TREK

TELEMETRY TRAINER

USER GUIDE

November 2012

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1 What You Need To Know Before You Read This Document

Before reading this document you should be familiar with the material in the TReK Getting Started User Guide (TREK-USER-001) and the TReK Telemetry Tutorial (TREK-USER-002). If you have not read these documents, you may have difficulty with some of the terminology and concepts presented in this document.

It is also recommended that you work through the Telemetry Trainer Tutorial (TREK-USER-018) before reading this document. The Telemetry Trainer Tutorial provides a step-by-step guide to the main features in the Telemetry Trainer application. In contrast, this document provides details about each menu, dialog box, and message.

We assume you are an experienced Windows user. Information about how to use a mouse or how to use Windows is not addressed in this user guide. Please see your Windows documentation for help with Windows.

2 Technical Support

If you are having trouble installing the TReK software or using any of the TReK software applications, please try the following suggestions:

Read the appropriate material in the manual and/or on-line help.

Ensure that you are correctly following all instructions.

Checkout the TReK Web site at http://trek.msfc.nasa.gov/ for Frequently Asked Questions.

If you are still unable to resolve your difficulty, please contact us for technical assistance:

TReK Help Desk E-Mail, Phone & Fax:

E-Mail:	trek.help@nasa.gov
Telephone:	256-544-3521 (8:00 a.m. - 4:30 p.m. Central Time)
Fax:	256-544-9353

TReK Help Desk hours are 8:00 a.m. – 4:30 p.m. Central Time Monday through Friday. If you call the TReK Help Desk and you get a recording please leave a message and someone will return your call. E-mail is the preferred contact method for help. The e-mail message is automatically forwarded to the TReK developers and helps cut the response time.

3 Introduction

The TReK Telemetry Trainer application provides the capability to generate data packets on your TReK system. As discussed in the TReK Telemetry Tutorial (TREK-USER-002), a TReK system can receive telemetry data from multiple sources. The Telemetry Trainer application is used as a training tool to generate packets and send them to a designated TReK system for processing.

Once you have decided to simulate a particular telemetry packet there are several things you can do with the packet. You can choose to send, stop, pause, resume, or delete the packet. You can also view and change the properties of a packet at any time.

4 Telemetry Trainer Main Window

The Telemetry Trainer main window consists of two main areas as shown in Figure 1. The top part of the main window contains the list of packets that your Telemetry Trainer is configured to send. When you start the Telemetry Trainer application the list will be empty. This is because you have not yet added any packets to the list. The bottom part of the window is a message area that is used to display important status and error information messages about the Telemetry Trainer activities in progress.

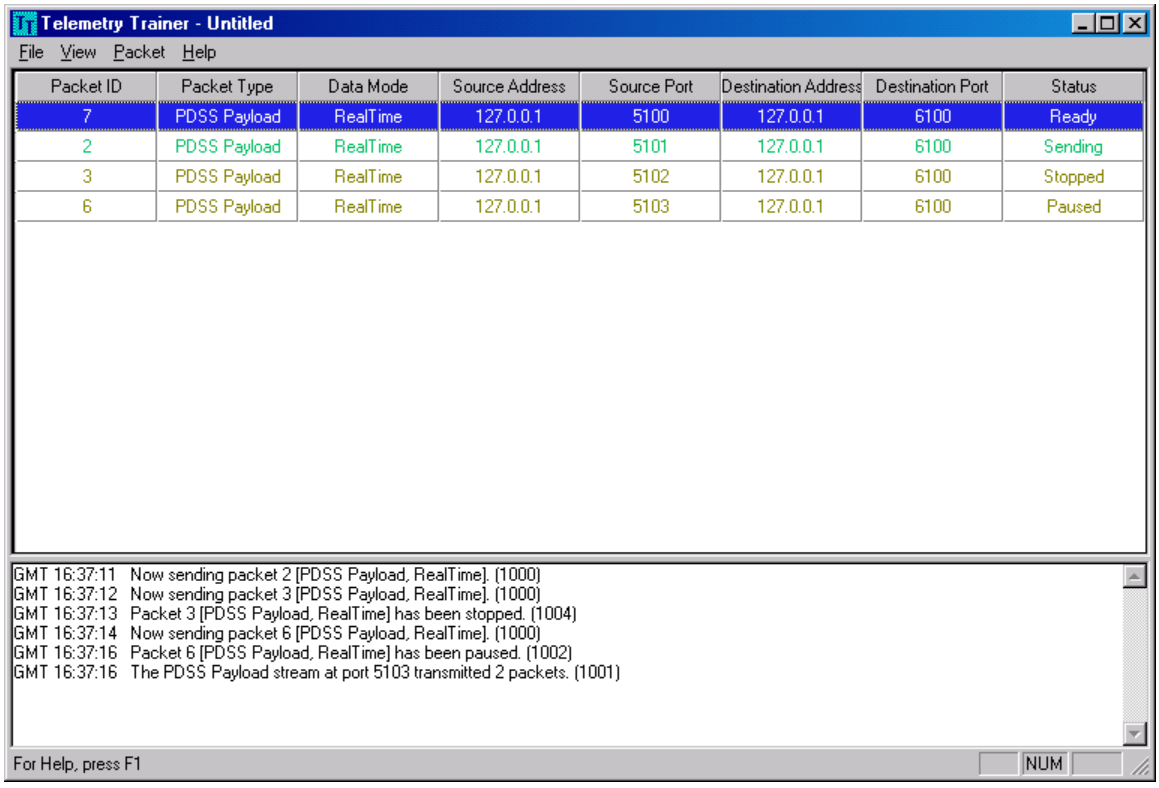

Figure 1 Telemetry Trainer Main Window

There are eight pieces of information that are displayed for each packet in the packet list. They are Packet ID, Packet Type, Data Mode, Source Address, Source Port, Destination Address, Destination Port, and Status. The Packet ID, Packet Type, Data Mode, Source Address, and Destination Address uniquely identify the packet. The Source Address, Source Port, Destination Address, and Destination Port identify the Transmission Information needed to send the packet. The Status identifies the state of the packet stream (e.g., sending, stopped, paused, etc.). This information will help you identify what packet stream you are sending.

In Figure 1, the first packet in the list has a Packet ID of 7, which is a simulated PDSS Payload packet. This packet shows Ready in the Status column, meaning that the packet has not been sent, but it is ready to be sent. The second packet in the list is Packet ID 2. The Status column indicates that it is being sent, which means the Telemetry Trainer is currently sending this packet. The third packet in the list is Packet ID 3, which is a PDSS Payload packet. This packet has been stopped as indicated in the Status Column. This packet can be sent again or deleted from the list. The fourth packet in the list is Packet ID 6. It is in a paused state and can be resumed, stopped, or deleted from the list. All the packets in the packet list are controlled using the Packet menu. There are also additional options on the File menu that provide a way to save a packet list configuration.

If you are running the Telemetry Trainer application or viewing this document from within Microsoft Word then you have probably noticed that each packet row has a color associated with it. The color provides information about the packet. For example, when using the default colors, if the packet row is blue, this indicates that the packet is ready to send. If the packet row is green, this indicates that data packets are being sent. If the packet row is gold, this indicates that the generation of data packets has been paused or stopped. The colors are helpful in providing immediate information about the general configuration and status of each packet in the list.

