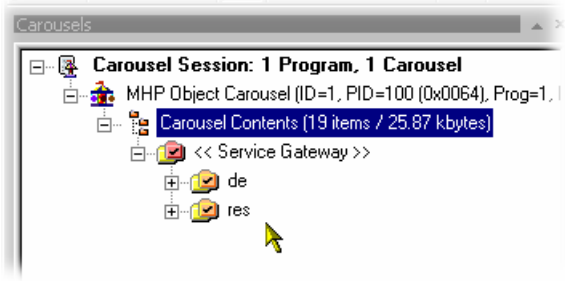
Add Subdirectories: All subdirectories of the selected directory will be added to the carousel.

Include Topmost Directory: The selected directory will be added to the carousel (not just the files and/or subdirectories).

Include in Synchronisation: The selected directory will by synchronised with its source directory (see page 59).

3.) Select the required directory and enable the required checkbox options. Select **OK** to add the directory to the carousel.

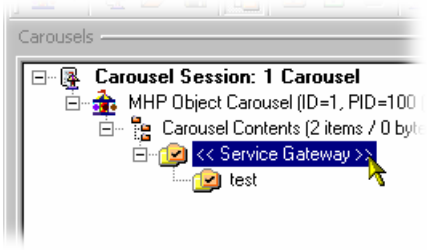
4.) The new directory is added below the highlighted node.



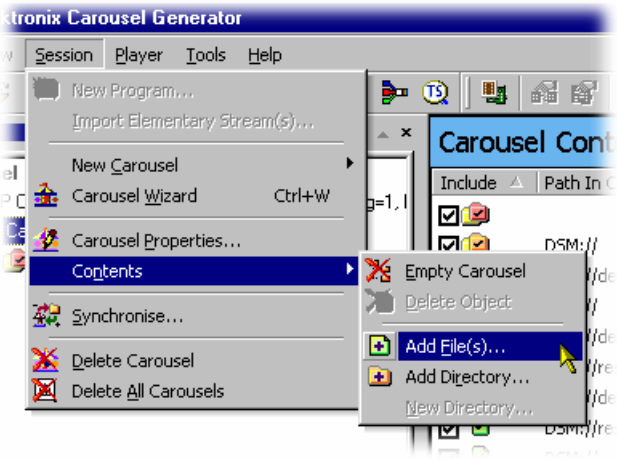
NOTE. When directories are dragged and dropped from Windows Explorer, all subdirectories and files will included. If the Shift key is held down during this action, the topmost directory name is not included.

Adding Files

1.) Highlight the directory node in the carousel where the file is to be added.

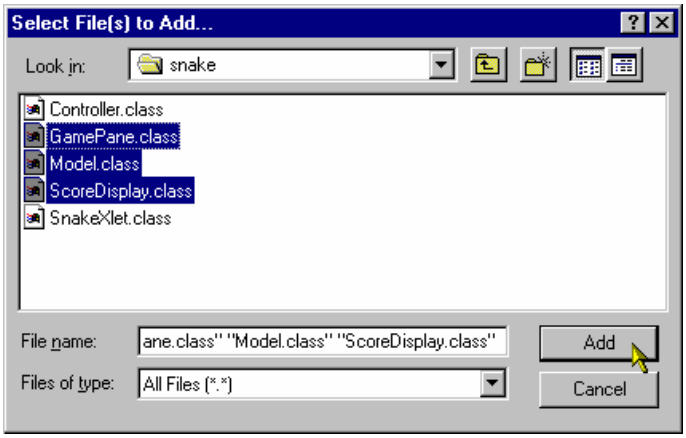


2.) Select **Carousel ➔ Contents ➔ Add file(s)…**



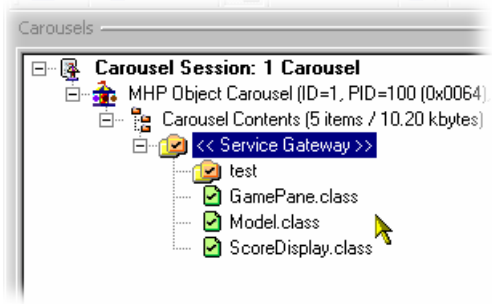
The **Select File(s) to Add** dialog is displayed.

3.) Select the file(s) to be added.



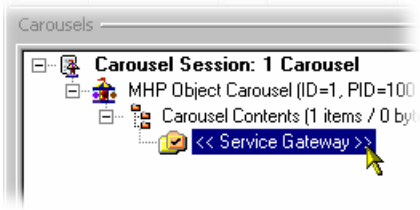
4.) Select **OK** to add the files to the carousel.

5.) The new file(s) are added to the selected directory node.

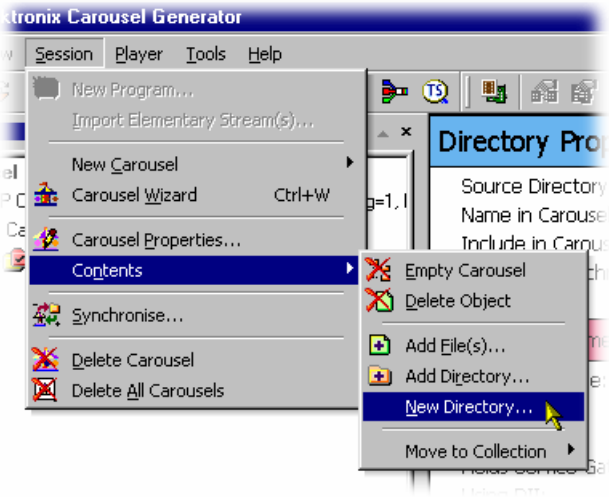


Creating a New Directory

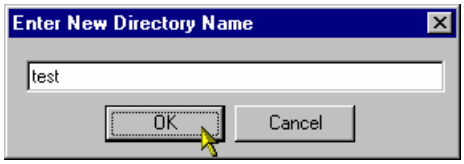
1.) Highlight the node in the carousel where the directory is to be created. (In this screenshot, the new directory is the first object to be created.)



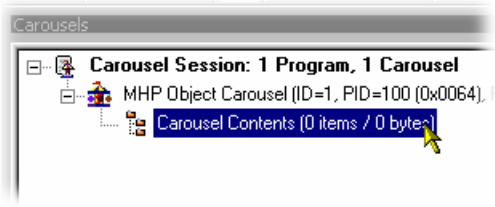
2.) Select **Carousel ➔ Contents ➔ New Directory…**



3.) Enter the name of the new directory and select **OK** to create the directory.



4.) The new directory is created below the highlighted node.



Moving an Object

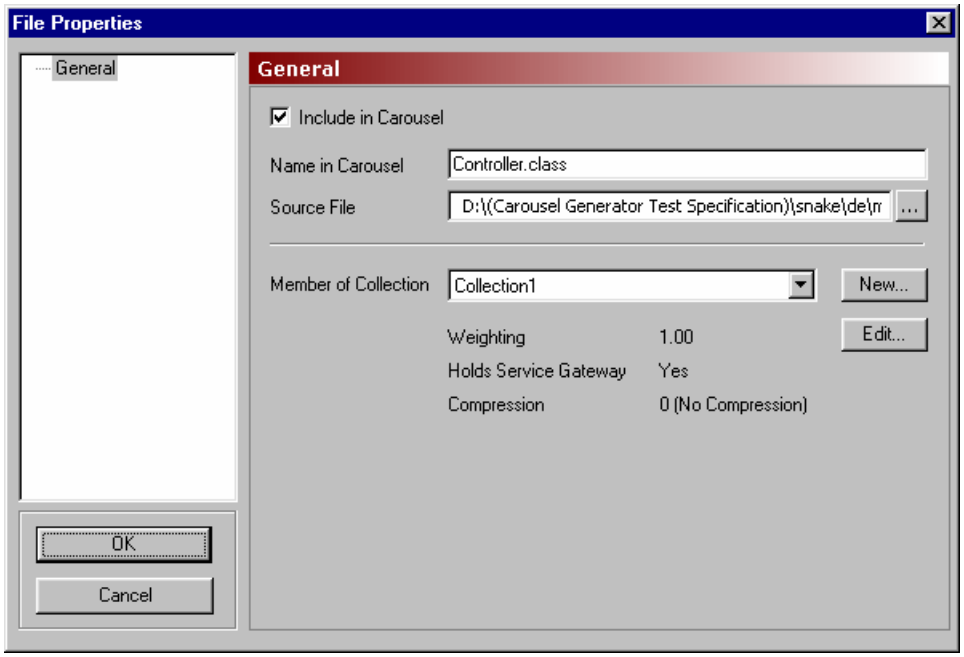
Files and directories are moved within a carousel using standard Windows commands and techniques, i.e. Copy, Cut and Paste and Drag and Drop.

Removing an Object

Files and directories are removed from a carousel using standard Windows commands and techniques.

File Properties

When a file is highlighted, the properties of that file are summarised in the Properties window. The properties can be viewed in detail and edited by selecting **Edit…** and displaying the **File Properties** dialog.



The File Properties dialogs for files contained in all types of carousel are similar. However, for the MHP carousel type, if a file is designated as an application (Java or HTML), there are additional properties; these are described in the following sections.

Include in Carousel: If this box is checked, the file object will be included in the generated carousel. If not checked, the file object will not be included in the generated carousel.

Name in Carousel: This is the name of the object as it will appear in the BIOP message in the output stream.
Range: 254 characters maximum (specified by the DSMCC specification. Additional characters will be truncated.)
ASCII character set excluding: **\ : / * ? " < > |**.

Source File: This field is set when the object is added to the carousel and can be edited to point to another object if required. This field does not appear in the output stream and is limited to 260 characters.

Member of Collection: This is a list of all the Collections currently included in this carousel. Selecting a different Collection effectively put this object into a different module possibly with different cycle times and compression characteristics. In the case of a directory object, all child objects below it are also moved to the selected Collection.

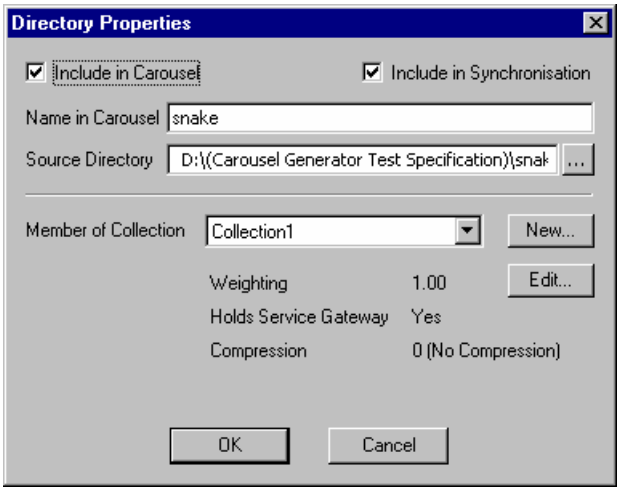
New Create a new Collection (see page 60).

Collection Properties:

Displays a summary of the properties of the Collection that the object is a member of. The properties can be edited by using the **Edit…** button to open the Collection Properties dialog (see page 60).

Directory Properties

When a directory is highlighted, the properties of that directory are summarised in the Properties window. The properties can be viewed in detail and edited by selecting **Edit...** and displaying the **Directory Properties** dialog.



Include in Carousel: If this box is checked, the directory object will be included in the generated carousel. If not checked, the directory object will not be included in the generated carousel.

Include in Synchronisation

If this box is checked, the source directory will be included in the Synchronisation process which aims to match the source directory structure with the carousel structure, removing and adding file and directory objects as necessary.
If this box is cleared, this directory will not be compared to the source directory and neither will any subdirectories, regardless of their individual settings.

Name in Carousel: This is the name of the object as it will appear in the BIOP message in the output stream.
Range: 254 characters maximum (specified by the DSMCC specification. Additional characters will be truncated);
ASCII character set excluding: **\ : / * ? " < > |**.

Source Directory: This field is set when the directory is added to the carousel and can be edited to point to another directory if required. Newly created directories may not initially have a correct source directory, but this can be edited if desired. This field does not appear in the output stream and is limited to 260 characters.

The Source Directory will be used when the carousel is synchronised only if the **Include in Synchronisation** box is checked (see page 59).

Member of Collection: This is a list of all the Collections currently included in this carousel. Selecting a different Collection effectively put this object into a different module with possibly different cycle times and compression characteristics. In the case of a directory object, all child objects below it are also moved to the selected Collection.

New Create a new Collection (see page 60).

Collection Properties:

This panel displays a summary of the properties of the Collection that the object is a member of. The properties can be edited by using the **Edit…** button to open the Collection Properties dialog (see page 60).

Applications

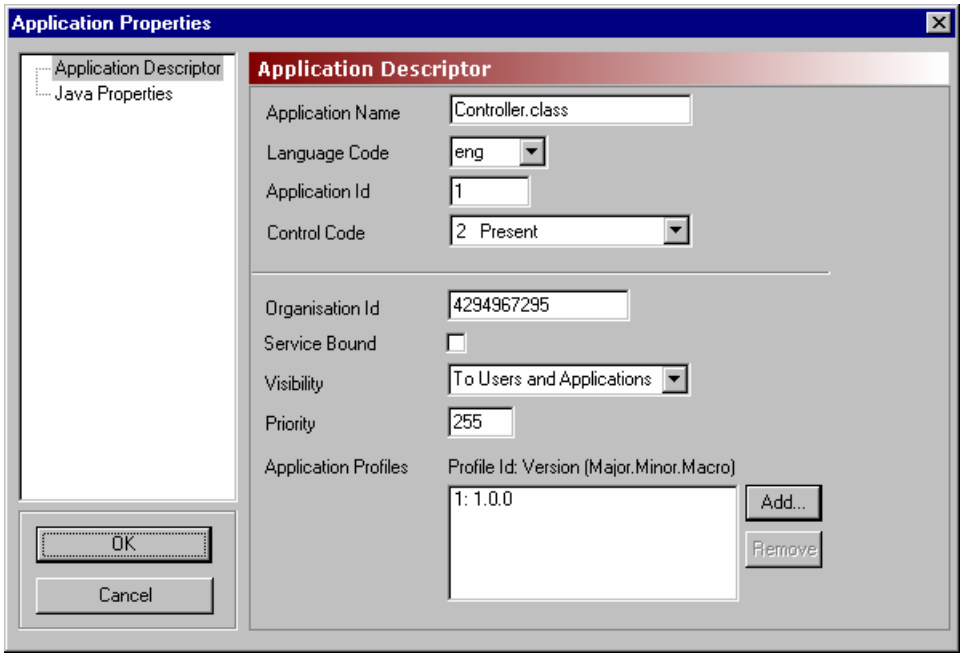
In MHP, applications are transmitted in object carousels. Applications can be written in Java or HTML. All files that comprise the application should be added to the carousel. However, the receiver must be made aware of the entry point into the application and certain other information about the characteristics of the application. This information is sent in the Application Information Table (AIT) which the receiver must process before it can start any application.

To define an application entry point and other application information, highlight a file and select **Carousel ➔ Contents ➔ Make Java Application** or **Make HTML Application**. The **Application Properties** dialog will be displayed. The components of the Application Properties screens are described in the following paragraphs. Note that when the file properties of an application are viewed, the File Properties **General** screen is also displayed.

Application Descriptor screen

The **Application Descriptor** screen is common to both Java and HTML applications

All the properties on this screen are described in the Application Signalling section of the MHP specification, e.g. TS 101 812 v1.1.1, Section 10, Application Signalling.

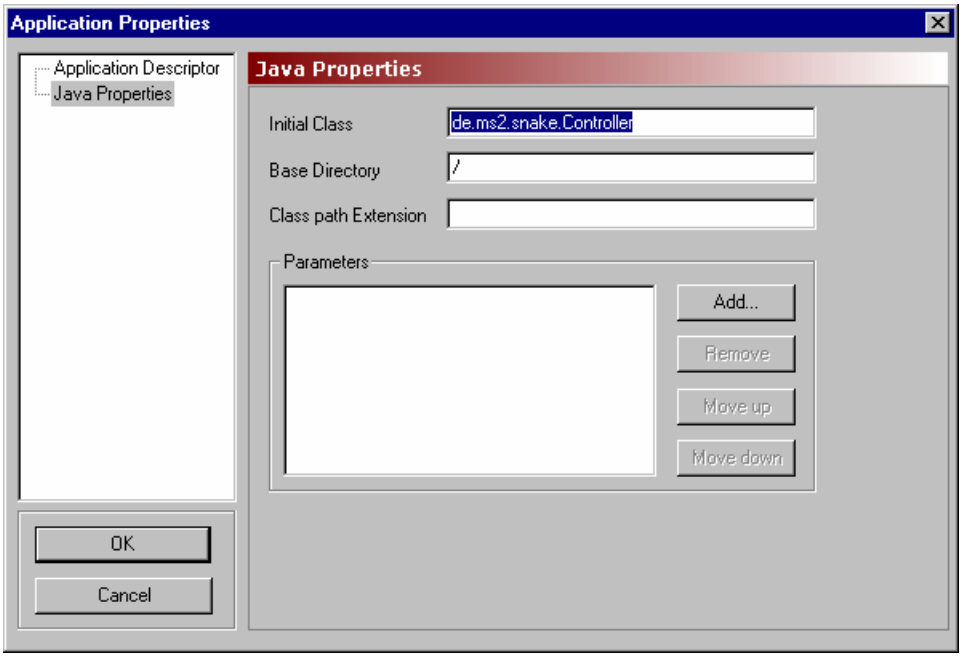


Application Descriptor Name	TS 101 812 identity
Application Name:	Application Name Descriptor
Language Code:	Application Name Descriptor
Application ID:	Application Identifier

Application Descriptor Name	TS 101 812 identity
Control Code:	application_control_code
Origination ID:	Application Identifier
Service Bound:	Application Descriptor
Visibility:	Application Descriptor
Priority:	Application Descriptor
Application Profiles:	Application Descriptor

Java Properties screen

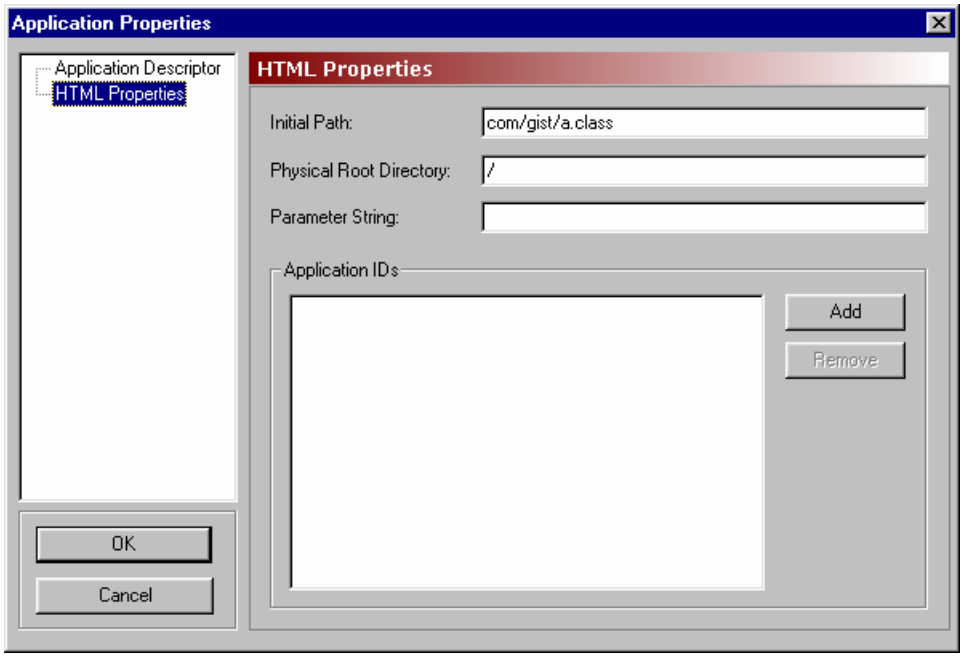
All the properties on this screen are described in the DVB-HTML Specific descriptors of the MHP specification, e.g. TS 101 812 v1.1.1, Section 10, Application Signalling.



