

User Manual



Multiplexer (Demo)

077-0198-00

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Contacting Tektronix

Tektronix, Inc.
14200 SW Karl Braun Drive
P.O. Box 500
Beaverton, OR 97077
USA

For product information, sales, service, and technical support:

- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

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Preface

This manual supports the Multiplexer demo.

Other documents are available on the Tektronix Web site (www.tektronix.com/manuals):

- *MTS400 Series MPEG Test System Generator Application User Manual (077-0204-xx)*
- *MTS400 Series MPEG Test System Analyzer Application User Manual (077-0205-xx)*
- *MTS400 Series MPEG Test System Carousel Application User Manual (077-0203-xx)*
- *MTS400 Series MPEG Test System Programmer Manual (077-0206-xx)*
This manual specifies the remote control and status monitoring interfaces available to a management application.

Manual Conventions

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.
- 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\`.

Introduction to the Demo Version

The Tektronix Multiplexer (Demo version) provides off-line multiplexing of ATSC, MPEG-2, DVB, and ISDB transport streams.

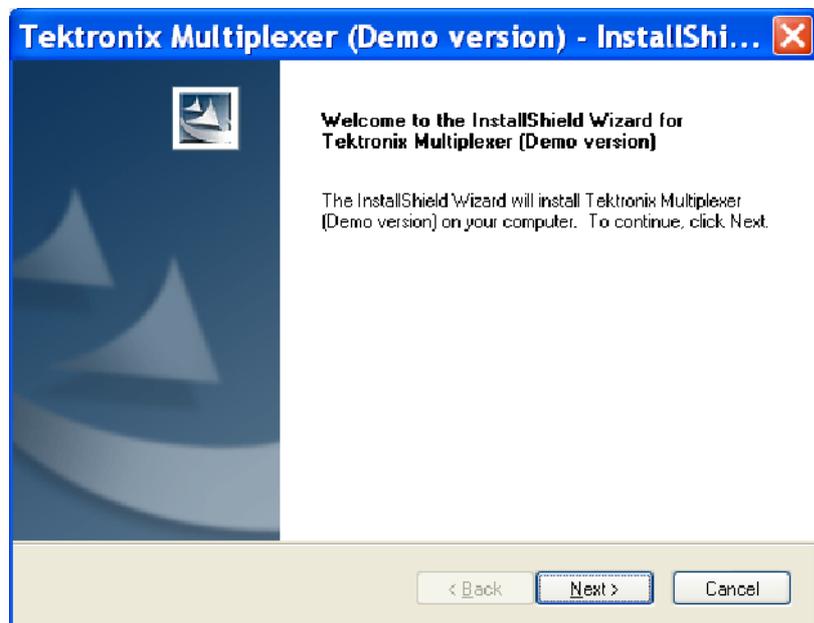
Transport streams (TS), elementary streams (ES), packetized elementary streams (PES), Packet Identifiers (PID) can all be selected, manipulated, and recombined to form customized, synthesized transport streams in the demo version.

On opening, streams are analyzed and displayed according to the selected standard: MPEG, DVB, ATSC, or ISDB.

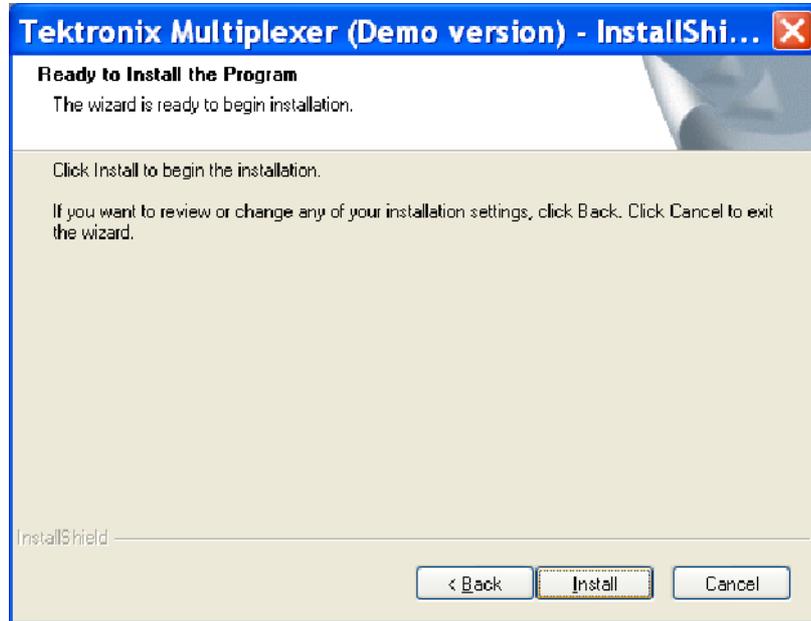
Installing the Demo Version

You can download the MultiplexerSetup.exe file from www.tektronix.com/software and follow these steps to install the demo version of Multiplexer.

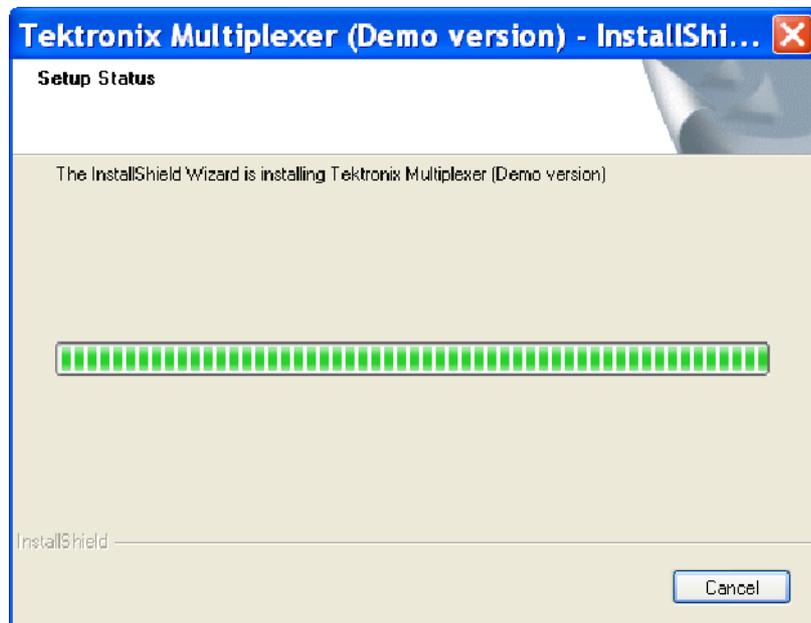
1. Double-click MultiplexerSetup.exe to start the InstallShield Wizard that installs the Multiplexer demo version on your computer. Click **Next** to continue.



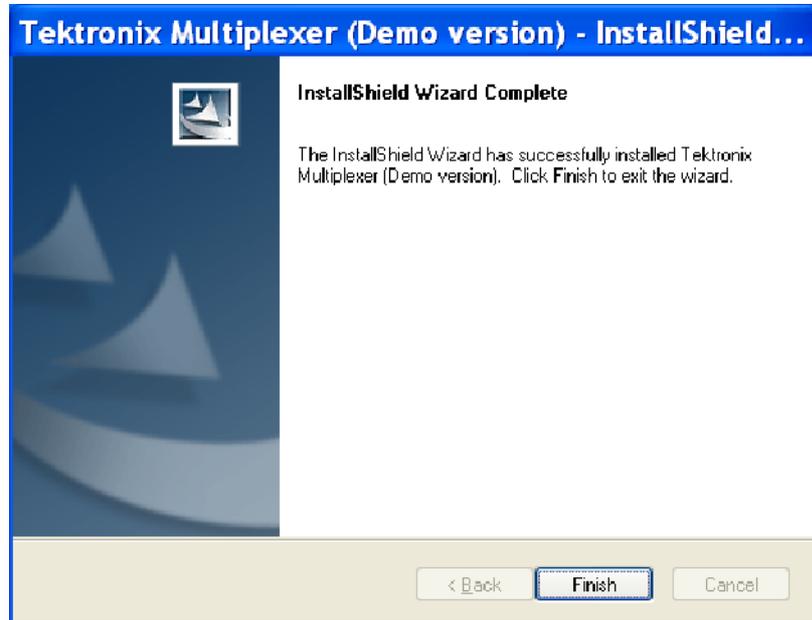
2. Click **Install** to begin the installation process.



The InstallShield Wizard installs the application while displaying the progress.



3. Click **Finish** to exit the Wizard once the demo version is successfully installed.



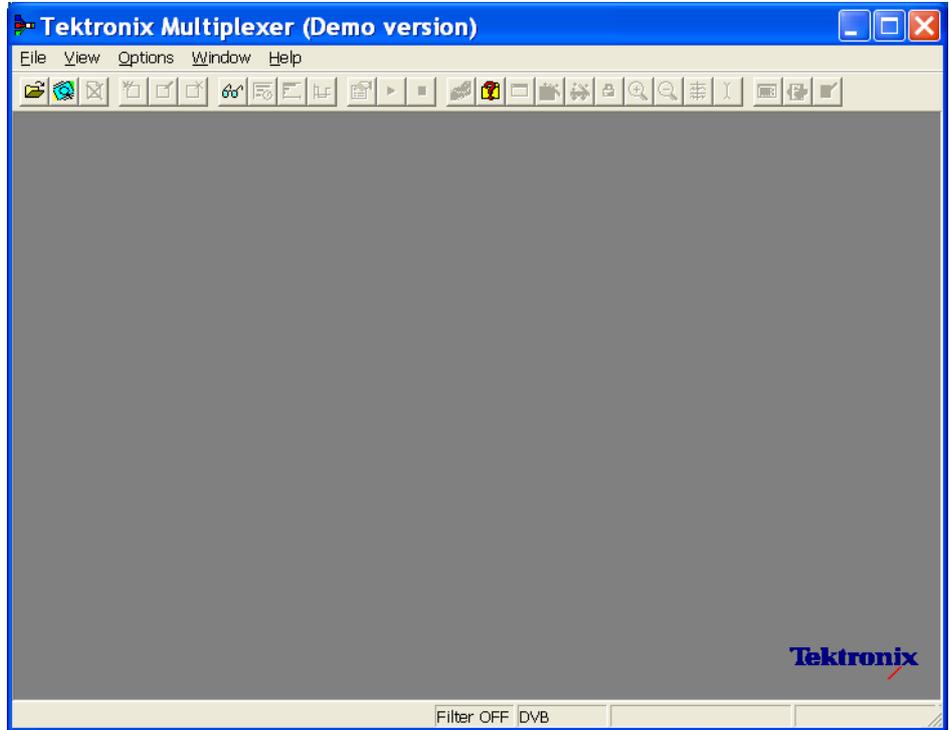
Starting the Program

Start the program by selecting the Multiplexer option from the Start > Programs > Tektronix (Demo versions) > Generators menu or by double-clicking the Tektronix Multiplexer (Demo version) shortcut on the desktop.



Initial Appearance

Once the demo program starts and is ready for use, it opens a main window as follows:



The title bar of the main window shows Multiplexer to be a demo version.

Export Mode

The Export mode is disabled for the demo version. You cannot export data from the Programs view (section data), the Tables view (section data), or the Pids view (elementary stream and payload data).

All of the Export options (Export Payload, Export Elementary Stream, and Export Section Data) of the Edit menu are also disabled.

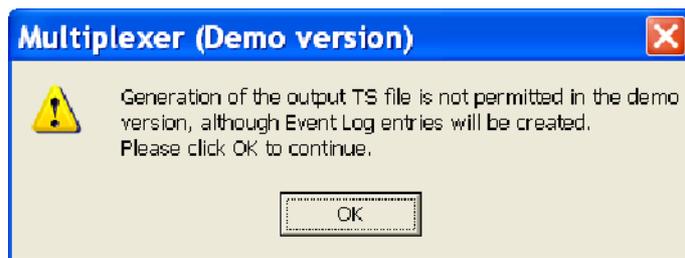
When you click the **Export** and **Export As** options of the File menu, the file is not exported. Instead a message informs you that the export mode is disabled.



Multiplex Process

The demo version does not generate an output TS file, so you will not be prompted to save the output file. However, the Mux cycle will end.

When you start the Multiplex Engine, a message informs you that the output TS file is not generated.

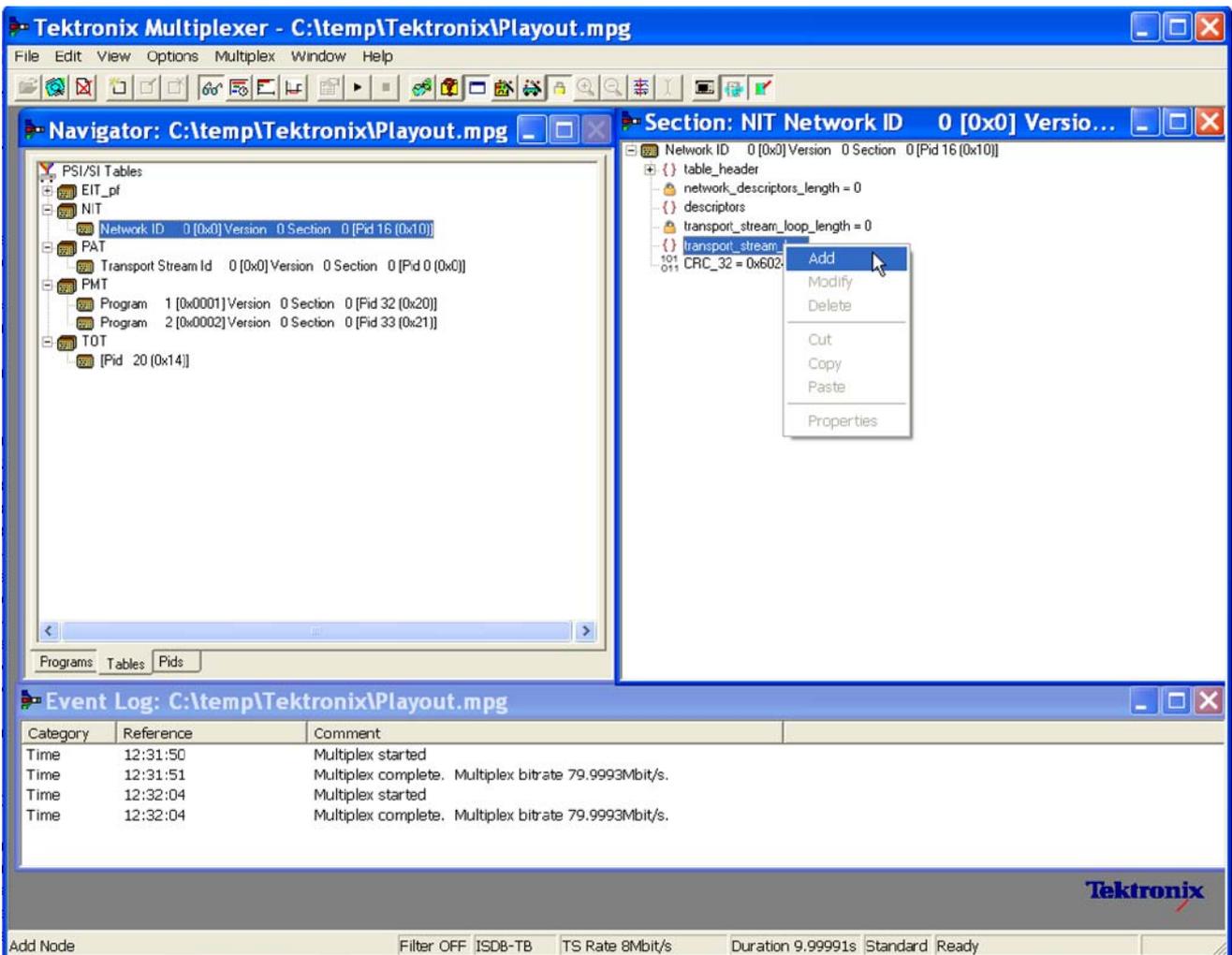


Pseudo Realtime Playout

The Multiplexer in demo mode cannot play out the multiplexed files. The Playout menu/toolbar option is disabled.

Multiplexer - Getting Started

The Tektronix Multiplexer (Full version) provides off-line multiplexing of ATSC, MPEG-2, DVB, and ISDB transport streams.



Transport streams (TS), elementary streams (ES), packetized elementary streams (PES), Packet Identifiers (PID) can all be selected, manipulated and recombined to form customized, synthesized transport streams. Program Specific Information (PSI), Service Information (SI), and Program and System Information Protocol (PSIP) are often referred to as simply SI in this section.

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 that either conform strictly to the standards selected for interpretation or have precisely engineered, known, nonconformances.
- Two or more instances of Multiplexer can run concurrently. This allows table information to be copied from one file to another.
- The source data for nonconformant streams can be saved in a raw format, which can be quickly reloaded as the basis for generating more stream data.
- Conformance of edits to the standards is checked interactively and enforced by default. Checking and enforcement can be turned off when specifying nonconformances to be introduced into the new transport stream.

On opening, streams are analyzed and displayed according to the selected standard: MPEG, DVB, ATSC, or ISDB. Scripts are used by the analysis process; this allows private PSI/SI tables and descriptors to be defined.

NOTE. Most examples given in this section of the user manual are based on DVB SI. Multiplexer is equally at home with all major DTV standards, MPEG-2, DVB, ATSC, and ISDB as well as the major regions to those standards.

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 box (see Scripts, page 13).

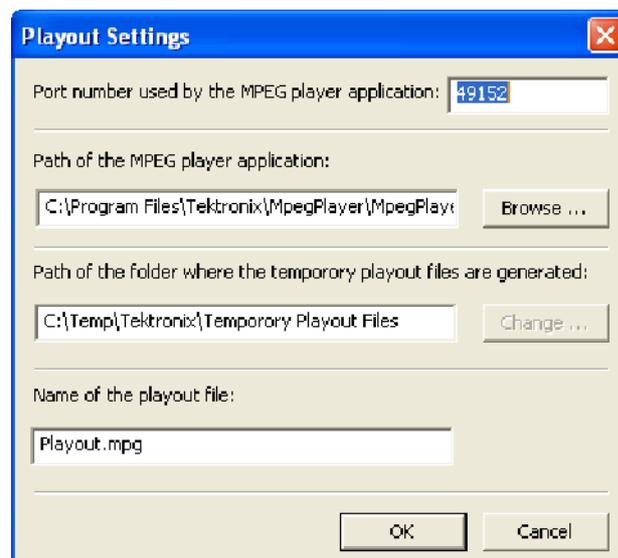
However, when you are multiplexing streams containing DSM-CC or MPE addressable sections, the related scripts must not be active.

Multiplexer in Playout mode

You can initiate a playout in the Multiplexer application using the playout feature as soon as the multiplex operation is complete. Multiplexer creates a temporary transport stream in the location specified by the Playout Settings and then initiates a playout by loading this file into the player. To play the stream in the loop mode, enable the loop mode in the Playout settings.

To open Playout Settings dialog box, select Multiplex > Playout settings.

NOTE. The Playout functionality is not available in demo version.



H.264 ES Input Characteristics

The H.264 elementary streams used by the Multiplexer should comply with ISO/IEC-14496-10/2005 Rec. H.264. The transport stream generated by the Multiplexer should comply with ISO/IEC-13818-1/2000/AMD_3/2004.

- SEI (Supplemental enhancement information) stream support

The multiplexer detects a H.264 stream as an SEI stream if the following conditions are met:

- VUI (video usability information) packet contains the coded bit rate.
- HRD (hypothetical reference decoder) parameters are specified in the SEI packets.

- Non-SEI stream support

Those streams that are not detected as SEI streams are assumed to be non-SEI streams.

PTS/DTS Timestamp Generation

Table 1 lists the stream properties of H.264/AVC and generated transport stream characteristics.

Table 1: PTS/DTS Timestamp Updates

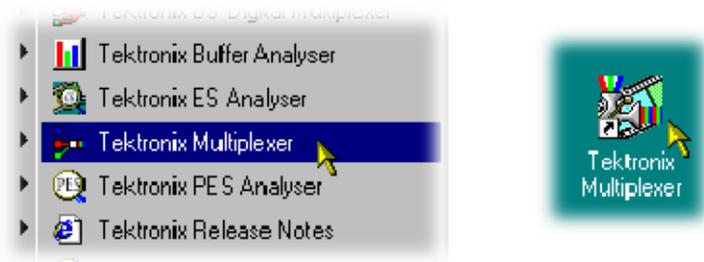
H.264/AVC stream properties			Comments	Generated TS characteristics	
SEI	VUI	BM(Valid Buffering Messages)		Bit rate	Comments
-	-	-	Stream without any buffering messages	Prompted or auto detected	TS will have PTS and DTS calculated at a constant frame rate from the VUI parameters of the stream unless you change the parameters. If the stream does not have VUI parameters 25 fps is taken as the default.
●	-	-	SEI NAL units potentially carrying private data	Prompted or auto detected	TS will have PTS and DTS calculated at a constant frame rate from the VUI parameters of the stream unless you change the parameters. If the stream does not have VUI parameters 25 fps is used as the default.
●	●	-	SEI stream without full HRD data	Prompted or auto detected	TS will have PTS and DTS calculated at a constant frame rate from the VUI parameters of the stream unless you change the parameters. If the stream does not have VUI parameters 25 fps is used as the default.
●	●	●	SEI stream with both buffering period and picture timing present (HRD Compliant)	Coded bit rate will be auto-detected	TS will carry PTS and DTS as coded by the SEI timing information.

Auto detection The stream bit rate is calculated as follows.

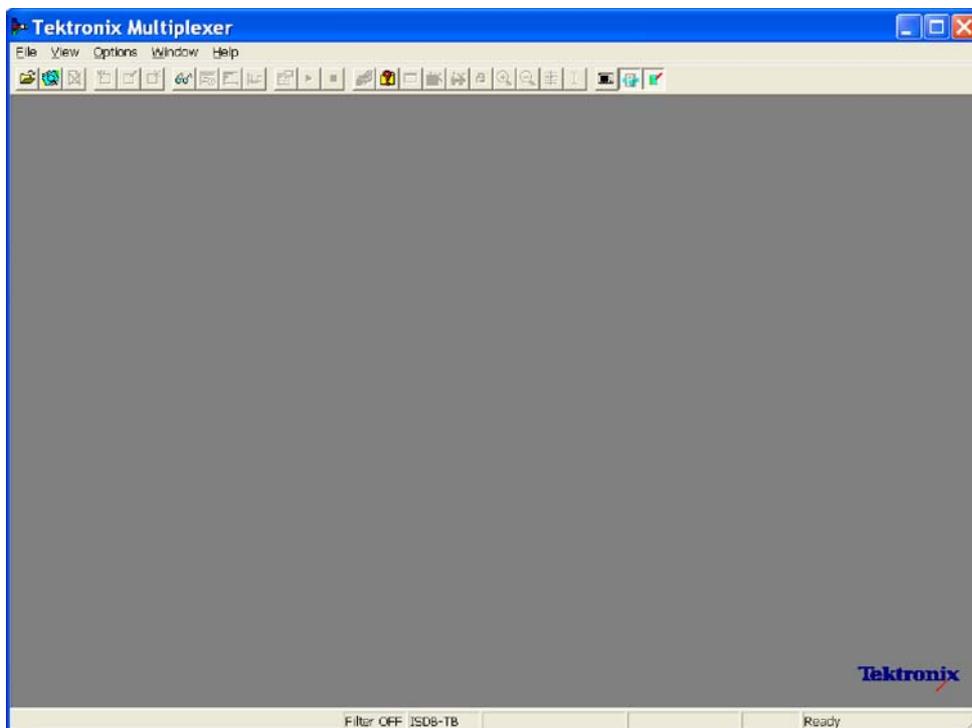
$$Bitrate = \frac{File\ Size}{(Number\ of\ Frames / Frame\ Rate)}$$

Starting the Program

The program can 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 the following illustration.



Use the View menu to select a standard that will be used to interpret transport streams, and then open a transport stream file or import a multiplex configuration file.

Initial Menu Options When the application is opened, you are presented with options relevant only to opening new or existing multiplex files. Options that are not relevant at this time are inactive (grayed out).

File Menu Options. Table 2 lists the options available in the initial File menu.