5 Telemetry Trainer Menus

The Telemetry Trainer application contains four main menus: File, View, Packet, and Help. Each of these menus are described in more detail below.

5.1 File Menu

The File menu is used to create, open, and save Telemetry Trainer configurations and to exit the Telemetry Trainer application. A Telemetry Trainer configuration is comprised of the packets in the packet list along with all the information associated with each packet. For example, suppose you have 3 packets in the packet list with different destination port numbers and IP Addresses. If you save the configuration, all of this information will be saved in a file. When you save a configuration, the Telemetry Trainer application will default to the

<base_path>\configuration_files\telemetry_trainer directory. The <base_path> on a Windows 2000 computer is shown below.

<base_path> = C:\Documents and Settings\<username>\Application Data\TReK

You can save your configuration files anywhere you like, but this default directory provides an easy way for you to keep up with your files.

Each of the items on the File menu is described below.

New
New provides a way to start a new configuration. When you start a new configuration any packets in the list are deleted and all activities associated with those packets are stopped. If there are packets in the packet list when New is selected, you will be given the option of saving the configuration before all the packets are deleted from the packet list.

Open
Open provides a way to open a previously saved configuration.

Save
Save provides a way to save the current configuration.

Save As
Save As provides a way to save the current configuration with another name.

Exit
Exit provides a way to exit the Telemetry Trainer application.

5.2 View Menu

The View menu is used to change attributes associated with the Telemetry Trainer main window. There are three items on the View menu. Each is described below:

Status Bar
The Status bar is located at the very bottom of the Telemetry Trainer main window. The status bar is used to display messages and useful information to you without interrupting your work The status bar has "panes," which include "indicators" and a "message line." The indicators provide the status of items such as SCROLL LOCK. The message line on the status bar can display information about program status or about a toolbar button or menu item that you are pointing to with the mouse. If you select the Status Bar item on the View menu, this will toggle the Status Bar on and off.

Set Color Preferences

The Set Color Preferences option brings up the Set Color Preferences dialog. This dialog can be used to turn off, turn on, or change the colors used in the Telemetry Trainer main window.

Clear Message Area
As mentioned in section 4, the Message Area is located at the bottom of the Telemetry Trainer main window. This is where important status and error messages will be displayed while you are working with the application. If you select the Clear Message Area item on the View menu, this will clear all the messages in the Message Area. Once they have been cleared, you can not get them back.

5.3 Packet Menu

The Packet menu is the most frequently used menu in the Telemetry Trainer application. It is used to add packets to the packet list in the main window, and to control all the activities associated with each packet. Each of the items on the Packet menu are described below.

Add A Packet
Used to identify a particular packet for the Telemetry Trainer to generate. When you select Add A Packet, a dialog box will be presented so that you can fill in the information your Telemetry Trainer needs in order to send the packet (see section 6.2 for Add A Packet Dialog).

Send Packet
Used to tell the Telemetry Trainer to start sending the packet. The Send Packet option is only available when you have a packet selected that is Ready or Stopped. Some of the Packet menu options (such as Pause Packet, Stop Packet, etc.) will be unavailable until you Send the packet.

Stop Packet
Used to tell the Telemetry Trainer to stop sending a particular packet. The Stop Packet option is only available when you have a packet selected that is Sending or Paused.

Pause Packet
Used to tell the Telemetry Trainer to pause sending for a particular packet. The Pause Packet option is only available when you have a packet selected that is Sending.

Resume Packet
Used to tell the Telemetry Trainer to resume sending for a particular packet. The Resume Packet option is only available when you have a packet selected that is Paused.

Delete Packet
Used to tell the Telemetry Trainer to stop sending a particular packet and remove it from the list. The Delete Packet option is only available when you have a packet selected.

Show Packet Properties
Used to see a complete list of properties about a particular packet, such as the Packet ID, Database, and Packet Type. It allows some of the properties to be changed (see section 6.5 for details on the Packet Properties Dialog). The packet properties are first set when you add the packet to the packet list using the Add A Packet dialog. In fact, when you select Show Packet Properties the dialog box that appears is identical to the Add A Packet dialog. The Show Packet Properties Option is only available when you have a packet selected.

5.4 Help Menu

The Help menu is used to access on-line help for the Telemetry Trainer application. Each of the items on the Help menu is described below.

Help Topics
Used to access the typical Windows Contents and Index on-line help window.

About Telemetry Trainer
Used to view the About Telemetry Trainer dialog.

5.5 Packet List Pop-Up Menu

The Packet List pop-up menu can be accessed by clicking the right mouse button in the packet list area of the main window. If you right click in the packet list area of the window, but you do not click on a packet in the list, many of the menu items will be insensitive. This is because these menu items are only applicable to a selected packet. If you right click on a packet in the packet list all the menu items which are applicable to that particular packet at that moment in time will be sensitive. The Packet List Pop-Up menu is identical to the Packet menu on the menu bar.

5.6 Windows Edit Pop-Up Menu

The standard Windows Edit Pop-Up Menu can be accessed whenever your cursor is located inside an edit field within the Telemetry Trainer application or within the message area on the Telemetry Trainer Main Window. This menu contains the standard edit commands such as Cut, Copy, and Paste.

6 Telemetry Trainer Dialog Boxes

This section describes all the dialog boxes in the Telemetry Trainer application. For an example of how some of these dialogs are used while working with the Telemetry Trainer application please see the Telemetry Trainer Tutorial (TREK-USER-018).

6.1 Set Color Preferences Dialog

The Set Color Preferences dialog is shown in Figure 2 below. It is used to control the color feature associated with the Telemetry Trainer main window packet list. The color of a packet in the packet list indicates if the packet is in a ready, sending, paused, or stopped state. The color feature can also be turned off. If it is off the packets in the packet list will always be black. If the color feature is on, the packets in the packet list will turn a specific color based on the packet status and the colors assigned in the Set Color Preferences dialog.

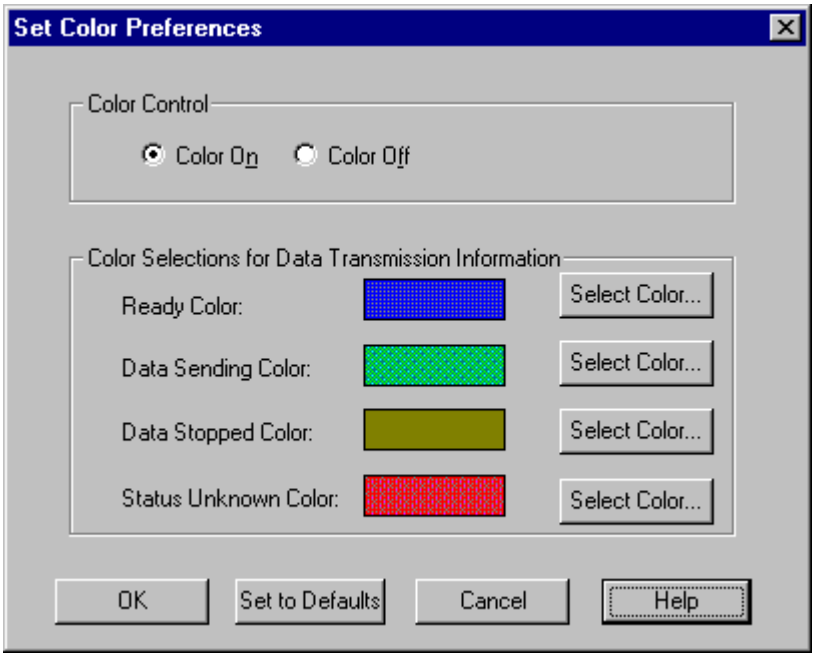

Figure 2 Set Color Preferences Dialog

Each field and control on the Set Color Preferences dialog is described below.