Application Descriptor Name	TS 101 812 identity
Initial Class:	DVB-J Application Location Descriptor
Base Directory:	DVB-J Application Location Descriptor
Class Path Extension:	DVB-J Application Location Descriptor
Parameters	DVB-J Application Descriptor

HTML Properties screen

All the properties on this page are described in the DVB-Java Specific descriptors of the MHP specification, e.g. TS 101 812 v1.1.1, Section 10, Application Signalling.

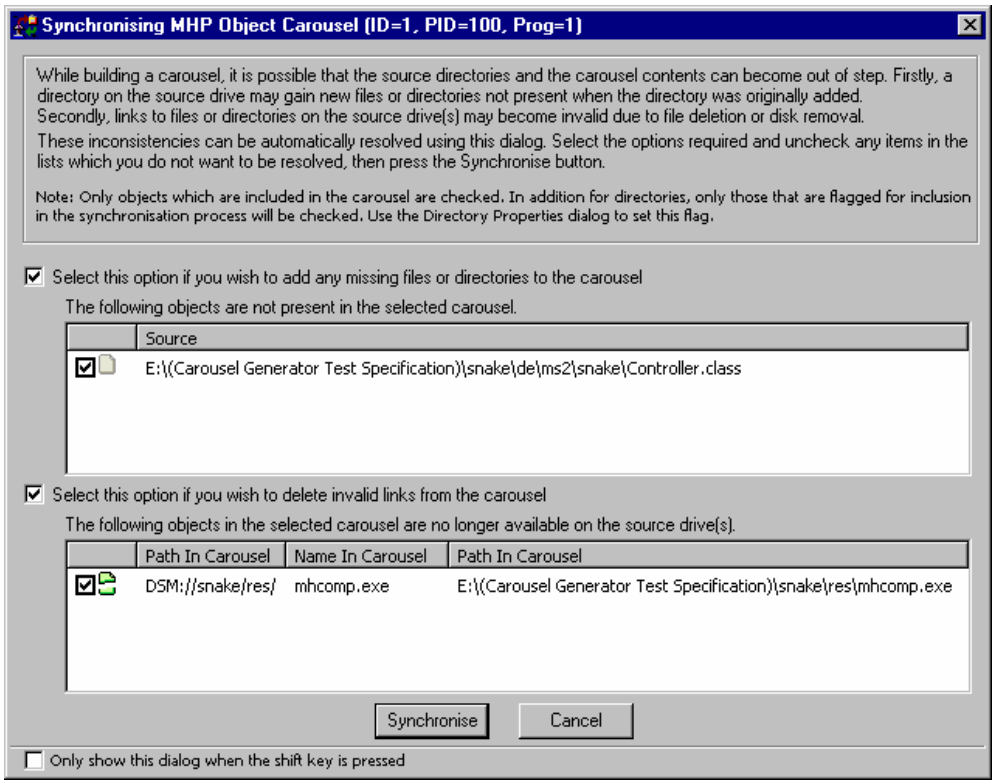


Application Descriptor Name	TS 101 812 identity
Initial Path:	DVB-HTML Application Location Descriptor
Physical Root Drive:	DVB-HTML Application Location Descriptor
Parameter String:	DVB-HTML Application Descriptor

Synchronicity

Directory objects included in carousels are simply references to directories that exist elsewhere, e.g. a PC hard drive.

If the **Include in Synchronisation** checkbox is enabled for a directory, the directory will be included in the Synchronisation process. When **Session ➔ Synchronise…** is selected, the source directory structure is matched with the carousel directory structure. Any objects missing from either the source directory structure or the carousel directory structure are listed in the Synchronising MHP Object Carousel dialog (as shown in the example screenshot below).



Files or directories available at source but not currently included in the carousel can be automatically added to the carousel by enabling the checkbox (**Select this option if you wish to add any missing files or directories to the carousel**). Individual files and directories listed in the panel can be included or excluded from the activity by enabling or disabling the adjacent checkbox.

Files or directories listed in the carousel but not available at source can be automatically removed from the carousel by enabling the checkbox (**Select this option if you wish to delete invalid links from the carousel**). Individual files and directories listed in the panel can be included or excluded from the activity by enabling or disabling the adjacent checkbox.

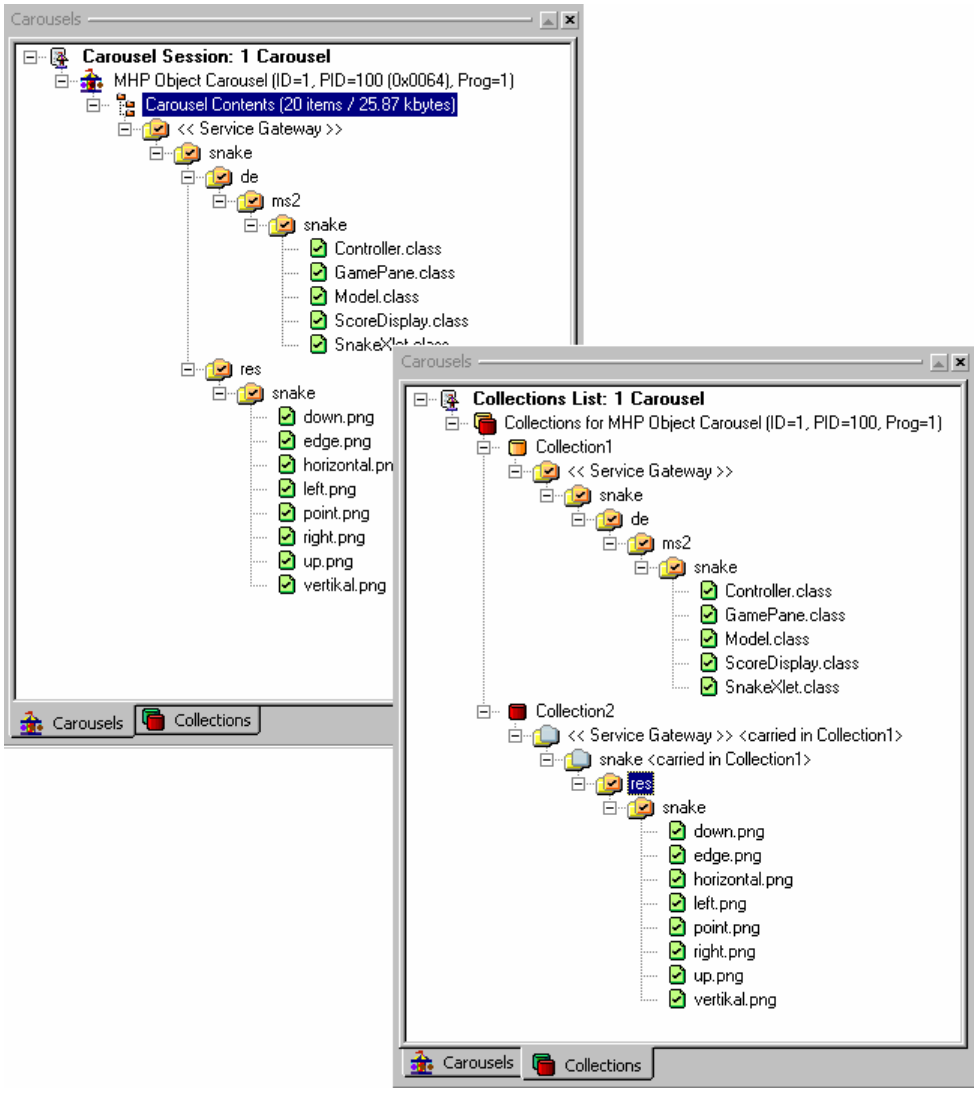
Select **Synchronise** to synchronise the carousel with the source files in accordance with the checkbox selections.

If the **Include in Synchronisation** checkbox is disabled for a directory, this directory will not be compared to the source directory and neither will any subdirectories, regardless of their individual settings.

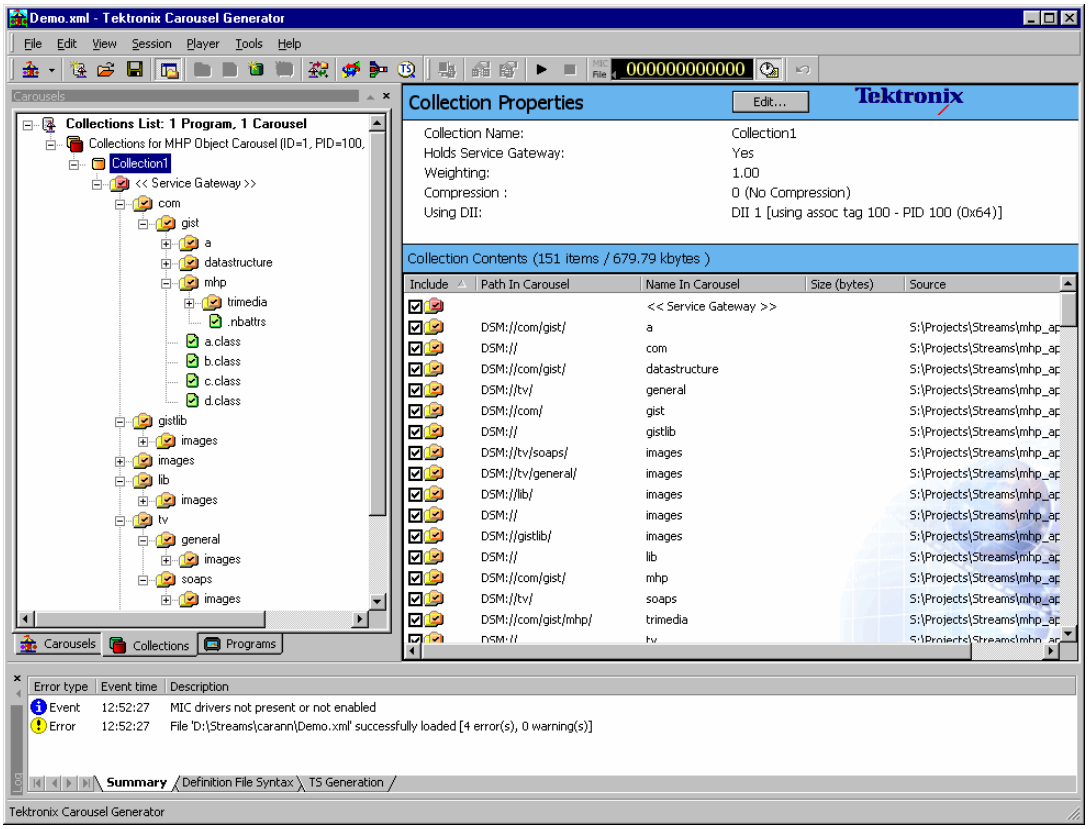
Collections

(See Carousel Generator Overview, page 4)

Collections provide a means by which objects can be grouped and transmitted in a single carousel with differing properties, e.g. repetition rate, compression. Each collection can have different properties; all objects in a collection are transmitted with the same properties.



Collections can be viewed by selecting the **Collections** tab in the Session window.



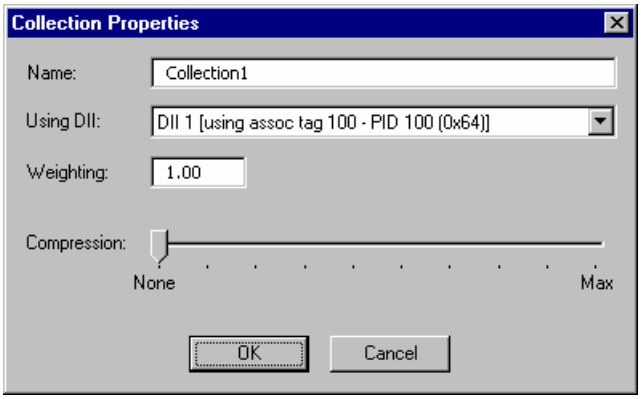
A summary of a Collection's properties is displayed in the Properties window. With a Collection node highlighted, the contents of the collection can be viewed.

Three icons are used at the Collection node:

(orange)	Collection containing the Service Gateway. At least one collection must exist during any session. The collection containing the Service Gateway cannot be deleted.
(red)	Ordinary collection.
	Compressed collection.

To open the Collection properties dialog, select **Edit...** in the Collection Properties bar.

Collection Properties



Name: Enter the required name.

Using DII: This is the list of all the DIIs in the carousel. The Collections in the carousel (and therefore the generated DSMCC modules) can be distributed amongst several DIIs or all be referenced by a single DII. This enables, for example, a minimal Collection containing just the objects needed for booting to be referenced in a DII with a short cycle time.

Weighting: This is the relative priority of the Collections in a single carousel. For example, the objects in a Collection with a weighting of 1.5 will be repeated half as often as those in a Collection with a weighting of 3.

This enables, for example, boot classes in a collection to be given a higher weighting than the other files in a carousel. The weighting is a floating point value so virtually any ratio can be achieved.
Range: 0 to 10000
A value of 0 signifies the objects will not appear in the stream.

Compression: The modules can be optionally compressed to decrease module size. There are 10 levels of compression ranging from 0 (no compression) to 9 (maximum compression). Compression is applied to the complete collection, although compression can be applied via any of the property dialogs. The Collection node icon in the Collections view will indicate that compression is to be applied  .

Adding a New Collection

To add a new collection, right-click on the Collections node in the Collections Session window and select **New Collection**. The properties of the new collection can be modified as required.

Removing a Collection

To delete a collection, highlight the collection node and select **Edit ➔ Delete Collection**. However, note that a collection cannot be deleted while it contains objects or while it contains the Service Gateway. These objects must be deleted or moved to another collection.

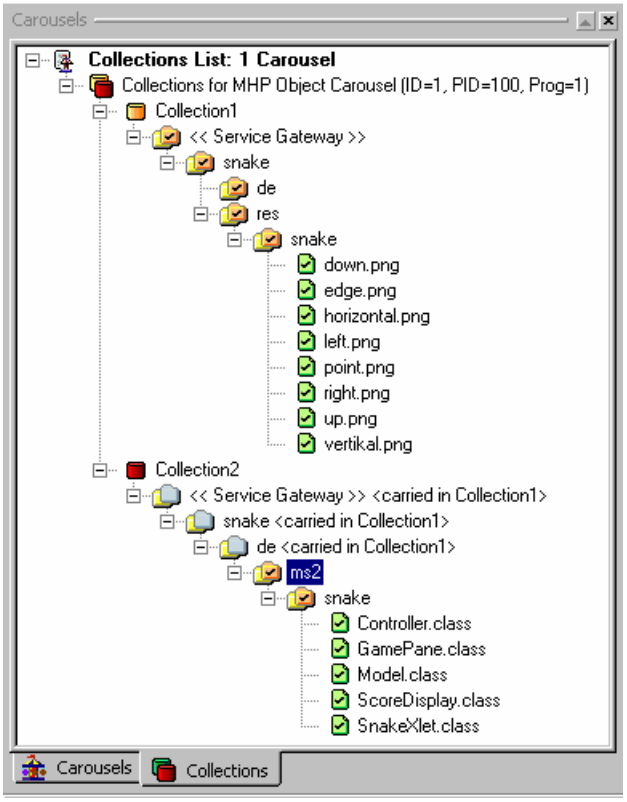
Moving Objects between Collections

Objects can be dragged and dropped between collections in the same carousel or cut and pasted.

When dragging and dropping directories, pressing the Shift key down while the object is moved will move only the directory, not the contained items. If the Shift key is not used, the directory and its contents is moved.

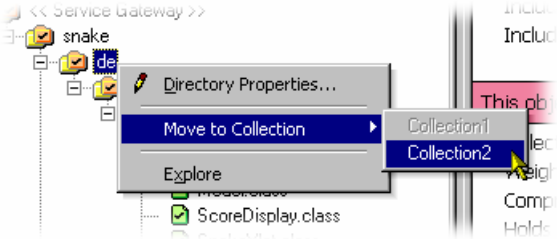
When items (file or directory) which are part of a tree structure are moved between collections, the complete path, from the Service Gateway, is shown. The icons above the moved object are greyed out to indicate that they are carried in another collection (in the screenshot they are the directory icons without a tick or a cross within them).

The node description indicates the owning collection.



Note that when an object is not included in the synchronisation process, the icon changes from  to  (see also Synchronicity, page 59).

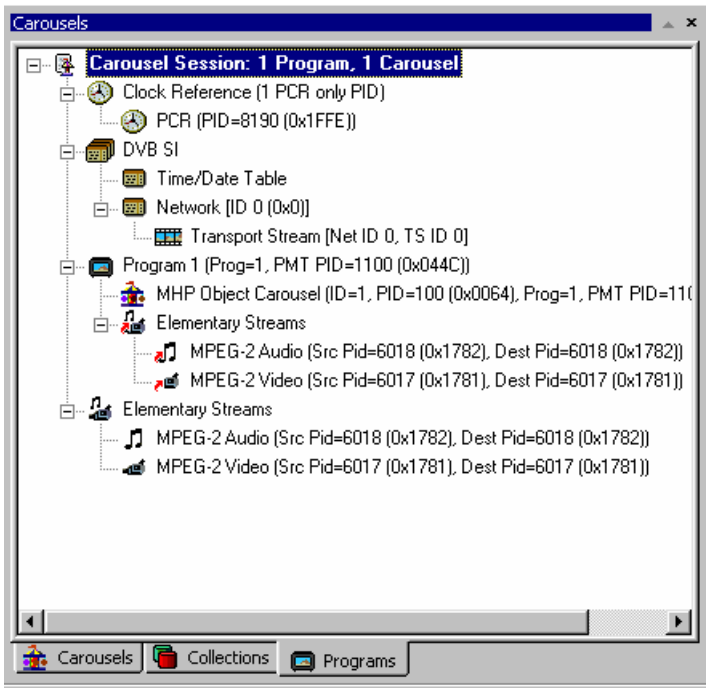
Objects can also be moved between collections in the same carousel by right-clicking on the object to be moved and selecting the collection from the **Move to Collection** list. All current collections will be included in the list.



Programs

(See Carousel Generator Overview, page 4)

Programs allow audio and video content to be added to the carousel-carrying stream. An example of the Program view is shown below:



Note that the Carousel Session is still the 'root' of the view, but in this view the program content is also shown; this includes tables and streams.

PCR PID references are displayed under the Clock Reference node.

Mandatory PSI/SI information is created by default and included in the generated stream. Changes made to the stream content are reflected in the PSI/SI information. Individual settings are accessible via the various Programs properties dialogs.

The **PSI/SI** node displays either MPEG or DVB service information that cannot be easily included elsewhere.

For MPEG PSI, only the Transport Stream ID, which is carried in the PAT, is displayed.

For DVB SI, the Transport Stream ID is augmented by mandatory DVB SI (NIT, SDT (actual), EIT (actual present/following) and TDT.) The TDT (**Time/Date Table**) and the NIT (**Network**) are the only entries under the PSI/SI node. Parameters for the other tables are available via other dialogs.

Under each **Program** node is a list of all the program components - Carousels and video and audio elementary streams

The **Elementary Streams** node lists the elementary streams that are included in the stream. These can be associated with one or more programs. Note that the elementary streams will be included in the generated stream even if they are not associated with a program.

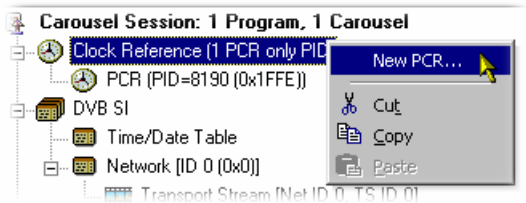
Clock Reference

This node indicates which PIDs are carrying PCRs.

Adding a PCR

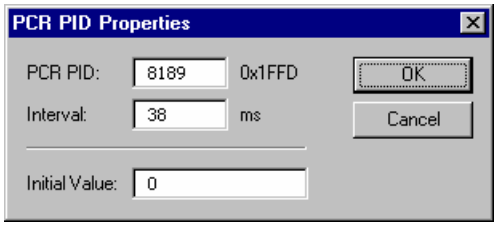
1.) Highlight the Clock Reference node in the Programs view.

2.) From the right-click menu select **New PCR…**.