Table 2: File menu options

Command	Function
New	Opens a new multiplex configuration file.
Open	Opens an MPEG file for use. The program opens the file selection dialog box allowing you 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 23.)
Import...	Opens a previously saved multiplex configuration file.
Export	(Currently disabled - see page 23.)
Export As	(Currently disabled - see page 23.)
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 might be empty or hold less than four files. Selecting a file name opens that file for use.
Exit	Finishes running the program.

View Menu Options. Table 3 lists the options available in the initial View menu.

Table 3: View menu options

Command	Function
Interpretation	Opens the Stream Interpretation dialog box. 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.

A check mark next to an option indicates that the object is currently visible.

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, for example, MPEG-2, DVB, ATSC, and ISDB.

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

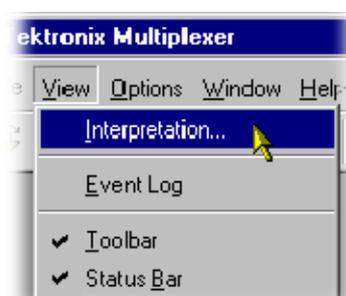
If a suitably configured script is selected and enabled before a stream is opened, custom data will be analyzed when the stream is opened. If the script is not selected or enabled, the stream will be analyzed, but any custom data will be reported as either an error in the stream configuration or as an elementary stream PID.

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

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

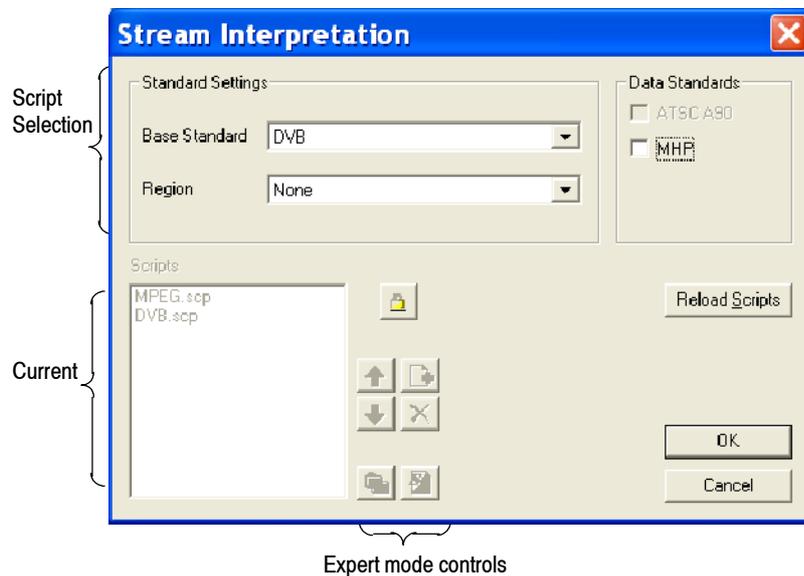
- It is present in the Scripts text box in the current analysis mode.
- It is successfully enabled by closing the Stream Interpretation dialog box using the OK button.

Handling Scripts



To open the Stream Interpretation dialog box, with all files closed, select View > Interpretation.

The Stream Interpretation dialog box is displayed as shown.



The top half of the dialog box 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.

Selecting Scripts

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

The Base Standard drop-down allows the MPEG-2, 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 specifications of the ISDB and MPEG-2 standards.

The selected standard will dictate the availability of the remaining options in the Regions and Data Standards sections.

The Regions section allows country-specific regions 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 regions add extra scripts to the current listing. As with the Base Standard, the choice of Regions option will dictate the availability of the options in the Data Standards section. The Custom selection in the Regions section allows users to include their own selection of scripts using Expert Mode controls.

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 (tektronix\scripts). Other directory locations can be specified in Expert Mode. All selections will be retained between sessions.

Checking Syntax

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 might 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 (the application has been opened or the Stream Interpretation dialog box 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 box open.

Syntax errors will be indicated and reported in the *Event Log* (see page 69).

Expert Mode



Expert Mode allows you to select and customize the scripts to be used in stream analysis and multiplexing. Note that when the expert mode is selected, the Custom region option is automatically selected and 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.



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

Table 4: Script Management

Buttons	Function
 	Script files are parsed in the order that they are listed; in some circumstances this might 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 box 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, move it using the Up and Down buttons. Scripts can be loaded from any directory.
	Delete the highlighted script.

Table 4: Script Management (Cont.)

Buttons	Function
	<p>Change scripts default directory; by default, all scripts are found in a default directory created during installation (tektronix\scripts). This button can be used to set a different default directory.</p> <p>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.</p>
	<p>View highlighted script with the associated application; by default, script files are associated with the ScriptPad utility.</p>

For a script file to be viewed successfully, the file extension (.scp) must be associated with a text editor in the Microsoft Windows environment. The MPEG Test System installation program by default associates a script editing utility called ScriptPad; you can use another text editor, for example, Microsoft 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: 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:

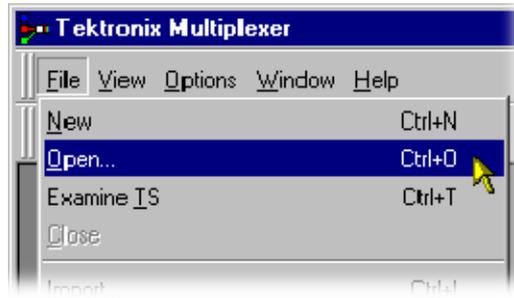
- Create a new null stream (using File > New)
- Open an existing stream
- Import a multiplexer configuration file

Opening an MPEG Stream

Any file holding a recorded or synthesized sample of a stream that conforms to the relevant standards can be opened and used as a basis for a new multiplex. Note that the Examine TS option (see page 70) can be used to preview stream.

Some nonconformant 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 File > Open. If the required file is in the list of recent files, it can be opened from the list using the Open File dialog box.



Alternatively use the Ctrl+O keyboard shortcut or drag the file from Windows Explorer and drop it into the Multiplexer window. A shortcut button is available on the Toolbar for opening a file.



Opening Multiplex Configuration Files

Any file holding a recorded or synthesized sample of a stream, which conforms to the relevant standards, can be opened. Many nonconformant 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 nonconformant streams. Having generated a nonconformant stream, it might not be possible to successfully open it again in Multiplexer.

The specification for a new transport stream can 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.

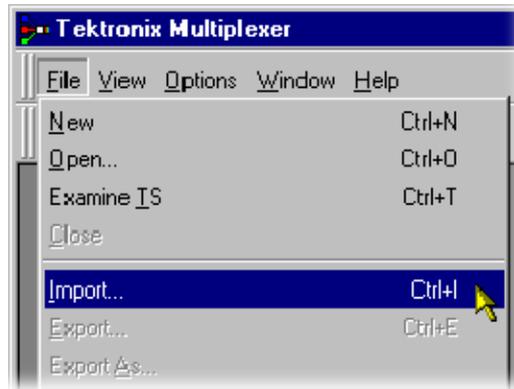
NOTE. The multiplex configuration file does not contain a copy of the transport stream; instead it refers to the original MPEG file by the full path name. Deleting or moving the MPEG file will result in a dialog box prompting for the new location of the file.

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 File > Import. If the required file is in the list of recent files, it can be opened

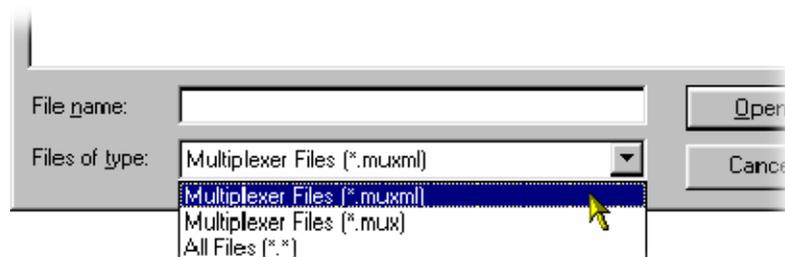
from the list to save using the Import file dialog box.



Alternatively use the Ctrl+I keyboard shortcut or drag the file from Windows Explorer and drop it into the Multiplexer window.

NOTE. Multiplexer reads the name and location of the MPEG file from the multiplex configuration file and then opens it automatically. The previously stored changes in the configuration file are applied to the display.

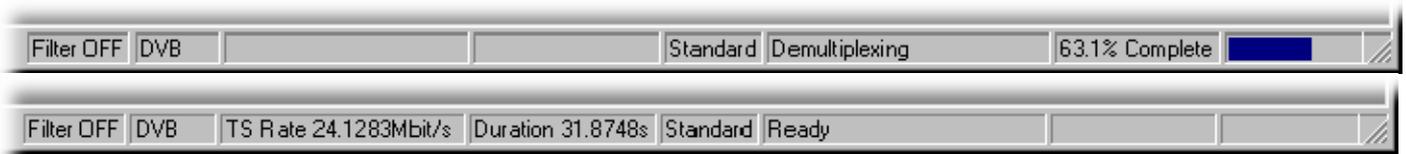
Note that the import dialog box offers a choice of file types: *.muxml, *.mux and *.*.



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 because they were analyzed in the session from which they were exported.

What to Do Next

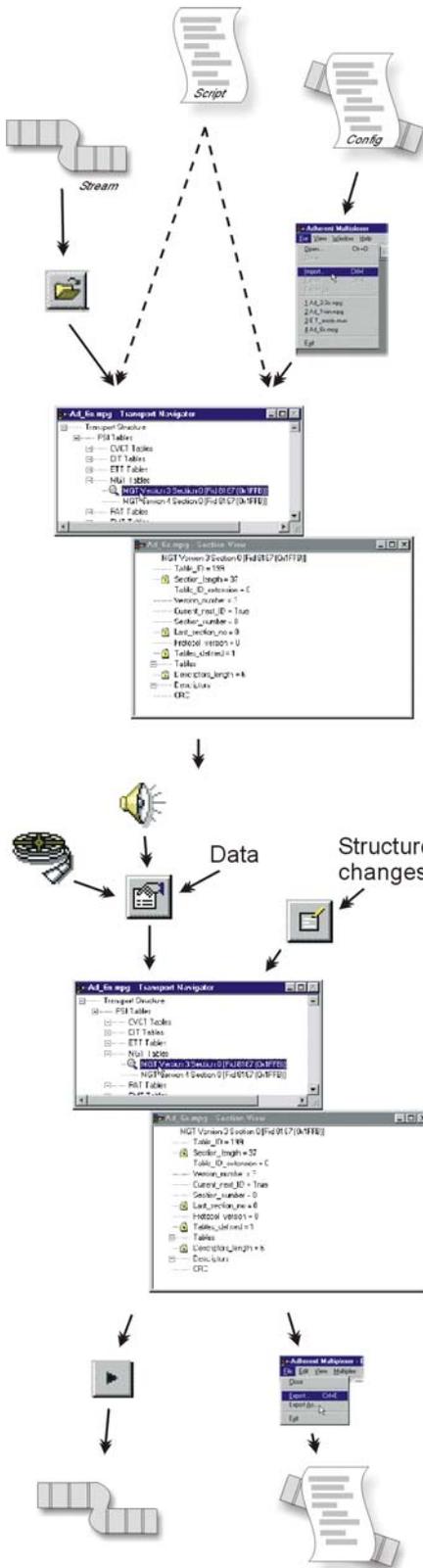
The file can now be manipulated to form a specification with which to synthesize a new transport stream. Tables, elementary streams, and PIDs are viewed and selected using the Navigator views. The components of any table selected in the Navigator views are viewed and selected using the Section View window.

Tables, Programs and PIDs can be added and modified using the wizards provided or manually. A selection of menu options is provided to facilitate manipulation of the data.

The Multiplex menu has options to inhibit and reenale forced conformance to the selected standards.

Having manipulated the file, a transport stream can be synthesized to the new specification by the multiplex engine. The engine is started from the Multiplex menu or using a toolbar button. The source file is used as reference data by Multiplexer and the output written to a different file.

The illustration on page 21 gives an overview of the Multiplex process.



Open/Import

Any file holding a recorded or synthesized sample of a stream that conforms 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*, page 18.

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*, page 19.

Transport Structure Modifications

The file can now be manipulated to act as the specification to synthesize a new transport stream. The tables and elementary streams are viewed and selected either with the aid of Wizards or in the Navigator windows.

Output/Export

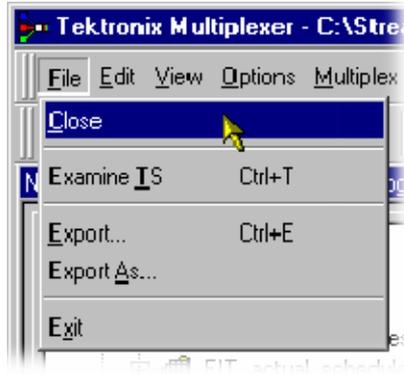
The Multiplex Engine synthesizes a new transport stream and writes it to an MPEG file.

To ensure that the specification for any synthesized stream can be reused, it can be saved to a multiplex configuration file.

See *Multiplexing Transport Streams*, page 125.

Closing Files

To close the files, select File > Close. This will close both the MPEG file and any multiplex configuration file that is open.

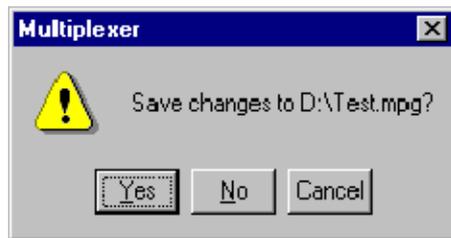


A shortcut button is also available on the Toolbar for closing a file, which has a standard file close symbol.



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.



Menus and Controls

This section describes the various menu options, toolbar controls, status bar, icons, and user interface.

Menu Options

The following pages describe all of the menu options. Since many of the options are context sensitive, they will be available only when their function is appropriate for the selected display or window element. When a menu option is not available, the option is grayed out.

File menu options

Table 5 lists the options available in the File menu.

Table 5: File menu options

Command	Function
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 option 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 the program.

Edit menu options Table 6 lists the options available in the Edit menu.

Table 6: Edit menu options

Command	Function
Add	Adds a table/section/loop to the currently selected item in the Navigator or Section View.
Modify	Edits the information in the currently selected field or item.
Delete	Deletes the item currently selected.
Cut	Cuts the current selection from the Window.
Copy	Copies the contents of the current selection to the clipboard.
Paste	Pastes data from the clipboard to the part of the transport structure that 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 as a simple data file.
Export Section Data	Extracts and exports section data. The created file can be imported as ES using Multiplexer's Add function or as SI using the Import Section Data option (see next option).
Import Section Data	Imports SI data from a file and analyzes it. The section is added to the Navigator view.

View menu options Table 7 lists the options available in the View menu.

Table 7: View menu options

Command	Function
Interpretation	Displays a read-only dialog box for viewing scripts that have been selected for analysis (see also <i>Initial Menu Options</i> , page 11).
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 Bit rate	Displays a graphical comparison of the stream bit rates.
Component Duration	Displays a graphical comparison of the stream component durations.
Available Bit rate	Displays a graphical view of the bit rate in the stream.
Properties	Opens a properties dialog box for editing the currently selected item in the Transport Navigator window.

Table 7: View menu options (Cont.)

Command	Function
Zoom In	Zooms in the Available Bit rate and Component Duration views.
Zoom Out	Zooms out from the Available Bit rate and Component Duration views.
Synchronize	Synchronizes zoom levels of the Available Bit rate and Component Duration views (toggle).
Show Cursor	Shows or hides the cursor in the Available Bit rate and Component Duration views.
Toolbar	Shows or hides the Toolbar.
Status Bar	Shows or hides the Status Bar.

Options menu options

Table 8 lists the options available in the Options menu.

Table 8: Options menu options

Command	Function
Display Filter	Opens the SI Filter dialog box.
Single Section View	Selects single or multiple section view. When disabled, multiple section views can be opened.
Program Wizard	Invokes the Program wizard.
Transport Wizard	Invokes the Transport wizard.
Scan Settings	Opens the Scan Settings dialog box.

Multiplex menu options

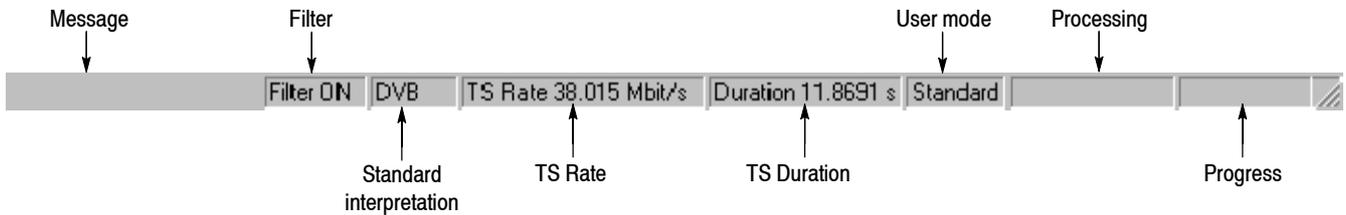
Table 9 lists the options available in the Multiplex menu.

Table 9: Multiplex menu options

Command	Function
Start	Starts the Multiplex Engine, to synthesize a new transport stream file.
Stop	Aborts multiplexing. The output file is closed and contains all of the data synthesized 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 that can be generated automatically.
Expert Mode	Inhibits the above conformance checking so that nonconformant files can 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 box in which the Make seamless parameters are specified.
Playout	When enabled, generates and captures MPEG-2 transport streams that are compliant with ATSC, DVB, and ARIB standards. This option is not available in demo version.
Playout Settings	Opens the Playout Settings dialogbox in which, the path of the MPEG player application and the folder where the temporary files are specified. This option is not available in demo version.
Loop	Sets whether the stream is output using the looping method. This option is not available in demo version.
Update	Opens a dialog box in which the parameters in a stream are updated when looped. This option is not available in demo version.

Status Bar

The Status Bar might be hidden from view, but when displayed it is always at the bottom of the main window. For example:



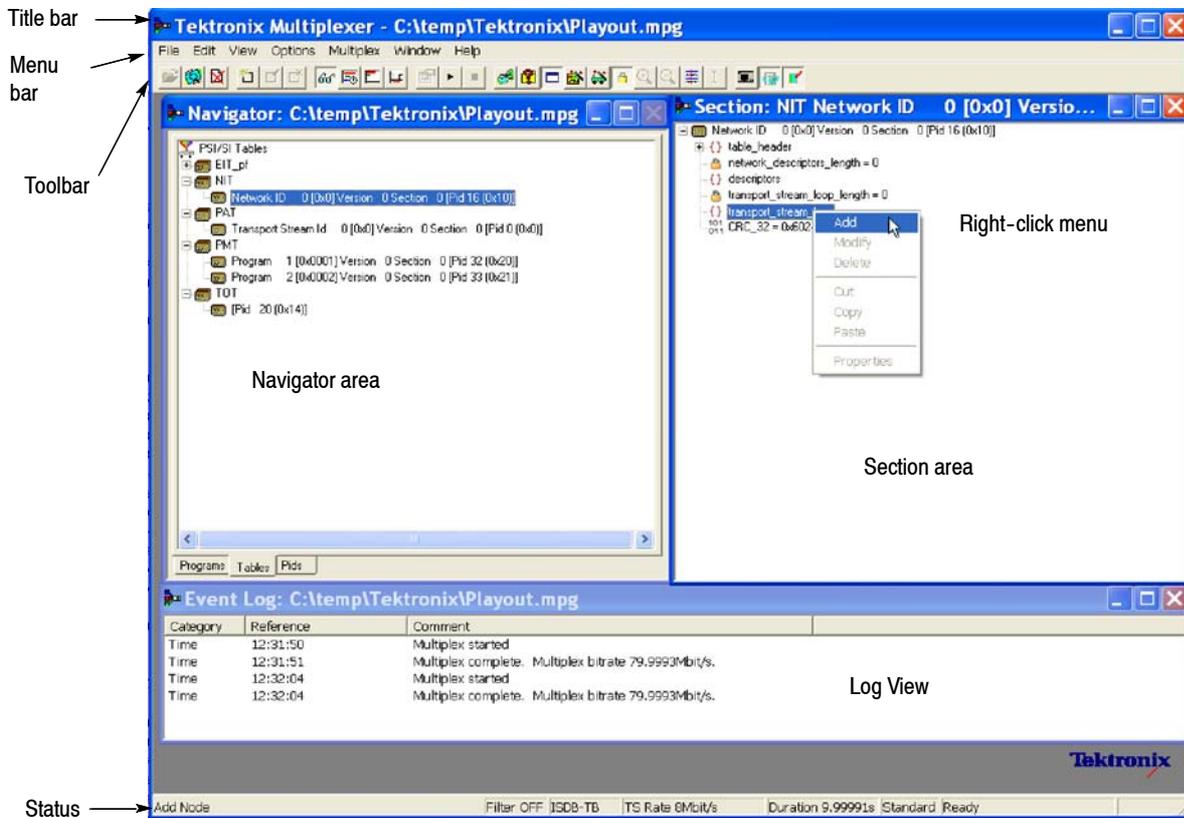
The following information is displayed from left to right on the Status Bar:

Message Field	Provides a description of any button or menu option over which the cursor pointer is placed. Other noncritical messages might also be shown.
Filter Status	Indicates the status (On/Off) of the SI Filter.
Standard Interpretation	Indicates the selected standard with which the file is processed: MPEG-2, ATSC, DVB, or ISDB.
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. The Standard mode prevents changes to certain fields. The Expert mode enables editing.
Processing Status	Indicates the progress (%) during initial analysis and multiplexing.
Processing Progress	Indicates the progress during initial analysis and multiplexing.

The Status bar can be hidden from view by selecting View > Status Bar.

NOTE. The status bar (Standard interpretation) displays ISDB-T SS whenever the ISDB interpretation with Single segment extension is selected. Similarly, when the Brazil Single segment is selected, the status bar displays ISDB-TB SS.

User Interface



NOTE. The Menu Bar contains the complete selection of options available in the Multiplexer. Shortcuts to options are available through the toolbar and context-sensitive shortcut menus.

Icons Icons are used throughout the Multiplexer user interface to assist you to identify components and make visual links with toolbar shortcuts and menu options.

The following table lists all the icons used.

Table 12: Icons

Icon	Description	Icon	Description
	About Multiplexer		Program
	Add		Program Group
	Audio stream		Program Wizard
	Bit field		Properties
	Close		Report
	Container/Loop		Seamless
	Copy		Seamless Settings
	Current selection		Section
	Cut		Section timing
	Delete		Section View
	Display Filter dialog box		Single window
	Examine Transport Stream		Standard mode
	Exit		Start
	Expert mode		Stop
	Export		Table

Table 12: Icons (Cont.)

Icon	Description	Icon	Description
	Export As		Transport Stream icon
	Export Elementary Stream		Transport Wizard
	Export Payload		Unknown
	Export Section Data		Video stream
	Import Section Data		View Event Log
	Modify		View Component Duration
	New		View Component Bit rate
	Open		View Available Bit Rate
	Paste		Playout
			Loop
			Update

NOTE. The Playout, Loop and Update icons are not available in demo version.

Cutting and Pasting

Table types, sections, and PIDs can be cut, copied, and pasted using the Windows clipboard. Only one selection can be held on the clipboard at a time. Alternatively, a selection can be dragged and dropped using the mouse.

Cutting a Selection to the Clipboard. A selection (table type, section or PID) can be deleted and automatically placed on the Windows clipboard. It can then be pasted to a different file or back into the current file. Highlight the selection in the Navigator Tables or PIDs view and select Edit > Cut or use the Ctrl+X keyboard shortcut.

Copying a Selection to the Clipboard. A selection (table type, section or PID) can 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 selection in the Navigator Tables or PIDs view and then select Edit > Copy or use the Ctrl+C keyboard shortcut.

Pasting a Selection from the Clipboard. More than one instance of Multiplexer can run concurrently on a machine. A selection (table type, section, or PID) can 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 (that is, in an instance of Multiplexer). Then select Edit > Paste 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, the main uses of the drag and drop feature are to modify multiplexes and to build new 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. Only the MPEG aspects of the transport structure are updated. Tables specific to DVB and ATSC are not updated.

Manipulation in Program view. The following manipulations are available in the 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, for example, DVB SDT.
- Where a conflict occurs with the target, new values will be allocated for the Program and PID numbers.
- Elementary streams can also be dragged and dropped between Program Views. They can be dropped only onto the elementary stream root node.
- An elementary stream can 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 box is activated.

Wizards

In the Navigator Programs view, wizards provide you 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 box will dictate which PSI/SI components are offered.