Color On
Turns the color feature on.

Color Off
Turns the color feature off.

Ready Color
The color assigned when the status of the packet is “Ready”. “Ready” indicates that the packet is ready to be sent. This will be the current state right after the packet has been added to the packet list.

Sending Color

The color assigned when the status of the packet is “Sending”. This status will occur when the packet is being transmitted.

Stopped Data Color
The color assigned when the status of the packet is “Stopped”. This status will occur when Telemetry Trainer has sent all of the packets requested or when the packet has been stopped or paused from the Packet Menu.

Status Unknown Color
The color assigned when the status of the packet is unknown. This will occur if the packet has been sent, but an error occurred while trying to determine the status of the packet.

Buttons

Select Color
The Select Color button is used to access the standard Windows Color dialog in order to change the assigned color.

Set to Defaults
The Set to Defaults button will reset all the fields and controls in the Set Preferences dialog box to the original values that were in place when the TReK software was installed.

6.2 Add A Packet Dialog

The Add A Packet dialog is used to add a packet to the packet list in the main window. Remember that this is how you add packets to the Telemetry Trainer to be sent to your TReK system for simulation purposes. Packets are uniquely identified by a combination of Packet ID, Packet Type, Data Mode, and Destination IP Address. As can be seen in Figure 3, the Add A Packet dialog is divided into two sections: Packet Information and Transmission Information. The Packet Information section contains information that tells your Telemetry Trainer what packet to generate. The Transmission Information section tells your Telemetry Trainer how to transmit the packet.

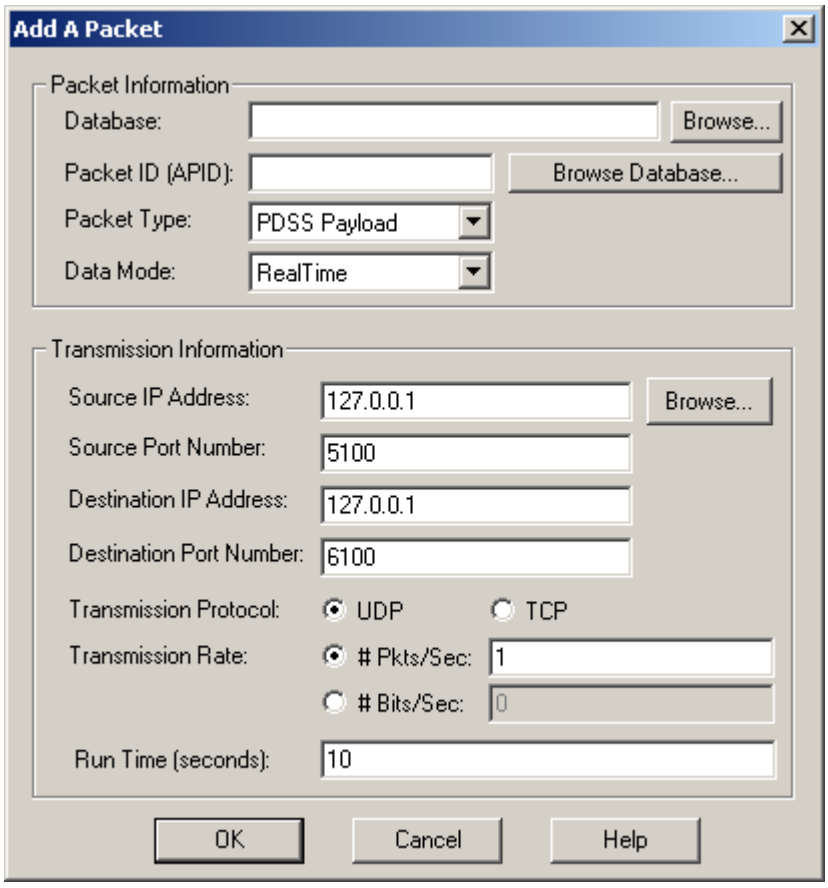

Figure 3 Add A Packet Dialog Box

Each field on the Add A Packet dialog is described below.

Database (Required Field)
The database field is used to tell your TReK system which database to use when processing (decommutating, calibrating, sensing, etc.) your packet and the parameters inside the packet. The database field must contain the complete directory path and name for your database. An example of this is `c:\TReK\database\TelemetryDatabase.mdb`. If you don't know the complete path, you can push the Browse… button located to the right of the Database field. This will bring up a Windows Open dialog box that you can use to search local directories to find your database file. The Open dialog is not described in this document since it is a typical Windows dialog box. If you need help with this dialog, please refer to the Windows on-line help. The Open dialog will default to the `<base_path>\database` directory. The <base_path> on a Windows 2000 computer is shown below.

<base_path> = C:\Documents and Settings\<username>\Application Data\TReK

You can save your database files anywhere you like, but this default directory provides an easy way for you to keep up with your database files.

Packet ID (APID) (Required Field)
The Packet ID is one of the primary packet attributes that is used by your Telemetry Trainer to identify a packet. The term Packet ID is synonymous with the term Application Process ID (APID). As described in the TReK Telemetry Tutorial (TREK-USER-002), the Packet ID (or APID) is located in the primary header of a Consultative Committee for Space Data Systems (CCSDS) packet. When a packet arrives at your TReK system, this header is checked to determine whether the packet should be accepted or dropped. If you don't have the Packet ID memorized, you can Browse the database to find the Packet ID. This can be done by pushing the Browse Database button located to the right of the Packet ID field. The Browse Database dialog is described in section 6.3.

Packet Type (Required Field)
The Packet Type field is used to tell the Telemetry Trainer something about the simulated source of the packet and the packet type. There are a fixed set of packet types that will be simulated: CCSDS, CDP, EXPRESS, FDP, GSE, GSE Merge, IMAQ ASCII, PDSS Core, PDSS Payload, PDSS RPSM, PDSS UDSM, PRCU, Suitcase Simulator, UFO, VCDU. Please note that when the Telemetry Trainer application generates PDSS Payload packets it will also generate the corresponding PDSS User Data Summary Message (UDSM) packets. See section 7.1 for more information about the Telemetry Trainer and PDSS UDSM packets.