3.) In the **PCR PID Properties** dialog, make the changes required and select **OK**.

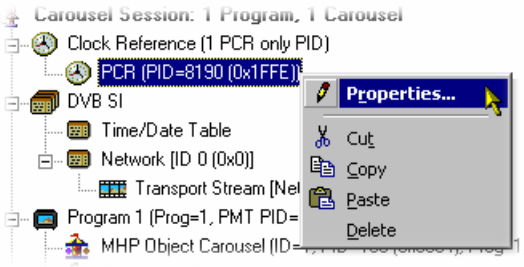
Note that the new PCR is added to the Clock Reference node.

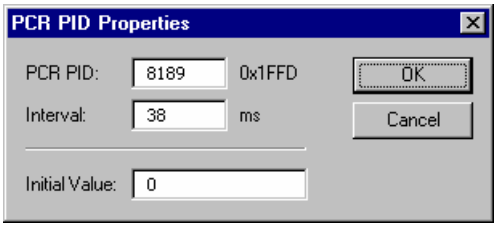


Also available on the Clock Reference right-click menu are Cut, Copy and Paste. These operations follow normal Windows conventions. Messages will be displayed where conflicts arise between existing PCRs and proposed new or pasted PCRs.

PCR Edit

The **PCR PID Properties** dialog of an existing PCR PID can be opened by highlighting the PCR PID and selecting **Properties…** from the right-click menu.





PSI/SI

The content of the SI node will depend on the SI Type selected: MPEG or DVB.

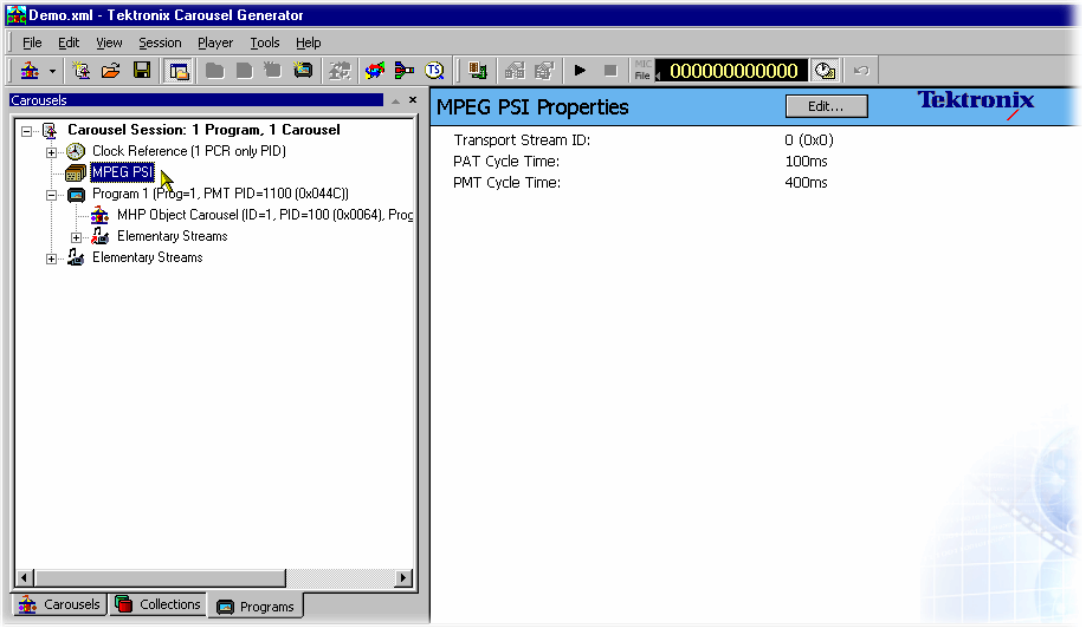
SI Type

SI Type is normally set in the Stream Generation properties (see page 39). However, a change can be made at any time before generation of the stream.

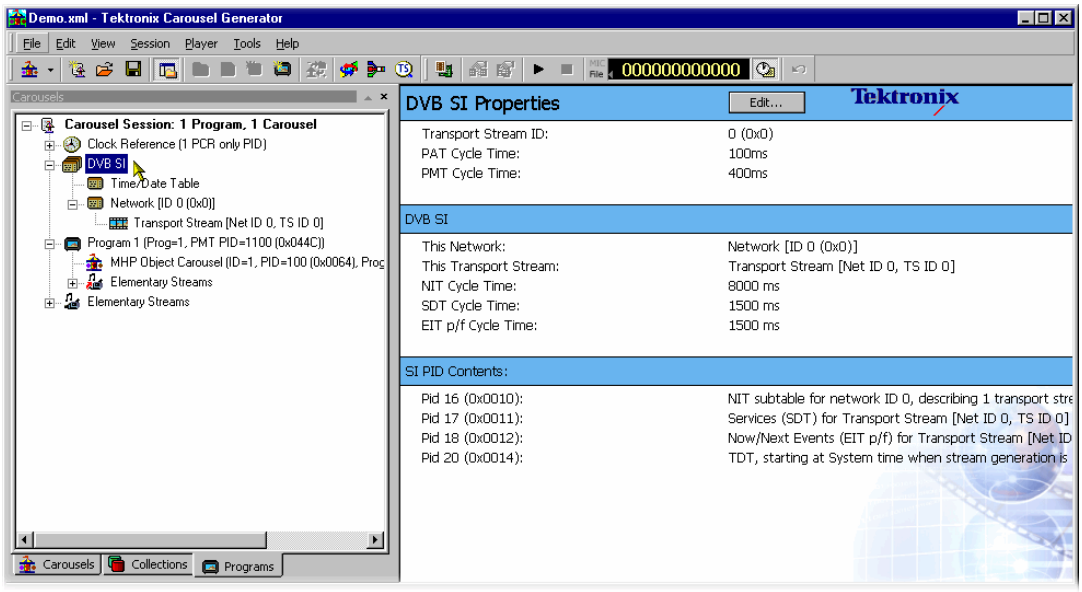
Switching SI types may involve some loss of data or some creation of default values. When switching from MPEG PSI to DVB SI, default values are applied to the TDT and Network information; the Transport Stream ID will be copied. Switching from DVB SI to MPEG PSI requires only the Transport Stream ID to be copied. In this phase, any user changes to the default values in the DVB SI properties will be lost and will need to be re-entered if the SI type is changed back to DVB, or a new session is created.

The EIT and SDT information is maintained between switching SI type as it is stored in the Program Properties. The tables will simply not be generated if the type is MPEG.

To switch between SI types during a session, highlight the **SI** node in the Programs view and select the required **SI Type** from the right-click menu



MPEG PSI

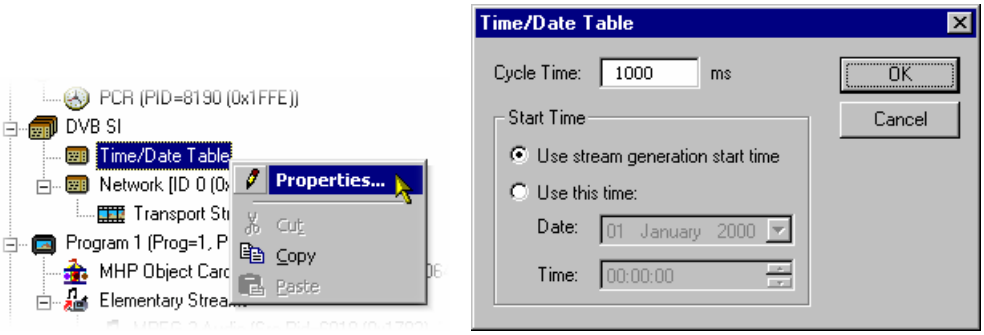


DVB SI

Time/Date Table (DVB Only)

The Time/Date Table carries a UTC time in the stream which is set to a starting value when the stream is generated. It is then continually updated throughout the stream to reflect the passing of time. The default setting of the initial value will be the time the generation is started, but this can be changed to any user defined value.

To edit the Time/Date Table parameters, highlight the **Time/Date Table** node and select **Properties…** form the right-click menu. The Time/Date Table Properties dialog is displayed.



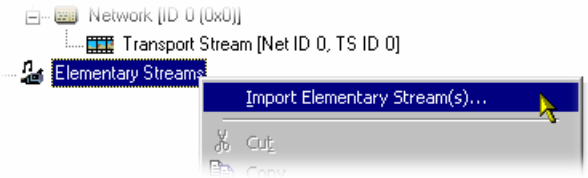
Cycle Time gives the frequency at which the time and date information should be repeated in the generated stream.

Elementary Streams And Programs

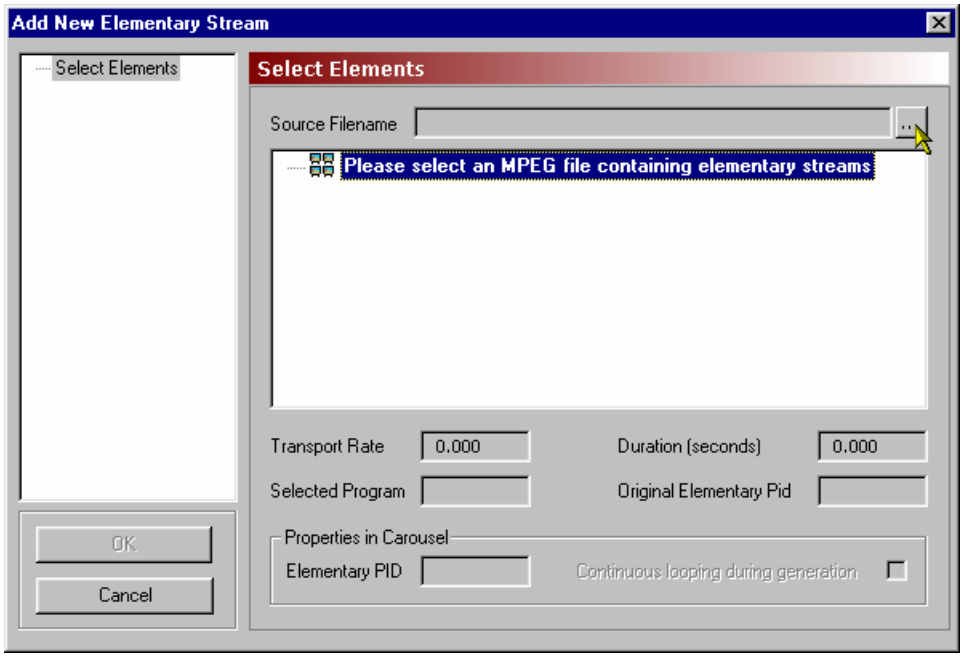
Audio and video elementary can be imported and incorporated into the generated stream. Subsequently, the imported streams can be associated with one or more programs.

Importing Elementary Streams

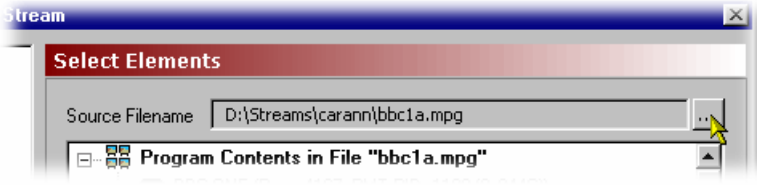
1.) In the Programs view, highlight the **Elementary Streams** node and select **Import Elementary Stream(s)…** from the right-click menu.



The **Add New Elementary Stream** dialog is displayed:



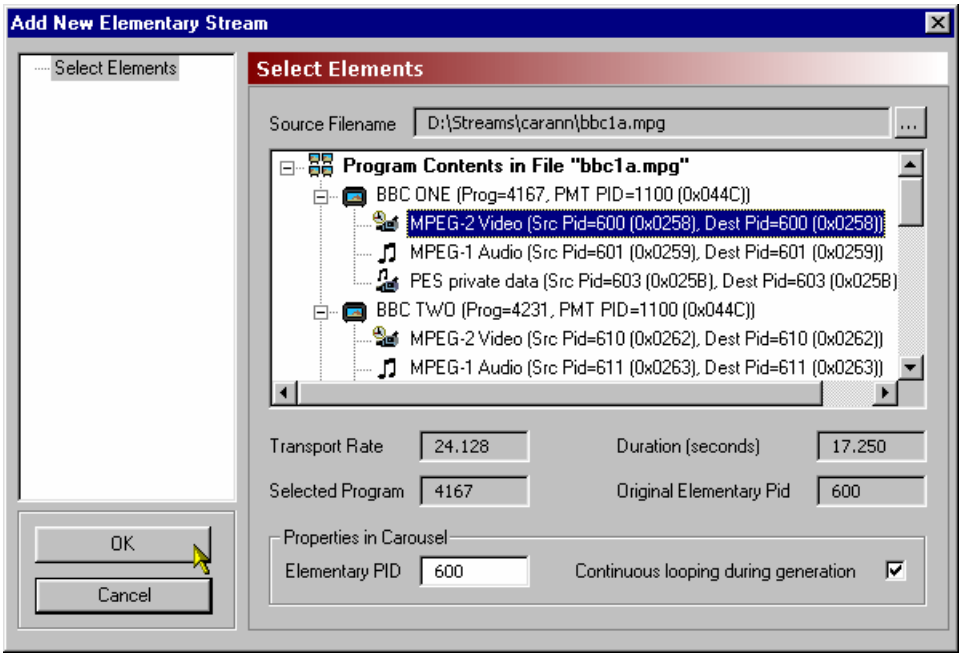
2.) Use the browse button to select the source file (mpg) from which the elementary streams are to be imported:



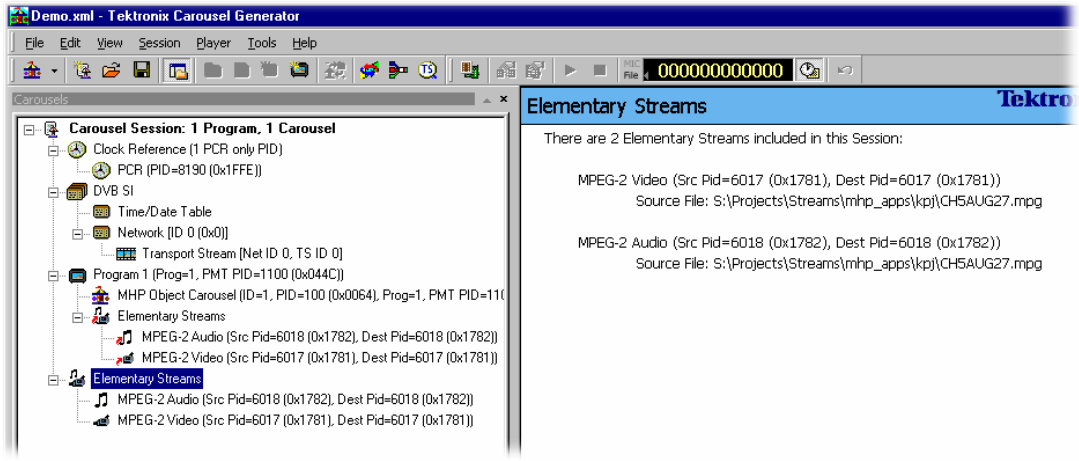
All programs in the source file are displayed, but only one program, or the elementary streams from one program, can be imported into a session.

3.) Highlight the program or elementary stream(s) to be imported.

Select **OK** to import the program/stream(s).



Note that selected elementary streams are displayed under the **Elementary Streams** node in the Programs view.



Elementary Stream Properties

Imported elementary streams are allocated the to the same PID used in the source program. If there is any conflict with existing PIDs in the session, a warning is displayed and an opportunity offered to make changes.

The elementary stream properties dialog allows the PID to be changed. A warning will be displayed if a conflict with an existing PID occurs. Continuous looping of the stream during generation can also be enabled.

To select the Elementary Stream Properties dialog, highlight the elementary stream and select **Elementary Stream Properties** from the right-click menu.

Linking Elementary Streams to Programs

When a carousel is created a Program node is automatically created. If the Carousel Wizard is used, elementary streams can be added during the process. Streams can also be added from a selected program as required.

Streams are added to the Program node(s) by dragging and dropping them from the Elementary Stream node. Note that in this case, they are simply linked to the Elementary Stream entry; if they are deleted from the program, they will continue to be listed under the Elementary Stream node. However, if an elementary stream is deleted from the Elementary Streams node, it will also be deleted from the programs in which it is used.

Note also that the Elementary Streams Properties dialog (when accessed via the Program entry) allows descriptors to be added to the elementary stream information loop in the PMT.

Output Stream Generation

To start generating the output stream, select **Player ➔ Start Playout**. The parameters used are part of the Stream Generation properties (see Stream Generation Properties, page 39).

The output setting (and status) is indicated on the Player toolbar as follows:

File output selected (not playing).

File output selected (playing).

MIC output selected (not playing).

MIC output selected (playing).

Any errors during stream generation are reported in the **TS Generation** tab of the Log view.

Carousel Definition File

The current state of the carousel generator session can be saved to disk at any time during the creation process using the **File ➔ Save Carousel Session** or **File ➔ Save Carousel Session As…** options. This can then be reloaded at any time using the **File ➔ Open Carousel Session…** option. The format of the saved file is standard XML and can be viewed in any XML compatible viewer (for example, Internet Explorer 5 onwards); editing the XML file is not recommended. Errors in the syntax of the XML file will be reported in the Definition File Syntax tab of the Log view; errors are summarised on the Summary tab of the Log view.

References

Glossary and Abbreviations

AIT	Application Information Table
DII	DownloadInfoIndication message
DSI	DownloadServerInitiate message
DSM-CC	Digital Storage Media - Command and Control
DTG	Digital Terrestrial Group
DTT	Digital Terrestrial Television
DTV	Digital Television
DVB	Digital Video Broadcasting
ISO	International Organization for Standardization
MHP	Multimedia Home Platform
MIC	MPEG-2 Interface Card
PAT	Program Association Table
PCR	Program Clock Reference
PID	Packet Identity
PMT	Program Map Table
PSI	Program Specific Information (MPEG)
PSIP	Program and System Information Protocol (ATSC)
SI	Service Information (DVB)
TDT	Time and Date Table (DVB)
UTC	Universal Co-ordinated Time

Bibliography

1 MHP ETSI 101812, Version 1.1.2 and 1.1.1

2 BS ISO/IEC 13818-6:1998 Information Technology - Generic coding of moving pictures and associated audio information - Part 6: Extensions for DSM-CC.

3 DTT DTG 3.1 (Blue Book): DTG DTT Requirements for Interoperablitiy

4 DVB EN 301 192, Version 1.2.1; DVB specification for digital broadcasting

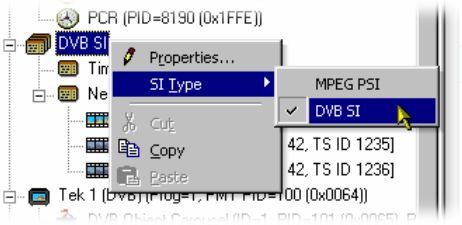
Appendix A: PSI and SI in the Carousel Generator Output Stream

PSI/SI Mode Settings 73
MPEG PSI tables 74
Program Association Table (PAT)..... 74
Program Map Table (PMT)..... 75
Carousel Descriptors in the PMT..... 76
DSM-CC Object Carousels.....76
DVB Object Carousels.....77
DTT Object Carousels 79
MHP Object Carousels.....79
DVB SI Tables 81
Network Information Table (NIT) 81
Delivery System Descriptors 82
Service Description Table (SDT)..... 83
Service_descriptor..... 84
Data_broadcast_descriptor..... 85
DSM-CC Object Carousel 85
MHP Object Carousels 85
DVB Object Carousels 86
DTT Object Carousels 87
Event Information Table (EIT) 88
Short_event_descriptor 89
Time and Date Table (TDT) 89
Application Information Table (AIT) 90
Application Descriptors in the AIT..... 92
Common Application Descriptors 92
Java Application Descriptors..... 94
HTML Application Descriptors..... 95

The Carousel Generator creates various PSI and SI tables while generating its output stream. The exact contents of the PSI and SI depends on many user settings; this note describes most of the auto-generated content and which options or properties affect that content. Note that all PSI/SI related properties can be accessed through nodes in the program tab.

