

COMMAND BRIDGE

TUTORIAL



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1 What You Need To Know Before You Read This Document

It is beneficial to understand the Telescience Resource Kit (TReK) before reading this document. This document will go over all of the steps needed to configure TReK in order for the Command Bridge to execute, but it will not go over any TReK details.

2 Technical Support

If you are having trouble installing using any of the TReK or Command Bridge 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 Command Bridge application provides the ability to capture a command sent on a network and forward it to any TReK command destination. This application was originally developed for internal use at MSFC in support of Payload Operations Integration Center (POIC) cadre training. However, since this capability can also be beneficial in a payload test environment, the Command Bridge application has been added to the TReK installation to provide expanded capabilities for all users.

The Command Bridge works by ‘bridging’ between TReK Telemetry Processing and TReK Command Processing. Figure 1 shows an example data flow. In this example, the Ground Support Equipment (GSE) computer software generates a command and sends it

out on the network. The TReK Telemetry Processing application has been configured by the TReK Command Bridge application to receive the incoming command data. The Command Bridge application retrieves the ‘telemetry’ using the TReK User API, and then passes it to a destination in the Command Processing application using the TReK Command User API.

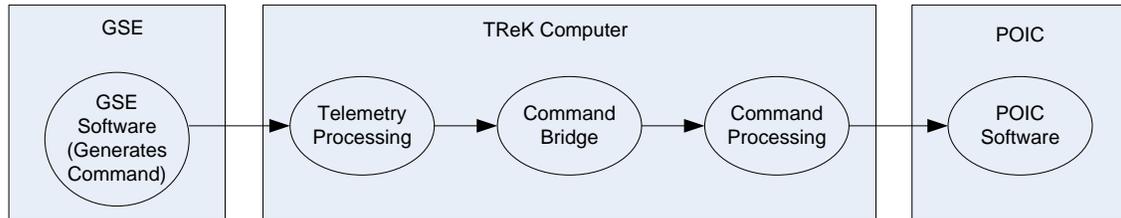


Figure 1 Command Bridge Data Flow

This scenario shows one of the ways the Command Bridge can be used if you have non-TReK software that generates flight commands for your payload. The Command Bridge allows a means of getting that data to the POIC without having to rewrite the code using TReK API calls.

A few notes:

- The Command Bridge application uses the Telemetry Processing User API to automatically configure Telemetry Processing. However, you will need to manually add a command destination in Command Processing to get everything working.
- The Command Bridge supports two packet types: CCSDS and UFO. CCSDS is the default packet type. When using CCSDS the ‘command data’ must be sent in a CCSDS packet and the APID value is checked. The UFO packet type provides the capability to send “unidentifiable” packets through the bridge. When using UFO the ‘command data’ format will not be checked. The UFO packet type makes it possible to configure one bridge to pass through multiple command APIDs.

4 Command Bridge Main Window

The Command Bridge main window consists of two main areas as shown in Figure 2. The top part of the main window contains a list of bridges. When you start the Command Bridge application the list will be empty. This is because you have not yet added any bridges to the list. The bottom part of the window is a message area that is used to display important status and error messages about the bridge activities in progress.