Data Mode (Required Field)
The Data Mode field is used to tell the Telemetry Trainer what type of data mode is associated with your packet. There are a fixed set of sixteen data modes which are supported by the Telemetry Trainer and your TReK system. They are: None, RealTime, Dump1, Dump2, Dump3, Playback1, Playback2, Playback3, Playback4, Playback5, Playback6, Playback7, Playback8, Playback9, Playback10, and Playback11. The None data mode is only used with Suitcase Simulator packets. It should never be used for PDSS Payload or GSE packets. If you select a playback data mode, this indicates that you will be simulating an external playback.

Source IP Address (Required Field)
The Source IP address field is used to tell your Telemetry Trainer the IP address of the network card your TReK system will send data from. The Source IP Address field defaults automatically to the first network card IP address located in the Windows registry. Your TReK system retrieves your local unicast IP address from the Windows registry. If you are not familiar with the registry don't worry about it. You don't need to be familiar with the registry to use the Telemetry Trainer application. If you want to see a list of all the IP addresses for your machine, just push the Browse button next to the Source IP address field. The Browse For IP Address dialog is described in section 6.4.

If your TReK system does not have network connectivity (such as no ethernet card or modem or the system is not connected to a network), the default will be set to 127.0.0.1.

This is called a loopback address and can be used while you are working in standalone mode.

Source Port Number (Required Field)
The Source Port Number is used to tell your Telemetry Trainer which port to send the packet from.

Destination IP Address (Required Field)
The Destination IP address field is used to tell your Telemetry Trainer the destination of the TReK system you wish to send the packet to. It's kind of like your home address on a letter that is arriving via a postal service. The Telemetry Trainer acts as the person who is sending the letter and puts your address on it so the post office knows where to deliver the letter. The Telemetry Trainer uses the Destination IP address (and port number) to tell the networks along the way how to get the packets to the TReK system you are sending to. In most cases you will probably enter your local TReK system's unicast IP Address. The Destination IP Address field defaults automatically to your local unicast IP address. Your Telemetry Trainer retrieves this information from the Windows registry. If you are not familiar with the registry, don't worry about it. You don't need to be familiar with the registry to use the Telemetry Trainer application.

If your TReK system does not have network connectivity (such as no ethernet card or modem or the system is not connected to a network), the default will be set to 127.0.0.1. This is called a loopback address and can be used while you are working in standalone mode.

Destination Port Number (Required Field)
The Destination Port Number is used to tell your Telemetry Trainer which port to send the packet to on your TReK system. The Destination Port Number is very similar to the Destination IP address in that it identifies specific information about where the packet will be sent. The destination port number and the source port should be different if sending to the same PC. Duplicate destination and source ports can be used if the destination is not the local PC.

You will define the Destination Port Number that should be used when the packet is generated. Therefore, make sure you identify the same Port Number on the receiving side in the Telemetry Processing application. Otherwise, the packet won't be accepted by your TReK system even though your TReK system is generating it.

Transmission Protocol
The Transmission Protocol is for sending a packet can be either UDP or TCP.

Transmission Rate
The Transmission Rate is used to tell your TReK system the rate at which to transmit your data. You can enter the transmission rate in packets per second or bits per second. For example, you may want to send 10 packets per second. If the Run Time is set to 10 seconds, then you would have sent approximately 100 packets during that runtime. Note,

the operating system's timing precision is limited to 1/100th of a second. Therefore, to achieve packet rates greater than 100 packets per second, the Telemetry Trainer must transmit packets in groups. This "bursting" implementation can create discrepancies between the number of packets that were expected to be sent and the actual number of packets that were sent.

Run Time
The Run Time is used to tell the Telemetry Trainer how many seconds the packet should be sent. For instance, you may want the Run Time to be 100 seconds. If the number of packets you were sending was 1 per second, then you would have sent 100 packets during the specified runtime.

6.3 Browse Database Dialog

The Browse Database dialog is shown in Figure 4. This dialog is used to search a TReK database for a Packet ID.

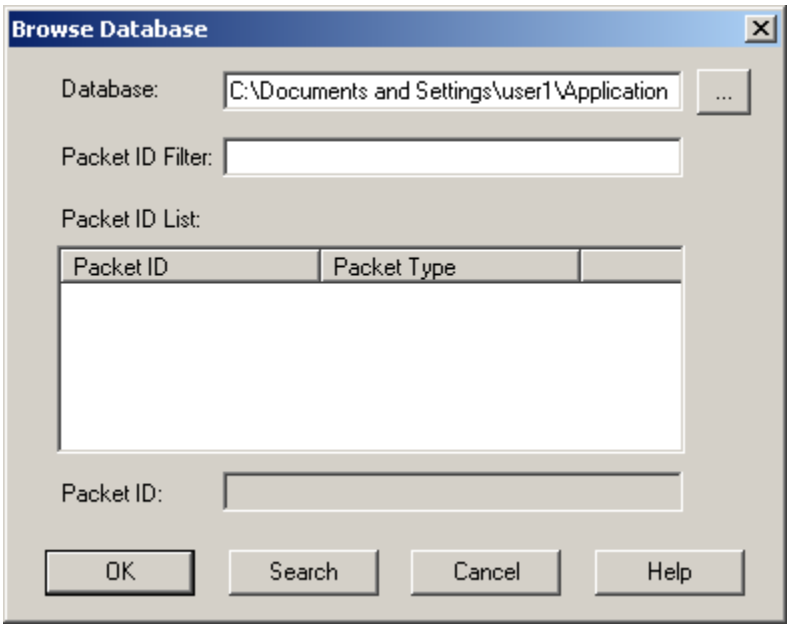

Figure 4 Browse Database Dialog

Each field in the Browse Database dialog is described below.

Database (Required Field)
The database field is used to tell your TReK system which database to search. The database field must contain the complete directory path and name for the database. An example of this is `c:\TReK\database\TelemetryDatabase.mdb`. If you don't know the complete path, you can push the … (dot dot dot) button located to the right of the Database field. This will bring up a Windows Open dialog box which you can use to search local directories to find your database file. The Open dialog will default to the

<base_path>\database directory. The <base_path> on a Windows 2000 computer is shown below.

<base_path> = C:\Documents and Settings\<username>\Application Data\TReK

Packet ID Filter (Optional Field)
If you do not fill in the Packet ID Filter field, the search will return all packet IDs in the database. You can use a * wildcard to represent zero or more characters when specifying the filter or a ? to represent any single character. For example, the following filters are valid: 12*, 1*3, *12, 1??. The 12* filter indicates that all Packet IDs that begin with 12 should be returned. The 1*3 filter indicates that all Packet IDs that begin with 1 and end with 3 and have any number of characters in between should be returned. The *12 filter indicates that all Packet IDs that end in 12 should be returned. The 1?? filter indicates that all Packet IDs that begin with 1 followed by exactly two more characters should be returned.

Packet ID List
This list shows all the Packet IDs returned as a result of the search. There are two columns of information. The column on the left shows the Packet ID and the column on the right shows the packet type. You can sort the list based on either Packet ID or Packet Type. To sort the list by Packet ID, use your mouse to left click on the column header labeled Packet ID. To sort the list by Packet Type, use your mouse to left click on the column header labeled Packet Type. When you click on a column header you will see an up arrow or a down arrow. The arrow indicates whether the sort is ascending or descending.

Packet ID
The Packet ID field is filled in when you select a Packet ID in the list. The Packet ID will be copied to the dialog box that contained the button you used to bring up the Browse Database dialog.