PSI/SI Mode Settings

There is one field that has a huge effect on the PSI and SI tables that Carousel Generator produces – the Session's 'PSI/SI type' field. This can be accessed from the Stream Generation Properties dialog (**Player ➔ Stream Generation Properties**), or by right-clicking on the SI node in the program tab, selecting the **SI Type** sub-menu, and selecting one of the two options.



MPEG PSI PAT, PMT, and AIT (for MHP carousels) will be generated.

DVB SI In addition to the standard MPEG tables, Carousel Generator will output NIT actual, SDT actual, EIT present/following actual and TDT sections.

MPEG PSI tables

Program Association Table (PAT)[1]

Table Syntax	CG Value	Comment
program_association_section() {		
table_id	*0x00*	
section_syntax_indicator	*1*	
'0'	*0*	
reserved	*0x3*	
section_length	*auto*	
transport_stream_id	*user*	SI node→Properties…→ (MPEG SI page) 'Transport Stream ID' field
reserved	*0x3*	
version_number	*0*	CG does not support table versioning
current_next_indicator	*1*	
section_number	*auto*	depends on the number of programs
last_section_number	*auto*	depends on the number of programs
for (i=0; i<n; i++) {		
program_number	*user*	Program node→Properties…→ (PMT entry page) 'Program Number' field
reserved	*0x7*	
if (program_number == 0) {		CG does not specify the network PID,
network_PID	*n/a*	13818-1 describes it as 'optional'
}		
else {		
program_map_PID	*user*	Program node→Properties…→ (PMT entry page) 'PMT PID' field
}		
}		
CRC_32	*auto*	
}		

[1] ISO/IEC 13818-1 (Systems) section 2.4.4.3

Program Map Table (PMT)[2]

Table Syntax	CG Value	Comment
TS_program_map_section() {		
table_id	*0x02*	
section_syntax_indicator	*1*	
'0'	*0*	
reserved	*0x3*	
section_length	*auto*	
program_number	*user*	Program node→Properties…→ (PMT entry page) 'Program Number' field
reserved	*0x3*	
version_number	*0*	CG does not support table versioning
current_next_indicator	*1*	
section_number	*0*	
last_section_number	*0*	
reserved	*0x7*	
PCR_PID	*user*	Program node→Properties…→ (PMT entry page) 'PCR PID' dropdown
reserved	*0xF*	
program_info_length	*auto*	
for (i=0; i<program_info_length; i++) {		
descriptor()	*auto + user*	Auto generation depends on carousel type. See 'carousel descriptors' note below. User can add additional descriptors via Program node→Properties…→ (Program Descriptors page)
}		
for (i=0; i<N1; i++) {		Carousel Generator will add elementary streams as required. Streams include carousel data, AITs, and imported PIDs.
stream_type	*auto*	Stream type 11 for carousel data, stream type 5 for AIT data, and the source stream type of any imported PIDs
reserved	*0x7*	
elementary_PID	*user*	User editable – edit method depends on the type of stream
reserved	*0xF*	
ES_info_length	*auto*	
for (i=0;i<N2;i++) {		
descriptor()	*auto + user*	Auto generation depends on stream type and carousel type. See 'carousel descriptors' note below.

[2] ISO/IEC 13818-1 section 2.4.4.8

}		
}		
CRC_32	*auto*	
}		

Carousel Descriptors in the PMT

The various standards supported by the Carousel Generator have differing signalling requirements, so the type and content of descriptors added to the PMT depend on the carousel types contained in a program.

DSM-CC Object Carousels (ISO/IEC 13818-6 defined)

The basic 13818-6 standard only supports a single carousel per program, and requires that a carousel_identifier_descriptor be inserted in the program_info loop (first descriptor loop) of the PMT section for a program carrying a DSM-CC carousel.

Descriptor Syntax[3]	**CG Value**	**Comment**
carousel_identifier_descriptor {		
descriptor_tag	*0x13*	
descriptor_length	*auto*	
carousel_identifier	*user*	Carousel node→Properties…→ (General) Carousel ID
for (n=0; n<N; n++) {		
private_data_byte	*n/a*	These bytes are not used when signalling
}		a basic DSM-CC Object Carousel
}		

[3] ISO/IEC 13818-6 (Extensions for DSM-CC) section 11.4.1

DSM-CC Object Carousels are carried on one or more PIDs referenced by the PMT with stream type 11. The ES_info loop for each of these streams contains an association_tag_descriptor which maps the association_tag used by DSM-CC messages to a particular PID.

Descriptor Syntax[4]	CG Value	Comment
association_tag_descriptor {		
descriptor_tag	*0x14*	
descriptor_length	*auto*	
association_tag	*user*	Carousel node→Properties…→(PID Settings) Association tag
use	*auto*	0 if the PID is used for a DSI, 1 otherwise
selector_byte_length	*auto*	
for (n=0; n<N1; n++) {		
selector_byte	*auto*	not used if 'use' is 1, otherwise follows the use_0_selector_bytes format below
}		
for (n=0; n<N2; n++) {		
private_data_byte	*n/a*	not used
}		
}		
use_0_selector_bytes {		
transaction_id	*auto*	Matches the transaction id of the DSI
timeout	*0xFFFFFFFF*	timeout unknown
}		

DVB Object Carousels (ETSI EN 301 192 defined)

Although not mentioned in the DVB data standard[5], the DVB implementation guidelines for data broadcasting allow support for multiple Object Carousels per program, by allowing the carousel_identifier_descriptor to be transmitted in the second descriptor loop of the PMT.

"DVB Guideline: The carousel_identifier_descriptor() shall be inserted in the second descriptor loop of the PMT (ES_info) corresponding to the elementary stream carrying the DSI of the object carousel. This allows more than one object carousel per MPEG-program and implicitly identifies the PID on which each carousel should be booted from."[6]

Carousel Generator therefore transmits a carousel_identifier_descriptor for every DVB Object Carousel in a program, as specified by this implementation guideline.

DVB also extends the carousel_identifier_descriptor slightly, by defining the contents of the private_data_byte section further with what it calls a FormatSpecifier. However, CarouselGenerator only uses the required parts of this extension – it sets the FormatId to zero which indicates that no format specifier is provided.

[4] ISO/IEC 13818-6 section 11.4.2

[5] ETSI EN 301 192 (Specification for the transmission of data services in DVB bitstreams)

[6] TR 101 202 (Implementation Guidelines for Data Broadcasting) section 4.7.7.1

Private_data_byte syntax6	CG Value	Comment
carousel_identifier::private_data_bytes {		
FormatId	0	0 indicates no FormatSpecifier present
FormatSpecifier() {		
FormatSpecifier_byte	n/a	Not used by Carousel Generator
}		
for (n=0; n<N1; n++) {		
private_data_byte	n/a	Not used by Carousel Generator
}		
}		

An association_tag_descriptor is added to the ES_info loop in exactly the same way as for DSM-CC object carousels.

Two more descriptors are also added to the ES_info loop for streams carrying DVB object carousels – the data_broadcast_id_descriptor and the stream_identifier_descriptor. Both are defined in EN300 468 (Specification for Service Information in DVB systems).

Descriptor Syntax	CG Value	Comment
stream_identifier_descriptor {		
descriptor_tag	*0x52*	
descriptor_length	*1*	
component_tag	*user*	LSB of the association_tag for this stream
}		
data_broadcast_id_descriptor {		
descriptor_tag	*0x66*	
descriptor_length	*2*	
data_broadcast_id	*7*	DVB Object Carousel code
for (i=0; i<N; i++) {		
id_selector_byte	*n/a*	DVB Object Carousels don't use these
}		selector bytes
}		

DTT Object Carousels (DTG D-Book (DTT Requirements for Interoperability))

Most of the PMT signalling for DTT Object Carousels is the same as for DVB Object Carousels. However, the D-Book does specify the contents of the id_selector_byte section of the data_broadcast_id_descriptor, and also requires that the data_broadcast_id value in that descriptor is 262 (0x106).

DTT id_selector_bytes Syntax[7]	CG Value	Comment
for (i=0; i<descriptor_length-2; i++) {		
application_type_code	*user*	DTT Object Carousel node→Properties… →(DTT Applications page) Application codes list contains the app codes used.
boot_priority_hint	*user*	Boot priorities accessed as above.
app_specific_data_length (N2)	*0*	
for (j=0; j<N2; j++) {		
app_specific_data_byte	*n/a*	Not used.
}		
}		

MHP Object Carousels (ETSI TS 101 812)

MHP uses an additional table, the AIT, for most of its signalling requirements. The location of the AIT table for a program is identified through an elementary stream PID entry in the PMT with stream type 5. The ES_info loop for the AIT PID also carries an application_signalling descriptor (AIT information is given in the DVB SI Tables section of this appendix):

Descriptor Syntax[8]	CG Value	Comment
application_signalling_descriptor {		
descriptor_tag	*0x6F*	
descriptor_length	*auto*	
for (i=0; i<descriptor_length; i++) {		
application_type	*auto*	An entry for application_type 1 will be present if any Java apps are defined in the carousel, and an entry for type 2 will be present if any HTML apps are defined in the carousel.
reserved_future_use	*0x7*	
AIT_version_number	*0*	CG does not support table versioning – all tables have version number 0.
}		
}		

[7] UK DTG D-Book (Digital Terrestrial Television Requirements for Interoperability) section 18.5.2.1

[8] ETSI TS 101 812 (Multimedia Home Platform (MHP) specification) section 10.7.1

The PMT signalling for MHP carousel carrying streams is very similar to that for DVB Object Carousels. The only difference is that, like DTT, MHP defines additional content for the data_broadcast_id_descriptor's data_broadcast_id value and id_selector bytes. The MHP data_broadcast_id value is 240 (0xF0), and the id_selector bytes are as defined below:

MHP id_selector_bytes Syntax[9]	CG Value	Comment
for (i=0; i<descriptor_length-2; i++) {		
application_type	*auto*	An entry for application_type 1 will be present if any Java apps are defined in the carousel, and an entry for type 2 will be present if any HTML apps are defined in the carousel.

[9] ETSI TS 101 812 section 10.7.2.2

DVB SI Tables

The following SI is only generated when the session's SI type is set to DVB SI. All user-editable properties of these tables can be accessed through nodes in the Programs tab.

Network Information Table (NIT)

The Carousel Generator only generates NIT actual sections, and the contents of the NIT can be accessed by editing the properties of the Network node and its children.

Table Syntax[10]	CG Value	Comment
network_information_section() {		
table_id	*0x40*	NIT actual – CG does not generate NIT other sections.
section_syntax_indicator	*1*	
reserved_future_use	*1*	
reserved	*0x3*	
section_length	*auto*	
network_id	*user*	Network node→Properties…→ 'Network ID' field
reserved	*0x3*	
version_number	*0*	CG does not support table versioning
current_next_indicator	*1*	
section_number	*auto*	
last_section_number	*auto*	
reserved_future_use	*0xF*	
network_descriptors_length	*auto*	
for (i=0;i<N;i++) {		A network_name_descriptor will always be added, with the name
descriptor()	*auto + user*	specified in the Network Properties→ 'Name' field.
}		The user can add custom descriptors to this loop by editing the descriptor list in the Network Properties dialog.
reserved_future_use	*0xF*	
transport_stream_loop_length	*auto*	
for (i=0; i<N; i++) {		CG will always add at least one transport stream to this loop (the 'actual' transport stream' but the user can add additional transport streams (by right-clicking on the network node).
transport_stream_id	*user*	Transport Stream node→Properties… →(Transport Stream page) Transport Stream ID field
original_network_id	*user*	As above → Original Network ID field
reserved_future_use	*0xF*	
transport_descriptors_length	*auto*	

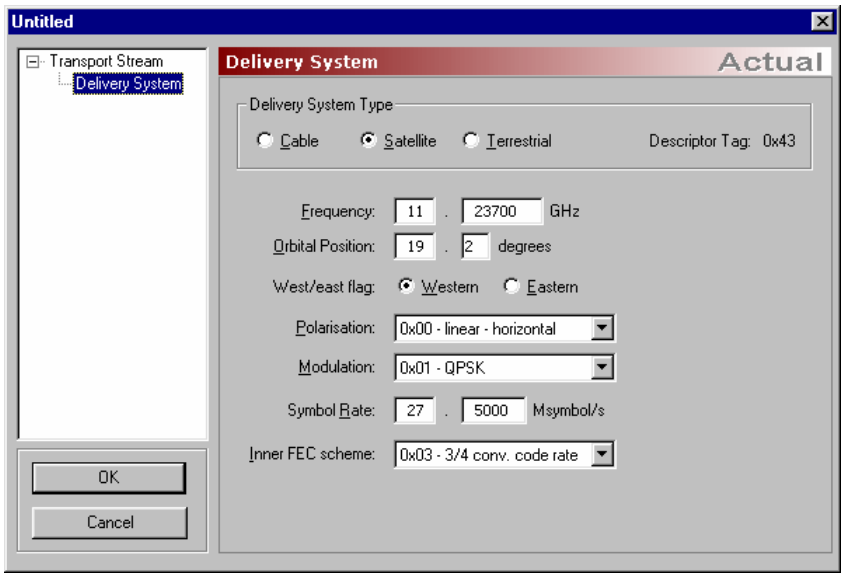
[10] ETSI EN 300 468 (Specification for Service Information in DVB systems) section 5.2.1

for (j=0; j<N; j++) {		One of the three delivery system descriptors will always be present (see 'Delivery System Descriptors' below)
descriptor()	*auto + user*	The user can also add custom descriptors via Transport Stream node →Properties…→(Transport Stream page) Descriptors list
}		
}		
CRC_32	*auto*	
}		

Delivery System Descriptors

Every transport stream listed in the NIT will contain at least one descriptor – one of either the cable delivery system descriptor[11], the satellite delivery system descriptor[12] or the terrestrial delivery system descriptor[13]. The type of descriptor used, and the contents of all its fields, are edited through the Transport Stream node ➔ **Properties… ➔ Delivery System** page.

All of the delivery system descriptor fields defined in EN 300 468 can be modified.



[11] ETSI EN 300 468 section 6.2.12.1

[12] ETSI EN 300 468 section 6.2.12.2

[13] ETSI EN 300 468 section 6.2.12.3

Service Description Table (SDT)

Table Syntax[14]	CG Value	Comment
service_description_section() {		
table_id	*0x42*	SDT actual – CG does not generate SDT other sections.
section_syntax_indicator	*1*	
reserved_future_use	*1*	
reserved	*0x3*	
section_length	*auto*	
transport_stream_id	*user*	Matches the transport_stream_id of the actual transport stream
reserved	*0x3*	
version_number	*0*	CG does not support table versioning
current_next_indicator	*1*	
section_number	*auto*	
last_section_number	*auto*	
original_network_id	*user*	Matches the original_network_id of the actual transport stream
reserved_future_use	*0xFF*	
for (i=0; i<N; i++) {		CG auto-generates an entry for every program in the session.
service_id	*auto*	Matches the program number
reserved_future_use	*0x3F*	
EIT_schedule_flag	*0*	EIT schedule tables not supported.
EIT_present_following_flag	*user*	Transmission of an EIT_pf is user-controllable per service. See the EIT section below.
running_status	*0x4*	Always set to 4 – Running
free_ca_mode	*0*	Always set to 0 – No scrambling
descriptors_loop_length	*auto*	
for (j=0; j<N; j++) {		
descriptor()	*auto*	A service_descriptor is always added, and depending on the carousel content of the program, data_broadcast_ descriptor(s) may be added.
}		
}		
CRC_32	*auto*	
}		

[14] ETSI EN 300 468 section 5.2.3

Service_descriptor

Descriptor Syntax[15]	CG Value	Comment
service_descriptor() {		All of the properties in this
descriptor_tag	*0x48*	descriptor are accessed via the Program node that is associated with the service. Program node→Properties…→Additional SI page
descriptor_length	*auto*	
service_type	*user*	→Service Type dropdown
service_provider_name_length	*auto*	
for (i=0; i<N; i++) {		
char	*user*	→Service Provider field
}		
service_name_length	*auto*	
for (i=0; i<N; i++) {		
char	*user*	→Service Name field
}		
}		

[15] ETSI EN 300 468 section 6.2.30

Data_broadcast_descriptor[16]

The data_broadcast_descriptor is a DVB defined descriptor that can be used in either the SDT or EIT to indicate that a carousel is associated with a service or event. Carousel Generator only supports associating a carousel with a service, so will only add the data_broadcast_descriptor to the SDT.

Descriptor Syntax[16]	CG Value	Comment
data_broadcast_descriptor() {		
descriptor_tag	*0x64*	
descriptor_length	*auto*	
data_broadcast_id	*auto*	depends on the type of carousel
component_tag	*user*	LSB of the assoc_tag of the PID carrying the carousel's DSI
selector_length	*auto*	
for (i=0; i<selector_length; i++) {		
selector_byte	*auto*	depends on the type of carousel
}		
ISO_639-2[3]_language_code	*"und"*	CG does not use the text field, so the language code is set to "und"efined
text_length	*0*	
for (i=0; i<text_length; i++) {		
text_char	*n/a*	Not used
}		
}		

The use of the data_broadcast_descriptor, and the contents of the data_broadcast_id and selector_bytes fields depend on the type of carousel(s) in the program.

DSM-CC Object Carousel

The DSM-CC standard does not define the data_broadcast_descriptor, and so a data_broadcast_descriptor is not added to the service entry for a program containing a DSM-CC object carousel.

MHP Object Carousels

MHP uses the AIT for all its signalling requirements, and so does not require the use of the data_broadcast_descriptor.

[16] ETSI EN 300 468 section 6.2.10

DVB Object Carousels

A data_broadcast_descriptor is added for every DVB Object Carousel contained in a program. The data_broadcast_id is set to 7, and the selector_byte format is as follows:

DVB selector_bytes Syntax[16]	CG Value	Comment
Carousel_type_id	*0x2*	
Reserved	*0x3F*	
Transaction_id	*auto*	Matches the carousel DSI transaction ID
time_out_value_DSI	*0xFFFFFFFF*	not used
time_out_value_DII	*0xFFFFFFFF*	not used
Reserved	*0x3*	
leak_rate	*0*	
for (i=0; i<N; i++) {		
ISO_639_language_code	*n/a*	The object names loop is not used
object_name_length	*n/a*	by the Carousel Generator.
for (j=0; j<object_name_length; j++) {		
object_name_char	*n/a*	
}		
}		

DTT Object Carousels

The DTG D-Book requires that there only be a single data_broadcast_descriptor per service, to identify the application type carried in that service. The Carousel Generator uses the first Carousel it encounters in a program that has at least one application id set as the carousel referenced by the data_broadcast_descriptor. Generally, only one of the DTT Object Carousels in a program should have any application IDs set.

Because only a single data_broadcast_descriptor is allowed per service, the component_tag value of the descriptor is set to zero – the descriptor does not identify any particular stream as carrying a carousel.

The data_broadcast_id for the descriptor is set to 262 (0x106), and the selector_bytes format is as follows:

DTT selector_bytes Syntax[17]	CG Value	Comment
for (i=o; i<selector_byte_length;i++) {		
application_type_code	*user*	The first application id defined in a DTT carousel contained in the service.
number_languages	*0*	
for (j=0; j<number_languages;j++) {		
ISO_639_language_code	*n/a*	Not used
}		
application_specific_data_length	*0*	
for (j=0; j<a_s_d_length; j++) {		
application_specific_data_byte	*n/a*	Not used
}		
}		

[17] UK DTG D-Book section

Event Information Table (EIT)

The Carousel Generator only supports the creation of EIT present following information, for the actual transport stream. The presence of EIT p/f sections for a particular service is user controllable, but where transmitted, information will only be included for the present (now) event. The following (next) event section will always be empty. If an EIT p/f is present for a particular service, the relevant EIT_present_following_flag in the SDT will be set.