There are two major wizards: the Transport Wizard and the Program Wizard. Other minor wizards can be opened by these major wizards or they can be opened in a new window to facilitate specific tasks, such as adding EIT information. When configuring a new multiplex, the Transport Wizard is opened, 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 opens. For some detailed operations, only the appropriate wizard can be opened.

At their most basic level, wizards open, in a logical order, the property dialog boxes that are available when building a stream manually.

The following paragraphs provide a step-by-step description of the wizards.

Wizard Controls

The following control buttons are provided on the wizard dialog boxes where relevant:

Next	Retain changes made using this dialog box and move to next dialog box.
Back	Discard changes made using this dialog box and return to the previous dialog box.
Cancel	Exit the wizard and discard all changes.
Finish	Exit the wizard and implement all changes.

Transport Wizard

Toolbar icon: 

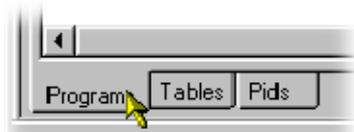
The Transport wizard allows you to easily create a basic stream populated with the PSI/SI necessary to hold program information. It can also be opened when PSI/SI is to be added to an existing stream.

Creating a New Transport Stream

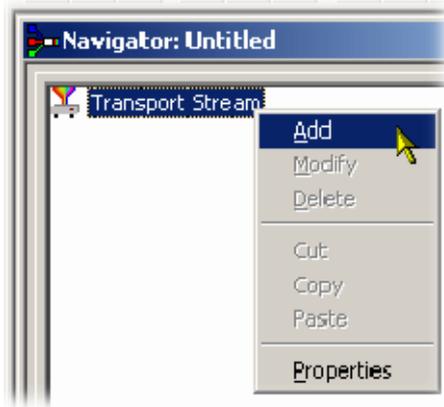
The following steps show the screens used in the creation of a DVB stream.

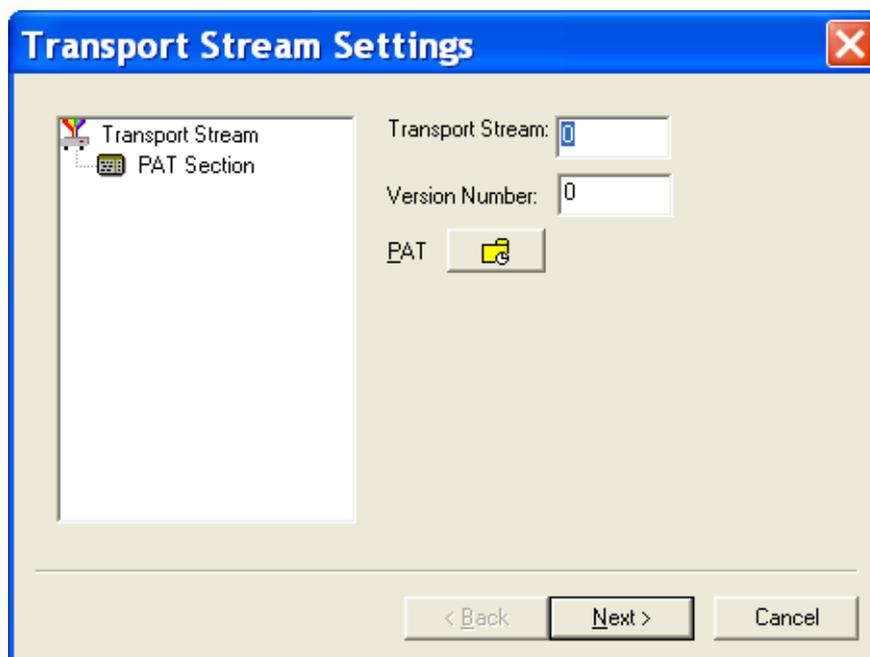
NOTE. When the Transport Wizard is used to populate a new stream, if the defaults in the various dialog boxes are retained, then the resulting stream will conform to the selected standard.

1. Open a new file; File > New.
2. Select the Program tab in the Navigator view.



3. 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.
4. Select Add from the shortcut menu.



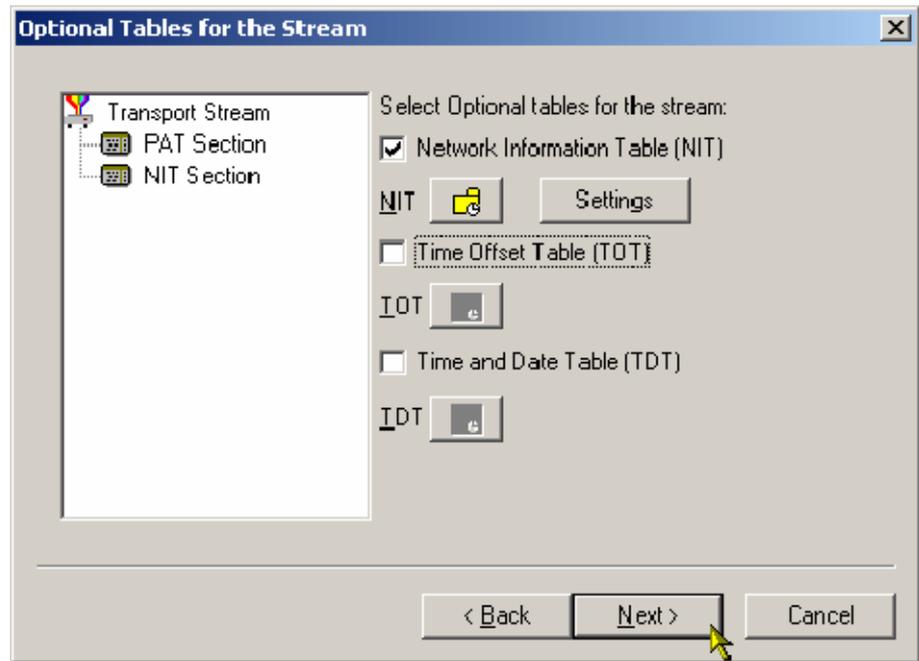


The Transport Stream Settings dialog box allows you to set up the transport stream identity (part of the PAT section) and version. Adjustments can also be made to the PAT timing, if required, by selecting the PAT button.

PAT timing - see *Editing PSI/SI Table Properties*, page 98.

NOTE. You cannot add a PAT with the ISDB or ISDB-TB interpretation and Single segment extension selected. When you click Add, Add a Program wizard is displayed instead of the Transport Stream Settings.

5. Select Next to move to the Optional Tables dialog box.
6. This dialog box allows you to include, and if required, configure basic PSI/SI information.



As the check box 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 98

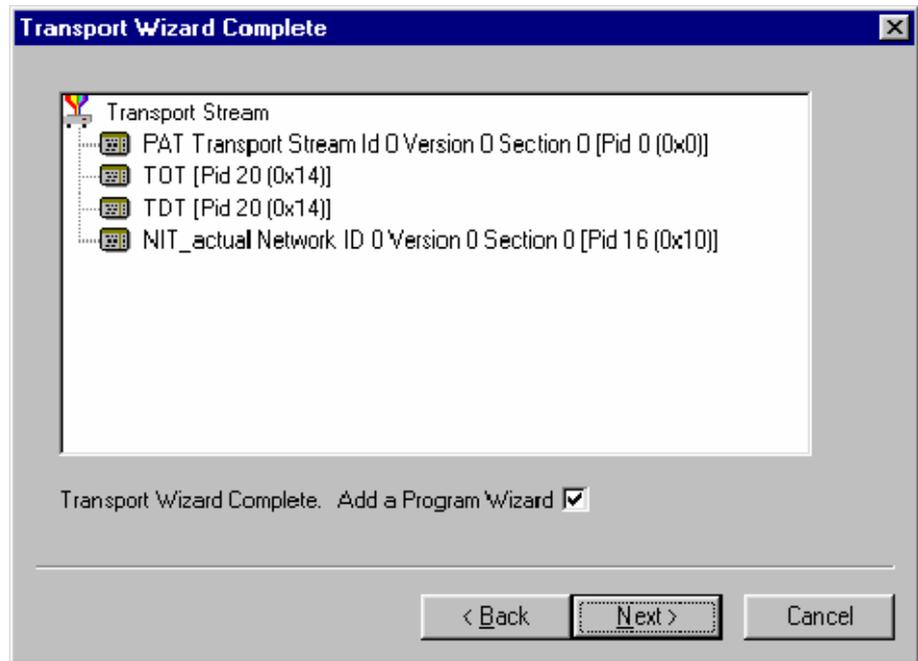
NIT Settings

The screenshot shows a dialog box titled "Set up the Nit". It contains the following fields and controls:

- Version: 0
- Network Id: 1 (Astra Satellite Network 19.2E)
- Network Name: Astra Satellite Network 19.2°E
- Transport Stream: (empty)
- Original Network Id: 0
- Delivery System: Terrestrial
- Settings button (next to Delivery System)
- OK button
- Cancel button

To set up the Network Information Table (NIT), enter or select the required values and select the OK button. Note that if a Delivery System other than Undefined is selected, an additional settings dialog box becomes available, specific to the Delivery System chosen.

7. Select Next to move to the Transport Wizard Complete dialog box.



This dialog box allows you to review the changes made by the wizard before confirming the process.

The process can be cancelled, thereby losing all changes, by selecting the Cancel button.

At this stage in the creation of a new multiplex, if you want to add programs, leave the Add Program Wizard check box enabled and select Next. If you want to add them by some other means, clear the Add a Program Wizard check box. The Next button label will change to Finish, which allows you 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

Toolbar Icon: 

The Program Wizard allows you to add programs as required to a stream that is 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 opened each time.

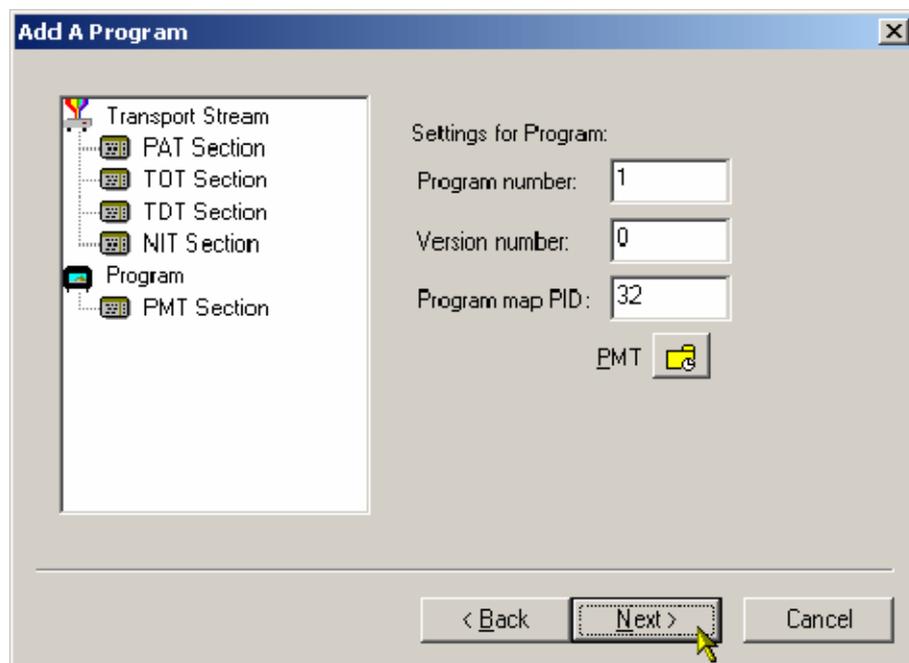
If a new stream is being created, the Transport Wizard offers an opportunity to open the Program Wizard. Alternatively, in the Navigator Programs view, highlight the Programs node and select Add from the shortcut menu.

Adding a Program to a Transport Stream

To add a program to the transport stream, follow these steps:

NOTE. If, when the Program Wizard is used to add programs to a stream, the defaults in the various dialog boxes are retained, the resulting stream will conform to the DVB standard.

1. When you open the Program Wizard, either as a continuation of creating a new stream or as an attempt to add a new program, a dialog box similar to that shown below is displayed:



The values placed automatically in the three displayed fields will be the next in the sequence of programs. (In the example screen, 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.)

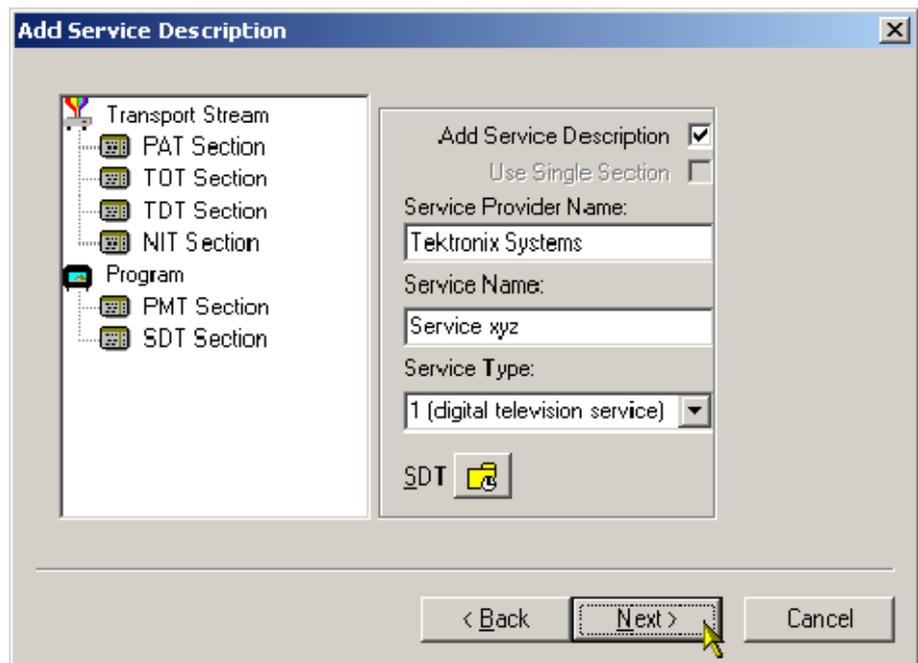
PMT Timing - see *Editing PSI/SI Table Properties*, page 98.

2. Select Next to move to the Add Service Description dialog box.

NOTE. If ISDB interpretation with Single Segment extension is selected the program number starts from 8 (default). However, you can enter numbers from 1 to 7.

Service Description Dialog Box

The Service Description dialog box allows you to identify the Service Provider to be associated with a program.



3. By default, the Add Service Description check box 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.

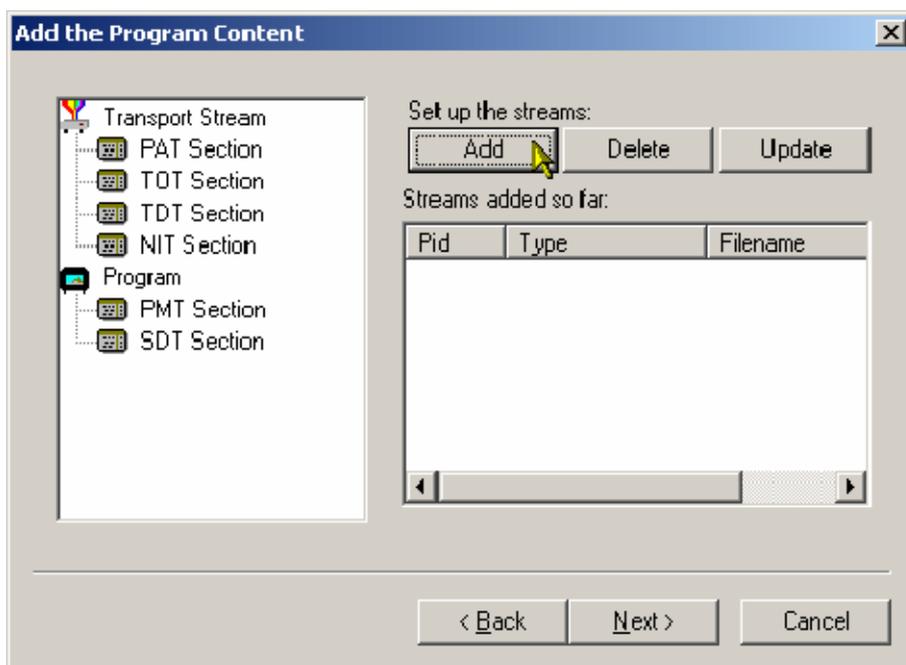
Enabling the Use Single Section check box will cause the SDT descriptors to be added to the existing SDT section. If the stream contains no SDT section, the check box is disabled.

SDT timing - see *Editing PSI/SI Table Properties*, page 98.

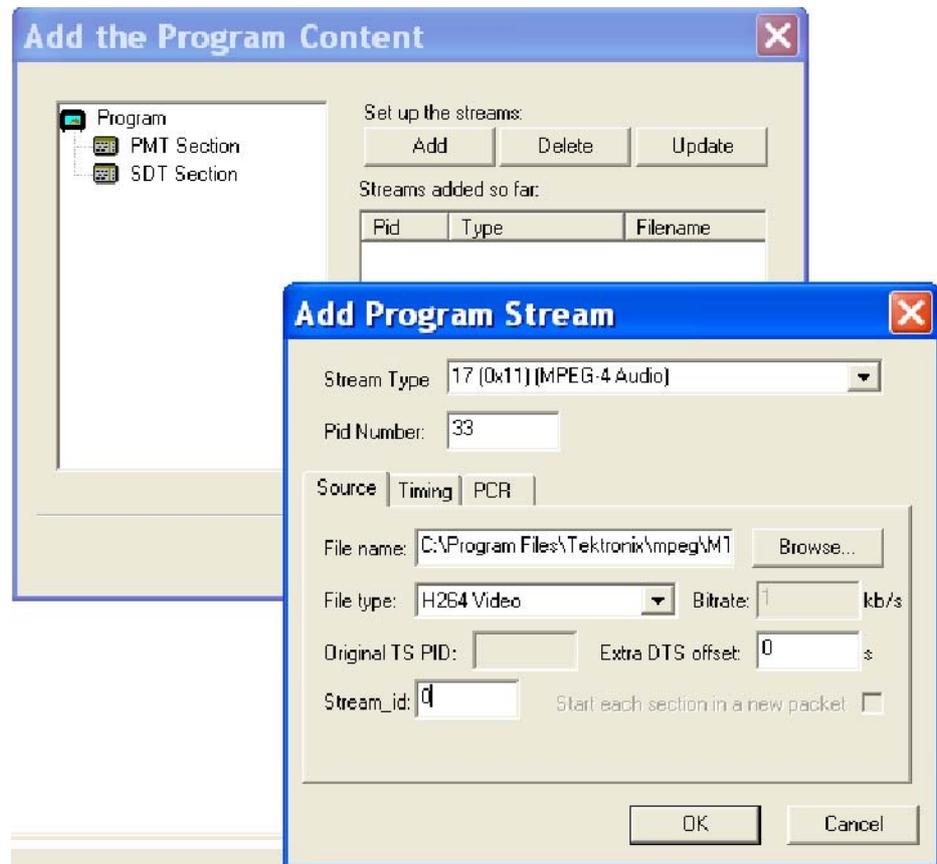
4. Select Next to move to the Program Content dialog box.

Program Content Dialog Box

This dialog box allows you to compile a list of elementary streams to be associated with the program in the final multiplex.



5. Select Add to display the Add Program Stream dialog box.



This dialog box allows you to identify elementary streams to be included in the new multiplex. You must specify the PID and 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, for example, the Event Information Table.

The dialog box consists of three tabbed pages that specify the source of the stream, its timing within the multiplex, and whether it should be carrying a PCR PID.

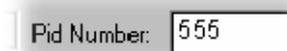
6. Select a Stream Type from the drop-down list.



This will be the Stream Type allocated to the stream in the new multiplex.

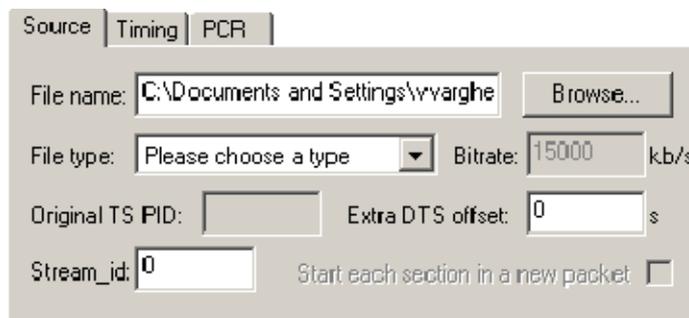
NOTE. The Stream Type drop-down list displays the previously selected stream as the default type.

7. Allocate a PID Number in which the elementary stream is to be carried.



8. Enable the Component Tag check box, if required. Enter a Component Tag number (0-255) in the enabled field.

Source Tab. The Source tab of the Add Program dialog box is used to select and specify elementary streams to be included in the new multiplex.



9. Enter an elementary stream File Name. You can enter it directly or use the Browse button to open a standard Windows file selection dialog box.
10. Select the File type of the selected stream from the drop-down list.
 - If you select MPEG-2 video, the bit rate is detected automatically and displayed in the Bit rate field.
 - If you select H.264 video with SEI messages, the bit rate is detected automatically and displayed in the Bit rate field.

- If you select H.264 video without SEI messages, the bit rate is not detected automatically.
- When the selected file type does not match with the selected file name, an error message is displayed and you will have to reselect the correct file type.



The remaining fields on this tab will be enabled or disabled depending on the Stream Type selected. Complete the enabled fields as necessary.

11. If you select H.264 video with SEI stream, a Suppress PTS/DTS insertion check box is displayed. The PTS/DTS insertion can be suppressed by selecting this check box.



Enter Bit rate for H.264 non-SEI streams. You can assign the bit rate in the following ways:

- If you know the actual bit rate of the ES, enter the value in the Bit rate field. Select the frame rate from Frame rate box and click Accept. The entered bit rate will be displayed in the Bit rate field of the Source tab.

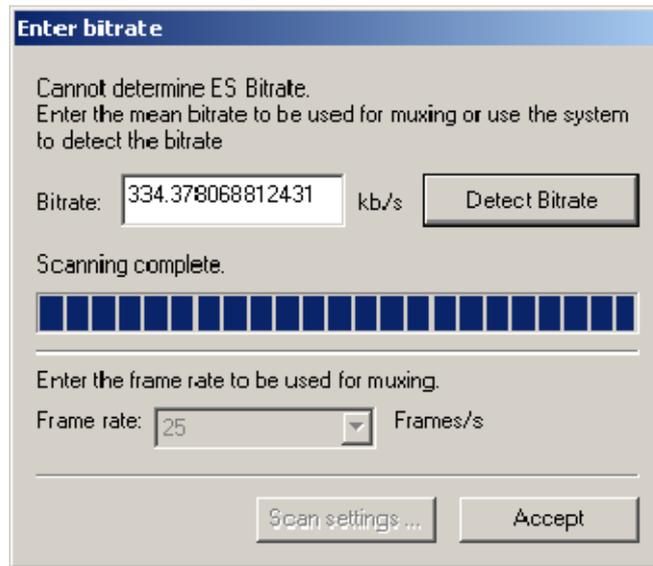
Enter bitrate

Cannot determine ES Bitrate.
Enter the mean bitrate to be used for muxing or use the system to detect the bitrate

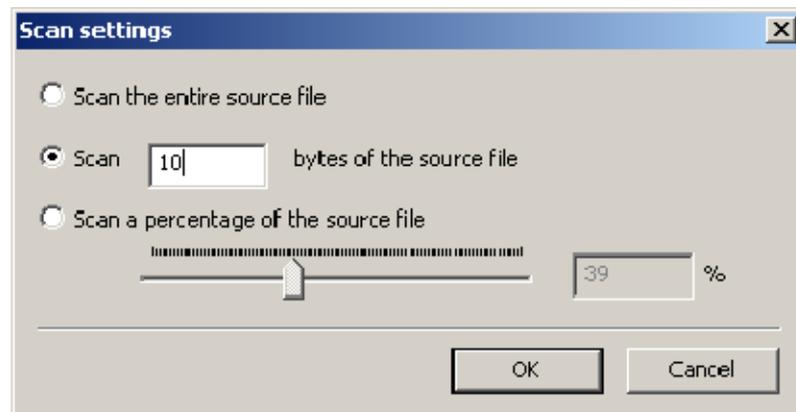
Bitrate: kb/s

Enter the frame rate to be used for muxing.
Frame rate: Frames/s

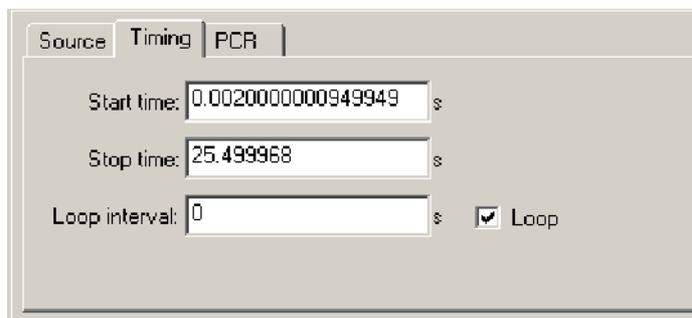
- If you want the Multiplexer to auto detect the possible bit rate, select the Frame rate and click Detect Bit rate. A progress bar is displayed giving the percentage of the scan completed and the bit rate is automatically filled in the Bit rate field of the Source tab.