Dialog Buttons
There is one non-standard button on the Browse Database dialog box. It is described below.

Search
The Search button executes the database search based on the criteria you have entered in the Database and Packet ID Filter fields.

6.4 Browse For IP Address Dialog

The Browse For IP Address dialog is shown in Figure 5. This dialog is used to search a TReK system for all IP addresses or network cards associated with the system.

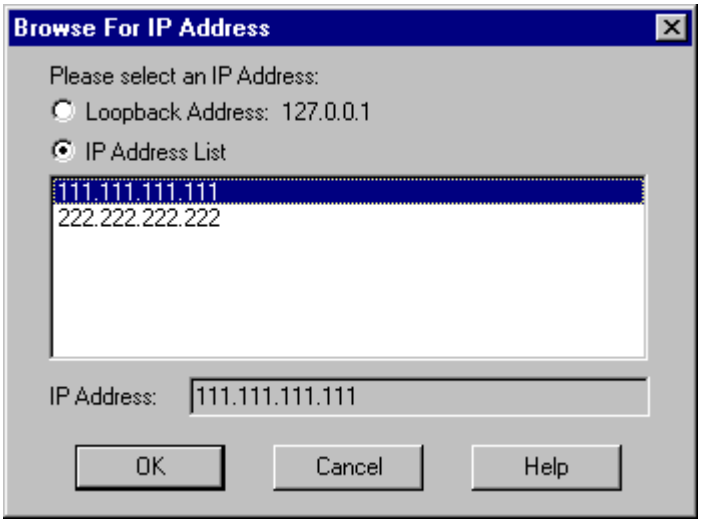

Figure 5 Browse For IP Address Dialog

Each field in the Browse For IP Address dialog is described below.

Please select an IP Address: (Required Field)
You have two options when choosing an IP address. If your TReK system does not have network connectivity (such as no ethernet card or modem or the system is not connected to a network), you need to use the standard loopback address (127.0.0.1). This option is provided by choosing the "*Loopback Address: 127.0.0.1*" radio button. Users with one or more network cards will need to choose which network card or IP Address they would like to use. Choosing the "*IP Address List*" radio button provides this option. The user must then select an IP address from the list.

IP Address
The IP Address field is filled in when you select the Loopback IP address or an IP Address in the list. The IP Address will be copied to the dialog box that contained the button you used to bring up the Browse For IP Address dialog.

6.5 Packet Properties Dialog

When you select Show Packet Properties for a packet a dialog that is identical (except for the title) to the Add A Packet dialog (see section 6.2) will be displayed. This is the Packet Properties dialog and it will be populated with all the properties you selected when you added the packet. All properties are read-only on this dialog after you have added the packet, except Destination IP Address, Destination Port Number, Runtime and Number of Packets. You cannot change any of the read only fields in this dialog. If you need to change these read only packet properties, you need to delete the packet from the packet list in the main window and add a new packet. You can, however, change the Destination IP Address, Destination Port Number, Runtime, or Number of Packets fields.

If any of these four properties have been updated the packet will be stopped and updated with the new properties. The Packet Properties dialog box can be accessed using the Packet Menu's Show Packet Properties option, by using the Packet List pop-up menu, or by double clicking on the packet in the main window packet list. You must have a packet selected in order to access this dialog.

6.6 Invalid Configuration Information Dialog

The Invalid Configuration Information dialog is shown in Figure 6. This dialog only appears if you attempt to open a configuration file that contains invalid configuration information. This usually happens when you move a configuration file from one machine to another. For example, when you save a configuration file, the packets and all the information associated with the packets (including the IP address information and the location of the database file) are stored in the configuration file. If you move the configuration file, then some of this information will no longer be valid.

The Invalid Configuration Information dialog contains two lists. The list at the top of the dialog contains a list of the packets that are stored in the configuration file. If the packet contains any invalid information it will be red. When you select a packet in the packet list, the list located below the packet list will display all the invalid items associated with that particular packet.

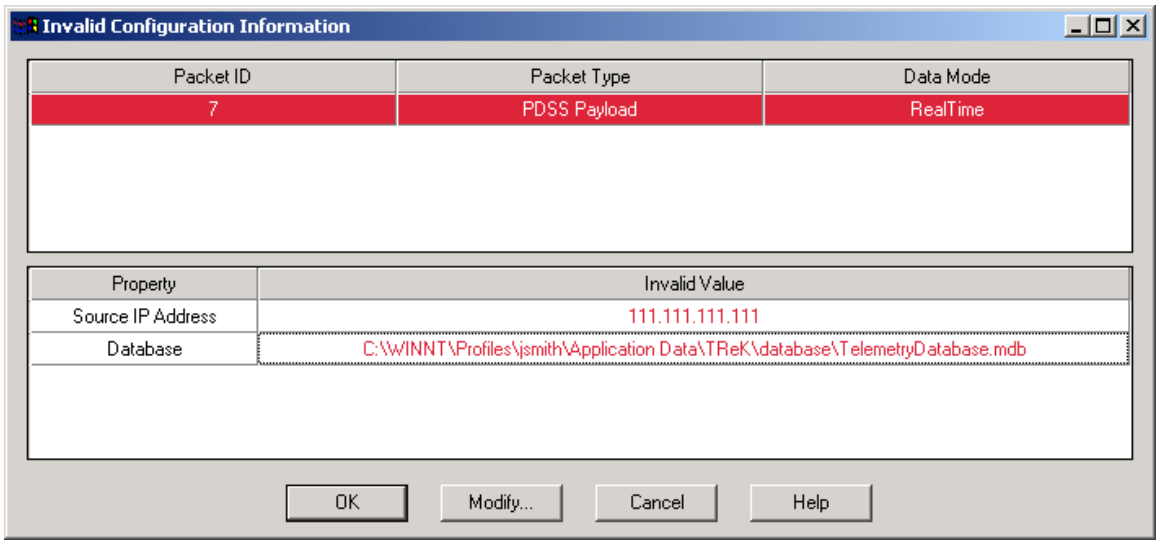

Figure 6 Invalid Configuration Information Dialog Box

Buttons

Modify
When you select a packet in the packet list and push the Modify button, the Packet Properties dialog will be displayed. The Packet Properties dialog can be used to change the properties that are invalid.

Cancel
Selecting the Cancel button will abort the entire process and leave the configuration file unchanged.

6.7 Delete Packet Warning Message Dialog

The Delete Packet Warning Message Dialog will appear if you attempt to delete an active packet from the packet list in the main window. If you are sure you want to proceed answer Yes. If you do not want to proceed answer No and no action will be taken.

Figure 7 Delete Packet Warning Message Dialog Box

6.8 Close Configuration Warning Message Dialog

The Close Configuration Warning message dialog will appear if you attempt to perform a New or Open and there are packets in the packet list. If you are sure you want to proceed answer Yes. If you do not want to proceed answer No and no action will be taken.