Table Syntax[18]	CG Value	Comment
service_description_section() {		
table_id	*0x4E*	EIT actual present/following – CG does not generate any other form of EIT.
section_syntax_indicator	*1*	
reserved_future_use	*1*	
reserved	*0x3*	
section_length	*auto*	
service_id	*auto*	
reserved	*0x3*	
version_number	*0*	CG does not support table versioning
current_next_indicator	*1*	
section_number	*auto*	section 0 is present event, 1 is following event
last_section_number	*1*	
transport_stream_id	*user*	Matches the transport_stream_id of the actual transport stream
original_network_id	*user*	Matches the original_network_id of the actual transport stream
segment_last_section_number	*1*	p/f table is not segmented
last_table_id	*0x4E*	Only table id 0x4E is used
for (i=0; i<N; i++) {		The present event section (section 0) will always contain a single event, while the following event section (section 1) will not contain any events. The following fields are therefore only used in section 0 of the EIT.
event_id	*0*	Event ID is always set to zero
start_time	*user*	The start time will match the start time of the TDT (see TDT section below)
duration	*99:59:59*	
running_status	*0x4*	Always set to 4 – Running
free_CA_mode	*0*	Always set to 0 – No scrambling
descriptors_loop_length	*auto*	CG always adds a single descriptor
for (i=0; i<N; i++) {		to the event descriptors loop, the
descriptor()	*auto*	short_event_descriptor.
}		
}		
CRC_32	*auto*	

[18] ETSI EN 300 468 section 5.2.4

}		

Short_event_descriptor

The fields of the short_event_descriptor for the present event are all accessed through Program Node ➔ **Properties… ➔ Additional SI** page. This page also contains the check box (**Include EIT present/following section for this service**) that controls whether an EIT will be transmitted for a particular service.

Descriptor Syntax[19]	**CG Value**	**Comment**
short_event_descriptor() {		
descriptor_tag	*0x4D*	
descriptor_length	*auto*	
ISO_639-2[3]_language_code	*user*	→Language Code dropdown
event_name_length	*auto*	
for (i=0; i<event_name_length;i++) {		
event_name_char	*user*	Set to match the service name field
}		
text_length	*auto*	
for (i=0; i<text_length; i++) {		
text_char	*user*	→Description field
}		
}		

Time and Date Table (TDT)

The TDT is accessed through the Time/Date Table node under the DVB SI node in the program tab. It carries current time information, and the user can specify whether that information will be filled with the current system time, or start at a time specified by the user and increment in real time.

Table Syntax[20]	**CG Value**	**Comment**
time_date_section() {		
table_id	*0x70*	
section_syntax_indicator	*0*	
reserved_future_use	*1*	
reserved	*0x3*	
section_length	*5*	
UTC_time	*auto*/*user*	This value starts at the time specified by the user (Time/Date Table node → Properties…→Start Time) and increments appropriately during stream output.
}		

[19] ETSI EN 300 468 section 6.2.33

[20] ETSI EN 300 468 section 5.2.4

Application Information Table (AIT)[21]

The AIT is the main signalling component of the MHP standard, and the Carousel Generator will generate an AIT for every program that carries one or more MHP carousels containing applications. Note that if the MHP carousel(s) in a program do not have any applications defined an AIT will not be generated for that program.

The AIT is split into sub-tables based on the application_type value. The current MHP spec defines two application types, Java and HTML, and Carousel Generator supports both. If only Java applications are present in the carousels in a program, only the Java sub-table will be generated, and the same is true for HTML applications. If both application types are present in the carousel(s) in a program, both sub-tables of the AIT will exist for that program.

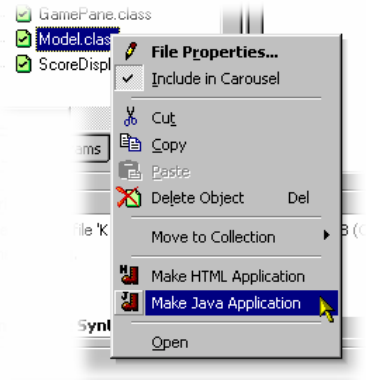


Table Syntax	CG Value	Comment
application_information_section() {		
table_id	*0x74*	
section_syntax_indicator	*1*	
reserved_future_use	*1*	
reserved	*0x3*	
section_length	*auto*	
application_type	*auto*	
reserved	*0x3*	
version_number	*0*	CG does not support table versioning
current_next_indicator	*1*	
section_number	*auto*	
last_section_number	*auto*	
reserved_future_use	*0xF*	
common_descriptors_length	*0*	
for (i=0; i<c_d_length; i++) {		
descriptor()	*n/a*	
}		
DVB_reserved_future_use	*0xF*	
application_loop_length	*auto*	

[21] ETSI TS 101 812 section 10.4

for (i=0; i<app_loop_length; i++) {		Carousel Generator will add applications as defined in the carousel. To create an application, right-click on the file and select Make HTML Application or Make Java Application.
application_identifier() {		
organisation_id	*user*	File node→Properties…→ (Application Descriptor page) Organisation ID field
application_id	*user*	File node→Properties…→ (Application Descriptor page) Application ID field
}		
application_control_code	*user*	File node→Properties…→ (Application Descriptor page) Control Code dropdown
app_descriptors_loop_length	*auto*	
for (j=0; j<a_d_l_length; j++) {		
descriptor()	*auto*/*user*	Carousel Generator creates the appropriate descriptors for each application type automatically. However, fields in the properties pages allow the contents of these descriptors to be edited. See 'application descriptors' note below.
}		
}		
CRC_32	*auto*	
}		

Application Descriptors in the AIT

Every application listed in the AIT will have five descriptors in the app_descriptors_loop, but two of these depend upon the type of application (Java or HTML). The three common descriptors are the application_descriptor, application_name_descriptor and transport_protocol_descriptor, and the two app specific descriptors will either be dvb_j_application_descriptor and dvb_j_application_location_descriptor (for Java apps) or dvb_html_application_descriptor and dvb_html_application_location_descriptor (for HTML apps).

Common Application Descriptors

Descriptor Syntax[22]	CG Value	Comment
application_ descriptor {		Note – all of the user editable fields are
descriptor_tag	*0x00*	accessed through File→Properties…→
descriptor_length	*auto*	Application Descriptor page
application_profiles_length		
for (i=0; i<N; i++) {		→Application profiles list
application_profile	*user*	
version.major	*user*	
version.minor	*user*	
version.micro	*user*	
}		
service_bound_flag	*user*	→Service Bound checkbox
visibility	*user*	→Visibility dropdown
reserved_future_use	*0x1F*	
application_priority	*user*	→Priority
for (i=0; i<N; i++) {		
transport_protocol_label	*auto*	Matches the transport_protocol_label value in the transport_protocol_descriptor.
}		
}		

[22] ETSI TS 101 812 section 10.7.3

Descriptor Syntax[23]	CG Value	Comment
application_name_descriptor {		Accessed through the same page as
descriptor_tag	*0x01*	described above.
descriptor_length	*auto*	
for (i=0; i<descriptor_length; i++) {		
ISO_639_language_code	*user*	→Language Code dropdown
app_name_length	*auto*	
for (i=0; i<a_n_length;i++){		
app_name_char	*user*	→Application Name field
}		
}		
}		

Descriptor Syntax[24]	CG Value	Comment
transport_protocol_descriptor {		
descriptor_tag	*0x02*	
descriptor_length	*auto*	
protocol_id	*0x0001*	transport via OC
transport_protocol_label	*auto*	set to match the component tag value
remote_connection	*0*	CG does not support remote carousels
component_tag	*auto*	Matches the component tag in the stream_identifier_descriptor for the DSI of the MHP Object Carousel that contains this application.
}		

[23] ETSI TS 101 812 section 10.7.4

[24] ETSI TS 101 812 section 10.8.1

Java Application Descriptors

Descriptor Syntax[25]	CG Value	Comment
dvb_j_application_descriptor {		This descriptor specifies the
descriptor_tag	*0x03*	Java application parameters, and
descriptor_length	*auto*	is accessed via Java app file→ Properties…→Java Properties page.
for (i=0; i<N; i++) {		The parameter list is edited via
parameter_length	*auto*	the Parameters list box and
for (j=0; j<parameter_length; j++) {		buttons.
parameter_byte	*user*	
}		
}		
}		

Descriptor Syntax[26]	CG Value	Comment
dvb_j_application_location_descriptor {		This descriptor specifies the
descriptor_tag	*0x04*	Java application path, and
descriptor_length	*auto*	is accessed via Java app file→ Properties…→Java Properties page.
base_directory_length	*auto*	
for (i=0; i<base_directory_length; i++) {		
base_directory_byte	*user*	→Base Directory field
}		
classpath_extension_length	*auto*	
for (i=0; i<classpath_ext_length; i++) {		
classpath_extension_byte	*user*	→Classpath extension field
}		
for (i=0; i<N; i++) {		
initial_class_byte	*user*	→Initial class field
}		

[25] ETSI TS 101 812 section 10.9.1

[26] ETSI TS 101 812 section 10.9.2

HTML Application Descriptors

Descriptor Syntax[27]	CG Value	Comment
dvb_html_application_descriptor {		This descriptor specifies the
descriptor_tag	*0x03*	HTML application parameters,
descriptor_length	*auto*	and is accessed via HTML app file→ Properties…→HTML Properties page.
appid_set_length	*auto*	
for (i=0; i<appid_set_length; i++) {		
application_id	*user*	→Application IDs list box
}		
for (j=0; j<N; j++) {		
parameter_bytes	*auto*	→Parameter String edit box
}		
}		

NOTE: The dvb_html_application_descriptor format shown above is that defined in TS 101 812 v1.1.2 (MHP v1.0.1) – previous versions of the standard did not have the application_id loop. Carousel Generator can be made to revert to the older version of the descriptor (v1.0.0) for a particular carousel by checking the MHP Object Carousel node ➔ **Properties…** ➔ (MHP page) **Use old style (MHP v1.0.0) HTML application descriptor** check box.

Descriptor Syntax[28]	CG Value	Comment
dvb_html_application_location_descriptor {		This descriptor specifies the
descriptor_tag	*0x04*	HTML application path, and
descriptor_length	*auto*	is accessed via HTML app file→ Properties…→HTML Properties page.
physical_root_length	*auto*	
for (i=0; i<physical_root_length; i++) {		
physical_root_bytes	*user*	→Physical Root Directory field
}		
for (i=0; i<N; i++) {		
initial_path_bytes	*user*	→Initial Path field
}		

Summary

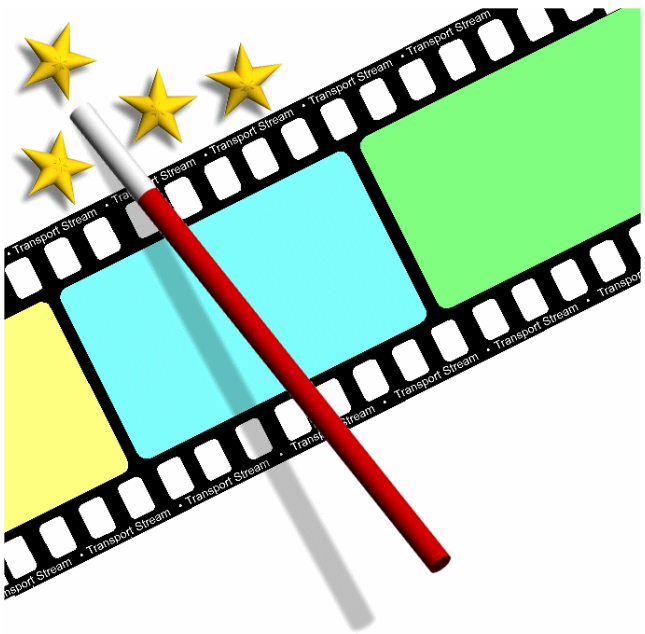
Carousel Generator v2.0 is designed to generate enough SI to create a fully DVB conformant stream, which should be enough to drive most set-top boxes. If any additional SI is required, another suitable tool (the Tektronix Multiplexer) should be used to insert the extra information into the generated stream.

[27] ETSI TS 101 812 section 10.10.1

[28] ETSI TS 101 812 section 10.10.2

Section 16

Transport Stream Maker



Introduction 3
Starting the Wizard 4
From the Desktop 4
From Another Program 4
Making a File 5

Introduction

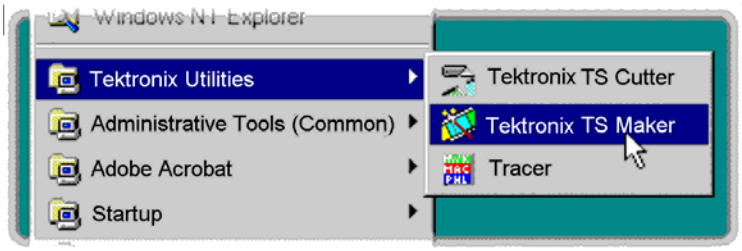
This Wizard creates and initialises a new, empty file for recording transport streams in. The file is not a valid MPEG-2 stream until a complete recording has been made to it by TS Player or Monitor/Recorder. TS Maker may be run from the desktop, TS Player and TS Monitor/Recorder. There are 4 pages including the optional introduction page:

Starting the Wizard

Transport Stream Maker may be run from the Windows™ desktop or from one of the programs which can record streams.

From the Desktop

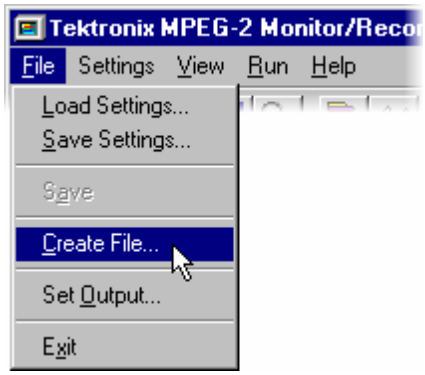
The wizard may be started by selecting the **Tektronix TS Maker** option from the **Tektronix Utilities** sub-menu of the **Start -> Programs** menu (left). Alternatively double click on the **Tektronix TS Maker** Shortcut on the desktop (right).

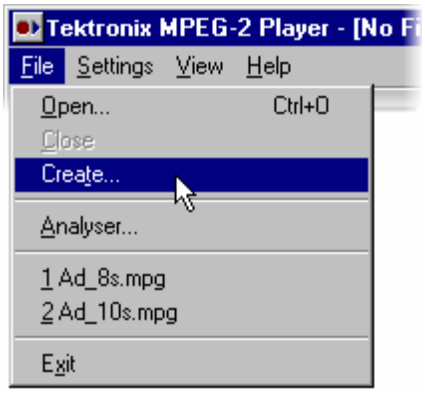


or

From Another Program

A menu option to create a new file, using this wizard, is available from both the TS Monitor/Recorder and TS Player programs. Select the **Create…** option from the **File** menu of either program:

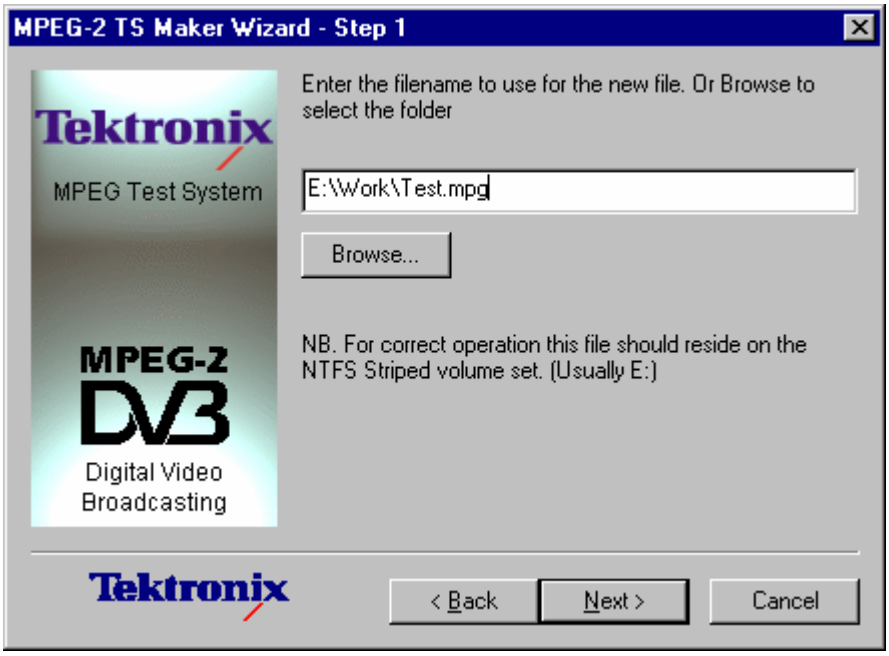




Making a File

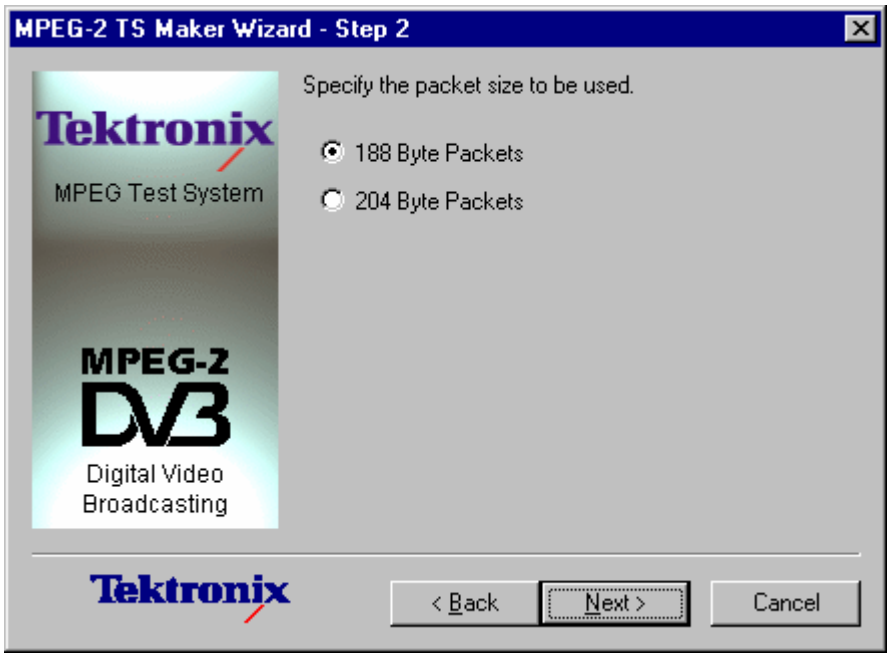
By default the wizard will display this Introduction first.

It may be disabled by checking the **Skip this page on startup** option. Selecting the **Next** button moves on to Step 1 - Specifying the name and location for the new file:



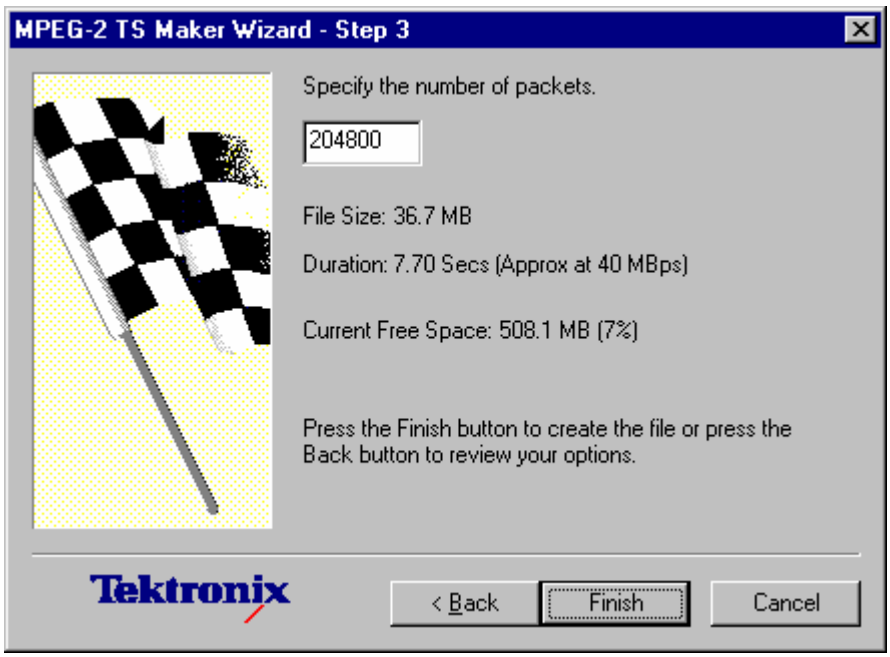
Select the **Browse…** button to open a standard file browser window for choosing a directory and naming the file. Then select the **Next** button to move on to Step 2.