You can detect the bit rate by setting the scan value in the Scan settings dialog box. Select the options accordingly to scan the entire source file, bytes of the source file, or percentage of the source file.

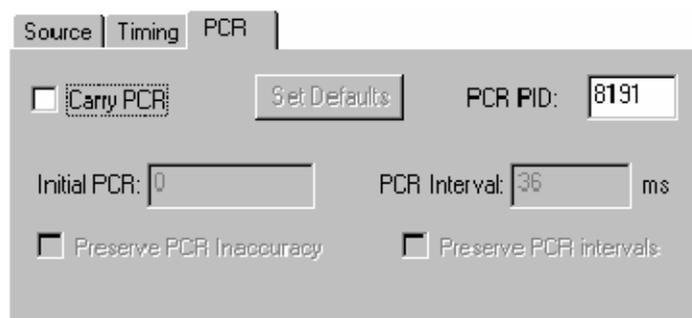


Timing Tab. The Timing tab of the Add Program dialog box is used to specify the portion of the new multiplex that the selected stream will use. The default start time is set to 0.002 s.



12. Complete the fields as required. The default settings assume that the stream is to be carried throughout the new multiplex, looping if necessary.

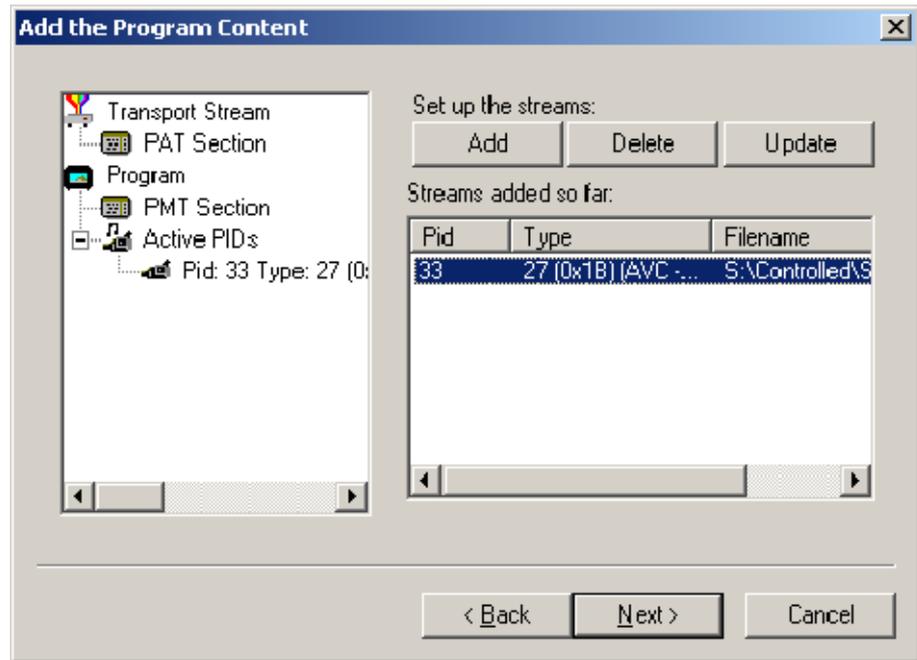
PCR Tab. The PCR tab of the Add Program dialog box is used to specify whether PCR information should be carried with the selected elementary stream or in a separate associated PID.



13. If the PCR is to be held in an associated PID, disable the Carry PCR check box and enter a PCR PID number.
14. If the PCR is to be carried with the stream, enable the Carry PCR check box and complete the remaining fields as required.

Set Defaults returns the settings to their initial values.

15. Select the OK button to complete adding an elementary stream to the listing in the Program Wizard.
16. 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.



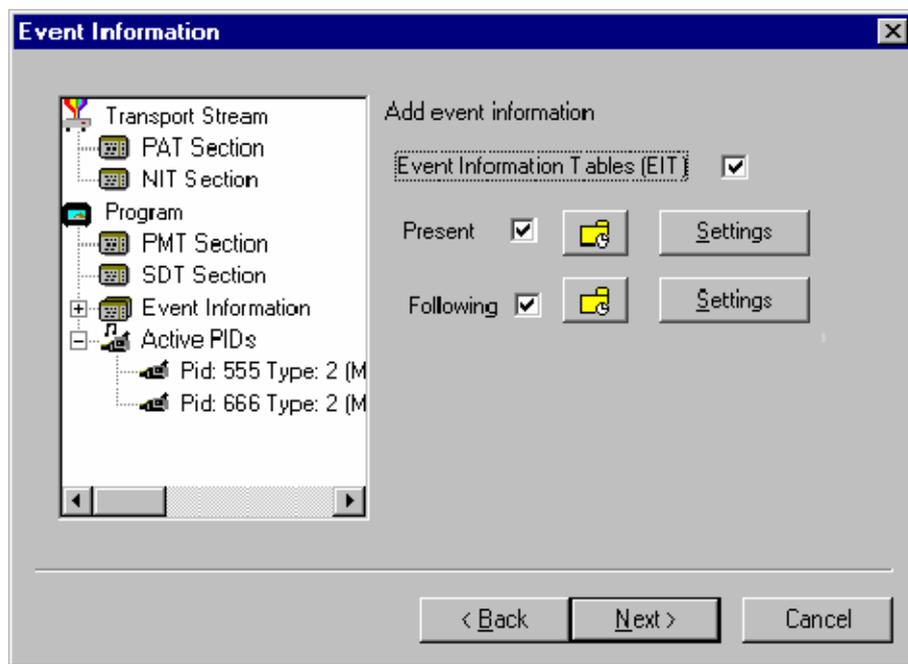
This completes the addition of one or more program streams.

17. Select Next to move to the Event Information dialog box.

For more details about the fields on these tabs, refer to *Adding an Unreferenced Elementary Stream*, page 105.

Event Information Dialog Box

The Event Information dialog box allows you to add Present and Following event information.



18. If the Event Information Table (EIT) is to be included in the multiplex, enable the Event Information Table check box.

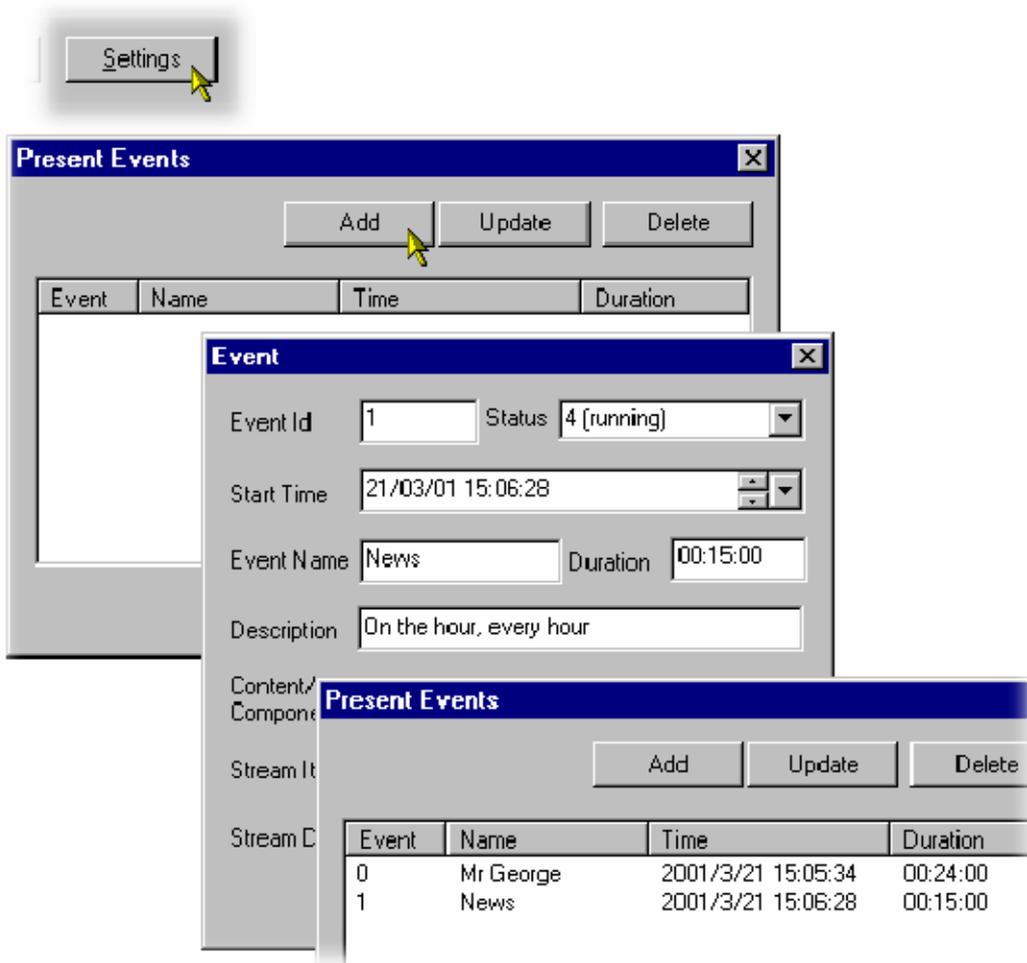
19. Enable the Present and Following check boxes as required.



Present/Following timing -

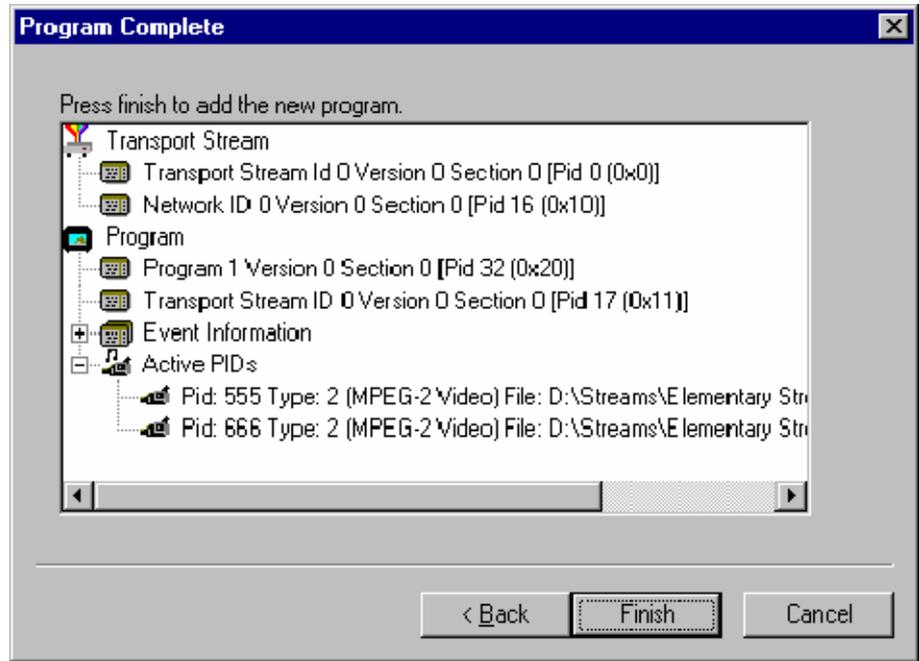
For more information on Present/Following timing see *Editing PSI/SI Table Properties*, page 98.

20. Use the Settings buttons to open the Present/Following Events dialog box and add and specify events as required.
21. Select Next to move to the Program Complete dialog box.



Program Complete Dialog Box

The Program Complete dialog box provides you with a summary of the created Transport Structure.



22. To confirm and implement the Transport Structure, select the Finish button. Note that the proposed structure is created in the Navigator views.

This completes the procedure of adding a program to a transport stream using the Program Wizard.



Views

The Multiplexer contains 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.

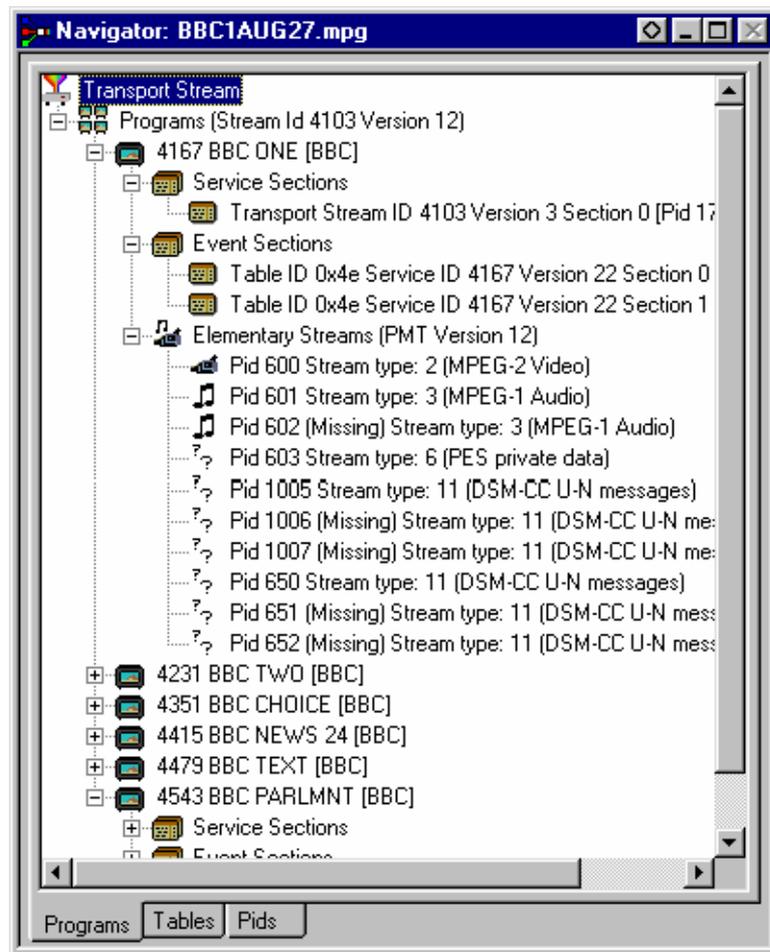
Each available view displays a different aspect or level of detail of stream analysis and manipulation.

Navigator Views

The Navigator view contains three subviews or tabs: Programs, Tables, and PIDs.

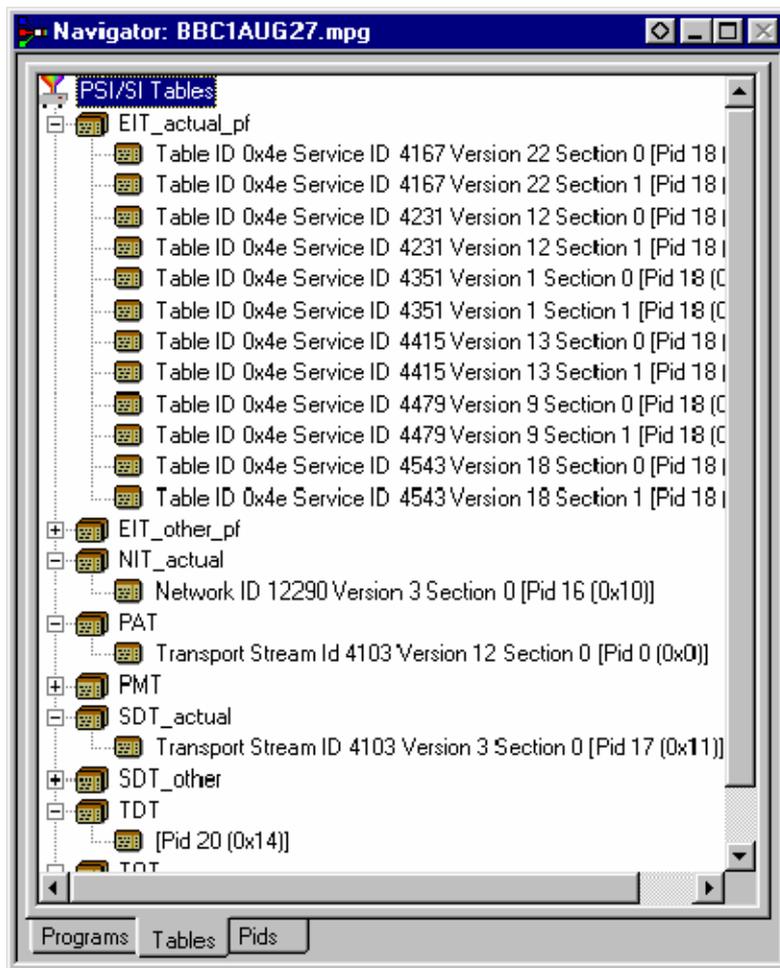
Program Views

The Navigator Programs view extracts and displays system information that is relevant to programs. Information that is not directly related to programs (for example, NIT), or that has not been incorporated into a program (for example, elementary streams not listed in a PMT) will be omitted from the Program view. The system information is still available for viewing in the Navigator Tables and PIDs views.



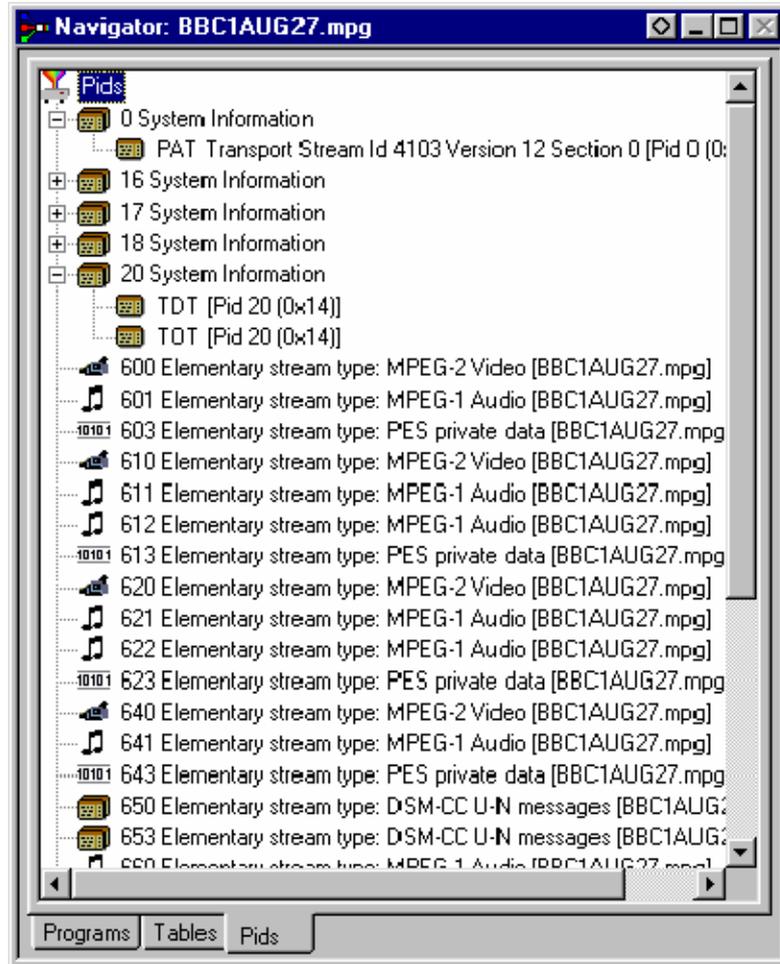
Manipulation of programs and elementary streams should take place from the Program view.

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.

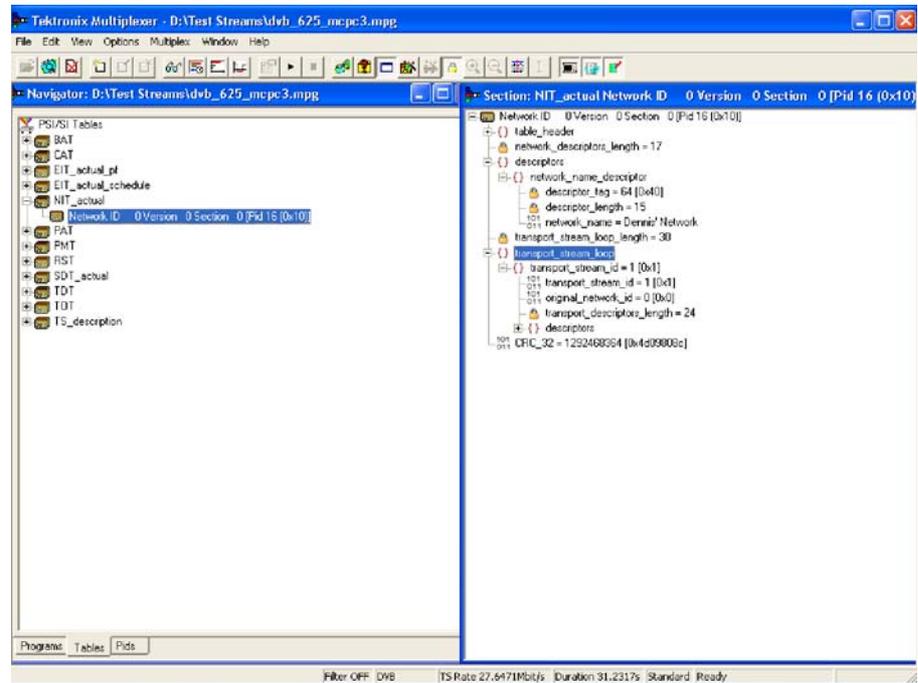


PSI/SI table types are identified in the section nodes of System Information nodes.

Elementary stream PIDs are identified by source and type where possible.

Section View

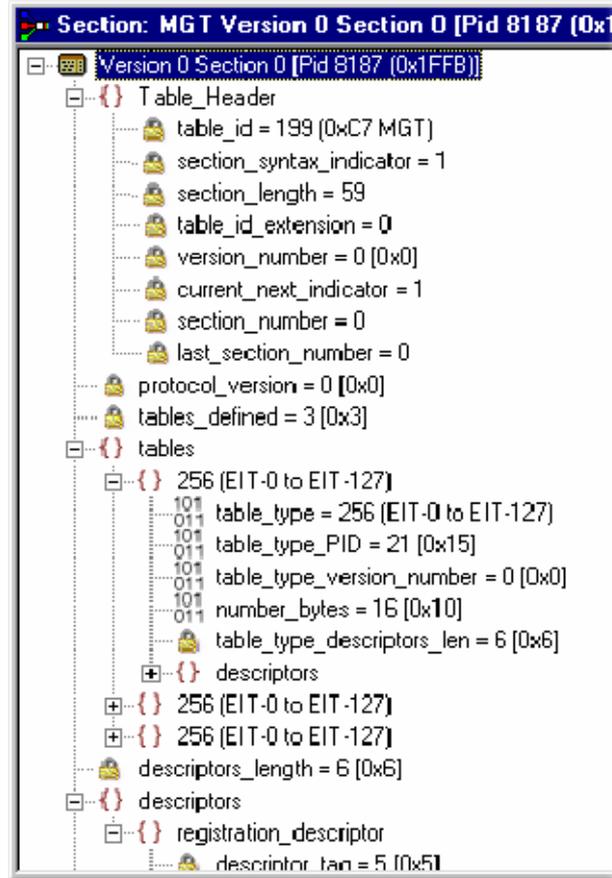
The Section View displays the contents of the currently selected section in any of the Navigator views.



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 that those items have restricted access due to the mode of user operation: Expert or Standard.