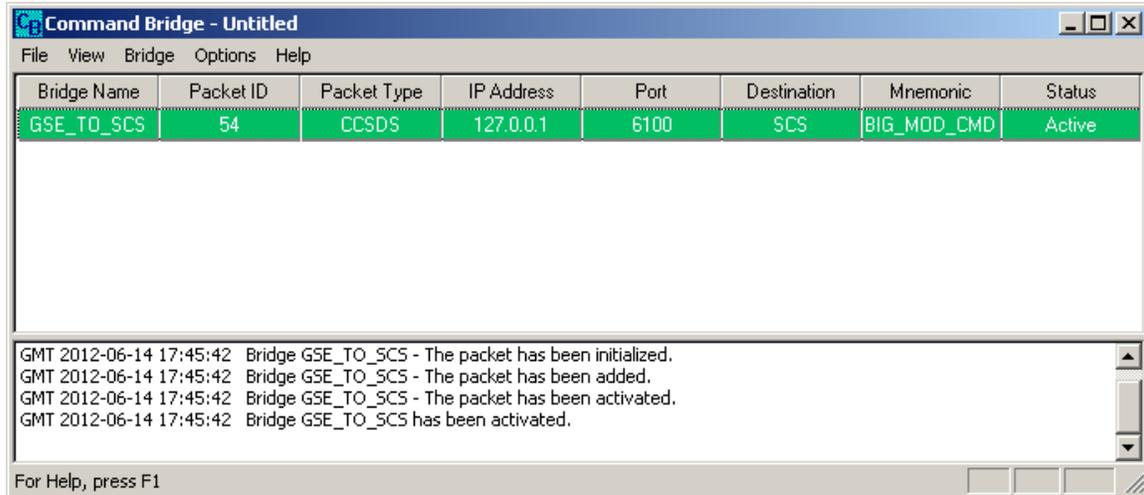


Figure 2 Command Bridge Main Window

There are eight pieces of information that are displayed for each bridge in the bridge list. The Bridge Name uniquely identifies the bridge. The Packet ID, Packet Type, IP Address, and Port identify properties associated with the data flowing into the TReK Telemetry Processing application. The Destination and Mnemonic identify properties associated with the command flow into the Command Processing application. The Status identifies the state of the bridge. This information provides an overview of the bridge's configuration.

When you add a bridge to the bridge list, the bridge row has a color associated with it. The color provides information about the bridge. For example, when using the default colors, if the bridge row is black, this indicates that the bridge has not been activated. If the bridge row is purple, this indicates that the bridge is initializing. If the bridge row is green, this indicates that the bridge is ready to perform the command data routing. The colors are helpful in providing immediate information about the general configuration and status of each bridge in the list.

5 Step by Step

The following steps will configure a data flow to flow incoming commands to a Suitcase Simulator destination. If you need to send commands to a different destination type, just configure TReK Command Processing for that destination type.

5.1 Steps 1 through 4 – Configuring TReK Command Processing

The Command Bridge relies on an active destination in TReK Command Processing in order to route the commands. The Command Bridge will work with any destination, but this tutorial will describe setting up TReK Command Processing for an SCS destination.

Step 1 – Start TReK Command Processing

Start the TReK Command Processing application from the Windows Start menu. The TReK Command Processing main window as shown in Figure 3 will appear.