In step 2 the packet size is specified.



Choose 188 byte or 204 byte as required and then select the **Next** button. Clicking on the **Back** button will return to Step 1 so that the file name and location may be changed.

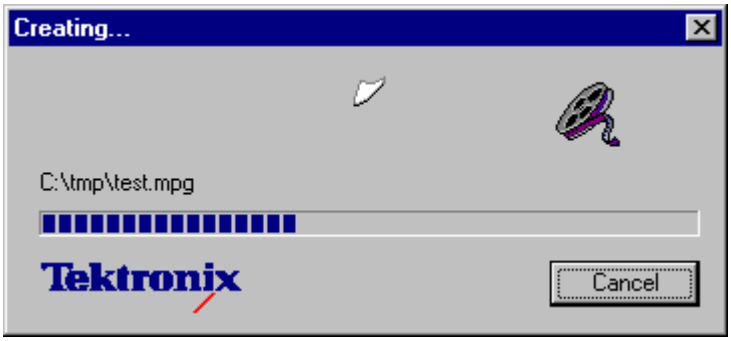
Step 3 is the last. Specify the size of the file by the number of packets it will hold. Select the text box and edit the number as required.



The size of the file that will be made is shown in bytes. An estimate of file size in run time is also displayed assuming a data rate of 40.0Mbps. Both of these sizes are updated to reflect changes in the number of packets as new values are typed in.

Select **Finish** to make the file or **Back** to change the packet size, file name or location.

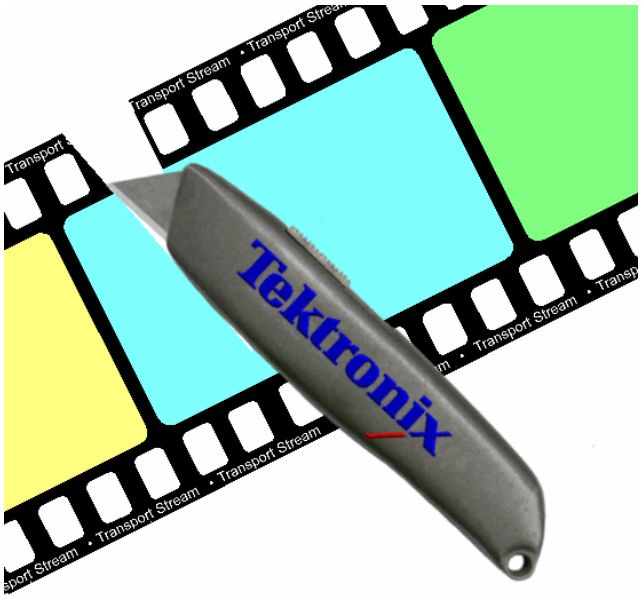
The wizard now creates the new file as specified. While it is working this dialog is displayed to indicate progress.



When the progress indicator reaches the right hand side, the dialog disappears and the file is ready for recording to.

Section 17

Transport Stream Cutter



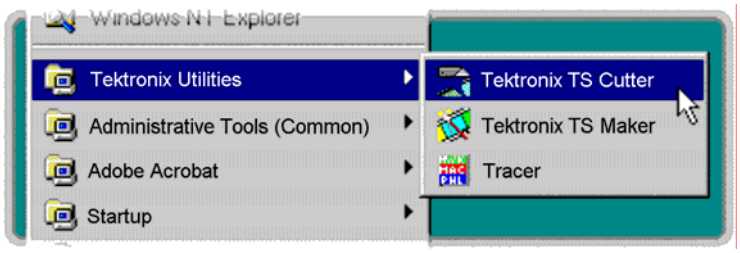
Introduction 3
Starting the Wizard 3
Cutting a File 4

Introduction

This is a Wizard which creates a new file from a slice of an existing file. It may is run from the Windows™ desktop. There are 4 pages including the optional introduction page:

Starting the Wizard

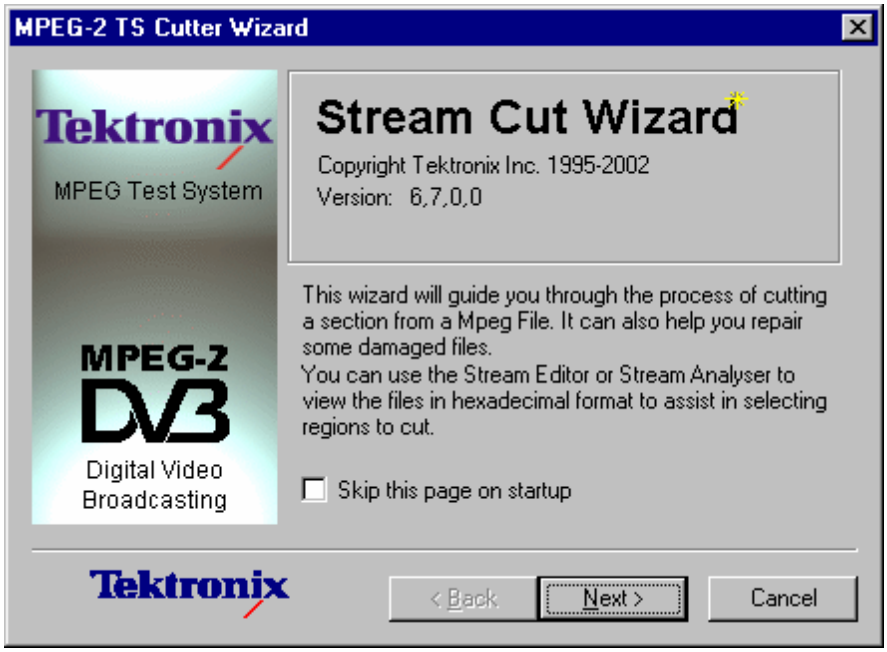
The wizard may be started by selecting the **Tektronix TS Cutter** option from the **Tektronix Utilities** sub-menu of the **Start -> Programs** menu (left). Alternatively double click on the **Tektronix TS Cutter** Shortcut on the desktop (right).



or

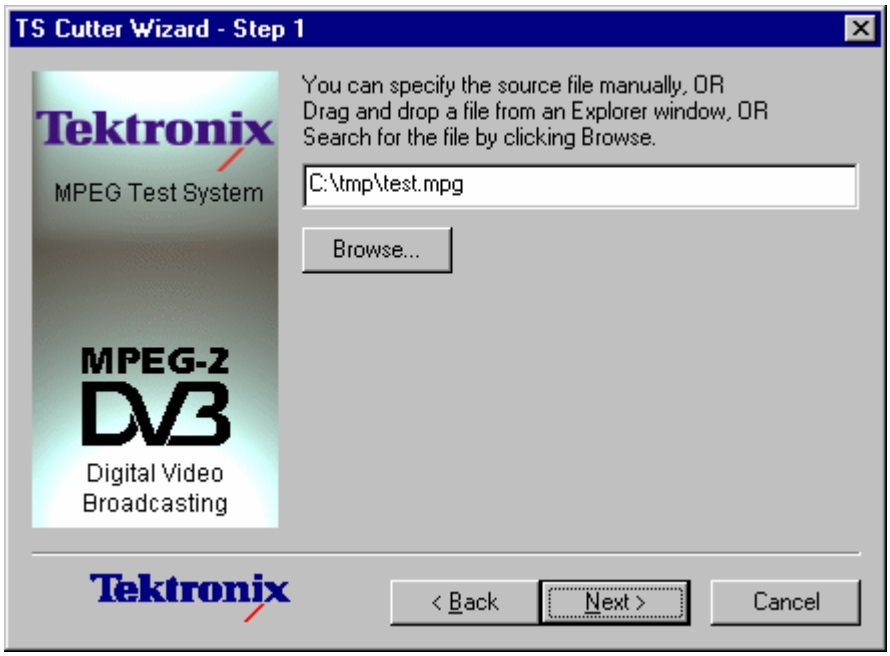
Cutting a File

By default the wizard will display this Introduction first.



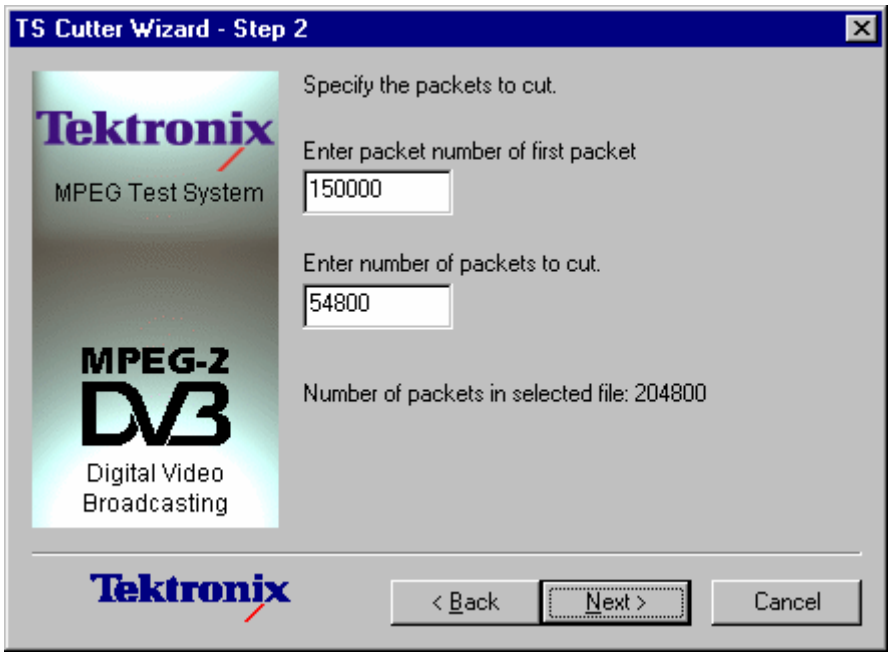
It may be disabled by checking the **Skip this page on startup** option. Select the **Next** button to move on to Step 1.

Step 1 - Specify the name and location of the source file to copy a slice from:



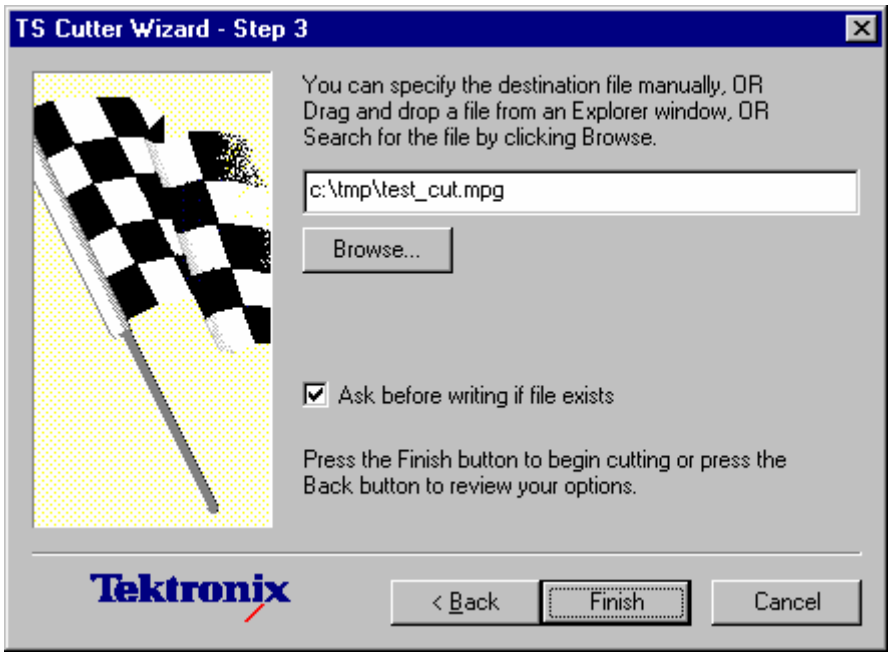
Select the **Browse…** button to open a standard file browser window to look for and choose the required file. Then select the **Next** button to move on to Step 2.

In step 2 the slice is specified by typing in the first and last packet to copy. The defaults values are the first and last packet numbers in the source file. In this example they would have been 0 and 1530001.



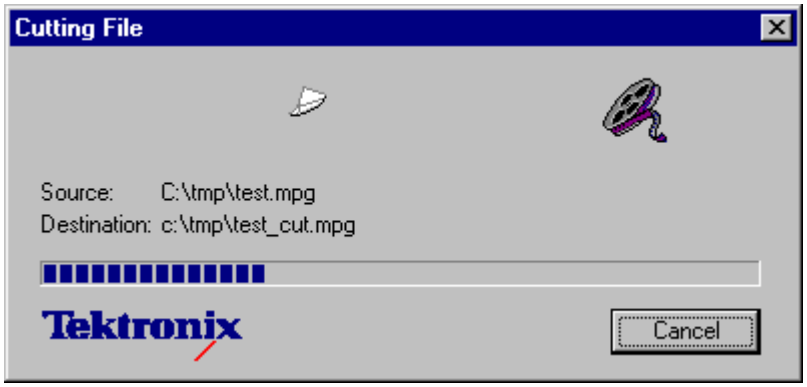
Selecting the **Back** button will return to Step 1 so that the source file name and location may be changed.

Step 3 is the last. Specify the name and location for the new file



Select **Finish** to create the file and copy over the required slice of data. Select **Back** to go back to change the source file, start and end packet numbers.

The wizard now creates the new file and copies over the selected data as specified. While it is working this dialog is displayed to indicate progress.



When the blue progress indicator reaches the right hand side the dialog disappears and the file is ready to use.

Section 18

ScriptPad

Overview 3
Setting Up 3
Starting the Program 4
Initial Appearance 4
Initial Menu Options 5
File Menu Options 5
View Menu Options 5
Script File Appearance 5
Opening a File 6
Menu and Controls 7
Menu Bar 7
Toolbar 11
Status Bar 11
Script File Editing 12
Keyword Color-Coding 12
Parsing 12
Encryption 13

Overview

ScriptPad is supplied with a number of Tektronix products to enable users to create and modify System Information (SI) scripts.

The rationale underlying SI Scripting is described elsewhere in this document; this section simply provides a guide to using ScriptPad.

It should be noted that script files are saved as ASCII files and that any ASCII text editor can be used to view and modify the files (e.g. Microsoft Notepad). However, features such as color-coding of keywords and syntax checking will not be available; also access to encrypted script files will not be possible.

Setting Up

The ScriptPad utility is installed automatically when the system is set up. There is no additional specific set up procedure. Simple user interface management is performed from within the utility.

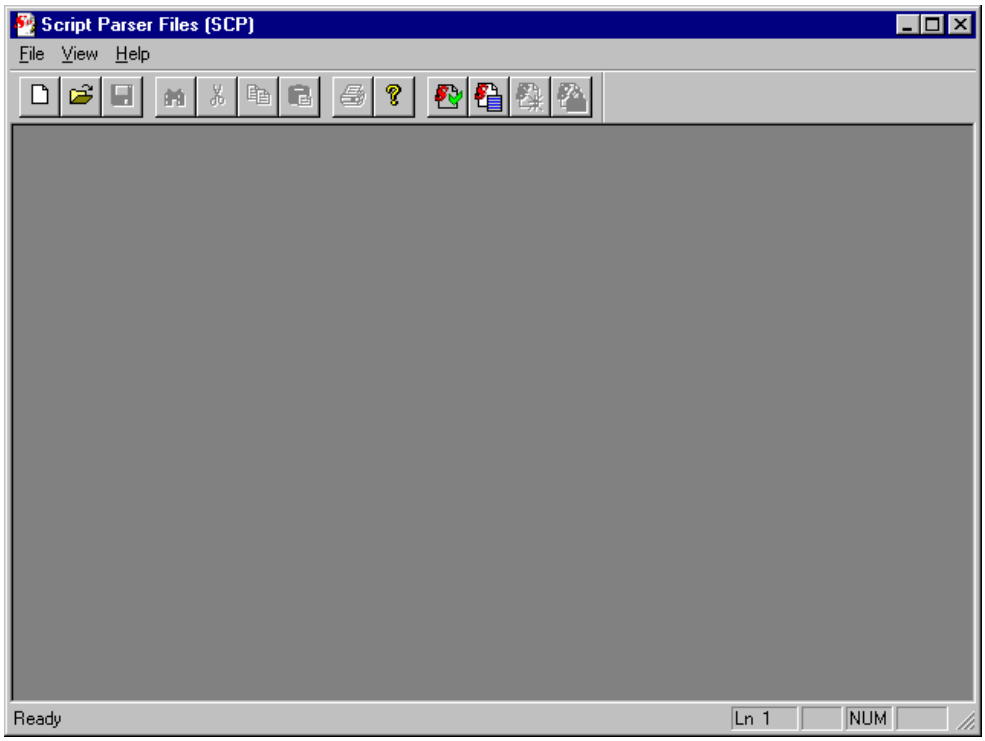
Starting the Program

Currently ScriptPad is most often started by double-clicking an existing script file. The necessary file associations (*.scp and *.scx) are made automatically during the installation process.

Alternative methods of starting ScriptPad are via a shortcut placed on the desktop or from the Start menu in the taskbar.

Initial Appearance

When the program has started and is ready for use, the main window is displayed, as shown below:



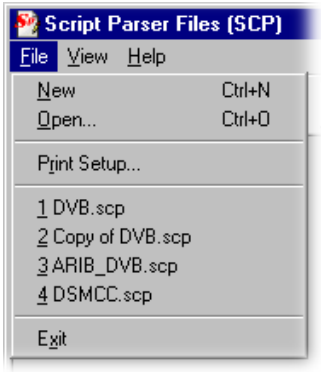
The Toolbar (row of buttons above the dark grey area of the empty window) may be hidden from view, moved to a separate window, either side or the bottom of the main window.

The Status Line at the very bottom of the window may be hidden from view.

The dark grey area constitutes the Working Area.

Initial Menu Options

File Menu Options



New	Opens a new file.
Open…	Opens a script file (*.scp) for analysis. The program opens the file selection dialogue allowing the user to choose the required file.
Print Setup…	Opens a dialog for selecting which printer and associated options to use.
1 *<filename>* **2 *<filename>*** **3 *<filename>*** **4 *<filename>***	A list of the four most recently analyzed files. If the program has recently been installed the list may be empty or hold less than 4 files. Selecting a filename opens that file for analysis.
Exit	Finishes running the program.

View Menu Options

(a check mark ✓ next to an option shows that the object is currently visible; no ✓ means that it is hidden.)

Toolbar	Toggles the Toolbar between being displayed or not.
Status Bar	Toggles the Status Bar between being displayed or not.

Select an option to change its status.

Script File Appearance

Scripts displayed in Script Pad are color-coded to aid understanding.

Script Pad makes no formatting corrections or changes; it is recommended that script authors use conventional programming layout.

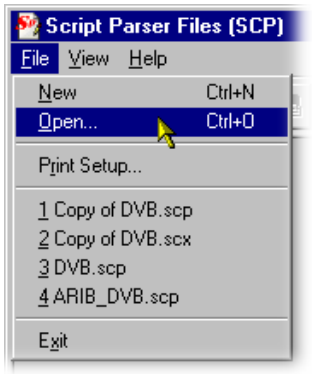
Single line comments are prefixed with a double slash (**//**); in ScriptPad they are colored green. Multi-line comments of the form **/* … */** are also accepted by the parser.

Opening a File

Any script file (*.scp or *.scx) can be opened for viewing and editing by this program.