Syntax of a Section The following diagram shows 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++) {

```

```

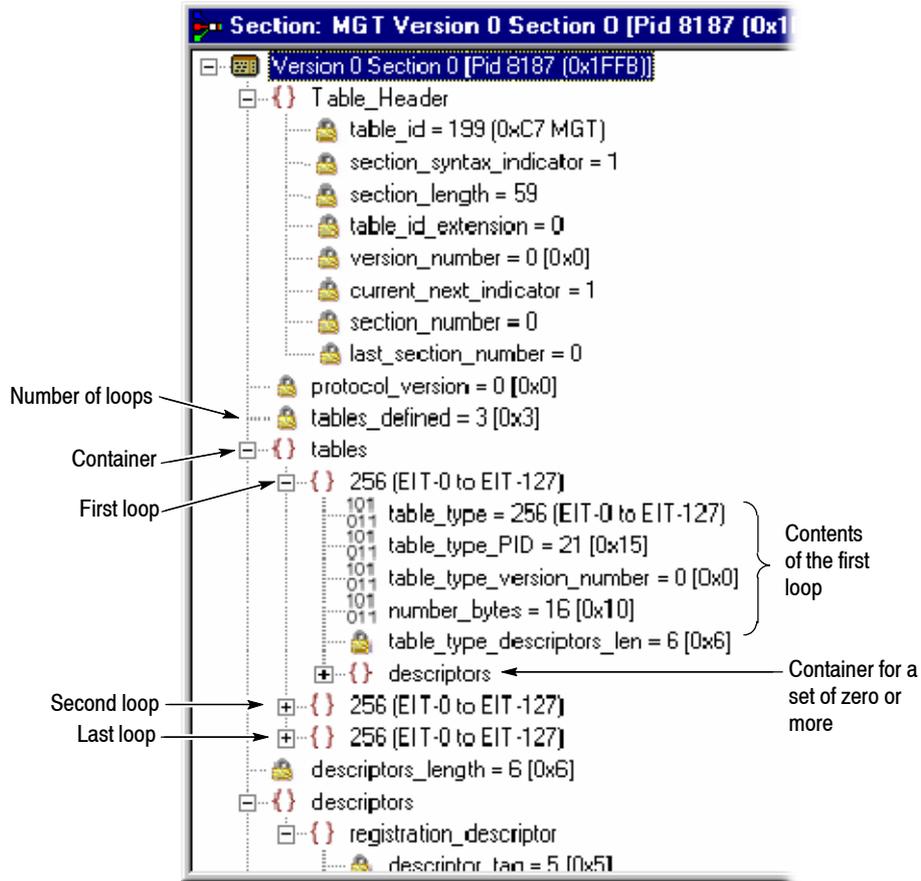
    table_type
    reserved
    table_type_PID
    reserved
    table_type_version_number
    number_bytes
    reserved
    table_type_descriptors_length
    for (k=0;k<N;k++)
        descriptor()
    }
    reserved
    descriptor_tag
    descriptors_length
    for (I = 0;I < N;I++)
        descriptor()
    CRC_32
}

```

The terms used in this manual to describe the components, represented by nodes, in the structure diagram are:

Container	A term used to describe a node in the structure diagram which can 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 subordinate loops. The structure diagram shows each loop as a node with the fields and subordinate 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:



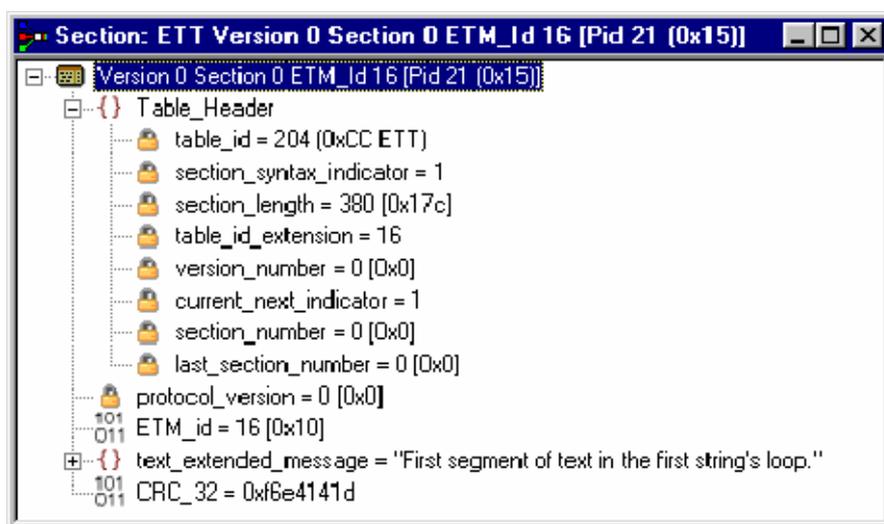
The loop for the first table, EIT-0 has been expanded to show the fields and subordinate loops that it contains.

Syntax of a Multiple String Structure

The ATSC standard A65 defines a data structure called the Multiple String Structure. An instance of this structure can contain zero or more strings and each string can 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.

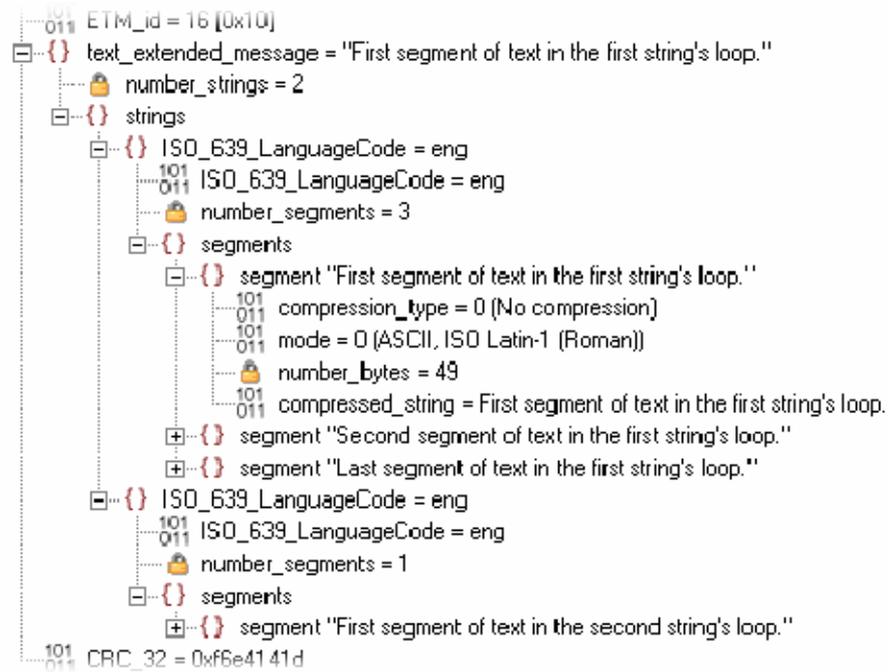
Expanding the node reveals a `number_strings` field which specifies the number of strings and a container which holds them (strings):

```
ETM_id = 16 [0x10]
text_extended_message = "First segment of text in the first string's loop."
number_strings = 2
strings
CRC_32 = 0xf6e4141d
```

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.