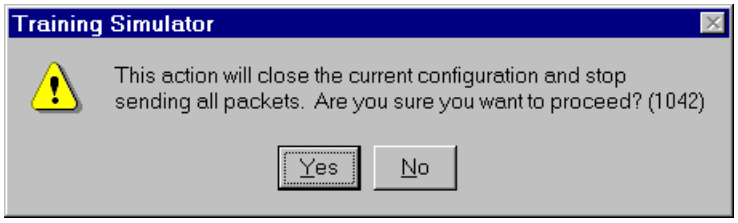

Figure 8 Close Configuration Warning Message Dialog Box

6.9 Save Changes Message Dialog

If you select New, Open, or Exit, and the current configuration has not been saved, the Save Changes message dialog will be displayed. If you are exiting the application, the application will Exit after you respond to the Save Changes dialog.

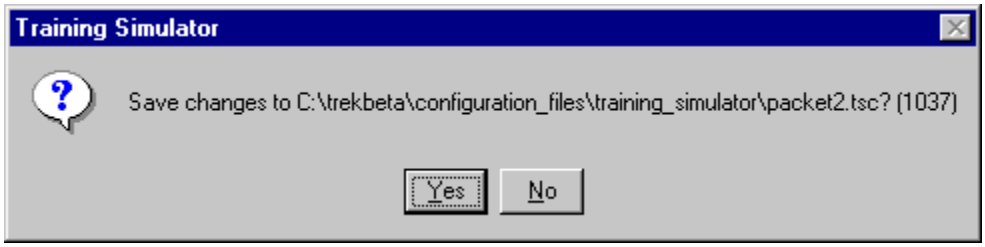

Figure 9 Save Changes Message Dialog Box

6.10 Exit Confirmation Message Dialog

The Exit Confirmation message dialog is displayed to help you avoid exiting the Telemetry Trainer application by accident. It will only be displayed if you exit the application with the current configuration unchanged. If the configuration has changed you will be prompted with the Save Changes dialog instead of the Exit Confirmation dialog. If you are prompted with the Exit Confirmation dialog and you are sure you want to exit answer Yes. If you do not want to exit the application, answer No, and the application will not proceed with the exit.

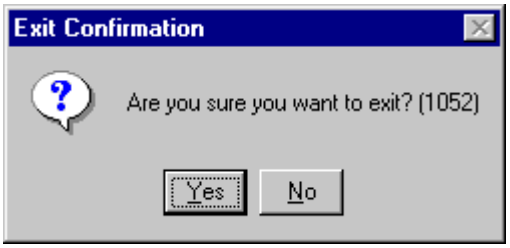

Figure 10 Exit Confirmation Message Box

7 Special Topics

This section addresses a few of the special topics associated with the Telemetry Trainer application.

7.1 Does Telemetry Trainer simulate PDSS UDSM packets?

In the POIC when a scheduled Loss of Signal (LOS) occurs, PDSS will generate a User Data Summary Message (UDSM) for any packet that is no longer arriving. The UDSM packet contains information on the number of packets transmitted, the start and stop time, and various errors. Please see the POIC to Generic User Interface Definition Document (SSP-50305) for more information about PDSS UDSM packets. The TReK Telemetry Trainer simulates this scheduled LOS UDSM packet. When the Telemetry Trainer completes transmission of a PDSS Payload packet a PDSS UDSM packet is generated and sent to the same destination IP address and port number. This packet contains the start and stop times and the number of packets transmitted. There are no errors generated in this packet. The UDSM packet is not generated when the user initiates a Pause or Stop from the packet menu.

7.2 Can I use the Telemetry Trainer application as a testing tool?

It is not advisable to use the Telemetry Trainer application as a testing tool to test your network or the performance of a TReK system. This is because the Telemetry Trainer was designed as a training tool only and not as a generic data packet generator tool to be used for testing purposes.

The Windows operating system's timing precision is limited to 1/100th of a second. Therefore, to achieve packet rates greater than 100 packets per second, the Telemetry Trainer must transmit packets in groups. This "bursting" implementation can create discrepancies between the number of packets that were expected to be sent and the actual number of packets that were sent. This is one of the main reasons that it is not advisable to use the Telemetry Trainer application as a test tool but instead as a training tool as it was intended.

The purpose of the Telemetry Trainer application is to provide a way for you to learn how to use your TReK system by providing a local data source that has no external dependencies.

8 Messages

Error messages are listed in the Telemetry Trainer On-Line Help.

Appendix A Glossary

Note: This Glossary is global to all TReK documentation. All entries listed may not be referenced within this document.

Application Programming Interface (API)	A set of functions used by an application program to provide access to a system's capabilities.
Application Process Identifier (APID)	An 11-bit field in the CCSDS primary packet header that identifies the source-destination pair for ISS packets. The type bit in the primary header tells you whether the APID is a payload or system source-destination.
Calibration	The transformation of a parameter to a desired physical unit or text state code.
Communications Outage Recorder	System that captures and stores payload science, health and status, and ancillary data during TDRSS zone of exclusion.
Consultative Committee for Space Data Systems (CCSDS) format	Data formatted in accordance with recommendations or standards of the CCSDS.
Consultative Committee for Space Data Systems (CCSDS) packet	A source packet comprised of a 6-octet CCSDS defined primary header followed by an optional secondary header and source data, which together may not exceed 65535 octets.
Conversion	Transformation of downlinked spacecraft data types to ground system platform data types.
Custom Data Packet	A packet containing a subset of parameters that can be selected by the user at the time of request.
Cyclic Display Update Mode	A continuous update of parameters for a particular display.
Decommutation (Decom)	Extraction of a parameter from telemetry.
Discrete Values	Telemetry values that have states (e.g., on or off).

Dump	During periods when communications with the spacecraft are unavailable, data is recorded onboard and played back during the next period when communications resume. This data, as it is being recorded onboard, is encoded with an onboard embedded time and is referred to as dump data.
Enhanced HOSC System (EHS)	Upgraded support capabilities of the HOSC systems to provide multi-functional support for multiple projects. It incorporates all systems required to perform data acquisition and distribution, telemetry processing, command services, database services, mission support services, and system monitor and control services.
Exception Monitoring	A background process capable of continuously monitoring selected parameters for Limit or Expected State violations. Violation notification is provided through a text message.
Expected State Sensing	Process of detecting a text state code generator in an off-nominal state.
EXPRESS	An EXPRESS Rack is a standardized payload rack system that transports, stores and supports experiments aboard the International Space Station. EXPRESS stands for EXpedite the PRocessing of Experiments to the Space Station.
File transfer protocol (ftp)	Protocol to deliver file-structured information from one host to another.
Flight ancillary data	A set of selected core system data and payload health and status data collected by the USOS Payload MDM, used by experimenters to interpret payload experiment results.