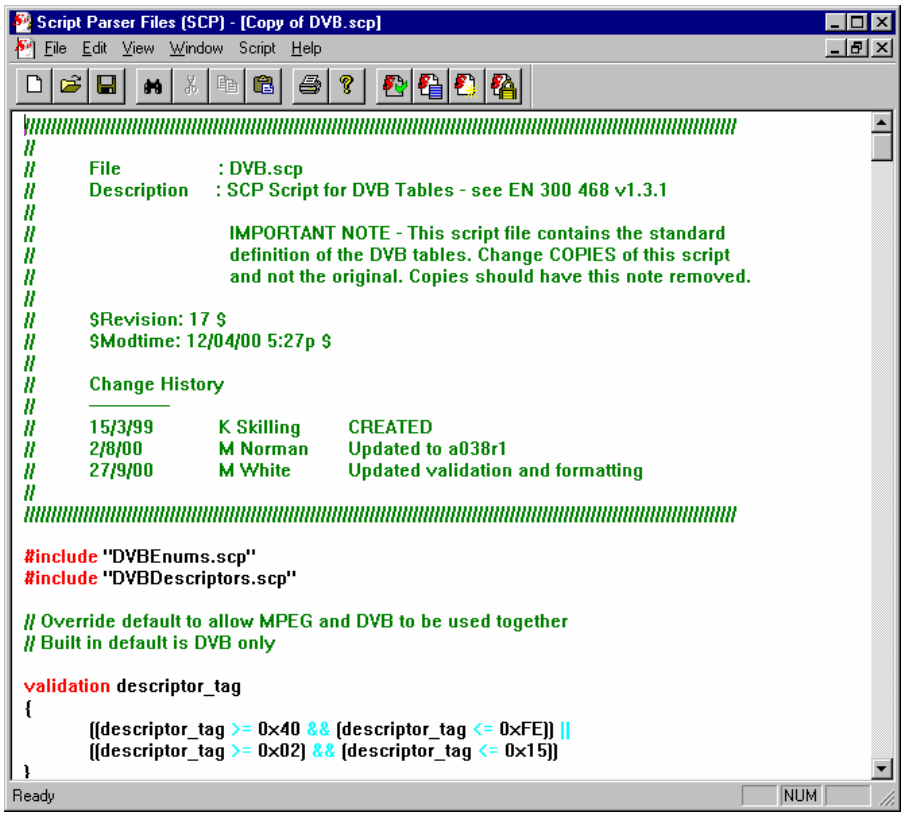
To open a file select the **Open…** option from the file menu. If the required file is in the list of recently analyzed files then it can be opened from the list to save using the Open file dialogue.

Alternatively use the **Ctrl+O** keyboard shortcut.



There is also a shortcut button available on the Toolbar for opening a file, which has the standard file open symbol.

On opening the script file is displayed in the working area.



Viewing and editing can start immediately. Note that multiple script files can be open simultaneously.

Menu and Controls

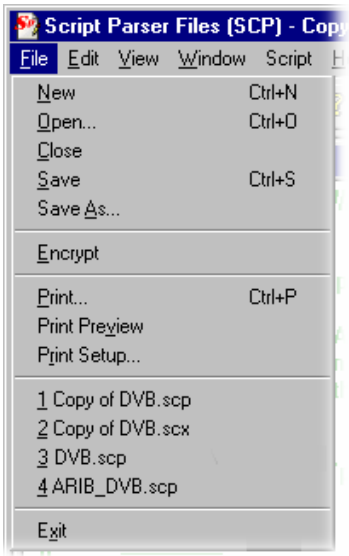
Different menus and options are presented before and after file opening and depending upon whether the file window or the message window is active.

Menu Bar

The Menu Bar offers all of the options currently available. Options are context sensitive; they will only be available where relevant. Some options are also available via keyboard shortcuts; these are indicated on the menus.

A check mark (✔) next to an option indicates that the function is currently visible or active; no check mark means that it is hidden or inactive.

File Menu Options



New Opens a new file.

Open… Opens a script file (*.scp) for analysis. The program opens the file selection dialogue allowing the user to choose the required file.

Close Closes the active script file window.

Save Saves the active script file window.

Save As… Allows the active script file to be saved under a different file name.

Encrypt When enabled, scripts will be saved in encrypted format (*.scx) and unencrypted format (*.scp).

Print… Opens Print dialog.

Print Preview Previews print using current print settings.

Print Setup… Opens a dialog for selecting which printer and associated options to use.

---

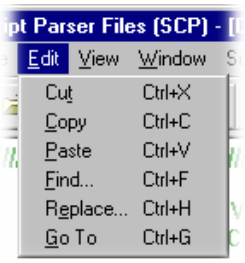
1 *<filename>*
2 *<filename>*
3 *<filename>*
4 *<filename>*

A list of the four most recently analyzed files. If the program has recently been installed the list may be empty or hold less than 4 files.

Selecting a filename opens that file for analysis.

Exit Exits the program. The user is given the opportunity to save any changed script files.

Edit Menu Options



Cut Delete the currently highlighted text and move it to the clipboard.

Copy Copy the currently highlighted text to the clipboard.

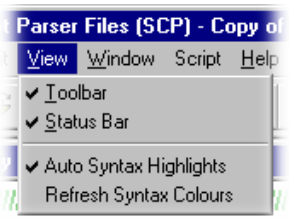
Paste Paste the contents of the clipboard to the current cursor location.

Find… Finds and highlights the text string entered in the **Find** dialog.

Replace… Finds and replaces the text string entered in the **Replace** dialog.

Go To… Places the cursor at the specified line number.

View Menu Options



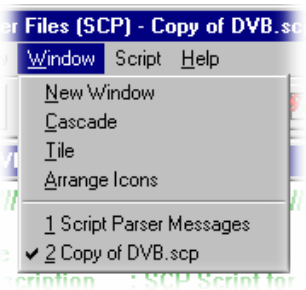
Toolbar Shows or hides the Toolbar which provides a set of convenient shortcuts for the more frequently used menu options.

Status Bar Shows or hides the Status Bar.

Auto Syntax Highlights When enabled, automatically color-codes keywords in the active file as they are typed during editing.

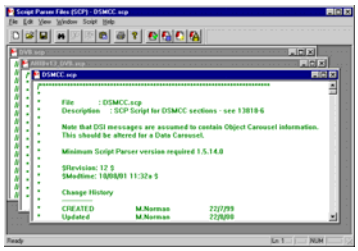
Refresh Syntax Colours Refreshes color coding of keywords in the active file.

Window Menu Options

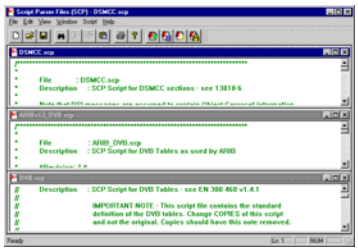


New Window Opens a new empty window.

Cascade Re-arranges the windows like this:



Tile Tiles the windows horizontally. For example, three windows would be tiled like this:

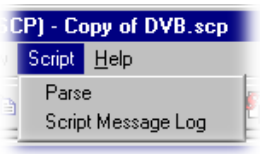


Arrange Icons Aligns icons of any minimised windows at the bottom of the program's main window.

---

1 <*window title*> List the currently open windows. The active (visible) window is indicated by the checkmark.

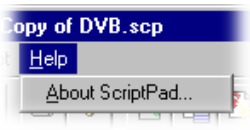
Script Menu Options



Parse Parses the script file to check for syntax errors.

Script Message Log Opens the parser message window.

Help Menu Options



About ScriptPad… Opens the About dialog which displays the program version number.

Toolbar

The Toolbar provides a set of convenient shortcuts for the more frequently used menu options. The available commands are:


Open a new file.


Allows an existing script file to be selected and opened.


Saves the active script file.


Finds specified text.


Allows the currently selected text to be cut. It may then be pasted to another location.


Allows the currently selected text to be copied. It may then be posted to another location.


Allows text currently held on the clipboard (having been previously cut or copied from elsewhere) to be pasted to the cursor location.


Allows the active script to be printed.


Opens the About ScriptPad dialog.

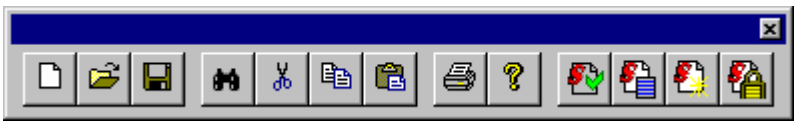

Parses the currently active script for syntax errors.


Toggles the display of the Script Parser Messages window.


Allows the color-coded highlights in the active script to be refreshed.


Enables encryption. Scripts saved while this function is enabled will be saved in encrypted format (*.scx) and enencrypted format (*.scp).

The Toolbar can be dragged off the edge of the main window into a floating pallet. To do this click on the background inside the Toolbar, i.e. not on one of the buttons, and drag into the main window area. The result is a self contained window which looks like this:



To replace the Toolbar on the window border drag it over the border until the outline changes shape. It can be placed on the top, bottom, left or right hand edges.

Status Bar

The Status Bar displays an information message when the cursor is placed over any toolbar button or menu option.

Script File Editing

Because script files are saved as ASCII files, editing follows normal text editing customs. However, ScriptPad does provide extra features to enhance and verify the process.

Keyword Color-Coding

When the **Auto Syntax Highlights** option in the **View** menu is enabled, keywords are automatically color-coded as they are typed.

When the **Auto Syntax Highlights** option is disabled, the color-coding can be refreshed by selecting the **Refresh Syntax Colours** option in the **View** menu.

Parsing

Script files can be syntactically checked by selecting the **Parse** option from the **Script** menu. A message box will indicate that errors were or were not found in the file. The Script Parser Message window will be automatically opened when the message is acknowledged.

Script Parser Message Window

The Script Parser Messages window logs the parsing activities and provides errors and warnings when necessary.

The following icons are used in the message window.

 Information  Error  Warning

Double-clicking and error message will bring the associated script file window to the front of the display.

Messages can be cleared from the window by right-clicking anywhere within the message window and selecting **Clear messages**.

Encryption

There are an increasing number of proprietary standards emerging whereby analysis is allowable (possibly subject to a licence fee), but the owner of the standard does not wish for the script file to be viewed by users. This is solved by using encrypted script files. The ScriptPad utility, which is used for creating and editing script files has an Encrypt option, such that a script file is saved in an unreadable encrypted format, that only the ScriptParser can interpret. ScriptPad is associated with the .scp and .scx suffixes used for unencrypted and encrypted scripts respectively during the installation process.

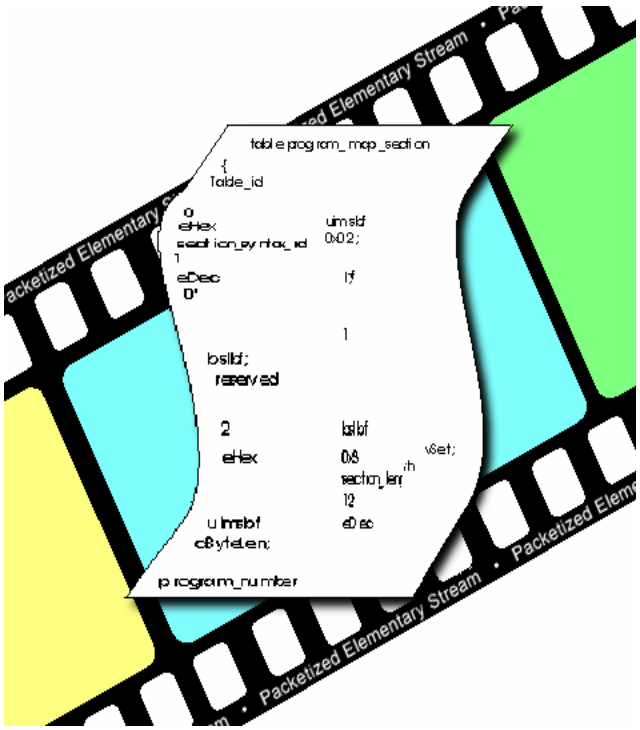
The script encryption process employs a robust, 128 bit symmetric-key algorithm based on the Feistel block cipher, which is similar to that used in the dongle encryption scheme. Additional functions have been included to increase the entropy of the cipher text.

Each time a script is encrypted, a unique file is generated. This makes it hard to determine the algorithm by making small changes to plain-text and then observing the change made to the cipher-text. In addition the cipher-text is protected from interference, meaning that changes to the cipher text are detected on decryption and the altered file will be rejected.

A dongle is a security or copy protection device that must be connected to an I/O port of the computer while the program is run. Programs that use a dongle may query the port at start-up and at programmed intervals thereafter, and terminate if it does not respond with the expected validation code.

Section 19

Custom SI Scripting



Introduction 3
Encrypted Scripts 3
Pre-Prepared Scripts 4
Application Differences 7
Scripting Examples 8
Semantics Overview 11
Error Reporting 13
Scripting Order 13
Mnemonics 14
References 14

Introduction

Whenever a transport stream that conforms to one of the major broadcast standards is opened by a MPEG Test System application, such as TS Analyzer or Multiplexer, the components of the stream are analyzed into the component tables and descriptors in accordance with script files which are associated with the application. The script files used are dictated by the broadcast standard and its variant that is selected: MPEG, DVB, ATSC or ISDB.

Scripts specify the structure of the data likely to be held within the stream; they do not provide the content.

Great flexibility is required in analysis to cater for the standards, their regional variations and the various data and proprietary standards. This is achieved by making a range of script files available. Each application using scripts makes provision in the user interface for assembling the scripts required to analyze the incoming stream. Analysis of a stream is often dependent upon the cumulative effect of two or more scripts; the user interface provides a simple and intuitive way of selecting the correct scripts for a specific stream.

As new broadcast standards are introduced, Custom System Information (SI) Scripting provides flexibility by allowing the user to specify SI table and descriptor formats in a simple text (script) file. Although primarily aimed at custom or private SI data carried within streams conforming to one or more broadcast standards, tables specified in the standard scripts can also be redefined if required. New broadcast standards can be completely defined using scripting.

Script files are syntactically checked as they are attached to the application with which they are to be used. Any errors found in the syntax are reported (usually as part of an Error Log).

Note that while some conformance tests are built into Transport Stream Analyzer and Multiplexer, even the most basic of analyses will require the association of one or more scripts to be successful.

Encrypted Scripts

There are an increasing number of proprietary standards emerging whereby analysis is allowable (possibly subject to a licence fee), but the owner of the standard does not wish for the script file to be viewed by users. This is solved by using encrypted script files. The ScriptPad utility, which is used for creating and editing script files has an Encrypt option, such that a script file is saved in an unreadable encrypted format, that only the ScriptParser can interpret. ScriptPad is associated with the .scp and .scx suffixes used for unencrypted and encrypted scripts respectively during the installation process.

The script encryption process employs a robust, 128 bit symmetric-key algorithm based on the Feistel block cipher, which is similar to that used in the dongle encryption scheme. Additional functions have been included to increase the entropy of the cipher text.

Each time a script is encrypted, a unique file is generated. This makes it hard to determine the algorithm by making small changes to plain-text and then observing the change made to the cipher-text. In addition the cipher-text is protected from interference, meaning that changes to the cipher text are detected on decryption and the altered file will be rejected.

Pre-Prepared Scripts

Tektronix Cambridge Ltd. ships a number of pre-prepared scripts that cover recognised broadcast standards; these are added to the Tektronix\Scripts subdirectory. The scripts also provide useful examples for users wishing to create their own scripts. The list of scripts is being added to constantly, so it is worth contacting Tektronix if a specific requirement arises.

In some instances, several scripts are used to implement the requirements of a particular standard. The user interface in each application enables the user to assemble the scripts required in the correct operational order. However, if the user chooses to assemble the scripts themselves, attention must be paid to the scripts used and the order in which they are assembled. The following pages contain diagrams which illustrate the use of scripts.

Figure 1 Standards implemented by the MPEG Test System
The first diagram illustrates which standards are implemented by the *MPEG Test System* and at which level of interpretation (Base standard, Regional extensions and Data Broadcasting).

Figure 2 Scripts roadmap (TS Analyzer, Stream Monitor Plus and AD954 MPEG Portable Analyzer)
Figure 3 Scripts roadmap (Multiplexer)

Figures 2 and 3 provide a definitive graphic script 'roadmap' for their respective applications. By selecting the scripting function required and finding the shortest route from Start to Finish, the user can identify the set of scripts to be used.

> E.g. In Figure 3, for (DVB) MHP, the shortest path from Start to Finish includes the following scripts: MPEG.scp + DVB.scp + MHP.scp; this is the minimum set of scripts that should be loaded to successfully analyze MHP data in a DVB stream.

Each application that accepts scripting is provided with a user interface in which the scripts to be used are selected and listed.

The script files should be loaded in the same order that they appear in the roadmap figures.

The Sky XSI, OpenTV and Viaccess standards require plug-in modules (refer to TS Analyzer Section). Their use is restricted; please contact your supplier for further details.