```
ETM_id = 16 [0x10]
text_extended_message = "First segment of text in the first string's loop."
number_strings = 2
strings
  ISO_639_LanguageCode = eng
  ISO_639_LanguageCode = eng
CRC_32 = 0xf6e4141d
```

Expanding each of the strings reveals the number of segments (`number_segments`) that make up each string and a `segments` container. Similarly, expanding the `segments` container reveals segments.

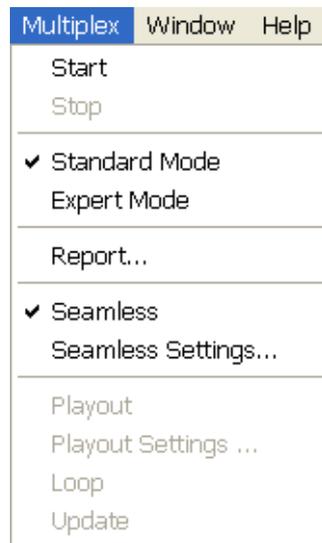


The contents of each segment loop define what compression and character set are used, followed by the actual text. The text is held in the compressed_string field.

Expert and Standard Modes

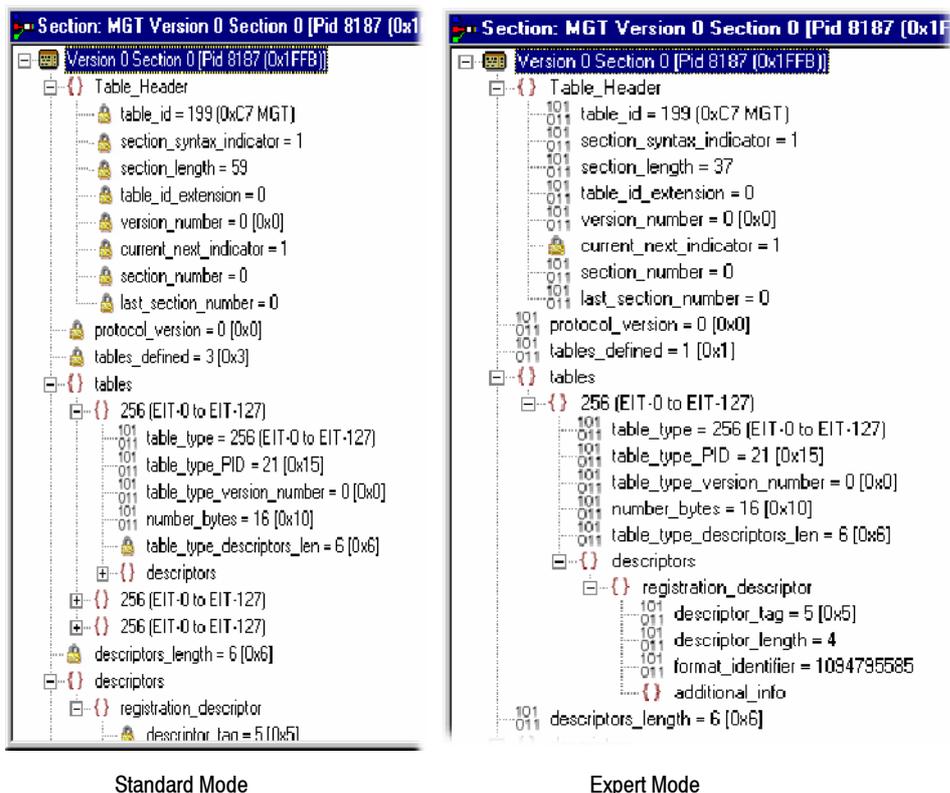
The Multiplexer has two modes of operation for conformance checking when editing table contents. These are selected from the Multiplex menu. The checks that affect the Navigator are:

- Standard Mode** Prevents changing the PID of a table whose PID number is specified in the standard, for example, 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.



An adjacent check mark indicates the mode selected. The mode is also indicated 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 screens below show the same tables in Standard and Expert mode.



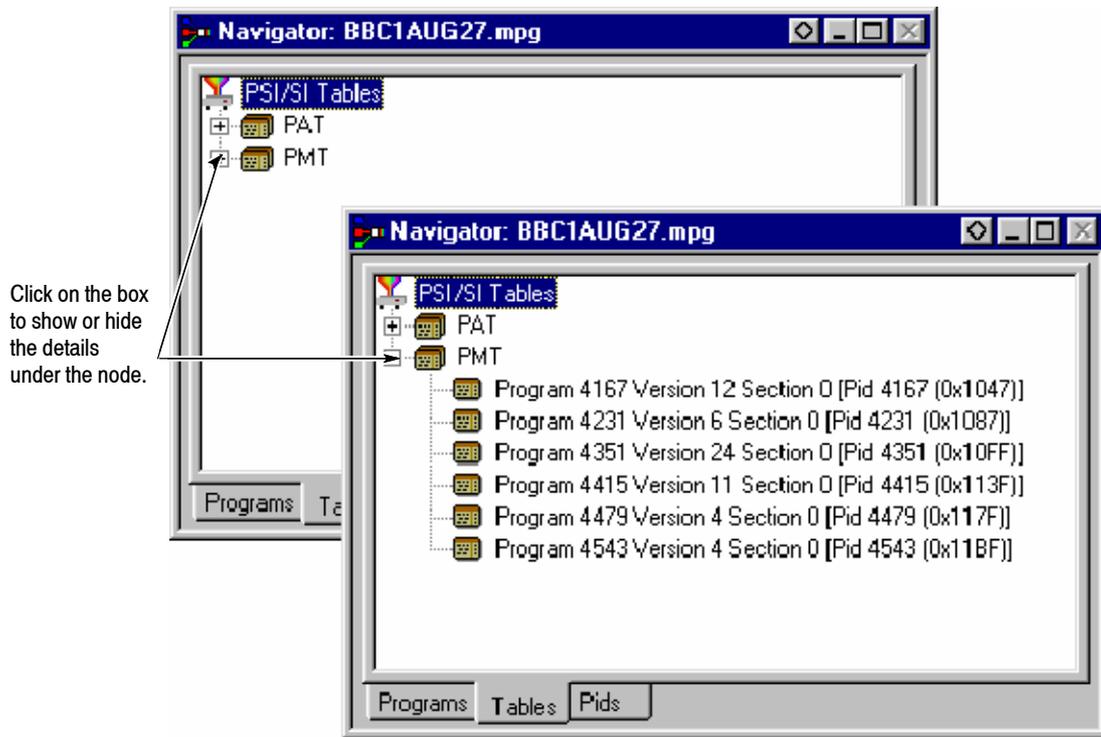
NOTE. The *current_next_indicator* in both Standard and Expert mode cannot be edited. This is because the field is affected solely by the Section Properties concerned with Version Timing (see Version Timing, page 100).

The selected mode is also reflected in the Wizards that are 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.

NOTE. The section view might need to be closed and reopened in order to update the padlock icons.

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) can be hidden by clicking the mouse pointer on the box.

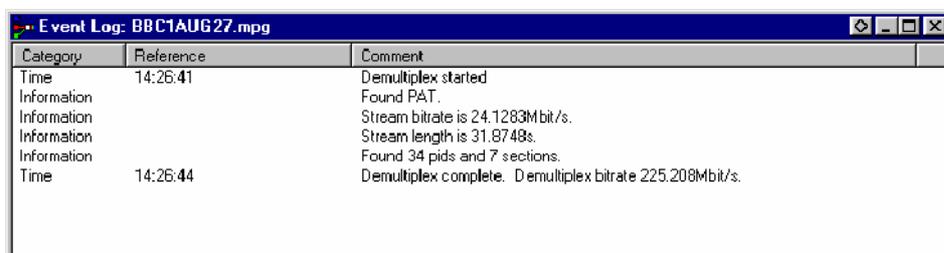
If the box contains a plus sign, there is another level in the node that is currently hidden. Click the mouse pointer on the box to display the next level of information under the node.

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 that cannot be edited directly are indicated by a padlock symbol, . This protection can be switched off by selecting Expert Mode from the Multiplex menu. It can be reenabled 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 can 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 PEES PID, and a Demultiplex complete message are written in the Event Log.



Category	Reference	Comment
Time	14:26:41	Demultiplex started
Information		Found PAT.
Information		Stream bitrate is 24.1283Mbit/s.
Information		Stream length is 31.8748s.
Information		Found 34 pids and 7 sections.
Time	14:26:44	Demultiplex complete. Demultiplex bitrate 225.208Mbit/s.

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 bit rate at which the demultiplex or the multiplex is performed is given in the Event Log. This is in addition to the stream bit rate derived from the stream itself.

When synthesizing a new transport stream any errors or warnings about the new stream are written to the Event Log between the start and completed messages.

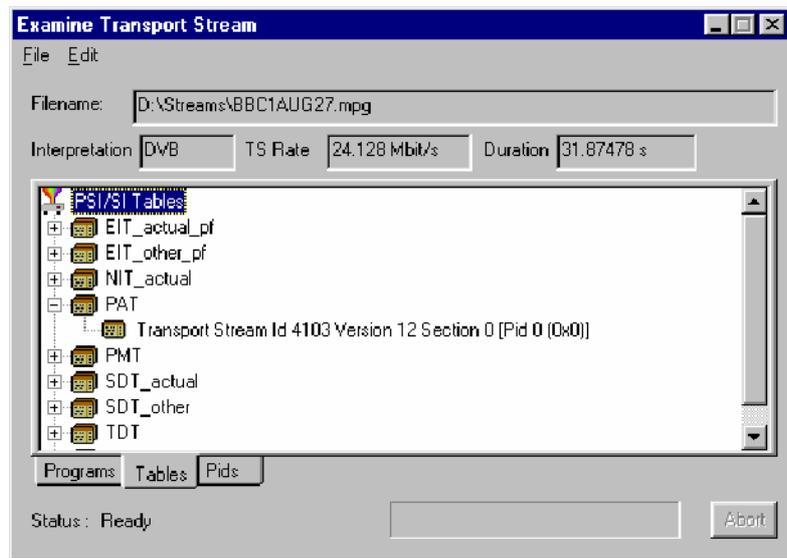
The Category column indicates the type of event. The subject or time of the event is shown in the Reference column and the details are given in the Comment column.

The complete text can be copied onto the Windows clipboard, using the Copy option from the shortcut 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 you to take an overview of a transport stream before subjecting it to full analysis.
- It allows tables and programs to be dragged and dropped from the examined stream to the file that is currently open in Multiplexer.



Menu
Bar
File
Summary

Navigator
Views

Menu Bar The Examine TS window menu bar contains only two items: File and Edit.

File Menu. Table 13 lists the items in the File menu.

Table 13: Examine TS - File menu options

Command	Function
Open...	Analyzes and opens the selected file in the Examine TS window. Closes the current file.
Close	Closes the Examine TS window.

Edit Menu. Table 14 lists the items in the Edit menu.

Table 14: Examine TS - Edit menu options

Command	Function
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 through the View menu: MPEG-2, DVB, ATSC, or ISDB.
TS Rate	The transport stream bit rate 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. Programs, Tables, and PIDs are shown as they would be 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

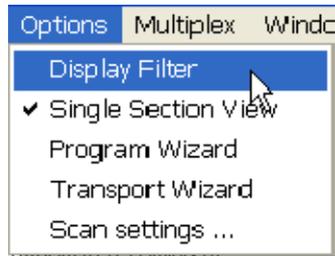
While examining transport streams, it is possible to copy sections to the main multiplex using the standard Windows techniques: copy and paste or by dragging and dropping them with the aid of the mouse.

For example, to import a section that is visible in the Examine TS window into the new multiplex configuration:

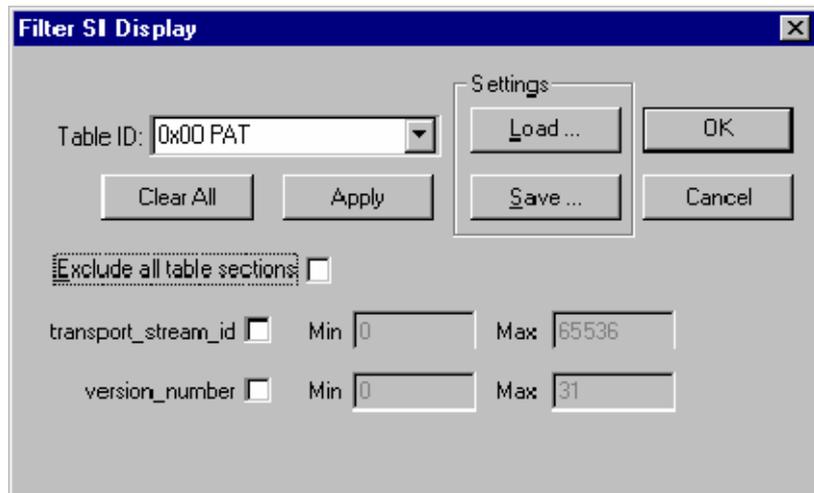
1. Select the Navigator Tables view.
2. Highlight the section to be copied in the Examine TS window and do one of the following:
 - Select Edit > Copy. With the Navigator Tables view active, select Edit > Paste.
 - Using the mouse, place the cursor over the highlighted section, press and hold the left button on the mouse and drag the section onto the Navigator Tables view. Release the mouse button.
3. 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 through Options > Display Filter.



The following dialog box is displayed:



Selecting a Table for Filtering

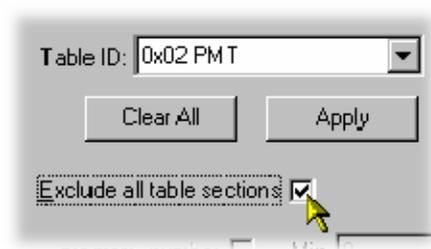
Example: Before filtering, the stream tree might appear be as shown below:



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

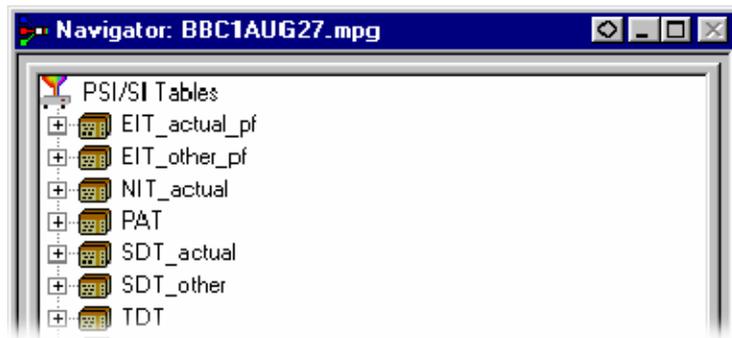


All sections of a table can be excluded by enabling the Exclude all table sections check box.



To preview the result of filtering, select the Apply button.

Note that all reference to the PMT tables is removed as shown below:

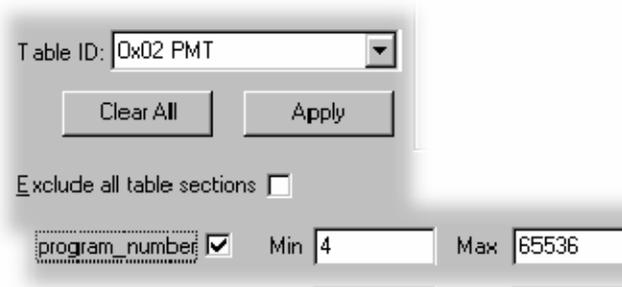


To exclude a range of sections, enable the section by selecting from the Table ID drop-down list and entering the required range.

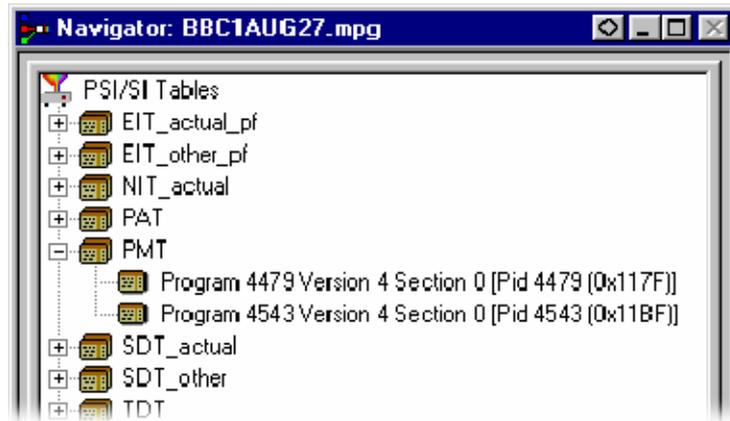
Note that section names shown in the dialog box change according to which table is selected.

To preview the result of filtering, select the Apply button.

For example, the following settings will result in the display shown overleaf:



NOTE. Minimum and maximum values can 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 box can be saved and subsequently reapplied 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 box. To retrieve or load filter settings, select the Load button and identify the filter file in the Open dialog box. The file extension *.fil is used.

Component Views

The Component views provide a graphical view of the bit rate 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 83.

Component Bit rate

The Component Bit rate view provides a graphical comparison of the stream components.

Open the Component Bit rate view either by selecting View > Component Bit rate from the Menu Bar or the toolbar button.



Each component includes the following information: Program name, PID, Description and the Bit rate in numerical and graphical form. Where appropriate, the Service ID and the Service Name is displayed (extracted from the SDT).

Program	Pid	Description	Bitrate (Mb/s)	Bitrate
1 Tektronix I				
	120	MPEG-2 Audio	0.094025	I
	130	MPEG-2 Audio	0.407350	I
	110	MPEG-2 Video	2.029528	
2 Tektronix II				
	230	MPEG-2 Audio	0.094015	I
	220	MPEG-2 Audio	0.156667	I
	210	MPEG-2 Video	4.007894	
3 Tektronix III				
	330	MPEG-2 Audio	0.156687	I
	320	MPEG-2 Audio	0.219350	I
	310	MPEG-2 Video	5.034838	
4 Tektronix IV				
	430	MPEG-2 Audio	0.219359	I
	420	MPEG-2 Audio	0.282019	I
	410	MPEG-2 Video	10.066074	
5 Tektronix V				
	530	MPEG-2 Audio	0.282012	I
	520	MPEG-2 Audio	0.407360	I
	510	MPEG-2 Video	15.168662	
	8191	Null	2.786581	

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 Duration view by selecting either View > Component Duration from the Menu Bar or the toolbar button.



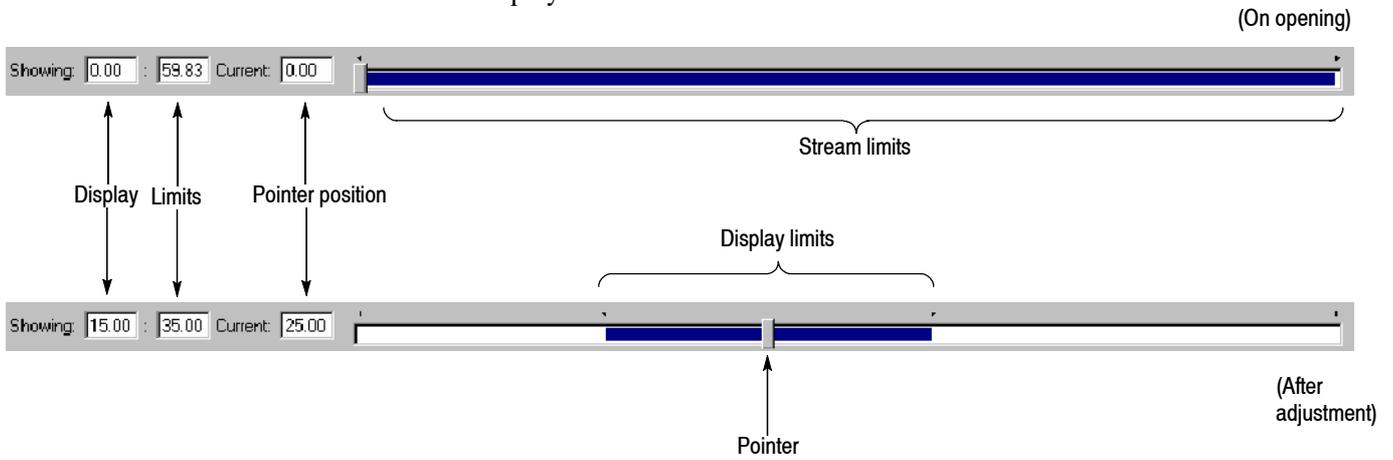
Component Duration: tek_sym1_test.mpg

Showing: 0.00 / 59.83 Current: 0.00

Program	Description	Pid	Start	Stop	Length	Bitrate (Mb/s)	Extent
1	Tektronix I		0.00	59.34	59.33		
	MPEG-2 Video	110	0.00	59.34	59.33	2.023528	
	MPEG-2 Audio	120	0.02	59.30	59.28	0.094025	
	MPEG-2 Audio	130	0.00	59.32	59.31	0.407350	
2	Tektronix II		0.00	59.04	59.04		
	MPEG-2 Video	210	0.00	59.04	59.04	4.007894	
	MPEG-2 Audio	220	0.01	59.16	59.15	0.156667	
	MPEG-2 Audio	230	0.02	59.28	59.25	0.094015	
3	Tektronix III		0.00	59.78	59.78		
	MPEG-2 Video	310	0.00	59.78	59.78	5.004000	
	MPEG-2 Audio	320	0.01	59.31	59.30	0.219350	
	MPEG-2 Audio	330	0.01	59.21	59.20	0.156687	
4	Tektronix IV		0.00	59.76	59.76		
	MPEG-2 Video	410	0.00	59.76	59.76	10.069074	
	MPEG-2 Audio	420	0.01	59.25	59.25	0.282019	
	MPEG-2 Audio	430	0.01	59.24	59.23	0.219359	
5	Tektronix V		0.00	59.02	59.02		
	MPEG-2 Video	510	0.00	59.02	59.02	15.168662	
	MPEG-2 Audio	520	0.00	59.31	59.30	0.407360	
	MPEG-2 Audio	530	0.01	59.28	59.27	0.282012	
	Null	6191	0.00	59.04	59.04	2.003528	

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 Bit rate. The timing and bit rate elements of this information are also available in the Program Stream Properties dialog box. (See *Program Content Dialog Box*, page 43.)

Scaling Bar. The Scaling bar, which is displayed at the top of the Component Duration view, allows you to select the portion of the transport stream that is to be displayed.



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.

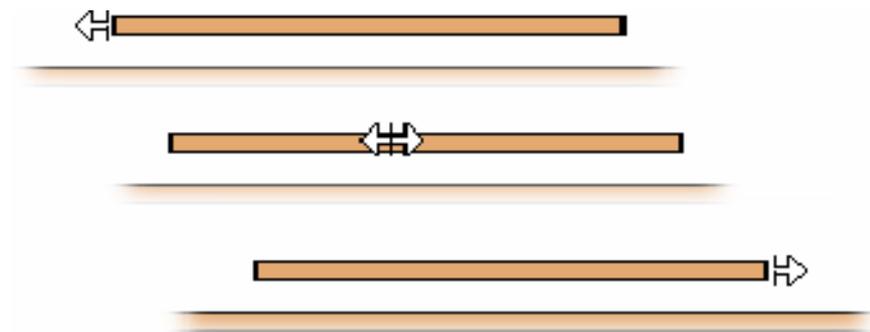
The *Display limits* fields indicate the extents of the *Display limits* bar and the current Pointer position.

The Pointer can be dragged to a new position on the *Stream limits* bar. The *Display limits* bar will center on the Pointer.

Duration Control. The duration of each element in the stream is given by the Start and Stop values and shown graphically by the associated bar. The components are color 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 the action that 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.

Program	Description	Fid	Start	Stop	Length	Extent
1	Tektronix I		11.21	49.76	38.55	
	MPEG-2 Audio	120	14.49	38.17	23.68	
	MPEG-2 Video	110	11.21	49.76	38.55	
2	Tektronix II		0.00	59.84	59.84	

Program duration

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), you can determine how and if the stream duration is updated. The available options will be:

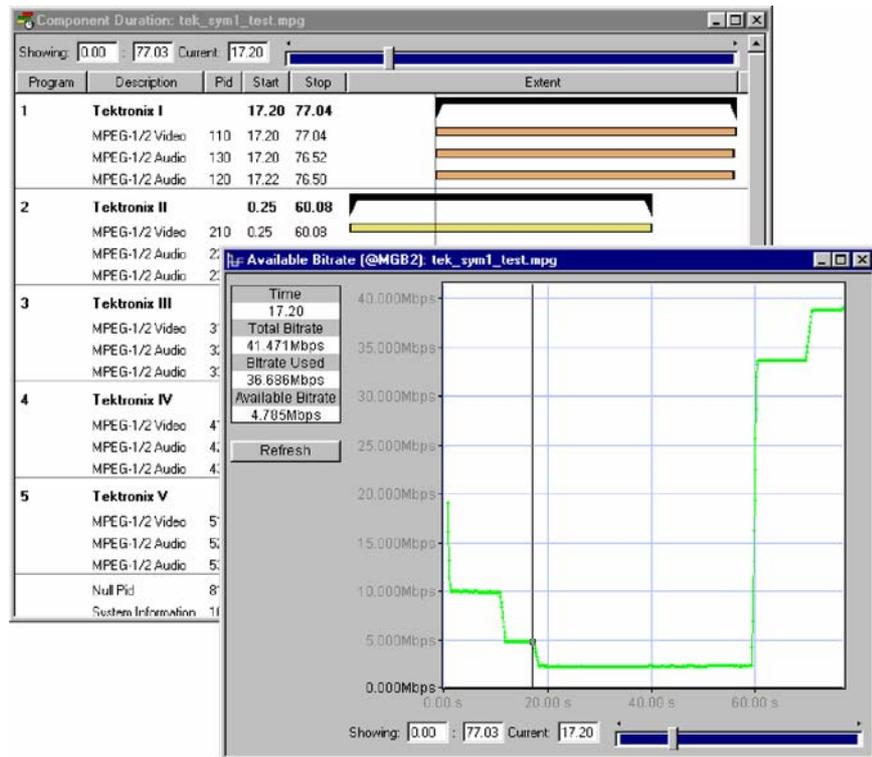
- Select Fixed to ensure that the stream duration can only be updated in the Stream Properties dialog box.
- Select Set to the greatest component stop time to ensure that the stream duration is set to the greatest stop time recorded in the SI/PSI/PSIP tables.

Component start and stop times changed in the Component Duration view are automatically updated in the SI/PSI tables.

Available Bit rate

The Available Bit rate 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 Available Bit rate view by selecting View > Available Bit rate from the Menu Bar or by using the toolbar button.



If the bit rate falls below zero, the points will be highlighted in red. When editing a multiplex, you 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 Bit rate fields.

The zoom level and cursor placement of the Available Bit rate and the Component Duration views can be synchronized by selecting View > Synchronize.

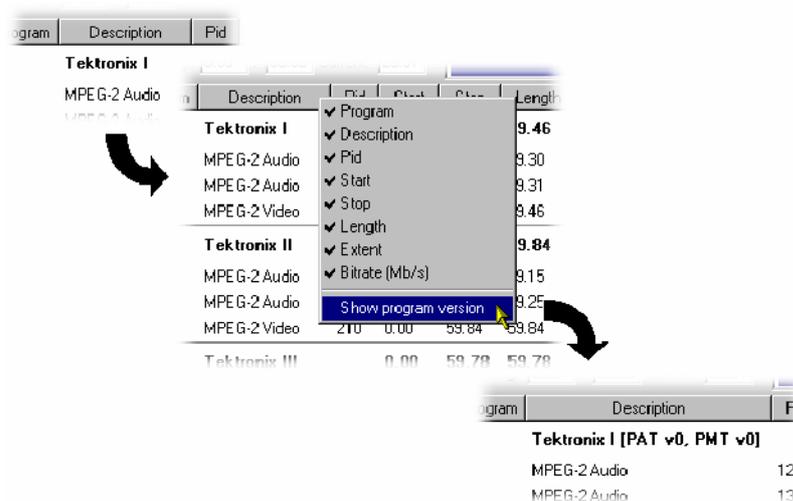
Common Features

Columns in the Component views can be sorted and rearranged to suit your preferences. Column management in the two Component views is similar.

Field Selection. You can select the fields to be displayed in each Component view. The Header bar indicates which fields are currently displayed.

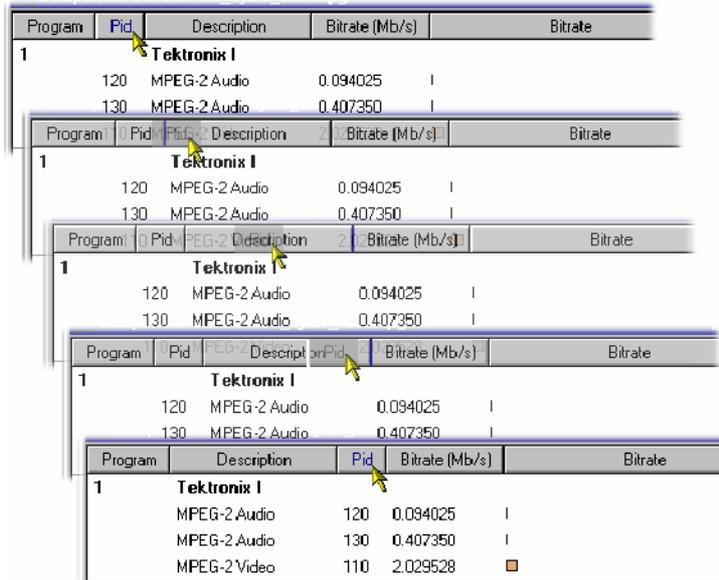
When you right-click on the Header bar, a menu is displayed. You can select which fields are to be displayed. A check mark next to a field name indicates that the field display is currently enabled.

The version number of the PAT and PMT can be displayed in the Description column by enabling the Show program version option in the shortcut menu from the Description column header.



Similarly, the PID numbers can be displayed in hexadecimal, by selecting Display in hexadecimal from the PID column shortcut 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.

The image shows two screenshots of a multiplexer interface. The top screenshot displays a table with the following data:

Program	Description	Pid	Bitrate (Mb/s)	Bitrate
1	MPEG-2 Audio	120	0.094025	I
1	MPEG-2 Audio	130	0.407350	I
2	MPEG-2 Audio	230	0.094015	I
2	MPEG-2 Audio	220	0.156667	I
3	MPEG-2 Audio	230	0.156667	I
2	MPEG-2 Audio	230	0.156667	I

The bottom screenshot shows the same table after sorting by Description. The data is as follows:

Program	Description	Pid	Bitrate (Mb/s)	Bitrate
	Null	8191	2.786581	
1	MPEG-2 Video	110	2.029528	
2	MPEG-2 Video	210	4.007894	
3	MPEG-2 Video	310	5.034838	
4	MPEG-2 Video	410	10.066074	
5	MPEG-2 Video	510	15.168652	
2	MPEG-2 Audio	230	0.094015	I

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 shortcut 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 open the menu.

A typical shortcut 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 shortcut menus:

Add	Adds a component to the currently selected item.
Modify	Opens the properties dialog box.
Delete	Deletes the currently selected component.
Properties	Opens a properties dialog box for editing the currently selected item.
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 created file can be imported as ES using Multiplexer's Add function or as SI using the Import Section Data... option.
Import Section Data	Imports SI data from 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.