Grayed out	Refers to a menu item that has been made insensitive, which is visually shown by making the menu text gray rather than black. Items that are grayed out are not currently available.
Greenwich Mean Time (GMT)	The solar time for the meridian passing through Greenwich, England. It is used as a basis for calculating time throughout most of the world.
Ground ancillary data	A set of selected core system data and payload health and status data collected by the POIC, which is used by experimenters to interpret payload experiment results. Ground Ancillary Data can also contain computed parameters (pseudos).
Ground receipt time	Time of packet origination. The time from the IRIG-B time signal received.
Ground Support Equipment (GSE)	GSE refers to equipment that is brought in by the user (i.e. equipment that is not provided by the POIC).
Ground Support Equipment Packet	A CCSDS Packet that contains data extracted from any of the data processed by the Supporting Facility and the format of the packet is defined in the Supporting Facility's telemetry database.
Huntsville Operations Support Center (HOSC)	A facility located at the Marshall Space Flight Center (MSFC) that provides scientists and engineers the tools necessary for monitoring, commanding, and controlling various elements of space vehicle, payload, and science experiments. Support consists of real-time operations planning and analysis, inter- and intra-center ground operations coordination, facility and data system resource planning and scheduling, data systems monitor and control operations, and data flow coordination.

IMAQ ASCII	A packet type that was added to TReK to support a very specific application related to NASA's Return to Flight activities. It is not applicable to ISS. It is used to interface with an infrared camera that communicates via ASCII data.
Limit Sensing	Process of detecting caution and warning conditions for a parameter with a numerical value.
Line Outage Recorder Playback	A capability provided by White Sands Complex (WSC) to play back tapes generated at WSC during ground system communication outages.
Measurement Stimulus Identifier (MSID)	Equivalent to a parameter.
Monitoring	A parameter value is checked for sensing violations. A message is generated if the value is out of limits or out of an expected state.
Parameter	TReK uses the generic term parameter to mean any piece of data within a packet. Sometimes called a measurement or MSID in POIC terminology.
Payload Data Library (PDL)	An application that provides the interface for the user to specify which capabilities and requirements are needed to command and control his payload.
Payload Data Services Systems (PDSS)	The data distribution system for ISS. Able to route data based upon user to any of a number of destinations.
Payload Health and Status Data	Information originating at a payload that reveals the payload's operational condition, resource usage, and its safety/anomaly conditions that could result in damage to the payload, its environment or the crew.
Payload Operations Integration Center (POIC)	Manages the execution of on-orbit ISS payloads and payload support systems in coordination/unison with distributed International Partner Payload Control Centers, Telescience Support Centers (TSC's) and payload-unique remote facilities.

Payload Rack Checkout Unit (PRCU)	The Payload Rack Checkout Unit is used to verify payload to International Space Station interfaces for U.S. Payloads.
Playback	Data retrieved from some recording medium and transmitted to one or more users.
Pseudo Telemetry (pseudo data)	Values that are created from calculations instead of directly transported telemetry data. This pseudo data can be created from computations or scripts and can be displayed on the local PC.
Remotely Generated Command	A command sent by a remote user whose content is in a raw bit pattern format. The commands differ from predefined or modifiable commands in that the content is not stored in the POIC Project Command Database (PCDB).
Science data	Sensor or computational data generated by payloads for the purpose of conducting scientific experiments.
Subset	A collection of parameters from the total parameter set that is bounded as an integer number of octets but does not constitute the packet itself. A mini-packet.
Super sampled	A parameter is super sampled if it occurs more than once in a packet.
Swap Type	A flag in the Parameter Table of the TReK database that indicates if the specified datatype is byte swapped (B), word swapped (W), byte and word swapped (X), byte reversal (R), word reversal (V) or has no swapping (N).
Switching	A parameter's value can be used to switch between different calibration and sensing sets. There are two types of switching on TReK: range and state code.

Transmission Control Protocol (TCP)	TCP is a connection-oriented protocol that guarantees delivery of data.
Transmission Control Protocol (TCP) Client	A TCP Client initiates the TCP connection to connect to the other party.
Transmission Control Protocol (TCP) Server	A TCP Server waits for (and accepts connections from) the other party.
Telemetry	Transmission of data collected form a source in space to a ground support facility. Telemetry is downlink only.
Telescience Support Center (TSC)	A TSC is a NASA funded facility that provides the capability to plan and operate on-orbit facility class payloads and experiments, other payloads and experiments, and instruments.
User Application	Any end-user developed software program that uses the TReK Application Programming Interface software. Used synonymously with User Product.
User Data Summary Message (UDSM)	Packet type sent by PDSS that contains information on the number of packets sent during a given time frame for a PDSS Payload packet. For details on UDSM packets, see the POIC to Generic User IDD (SSP-50305).
Uplink format	The bit pattern of the command or file uplinked.
User Datagram Protocol (UDP)	UDP is a connection-less oriented protocol that does not guarantee delivery of data. In the TCP/IP protocol suite, the UDP provides the primary mechanism that application programs use to send datagrams to other application programs. In addition to the data sent, each UDP message contains both a destination port number and a fully qualified source and destination addresses making it possible for the UDP software on the destination to deliver the message to the correct recipient process and for the recipient process to send a reply.

User Product	Any end-user developed software program that uses the TReK Application Programming Interface software. Used synonymously with User Application.
Web	Term used to indicate access via HTTP protocol; also referred to as the World Wide Web (WWW).

Appendix B Acronyms

Note: This acronym list is global to all TReK documentation. Some acronyms listed may not be referenced within this document.

AOS	Acquisition of Signal
API	Application Programming Interface
APID	Application Process Identifier
ASCII	American Standard Code for Information Interchange
CAR	Command Acceptance Response
CAR1	First Command Acceptance Response
CAR2	Second Command Acceptance Response
CCSDS	Consultative Committee for Space Data Systems
CDB	Command Database
CDP	Custom Data Packet
COR	Communication Outage Recorder
COTS	Commercial-off-the-shelf
CRR	Command Reaction Response
DSM	Data Storage Manager
EHS	Enhanced Huntsville Operations Support Center (HOSC)
ERIS	EHS Remote Interface System
ERR	EHS Receipt Response
EXPRESS	Expediting the Process of Experiments to the Space Station
ES	Expected State
FAQ	Frequently Asked Question
FDP	Functionally Distributed Processor
FSV	Flight System Verifier
FSV1	First Flight System Verifier
FSV2	Second Flight System Verifier
FPD	Flight Projects Directorate
FTP	File Transfer Protocol
GMT	Greenwich Mean Time
GRT	Ground Receipt Time
GSE	Ground Support Equipment
HOSC	Huntsville Operations Support Center
ICD	Interface Control Document
IMAQ ASCII	Image Acquisition ASCII
IP	Internet Protocol
ISS	International Space Station
LDP	Logical Data Path
LES	Limit/Expected State
LOR	Line Outage Recorder
LOS	Loss of Signal
MCC-H	Mission Control Center – Houston
MOP	Mission, Operational Support Mode, and Project
MSFC	Marshall Space Flight Center

MSID	Measurement Stimulus Identifier
NASA	National Aeronautics and Space Administration
OCDB	Operational Command Database
OS	Operating System
PC	Personal Computer, also Polynomial Coefficient
PCDB	POIC Project Command Database
PDL	Payload Data Library
PDSS	Payload Data Services System
PGUIDD	POIC to Generic User Interface Definition Document
POIC	Payload Operations Integration Center
PP	Point Pair
PRCU	Payload Rack Checkout Unit
PSIV	Payload Software Integration and Verification
RPSM	Retrieval Processing Summary Message
SC	State Code
SCS	Suitcase Simulator
SSP	Space Station Program
SSCC	Space Station Control Center
SSPF	Space Station Processing Facility
TCP	Transmission Control Protocol
TReK	Telescience Resource Kit
TRR	TReK Receipt Response
TSC	Telescience Support Center
UDP	User Datagram Protocol
UDSM	User Data Summary Message
URL	Uniform Resource Locator
USOS	United States On-Orbit Segment
VCDU	Virtual Channel Data Unit
VCR	Video Cassette Recorder
VPN	Virtual Private Network

Appendix C Trainer File Format

Generator Files

This short write up is to help users to build the text files needed to simulate packets. The example used will be based on PDSS Payload packets. However, you can "fake" other types of packets by changing these text files to actually generate something else (e.g., GSE Packets).