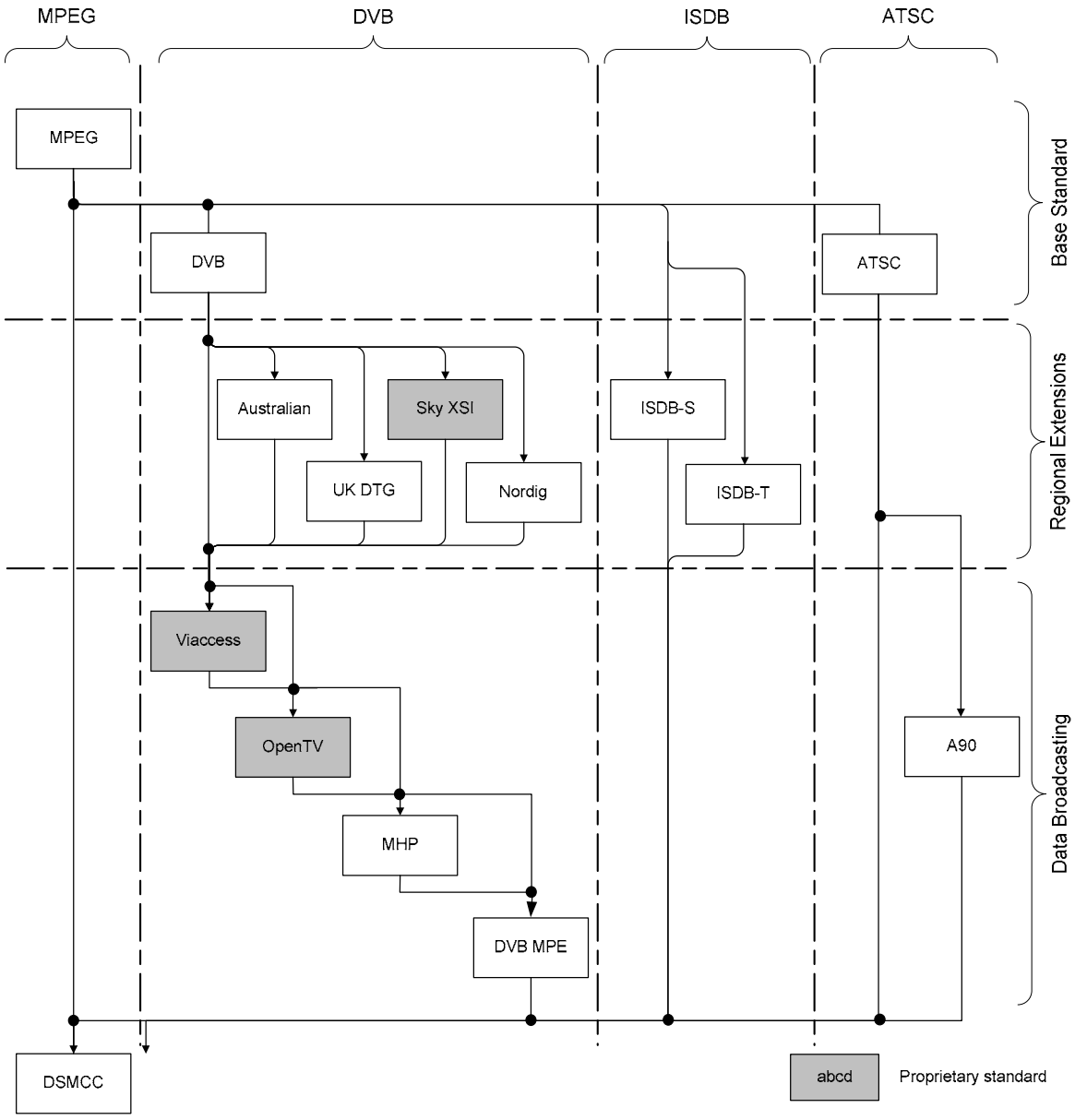


Figure 1 Standards implemented by the MPEG Test System

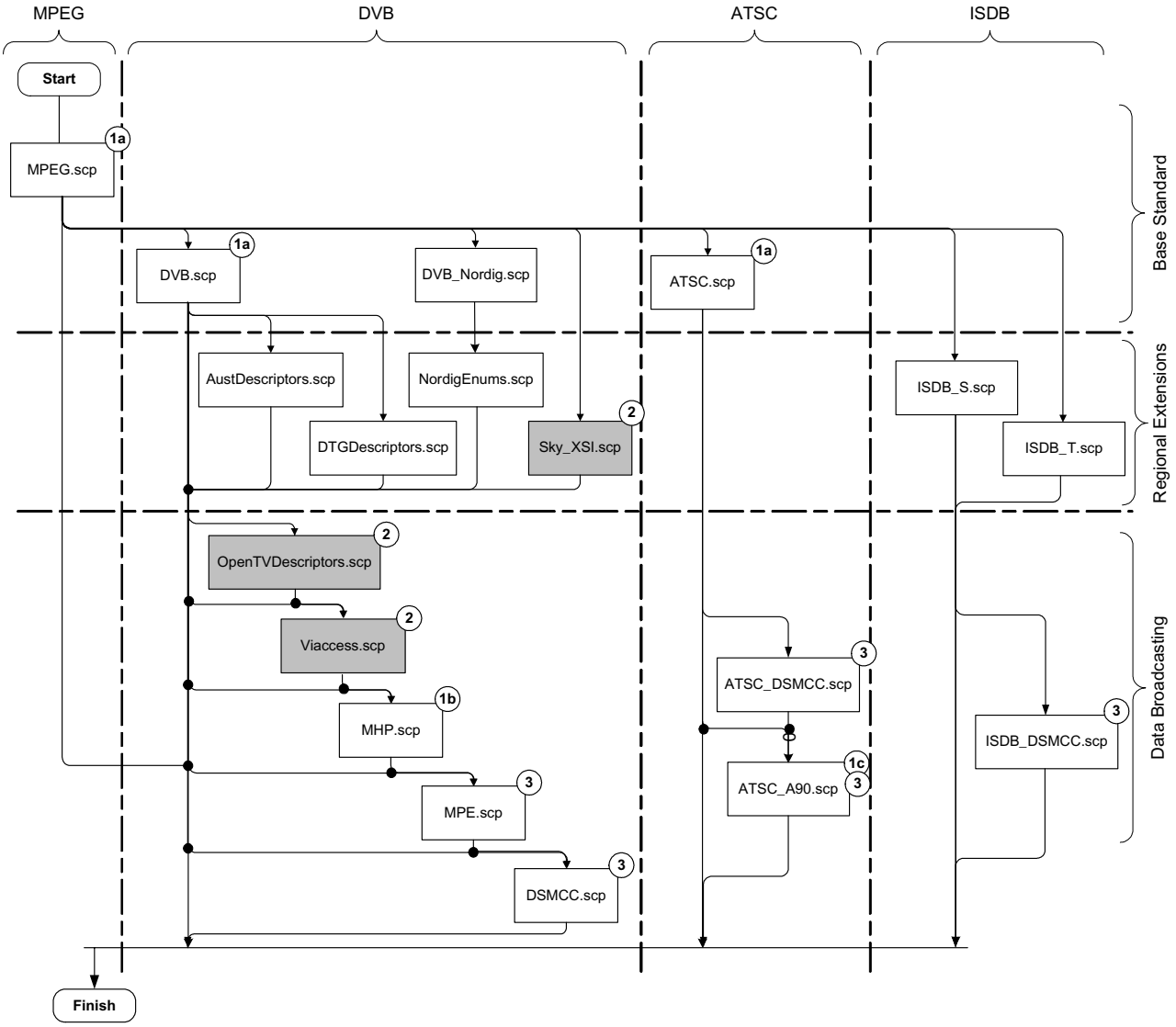


Figure 2 Scripts roadmap
(TS Analyzer, Stream Monitor Plus and AD954 MPEG Portable Analyzer)

Key:

Sky_XSI.scp - Proprietary script

-

1a Optional in Stream Monitor Plus and AD954 MPEG Portable Analyzer. However, if ATSC.scp is used, MPEG.scp must also be loaded.

1b Can only be used if DVB.scp is loaded.

1c Can only be used if ATSC.scp is loaded.

2 TS Analyzer only.

3 AD954 MPEG Portable Analyzer only analyzes tables on reserved MPEG, DVB and ATSC PIDs. These scripts only contain tables on PIDs not recognised by AD954 Portable Analyzer and descriptors for those unrecognised tables. Therefore, although they may be loaded by the AD954, they will not affect the analyses in any way.

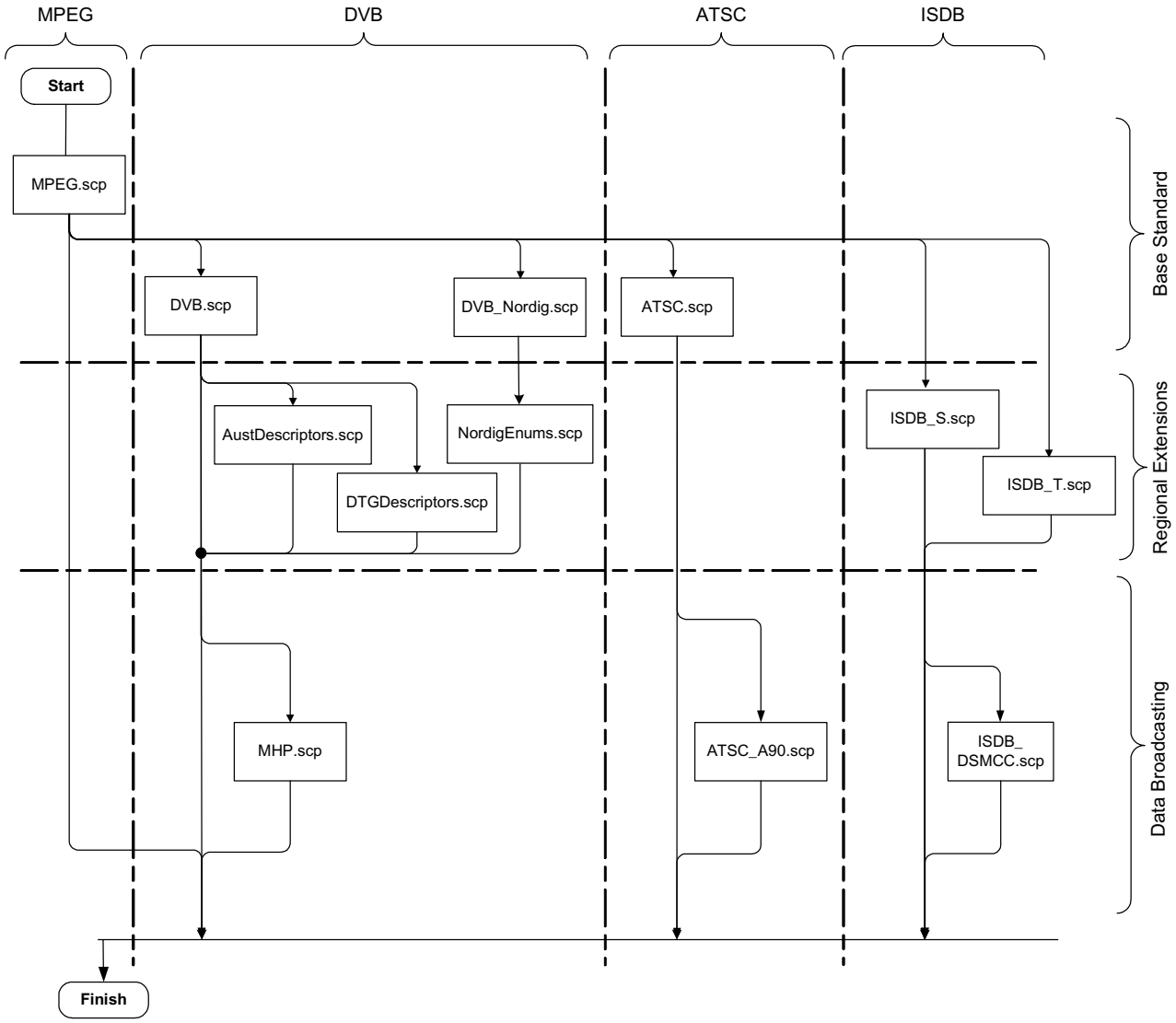


Figure 3 Scripts roadmap (Multiplexer)

Application Differences

Stream Monitor Plus and AD954 Portable Analyzer both contain internal templates for the MPEG, DVB and ATSC tables and descriptors. For these applications, the use of MPEG.scp, DVB.scp and ATSC.scp is optional. Loading the scripts allows flexibility over the interpretation (inherent in the scripting system) and allows the user to analyze the most up-to-date descriptors which may not have been implemented as internal templates. Note that a scripted analysis will always supersede an internal analysis.

The Transport Stream Analyzer program should always be used for reliable analysis of transport streams containing DSM-CC or MPE addressable section. In the absence of TS Analyzer, it is acceptable to use Multiplexer for analysis, provided that the DSM-CC and/or MPE scripts are applied.

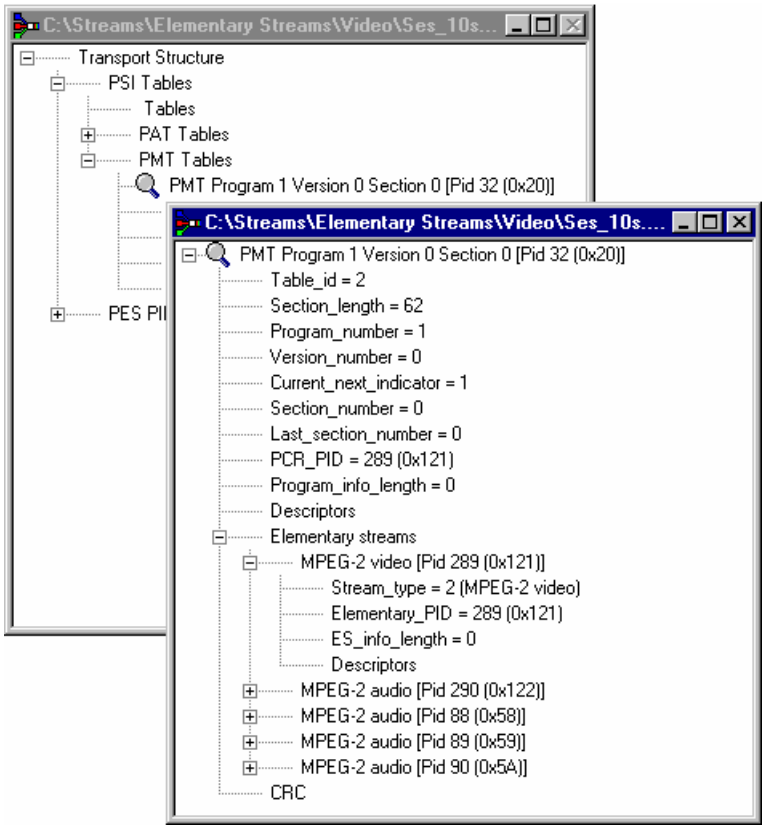
However, when multiplexing streams containing DSM-CC or MPE addressable sections, the related scripts must not be active.

Scripting Examples

Two examples of scripting are shown below. An explanation of the main structural elements follows. Refer to the Custom SI Scripting Technical Note for a detailed explanation of the entire scripting syntax and semantics.

Program Map Table

The screenshot below is taken from the Multiplexer and illustrates the contents of a typical Program Map Table (PMT) section. Following the screenshot is the scripting text for a PMT section, together with an explanation of the main parts of the structure.

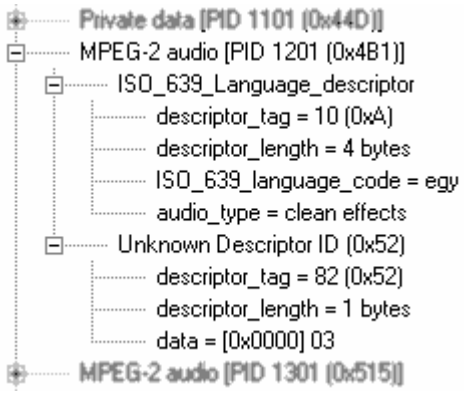


Script Example 1 - Program Map Table - from Multiplexer

```
table PMT
{
    table_id              8   uimsbf   eHex        0x02;
    section_syntax_id     1   bslbf    eHidden     1;
    '0'                   1   bslbf    eHidden;
    reserved              2   bslbf    eHidden     0x3          vSet;
    section_length        12  uimsbf   eDec        cByteLen;
    program_number        16  uimsbf   eDec;
    reserved              2   bslbf    eHidden     0x3          vSet;
    version               5   uimsbf;
    current_next_indicator 1  bslbf;
    section_number        8   uimsbf   eDec;
    last_section_number   8   uimsbf;
    reserved              3   bslbf    eHidden     0x7          vSet;
    PCR_PID               13  uimsbf   eDecHex;
    reserved              4   bslbf    eHidden     0xF          vSet;
    program_info_length   12  uimsbf   eDec        cDescriptors;

    // Loop of anonymous descriptors
    loop descriptors looplen(program_info_length)

        loop elementary_streams looplen(section_length - program_info_length - 13)
        {
        stream_type       8    uimsbf  eStreamType;
        reserved          3    bslbf   eHidden     0x7          vSet;
        elementary_PID    13   uimsbf  eDecHex;
        reserved          4    bslbf   eHidden     0xF          vSet;
        ES_info_length    12   uimsbf  eDec        cDescriptors;

        loop descriptors looplen(ES_info_length)
        }

    CRC                   32   rpchof  eNull;
```

Script Example 1 - Program Map Table script

ISO 639 Language Descriptor



Script Example 2 - ISO 639 Language Descriptor - from TS Analyzer

```
descriptor ISO_639_language_descriptor
{
    descriptor_tag                  8   uimsbf  eDec   0x0A;
    descriptor_length               8   uimsbf;

   loop ISO_639_language_codes looplen(descriptor_length)
   {
       ISO_639_language_code       24   bslbf   eISOLatin;
        audio_type                  8   bslbf   eAudioType;
    }
}
```

Script Example 2 - ISO_639_language_descriptor

Semantics Overview

Comparison between the screenshots and the Script excerpts should reveal a large part of the structure. The Script syntax has been deliberately designed to be as similar as possible to that used in the MPEG standards [3], with enhancements to allow the specification of additional information, such as default values, display format and validation.

Close examination of script examples will reveal that there are lines in the script that do not appear in the final table, such as the **reserved** fields. Similarly, there are elements of the displayed table that do not appear to correspond directly with the script structure. The following paragraphs provide more insight into scripting and its relationship to the analyzed stream.

Field Definition

Format:

```
<field_name> <bit_length> <format> [<enum> <fixed value> <validation> <default>] ";"
```

Example:

```
table_id        8       uimsbf   eHex      0x02;
```

This is the general format for field definitions within table section and descriptors.

The first three fields (i.e `<field_name>`, `<bit_length>`, `<format>`) must be included. The remaining fields are optional, but no gaps must be left. If the last field is required, then the previous fields must contain valid data.

All table section definitions must have a fixed value for the **table_id** field; this may follow the default form given below. All descriptors have a unique, fixed value **descriptor_tag** field. The Parser uses these fields to reference each template type.

The Multiplexer uses the presence of a fixed_value parameter (not including eNA, don't care) to determine whether to lock a field in the Standard Mode of operation.

Fixed Values

Lists and ranges of values are acceptable as shown below:

```
0x40                    Single
0x40..0x50              Range
[0x41, 0x42]            List

Example of composite (Single + Range): [0x40, 0x45..0x50]
```

Other formats will be rejected. Each value must be unique; that is, not in use by any other table.

Display Format

From the script example above:

```
PCR_PID        13       uimsbf eDecHex;
```

is based on the general form:

```
<field_name> <bit_length> <format> [<enum> <fixed value>  <validation> <default>] ";"
```

The display format of the field is expressed by the <enum> parameter. The field formats include:

- hex (<eHex>)
- decimal (<eDec>)
- hex and decimal (<eDecHex>)
- ASCII characters (<eISOLatin>)
- don't care (<eNA>)
- hidden (<eHidden>)
- user defined
- name only (<eNull>)

Hidden fields are mainly used for reserved fields that convey no information, but are inserted to ensure that the next field starts on a byte boundary.

Validation

Validation is carried out on predefined fields by the standard templates; this can be disabled or enhanced using the validation element. <eNA> means that no validation should be carried out unless the field is one of the standard template predefined fields.

Scripting allows validation to be carried out on user-identified fields; including overriding the predefined validation tests. The field formats include:

- all bits set (<vSet>)
- all bits clear (<vClear>)
- don't care (<eNA>)
- user defined

For example (vSet):

```
reserved       2       bslbf  eHidden      0x3      vSet;
```

is based on the general form:

```
<field_name> <bit_length> <format> [<enum> <fixed value>  <validation> <default>] ";"
```

Miscellaneous Notes

Other script keywords allow the user to:

- Include conditional fields, as illustrated in the following example:

```
if (field3 > 1)
   {
      field4    8     uimsbf;
   }
```

- Specify a valid list of descriptors for each table.
- Specified calculated field values. That is, auto-update a field value based upon the values of other fields within the table or descriptor.
- Override the standard format for the Section Name (as used in the Multiplexer).
- Indicate a textual meaning alongside a field value.
- Specify a list of enumerated textual values for a field.
- Override the default access key for defining section uniqueness.

Error Reporting

Script files are parsed for correct syntax as they are attached to an application. An error will be logged when the parser cannot resolve a script definition. This will result in one or more tables or descriptors being ignored.

A warning will be logged when a definition problem has been detected, but a default setting has been used instead, so that the affected tables and/or descriptors definitions may still be used.

Each log entry generated has a Category field (e.g. Warning or Error), a Reference field (e.g. script file name and line number) and a Description field.

Scripting Order

As mentioned above, the order in which scripts are listed, and therefore parsed, is important. This is because a definition (e.g. enum, validation, etc) made in one script may be used in another.

For example, the enumeration `eRunStatus` may be defined in Script file A as shown in the fragment below:

```
……
enum eRunStatus

{
    0       "undefined"
    1       "not running"
    2       "starts in a few seconds"
    3       "pausing"
    4       "running"
    5..7    "reserved for future use"
}
……
```

The descriptor may then be used in Script file B, thus:

```
……
loop running_status looplen(section_length)
{
    transport_stream_id     16              uimsbf;
    original_network_id     16              uimsbf;
    service_id              16              uimsbf;
    event_id                16              uimsbf;
    reserved_future_use     5     bslbf     eHidden    0x1F;
    running_status          3     uimsbf    eRunStatus;
}
……
```

If the usage is encountered before the definition, an error may be generated.

An alternative often used in Tektronix's script files is to use the `#INCLUDE` statement at the start of the script file, thus:

```
/*************************************************************************
*
*   File            : MPEG.scp
*   Description     : SCP Script for MPEG Tables - see BS ISO/IEC 13818-1
*
*************************************************************************/

#include "MPEGEnums.scp"
#include "MPEGDescriptors.scp"
……..
```

If this method is used, the 'included' script file(s) should not be present in the script file list.

Mnemonics

bslbf Bit string, left bit first, where 'left' is the order in which bit strings are written.

rpchof Remainder polynomial coefficients, highest order first.

uimsbf Unsigned integer, most significant bit first.

References

[1] European Telecommunications Standards Institute 1997, TR 101 290: Digital Video Broadcasting (DVB); Measurement Guidelines for DVB Systems.

[2] A/65 Program and System Information Protocol for Terrestrial Broadcast and Cable.

[3] Information technology - Generic coding of moving pictures and associated audio information, ISO/IEC 13818

See also Custom SI Scripting Technical Note, Tektronix Document Ref: SI185