Dragging and Dropping

To drag a file, click on its name and hold down the left 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.

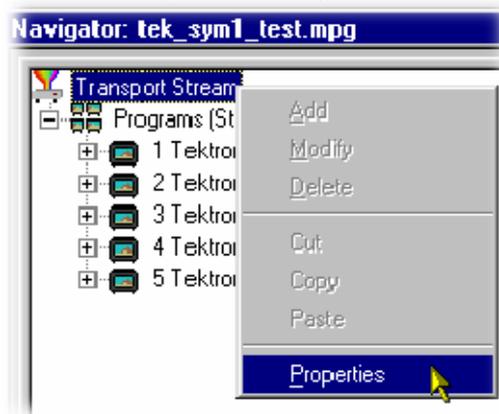
Transport Stream

Opening an MPEG File For information on *Opening a Stream*, refer to page 17.

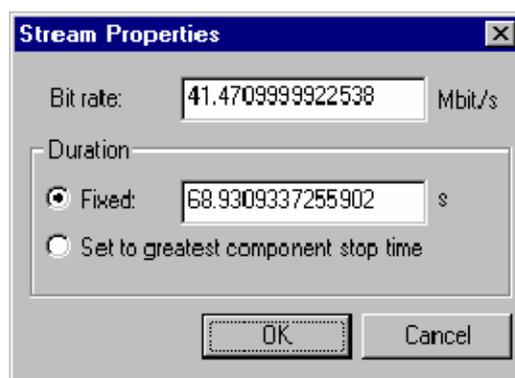
Opening a Multiplexer File For information on *Opening a Stream*, refer to page 17.

Changing Transport Stream Bit rate and Duration To specify a new bit rate or duration for the transport stream, select and highlight the Transport Structure component in the Navigator view.

From the shortcut menu, select Properties. The dialog box shown below will be displayed.



Edit the Bit rate and the Duration as required, then click on the OK button.



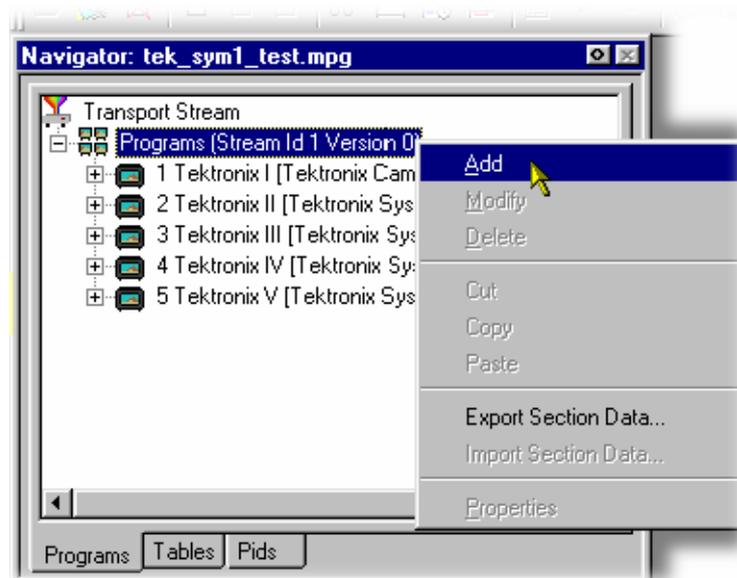
Programs

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. There can be a short delay before the node is highlighted, while the legality of the operation is checked.

Adding a New Program

With the Transport Stream ID field highlighted in the Navigator Programs view, selecting the Add option either from the shortcut menu (PAT highlighted in Navigator Programs view) or the Menu Bar (Edit > Add) will open the Program Wizard (see page 41).



In the Navigator Programs view, the PAT is represented by the Transport Stream ID field.

Copying/Moving 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.

Tables

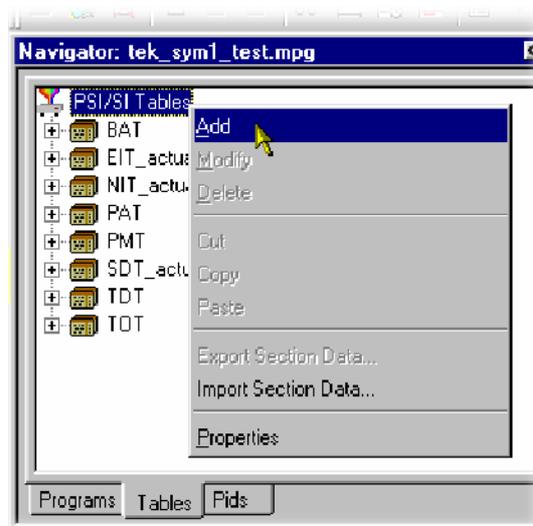
Adding a New PSI/SI Table

Methods available:

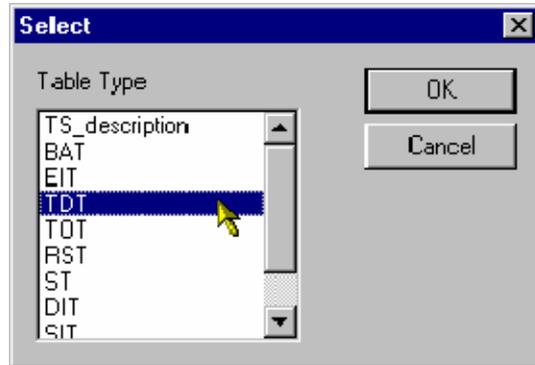
- Highlight the PSI/SI Tables level in the Navigator Tables view and select Add from the shortcut menu.
- Drag and drop (copy only) from the Examine TS window (Tables view) to the Navigator Tables view.
- Drag and drop (copy/move) from another instance of Multiplexer to the Navigator Tables view.

Any Table that is defined in the selected standards, and not already present, can be added the transport stream. To add a table to the transport stream, click on PSI/SI Tables in the Navigator Tables view:

1. Highlight the PSI/SI Tables level and select Add from the shortcut menu.



This will open the Select dialog box. The dialog box displays a list of the table types that are not already present in the stream.



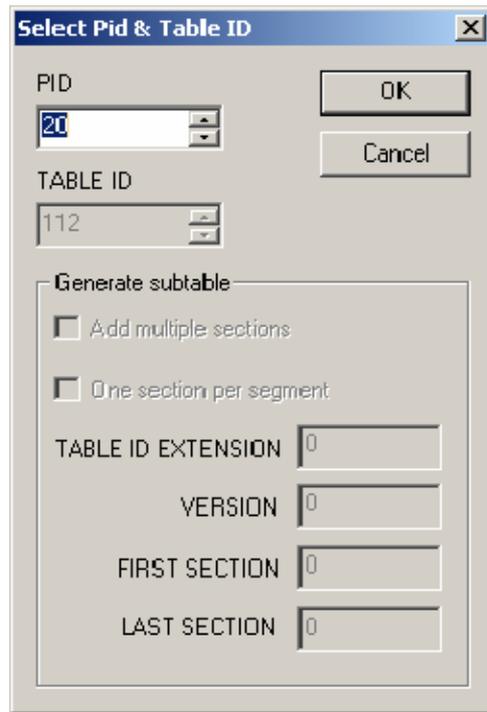
NOTE. A PAT table cannot be added when ISDB interpretation with Single segment extension is selected.

2. Highlight the required table type and then select the OK button.

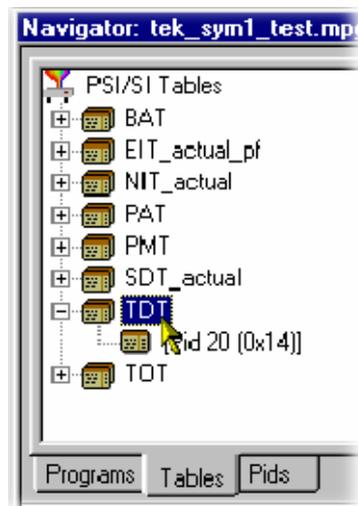
Pressing Cancel will abandon the operation without adding a new table.

Only the table types that are not currently specified for the stream are listed. If the required table type is not listed, press the Cancel button to close the dialog box without affecting the specification for the stream.

The Select PID & Table ID dialog box 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 102).

Exporting a Table

For more information on *Exporting a Section*, refer to page 103.

Importing a Table

For more information on *Importing a Section*, refer to page 104.

Sections

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 shortcut 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.

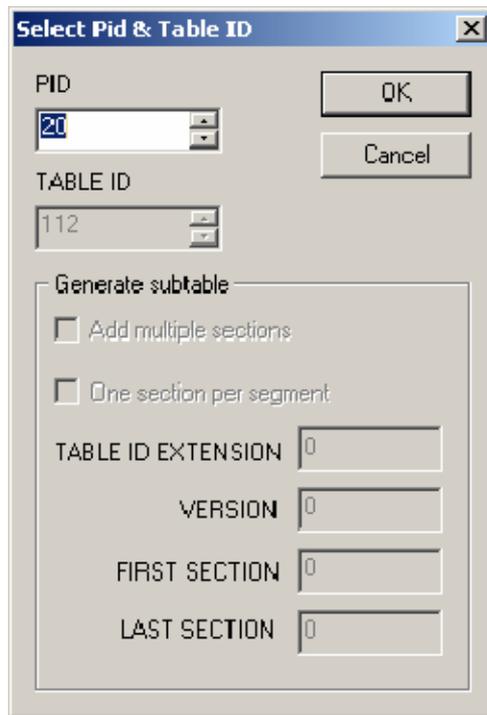
To add a section to a table, select the parent table in the Navigator Tables view. For example, to add a section to the SDT, select SDT Tables:



Then select Add from the shortcut menu.

The Select PID & Table ID dialog box 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.



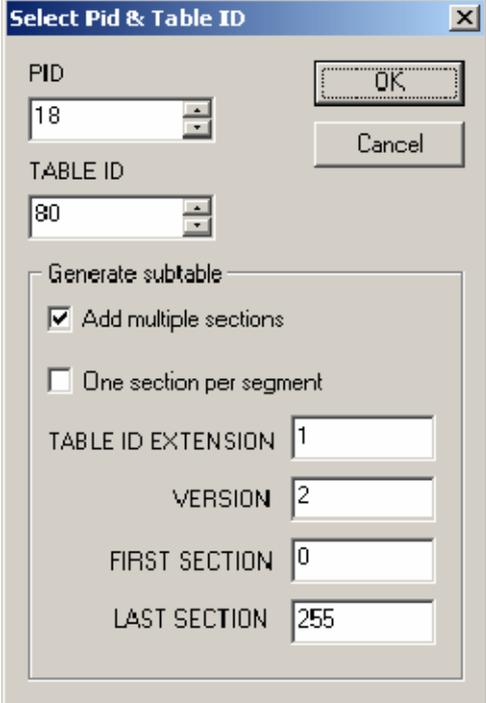
Pressing Cancel will abandon the Add operation without adding a new section.

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 to 0.

$$\text{version_numberNEW} = (\text{version_numberRECENT} + 1) \text{ modulo } 32$$

- For any table type that allows a section_syntax_indicator, the Add multiple sections check box in the Generate subtable part of the dialog box is enabled. Additionally, the One section per segment check box will only be enabled for the EIT schedule table type.



Select Pid & Table ID

PID: 18

TABLE ID: 80

Generate subtable

Add multiple sections

One section per segment

TABLE ID EXTENSION: 1

VERSION: 2

FIRST SECTION: 0

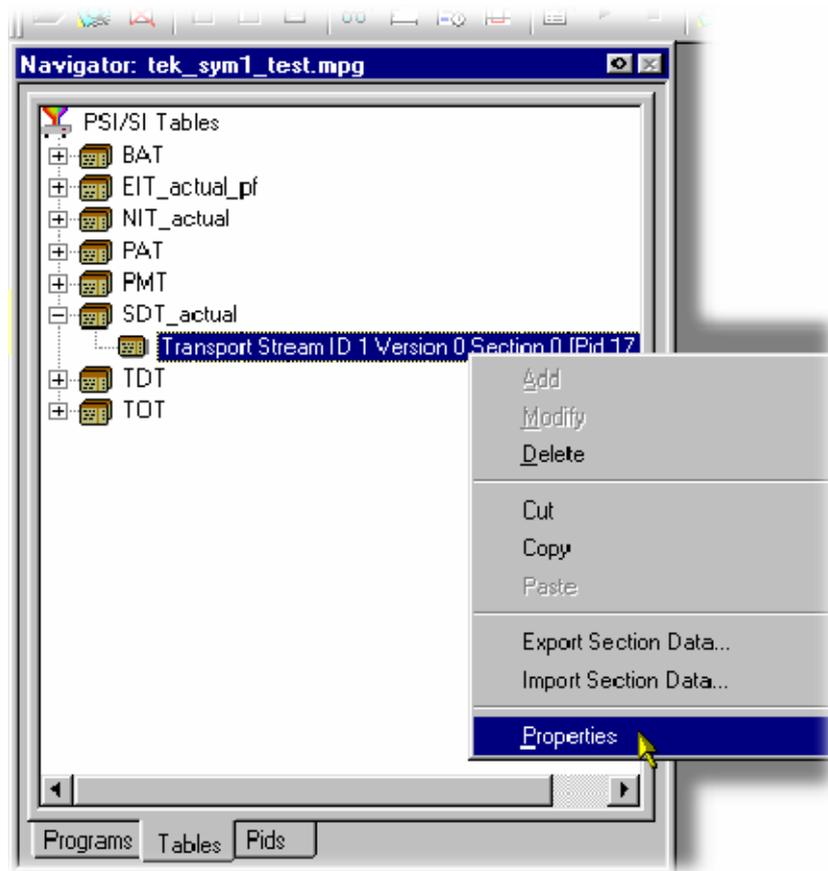
LAST SECTION: 255

- Up to 256 sections can be added.
- Additions to existing subtables using the same Table Id Extensions and Versions will be rejected.
- When multiple EIT Schedule sections are being added, the One section per segment check box is enabled. When it is checked, only the first section in each segment will be created, rather than all sections numbered between First section and Last section.

When dragging and dropping a section, the Multiplexer will resolve any numbering conflicts by creating new versions of duplicated tables.

Editing PSI/SI Table Properties

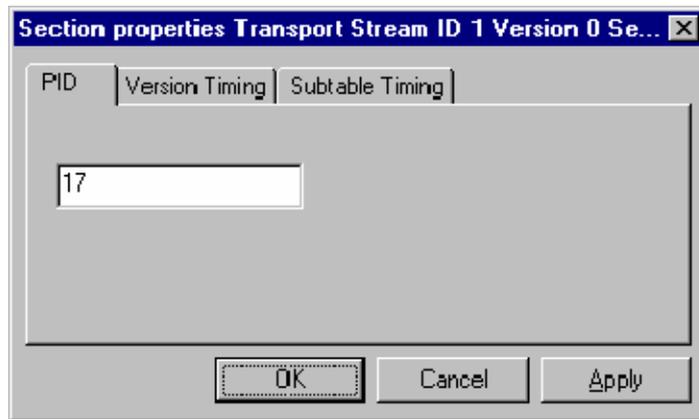
Table and Section Properties are edited by selecting and highlighting one of the versions/sections within the transport structure and selecting the Properties option from the shortcut menu.



This opens a dialog box with four tabs, one for each property. Depending on the type of table, properties can be applied to a specific version or section of the table. Multiplexer allows only operations that make sense in the context of the selected table type.

The properties that can be edited from the Navigator Tables view are:

PID Number. The PID tab is displayed by default when the Section Properties dialog box is opened.

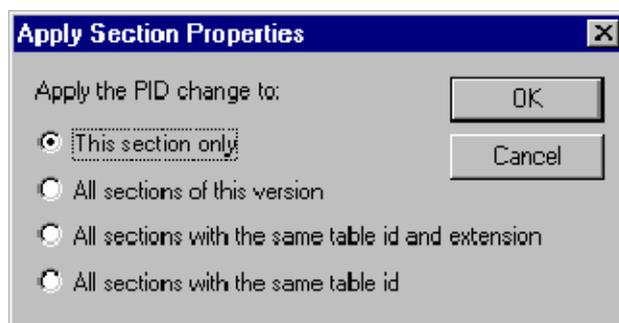


Edit the value and select OK to change the PID number.

Edit the value and select Apply to make the changes and update the other properties (tabs) without having to close this dialog box.

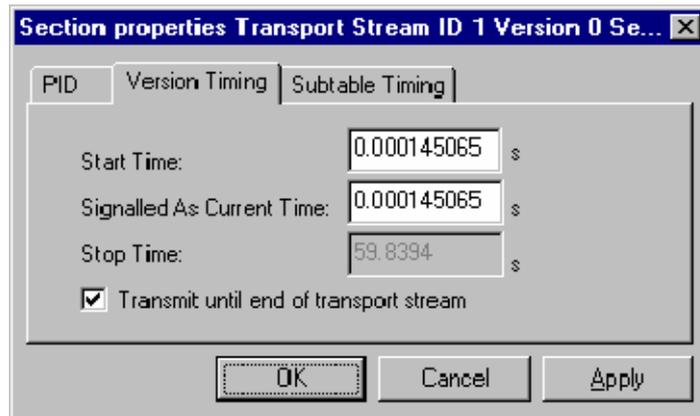
Multiplexer checks the new PID number against the selected standards and warns of any nonconformance issues. If a conflict is found, a warning message is displayed, with the option to continue. Multiplexer also checks for conflicts with other PIDs. If the new PID number conflicts with an existing PID, 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 box is opened to define the scope of the changes:



Select the required scope and click OK. Selecting Cancel will abandon the change.

Version Timing. The Version timing tab shows the time when the version will become current, and the start and end times. New values can be specified for any of these times.



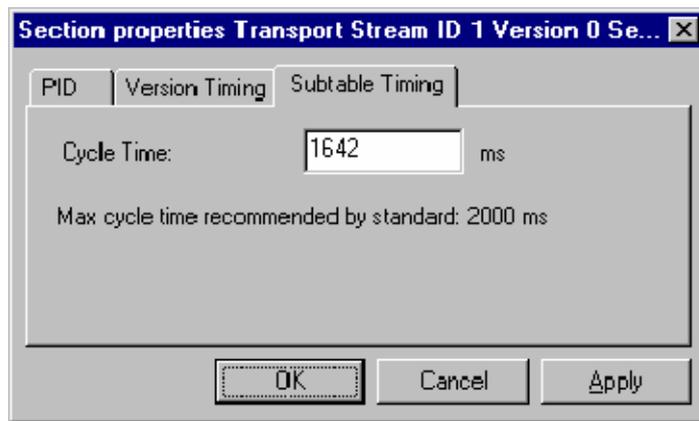
Start Time	Specifies the time at which sections of this version will start to appear in the transport stream.
Signalled As Current Time	Controls the time when the sections with this version will have the <code>current_next_field</code> set to 1. By default when these sections start to appear in the transport stream, the <code>current_next_field</code> of the section set to 0. To specify a version that is always current set the Start Time and Signaled 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 check box 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. The default start time for PAT is 0.00 s and for PMT is 0.001 s.

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 box.

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.



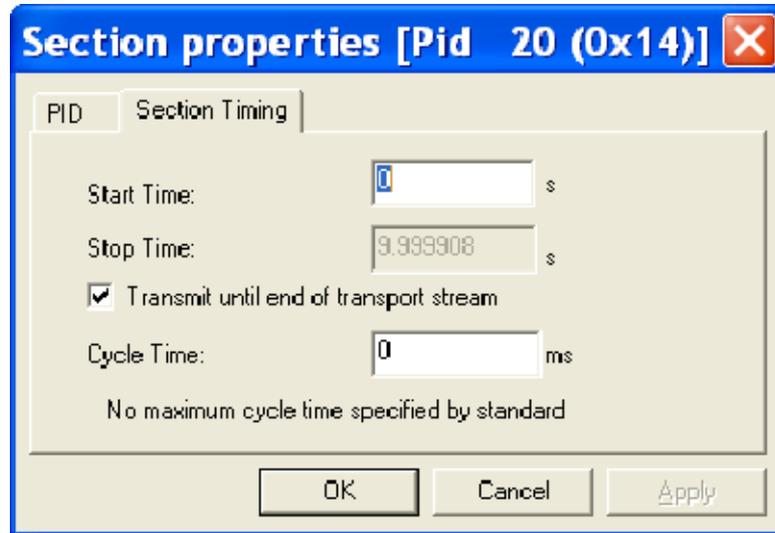
Cycle Time Displays the mean time between instances of the subtable specified for synthesizing a new MPEG file. The value can be edited to specify a different cycle time.

Beneath the Cycle Time, the dialog box 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 box.

When synthesizing 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 is displayed in the Properties dialog box.



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 box.

An error message is written to the event log when a table cannot be multiplexed in accordance with the timings set.

Deleting a Section

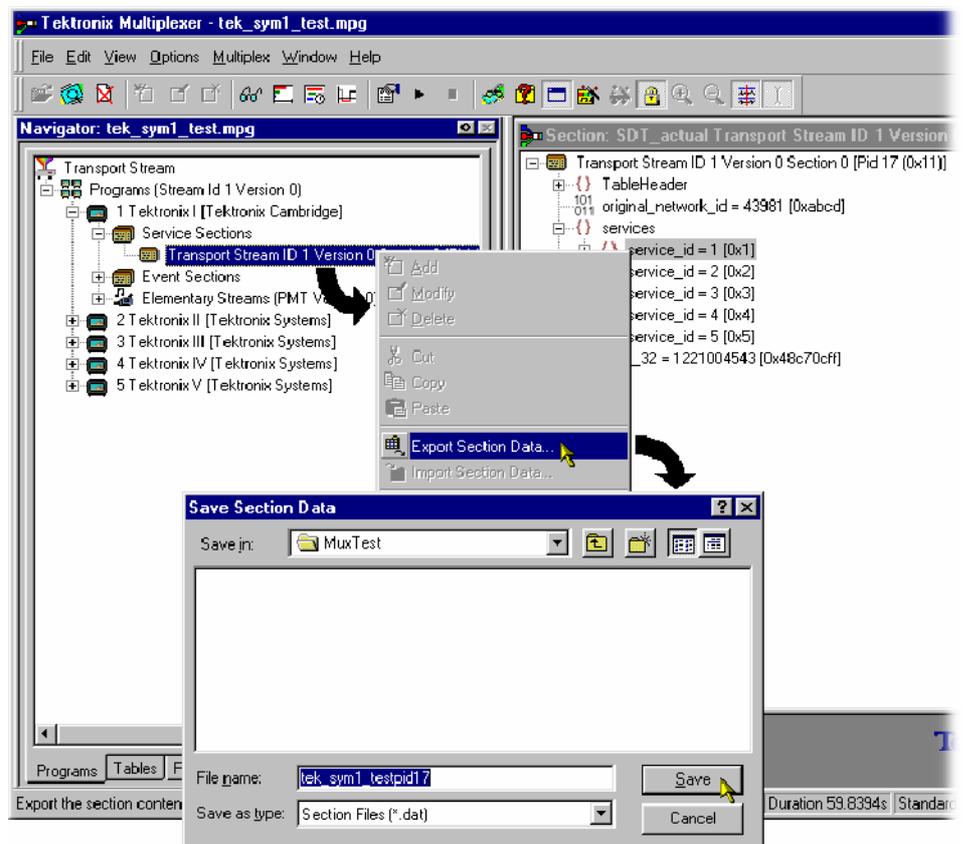
A section can be deleted from a table by highlighting it in the Navigator Tables view and selecting Delete from the shortcut menu. To delete more than one section, select and delete each one in turn. When the last section is deleted from a table, the table is automatically deleted from the structure.

Exporting a Section

Section data can be exported in the form of a binary file. In the Navigator Tables view, highlighting a Table node (for example, PMT Tables), allows all sections of the table to be exported. Similarly, highlighting a single section entry (for example, Program 123) allows only that section to be exported.

Highlight the required section or Table node in the Navigator Tables view. From the shortcut 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 shortcut 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, for example, TOT.



Importing a Section

In the Navigator Tables view, highlight the PSI/SI Table node. From the shortcut menu, select Import Section Data. In the PID tab of the Import Section Data dialog box, 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 that carry additional Elementary Streams can be multiplexed into the synthesized 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:

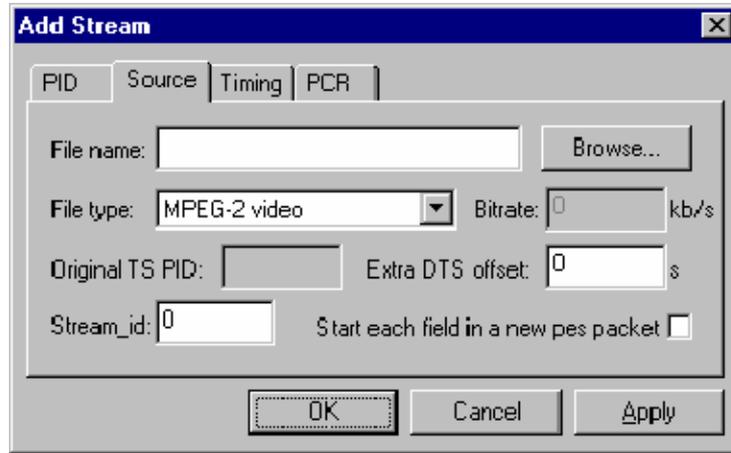
- Highlight the ES PIDs in the Navigator Tables view and select Add from the shortcut menu.
- Drag and drop (copy only) from the Examine TS window (Tables view) to the Navigator Tables view.
- Drag and drop (copy/move) from another instance of Multiplexer to the Navigator Tables view.

To add a new stream, highlight ES PIDs in the Navigator Tables view and select Add from the shortcut menu.



This opens the Add Stream dialog box; the Source tab is displayed by default.

Defining the PID Source. In the Add Stream dialog box, select the Source tab; this allows the PID source to be selected and defined.



File name Enter the file name of the stream to be multiplexed. If the file name is unknown, select Browse to open a standard file browser dialog box and locate the file required.

The names of files being copied to the multiplex will be automatically filled in.

File type Select the type of file to be multiplexed from the drop-down list box.

The following file types are available:

- MPEG-1 video ES or PES
- MPEG-2 video ES or PES
- MPEG-2 audio ES or PES (MPEG-1 or MPEG-2)
- MPEG-2 AAC audio ES or PES (ADTS format only)
- AC-3 audio ES or PES
- (ES - Elementary Stream;
- PES - Packetized Elementary Stream)
- H.264 video ES or PES
- MPEG-4 Audio ES and PES

Transport Packets: A single PID stream. The Bit rate 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 section 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 Bit rate value will require setting.

Other: Any binary or ASCII file that is to be packetized into the transport stream at the specified bit rate. The Bit rate value will require setting.

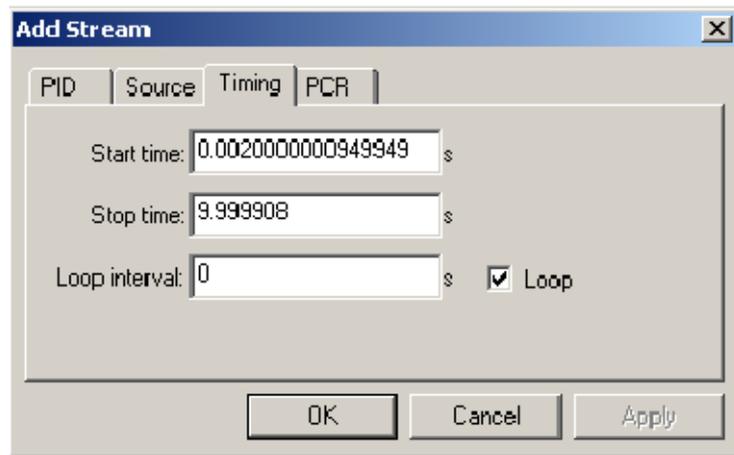
The remaining fields are interactive and will only be enabled when a value is required.

Bitrate	When first defining a source, the bit rate is unknown and 0 Kbps is displayed. If a Transport Packet Stream or an "Other" File Type is selected, the field is enabled and a value (in Kbps) can be entered. If MPEG-2 video or H.264 video with SEI messages is selected, the bit rate value is detected automatically and displayed. If H.264 video without SEI messages is selected, the bit rate is not detected automatically.
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). You can override this offset and make it larger (positive number) or smaller (negative number). Changing this value might cause the resultant stream to be nonconformant with respect to the T-STD of the MPEG-2 standard. Enter the DTS offset in seconds required.

Stream_id	<p>Only enabled for elementary stream types. This number specifies the value of the stream_id field in the PES packet header.</p> <p>Only needs to be set for DVB stream. Stream identity in the PES header.</p>
Start each field in a new PES packet	<p>Only enabled when File Type: MPEG-2 Video is selected.</p> <p>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.</p>
Start each section in a new packet	<p>Only enabled when File Type: Section is selected.</p> <p>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.</p> <p>When enabled, each section will begin in a new packet and stuffing bytes will be used to pad any payloads that are not full.</p>

Defining the Stream Timing. In the Add Stream dialog box, select the Timing tab. This tab will allow timing parameters for the selected source stream to be defined.

NOTE. To achieve compatibility between MUX and MTS4EA, the start time is set to the following default values: PAT is 0.000, PMT is 0.001, and ES is 0.002.



Start/Stop Time

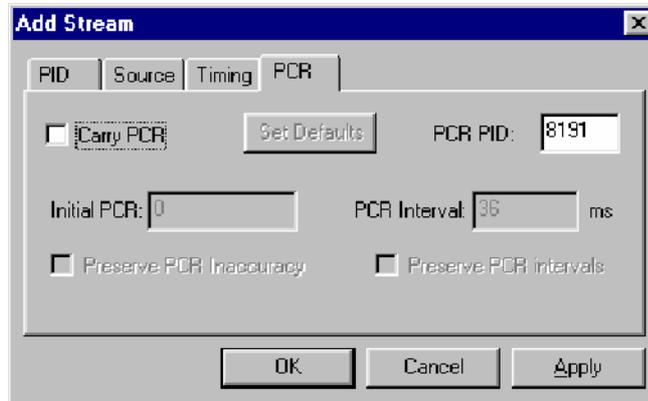
Enter the times that the selected source stream is to start and stop within the host transport stream. Note that the overall duration of the host transport stream is defined through the Transport Stream Properties dialog box.

Loop

Select this check box to loop the selected source stream for the duration of the synthesis. A Loop Interval can be set that introduces a delay between each repeat of the source stream; if zero is entered, the source stream will loop continuously. The Loop check box will always be disabled for transport stream types. The Multiplexer cannot loop transport streams.

Select OK to accept all changes and close the dialog box.

Defining the PCR Placement. In the Add Stream dialog box select the PCR tab; this will allow PCR placement to be defined.



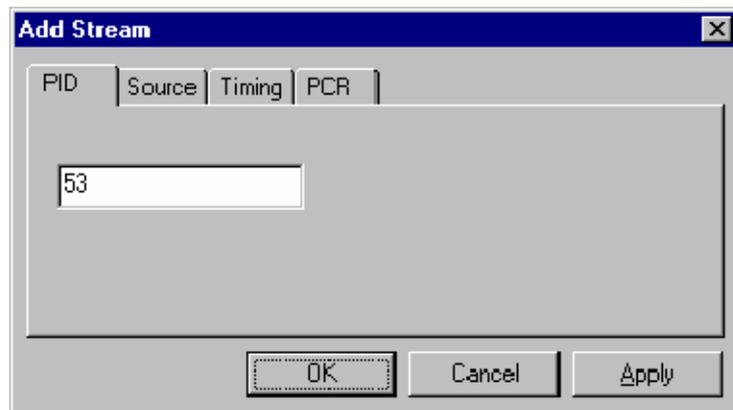
PCR for Elementary Streams. (Includes File Type: Transport Packets.)
PCRs are placed in the packets at the specified interval, starting with the specified initial value.