Where To Start

The easiest way to build a new packet is to start with a copy of a file that already works. The files shipped in the gen_files directory in the TReK installation are good starting points. These files already contain the EHS and CCSDS header information. You will just need to change a few values such as the APID and packet lengths.

When you make a copy of the file, rename it to apid_<NUMBER>.pkt. The NUMBER is the APID value in the CCSDS primary header. Even if the packet generates something else, the Training Simulator application will determine if it can generate a file based on the number in the filename.

File Format

There are two main sections in the generator file. The first section is the values section. It contains the detailed information about how to generate the different values that will be placed in the packet. This section is delimited by the #value and #end_value keywords. The second section is the packet layout section. This section has the details of how the values are placed in the packet. This section is delimited by the #packet and #end_packet keywords.

Values

An example of the data in this section is shown below:

```
EXS_TLM_DATA_TYPE    IUND  16      1       4
1                          ←|
0001                       |
1       ← one cycle        |
0002    ← one sample       |--  four sets
1                          |
0003                       |
1                          |
0004                       ←|
```

The first line contains the parameter name, data type, length (in bits), the number of samples per packet, and the number of sets of data. The parameter name will correspond to the parameter name in the packet layout section of the file. The data type is limited to the following: SASC, SASCB, SEBC, SUND, IDIS, IMAG, IUND, IUNS, ITWO, ITWOW, FEEE, TEHS, and TISS. The length of the parameter is always in bits. The number of samples is the maximum number of samples that can appear in a packet. The

number of sets of data allows you to have multiple sets of data generation information. The example above has four sets.

After the first line you will have each set of data. For each set of data, the first line is the number of cycles that the data set is active. In the example above each of the four sets is active for one cycle (packet). The next line will vary based on the data type used. In the example above the data type is IUND so the data is input in hex. The following table shows the data types and the expected input types from the file.

Data Type	Input Data As
SASC	ASCII Text
SASCB	ASCII Text
SEBC	ASCII Text
SUND	Hexadecimal
IDIS	Hexadecimal
IMAG	Value
ITWO	Value
ITWOW	Value
IUND	Hexadecimal
IUNS	Value
FEEE	Value
TEHS	Do not add a line, will use system time
TISS	Do not add a line, will use system time minus 30 minutes

The following is an example of a parameter that takes ASCII text as the input.

```
GENERIC_MESSAGE                SASC  2048    1         1
1
Now is the time for all good men to go to lunch.
```

And now an example of a parameter that takes a value as input.

```
M_CP_SC_14          IUNS   14       1         1
1
0         1         0         16383
```

The final line for the value consists of the start value (0), the increment value (1), the minimum value (0), and the maximum value (16383). These values can be integers or floating-point numbers. If the value reaches the maximum value, it will go back to the minimum value and continue changing. If the value reaches the minimum value, it will go back to the maximum value and continue changing. For the example above the sequence is…

1st packet – 0
2nd packet –1

3rd packet – 2
…
16383rd packet - 16382
16384th packet - 16383
16385th packet – 0

If you want to simulate a data type that is not supported by the Training Simulator, it is probably best to use an IUND data type. Set the length to the value of the data type to simulate and place the hexadecimal pattern in the values section. You can take advantage of the multiple sets option to generate several values.

Packet Layout
The packet layout section is a little more complex than the value section. The packet consists of parameters and containers (subsets). The containers consist of parameters and other containers. The first line after the #packet keyword will contain two fields as shown below

#packet
APID_889 40000

The first is just the name. It can be any string. The second value is the length of the packet in bits.

Below is an example for a parameter to be placed in the packet.

CORR_COEF_AUTOCORR 0 32 N S
10 32 1 0

Each parameter will have 2 or 3 lines to define its position in a packet. Using the example above the first line contains five fields: parameter name (CORR_COEF_AUTOCORR), start bit (0), length in bits (32), dependency (N), and parent type (S). The parameter name is the same name as the parameter name from the value section. The start bit is the start location of the first bit with respect to its parent container (packet or subset). The length is the size in bits of a single instance of the parameter. The dependency lets you know if something appears in every packet (N), is dependent on a counter (C), or is dependent on a range (R). The final field in the first line lets you know what the parent type is (in this case S means subset). Don't worry too much about this field. You should not have to change it unless you make major changes to your packet layout. The best way to make these updates is to start from another packet definition. Just keep the same parent type as before.

The second line of the packet layout contains four fields: The number in group (10), the group offset (32), the number in super group (1), and the super group offset (0). If the value for the number in group is 1, then the group offset is ignored. The same is true for number in super group and super group offset. The example above is equivalent to the MSFC-STD-1274 Bit Contiguous Group. Remember that TReK can process more than

what is defined in MSFC-STD-1274. If you only have one sample of a parameter the second line will always be

1 0 1 0

The third line of the packet layout (which doesn't exist in this example) defines the counter or range parameters (the C or R options for dependencies). If the value of the dependency is C or R, the third line is as follows:

DEP_PARAM 0 3

If this was for a counter dependent parameter (C), the first item is the parameter whose value is check for the dependency. The second item is the start counter and the third item is the counter offset. The parameter would appear when the counter was 0, 3, 6, etc. If this was for a range dependent parameter (R), the first item is the parameter whose value is checked for the dependency. The second item is the low range and the third item is the high range. For range parameters the second and third values can be floating point numbers.

Containers

Containers are like subsets. They are delimited by the #fixed_container and #end_fixed_container keywords. There is no preset limit to nesting of containers. No, there are not random containers (subsets) in this version. Below is a very simple example of a container.

```
#fixed_container
SUBSET_ONE              976    48     C      U
SOME_COUNTER            0      2
Measurement_Zero        0      16     N      F
3       16      1       0
#end_fixed_container
```

There is one required and one optional line for each container. The first line (required) contains the container name (SUBSET_ONE), the start bit (976), the length in bits (48), the dependency (C) and that parent type (U). Remember that the start bit is relative to the parent of the container. The second line (optional) is only present if the dependency type is C or R. In this case, the container (subset) is counter dependent and is available when the SOME_COUNTER value is even.

This container has a single parameter that is sampled three times in a group.

Single Characters and What They Mean

A little explanation of each type is appropriate now. For the dependency there are three possible values:

N No dependency

C Counter dependent
R Range dependent

It is a little more complex for the parent type…

H Header MSID, used only for items in the EHS Primary and Secondary Headers.
U User Data, includes CCSDS headers and data zone.
F Fixed Container, measurement data in a #fixed_container
S Subset