PCR for Remultiplexed PIDs. (Includes File Type: Transport Stream)

- If the Carry PCR check box is not enabled, any PCRs in the packets will be removed.
- If the Carry PCR check box is enabled, PCRs will be sent as follows: If Preserve PCR Inaccuracy 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 check box is enabled, PCRs will be sent in those packets that originally contained them, otherwise PCRs are inserted into packets at the specified intervals.

Specifying the PID Number

Enter the PID number. A new value can be entered using either decimal or hexadecimal notation. Values are assumed to be decimal unless preceded with 0x. The dialog box is not case sensitive and values can include zeros after the prefix and before any significant digits.



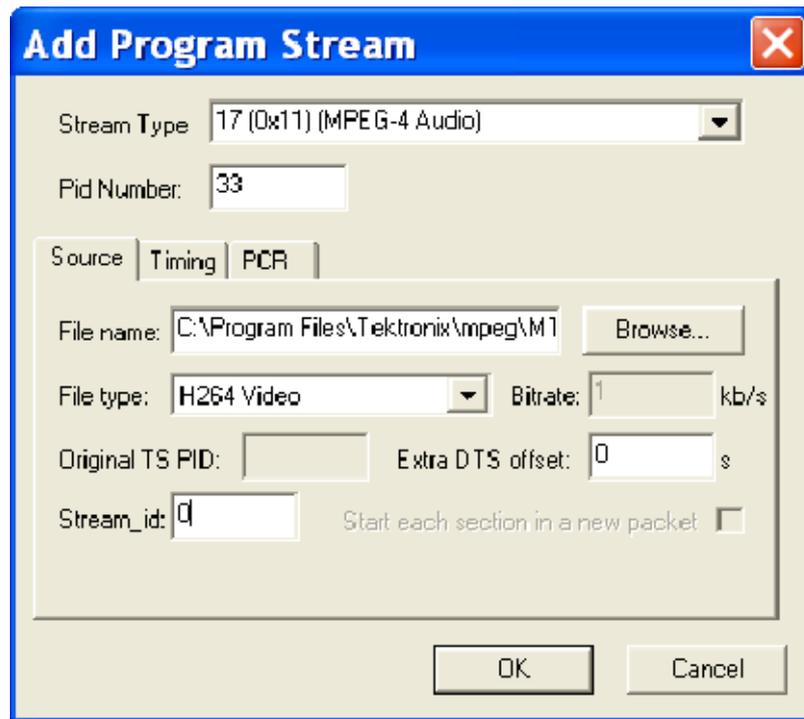
When all details (in all tabs) are satisfactory, select OK to accept all changes and close the dialog box.

Adding Elementary Streams to the Program Structure**Methods available:**

- Highlight an Elementary Stream node in the Navigator Programs view and select Add from the shortcut 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 using the Navigator Programs view.

1. In the Navigator Programs view, highlight an Elementary Streams node to which the elementary stream is to be added.
2. From the shortcut menu, select Add. The Add Program Stream dialog box is displayed.



The dialog box tabs allows the input elementary stream to be selected and specified. The main dialog box 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.

3. The functionality of the tabbed dialog boxes is described in the following pages:

Source	See <i>Defining the PID Source</i> , page 106,
Timing	See <i>Defining the Stream Timing</i> , page 109,
PCR	See <i>Defining the PCR Placement</i> , page 110.

4. Enable the Component Tag check box, 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, for example, Event Information Table.

Exporting Elementary Streams

The Export Elementary Stream option allows the nonpacketized 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 shortcut 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. 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 shortcut 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 shortcut menu. The Stream Properties dialog box and its tabs are identical to the Add Stream dialog box. Refer to *Adding an Unreferenced Elementary Stream*, page 105. Locate the parameter to be changed, and click OK when it is changed.

ES PID parameters can also be modified in the Navigator Programs view. Highlight an Elementary Stream in the Programs view and select Properties from the shortcut menu. The dialog box thus displayed (Program Stream Properties) is similar to the Add Program Stream dialog box shown on page 111.

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 shortcut menu. Then select the Delete option from the Edit or pop-up menus. Alternatively, click 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

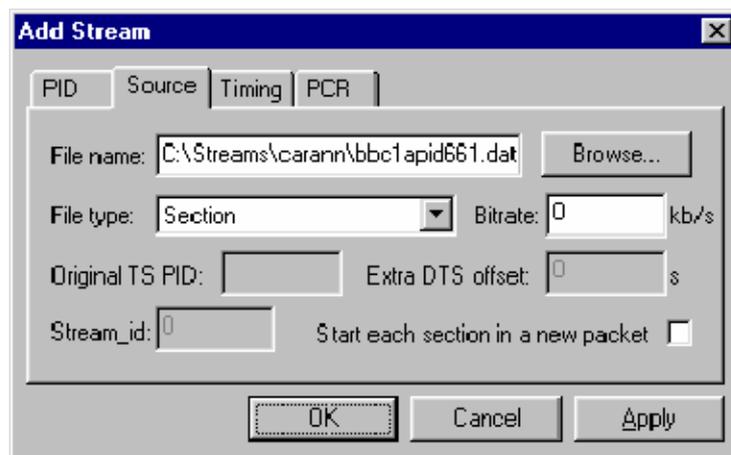
Adding an Unreferenced DSM-CC Section

Methods available:

- Highlight the ES PIDs node in the Navigator Tables view and select Add from the shortcut 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 105), with the following modifications:

In the Source tab of the Add Stream dialog box, select Transport Packets / Sections as the File type and set the bit rate.



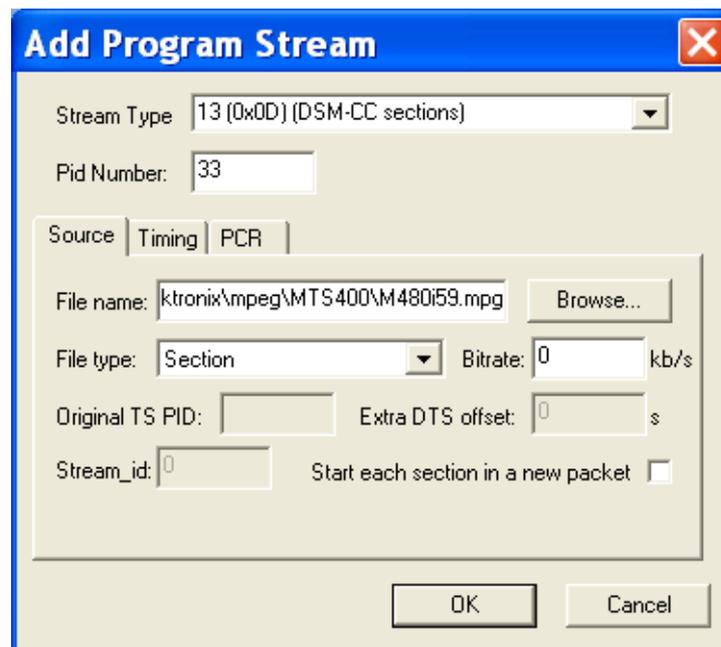
Adding DSM-CC Sections to the Program Structure

Methods available:

- Highlight an Elementary Stream in the Navigator Programs view and select Add from the shortcut 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 105), with the following modifications:

- The main dialog box 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 box, 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 shortcut 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 shortcut menu, select Export Section Data. Name the file to be created and choose a location. Select Save to confirm the action.

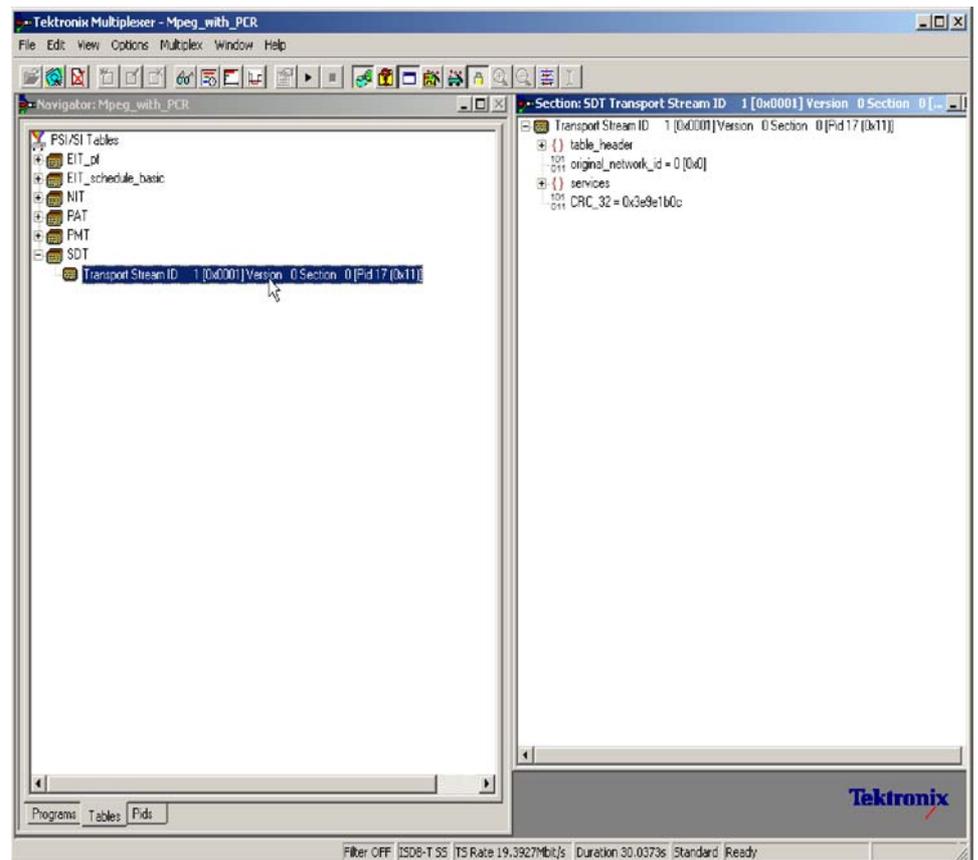
Individual DSM-CC sections can also be exported using the Navigator Programs view. Under any Elementary Streams node, highlight the DSM-CC section to be exported. From the shortcut menu, select Export Section Data.... Name the file to be created and choose a location. Select Save to confirm the action.

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 is not already open, select View > Section View.

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 shortcut menu.

Selecting a Field

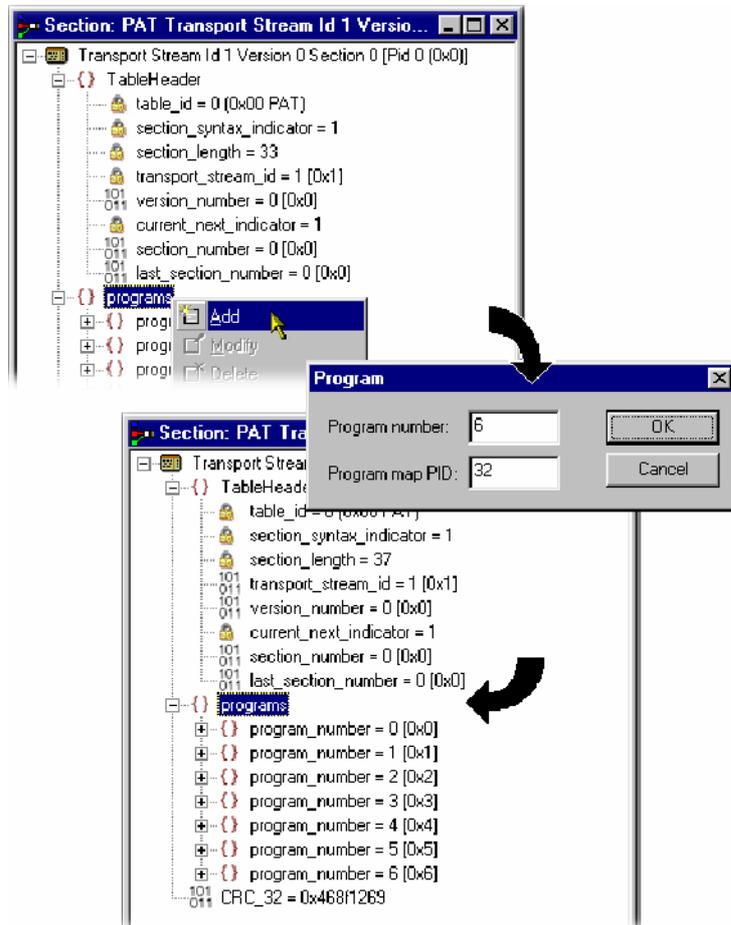
To select a field or container, place the mouse pointer over it and click the left button.

The magnifying glass icon indicates the selected component.

If Standard Mode is selected, the magnifying glass selection cannot be placed on a field that is locked. To select and edit locked fields, first select the Expert Mode option from the Multiplex menu.

Adding an Element to Loop

To add an element to a loop, select the parent loop that will contain it, and then select Add from the shortcut menu. For example, to add a program to a PAT, highlight the Programs container and select Add from the shortcut menu.



In this example, a dialog box is displayed in which the Program Number and Program Map PID can be accepted or changed. Other table loops might not display any dialog box, 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 preceding example, the new entry is program_number = 6 (0x6).

NOTE. The preceding example 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 66).

Deleting an Element in a Loop

To delete a loop element, in the Section view, highlight the element and select Delete from the shortcut menu.

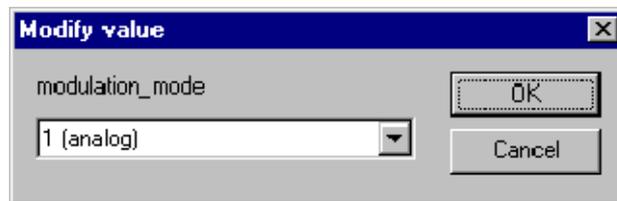
The element is deleted and the Section View window updated to reflect the changes.

Modifying the Contents of a Field

To edit the contents of a field, highlight the field and select Modify from the shortcut menu. This will open an appropriate dialog box for modifying the type of data held by the field.

The following paragraphs describe the different types of data that can be modified.

Enumerated Value. The Modify value dialog box 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.

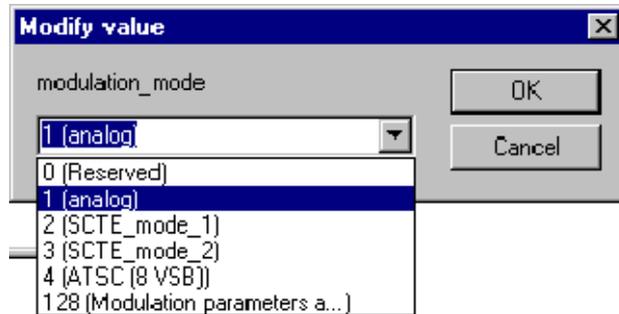


In this figure, the field being edited is a modulation_mode and the current text is 1 (analog).

Type the number, without any text, for the required value. When the changes are accepted, Multiplexer will display the interpretation in the Section View window.

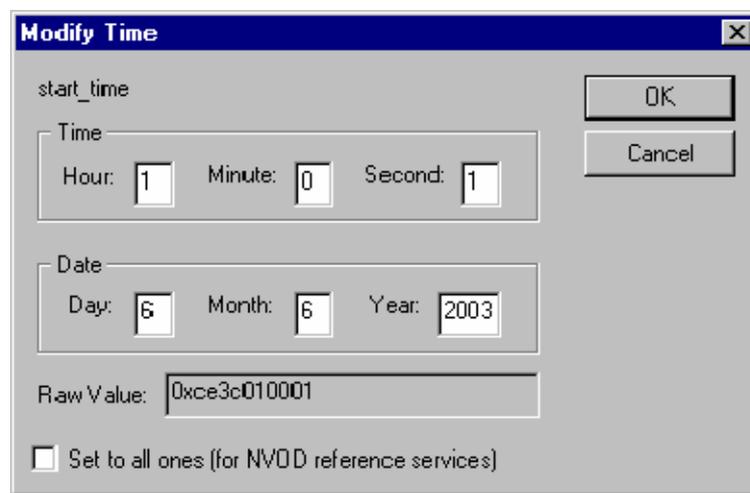
Alternatively, click the down arrow to select the value from the drop down list.

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 might open a simple context-sensitive dialog box offering advice and/or asking for more information or confirmation. An error message is displayed if the number that was typed in requires more bits than are allocated to the field.

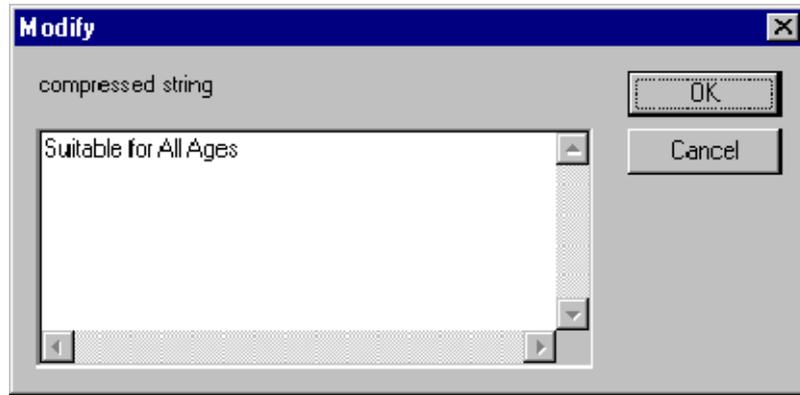
Date and Time. The Modify Time dialog box displays the name of the field. It displays the time in both interpreted and raw formats; only the interpreted mode can be edited.



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 check box, when enabled, sets the 40-bit date field to 0xFFFFFFFF. This might be required when setting the start_date for an event in a Near Video on Demand (NVOD) reference service.

Compressed String. The Modify dialog box displays the name of the field, which is always a 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. The Multiplexer checks to ensure that the new string length does not cause the total section length to exceed the maximum specified by the standards.

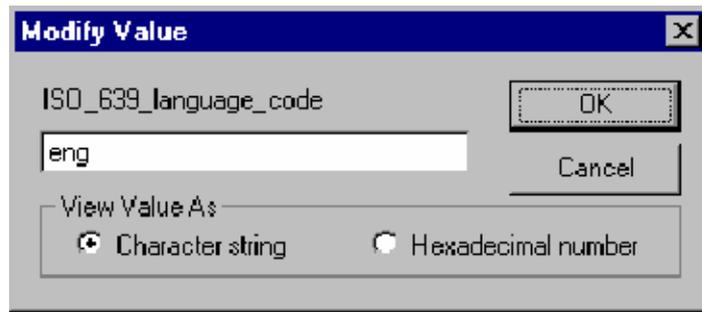
If the total section length exceeds the maximum specified by the standards, an error message is displayed:



Select OK to return to the Modify dialog box and shorten the string.

Text. The Modify Text dialog box 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 the following figure, the field being edited is an ISO_639_language_code and the current text is eng.

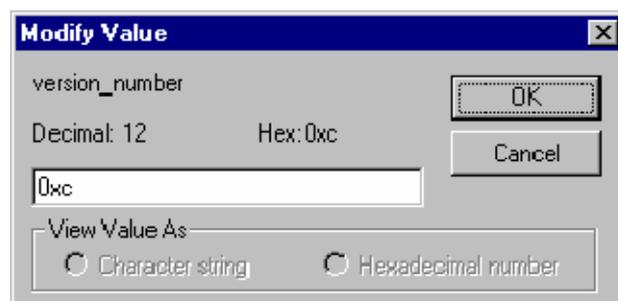


View Value As You can choose between viewing the text as an ASCII character string or a hexadecimal sequence.

Most text strings have a maximum length, specified by the governing standards, which this dialog box 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 box displays the name of the field and the current value in decimal. Edit the existing value or type in a new value.

In the following figure, the field being edited is a version_number and the current value is 0xc.



A new value can be entered using either decimal or hexadecimal notation. Values are assumed to be decimal unless preceded by 0x. The dialog box is not case

sensitive and values might include zeros after the prefix and before any significant digits.

Edit or replace the existing value and then select OK to continue. Select Cancel to abandon any changes made in the field.

The Multiplexer will check the new value against the governing standards and check for conflicts with other fields. It may open a simple context-sensitive dialog box offering advice and/or asking for more information or confirmation. For example: when changing a version_number, a dialog box is opened to determine the scope of the change.

Multiplexing Transport Streams

The Multiplex Engine in the Multiplexer synthesizes 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 that are displayed in the Navigator are synthesized from the current specification. Elementary streams and other data are acquired from the original MPEG file and other stream files and remultiplexed according to the specification.

Starting the Multiplex Engine

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 box to specify the file name and path for the synthesized transport stream.

A new file can be created or an existing file can be selected to be overwritten. The program will seek confirmation before overwriting an existing file.

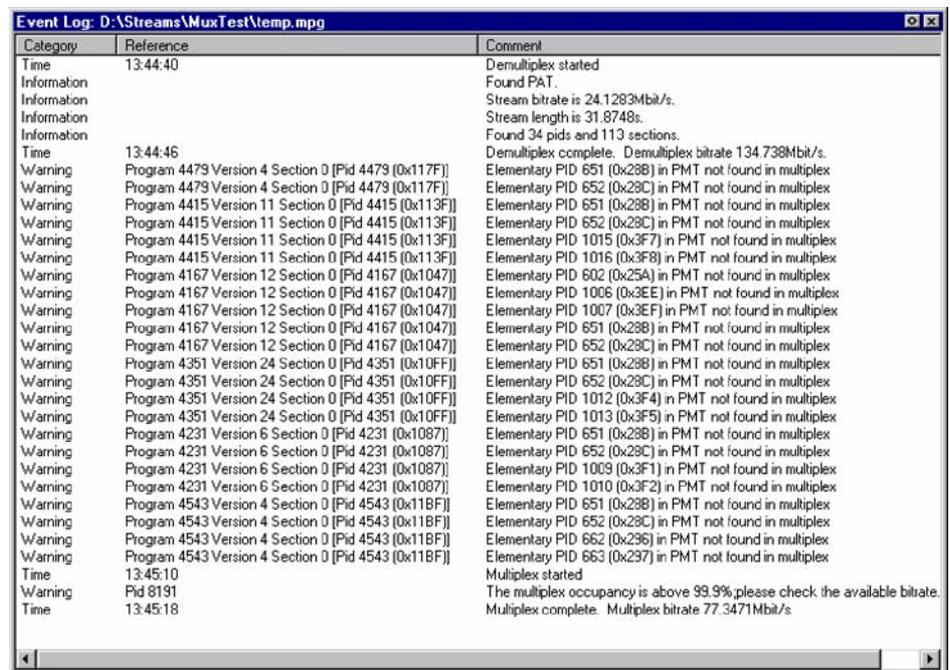
NOTE. The Multiplexer automatically creates 188 byte packets in the transport stream output file, regardless of the source material size.

Errors and Reporting

The right pane of the status bar indicates progress as the Multiplex Engine synthesizes the new transport stream.



Any errors are recorded in the Event Log, which can be opened at any time before, during, and after processing. Here is an example where a table cannot be multiplexed into the new stream at the specified rate.



Each table has a specification for nominal and maximum interval, in milliseconds, between instances of the table. These can be edited using the Navigator. The multiplex engine will try to multiplex the table into the synthesized 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 can be copied onto the Windows clipboard, using the Copy option from the shortcut menu. The text can also be cleared with the Clear command. Both commands are also available from the Edit menu.

Stopping the Multiplex Engine

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 synthesized up to the time the engine was stopped.

To stop the Multiplex Engine, select **Multiplex > Stop**.



Alternatively, select the stop button on the Toolbar.

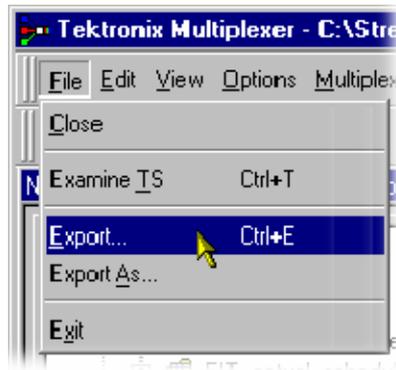


Exporting the Multiplex Configuration File

NOTE. Multiplexer is used for generating both conformant and nonconformant streams. Use the Export and Export As options to save copies of the specification for nonconformant 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 reopened using the Import option (see page 18).

Export Select File > Export 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 box to specify the file. This is the same as selecting the Export As... option.

Export As File > Export As exports a file with a user-specified name.



Multiplexer opens a standard file browser dialog box to select an existing file or specify a new file.

If you are creating a new file, specify the name of the exported file and select where it will be saved. By default, files are created with .muxml as the file extension.

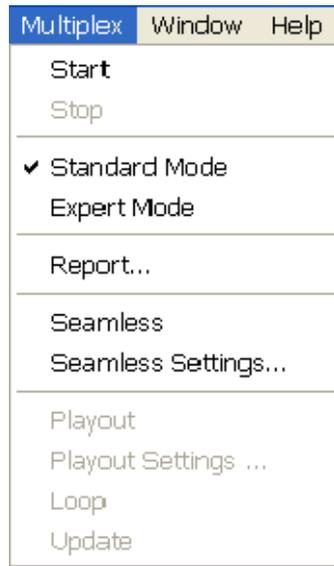
Make Seamless

When you loop 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.

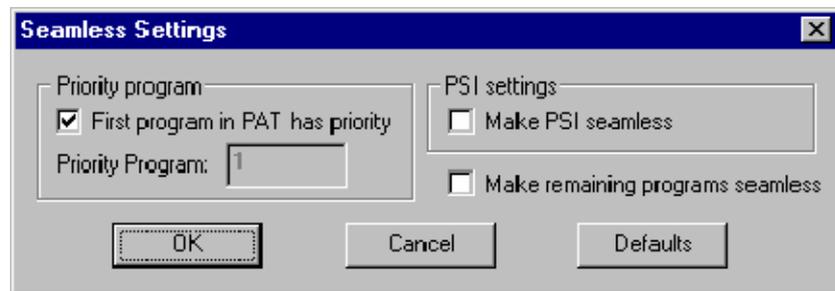
Enabling the Seamless option

Toggle the Seamless option by selecting **Multiplex > Seamless** or the toolbar button  .



Seamless Settings

Open the Seamless Settings dialog box by selecting Multiplex > Seamless Settings.... The dialog box 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	<p>If enabled, the service information contained in the transport stream is processed to make it seamless.</p> <p>If the setting is disabled, the PSI/SI is not processed but simply copied to the output transport stream.</p>
Make remaining programs seamless	<p>If enabled, the remaining programs are made seamless but are constrained by limits defined by the priority program. This can lead to these remaining programs having a gap at the beginning and end of the file.</p>

Reference

Abbreviations

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
DTS	Decoding Time Stamp
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)
PTS	Presentation Time Stamp
RAID	Redundant Array of Independent Disks
RRT	Regional Ratings Table (ATSC)
RST	Running Status Table (DVB)
SDT	Service Description Table (DVB)
SEI	Supplemental Enhancement Information (H.264)
SI	Service Information (DVB)

SIT	Satellite Information Table
STT	System Time Table (ATSC)
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 Coordinated Time
VCT	Virtual Channel Table (ATSC)
VUI	Video Usability Information (H.264)
XML	Extensible Markup Language