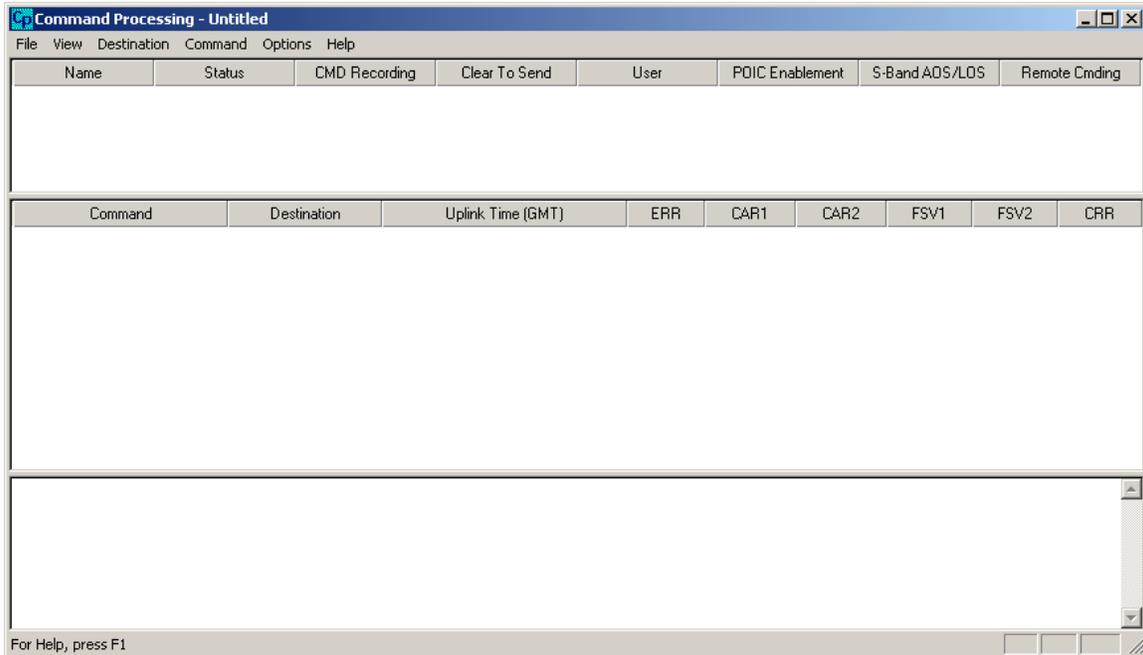


Figure 3 TReK Command Processing Main Window

Step 2- Add a Suitcase Simulator Destination

Bring up the Add Suitcase Simulator Destination dialog box by selecting **Add Suitcase Simulator Destination** from the **Destination** menu in TReK Command Processing. The dialog in Figure 4 will appear.

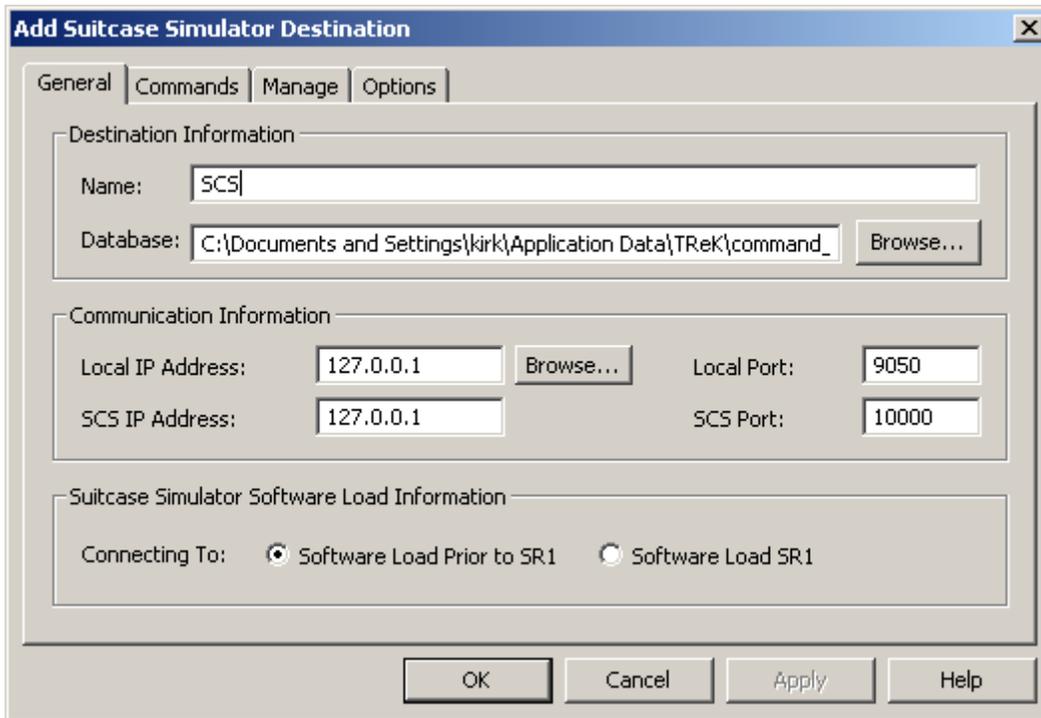


Figure 4 Add Suitcase Simulator Destination Dialog

The fields on the dialog should be set as follows:

- Name:** SCS – The name of the Command Destination. This name is also used by the Command Bridge. In the Command Bridge application you will enter this name in the Destination field on the Add Bridge dialog.
- Database:** Use the Browse button to select the CommandDatabase.mdb file that is delivered with TREK.
- Local IP Address:** Use the Browse button to the right of the field to select your IP address.
- Local Port:** 9050. You may change this value if you want.
- SCS IP Address:** Type in the IP address of the Suitcase Simulator.
- SCS Port:** 10000. You may change this value if you want.

Select the Commands tab in the Add Suitcase Simulator Destination dialog. The dialog will now look like Figure 5.

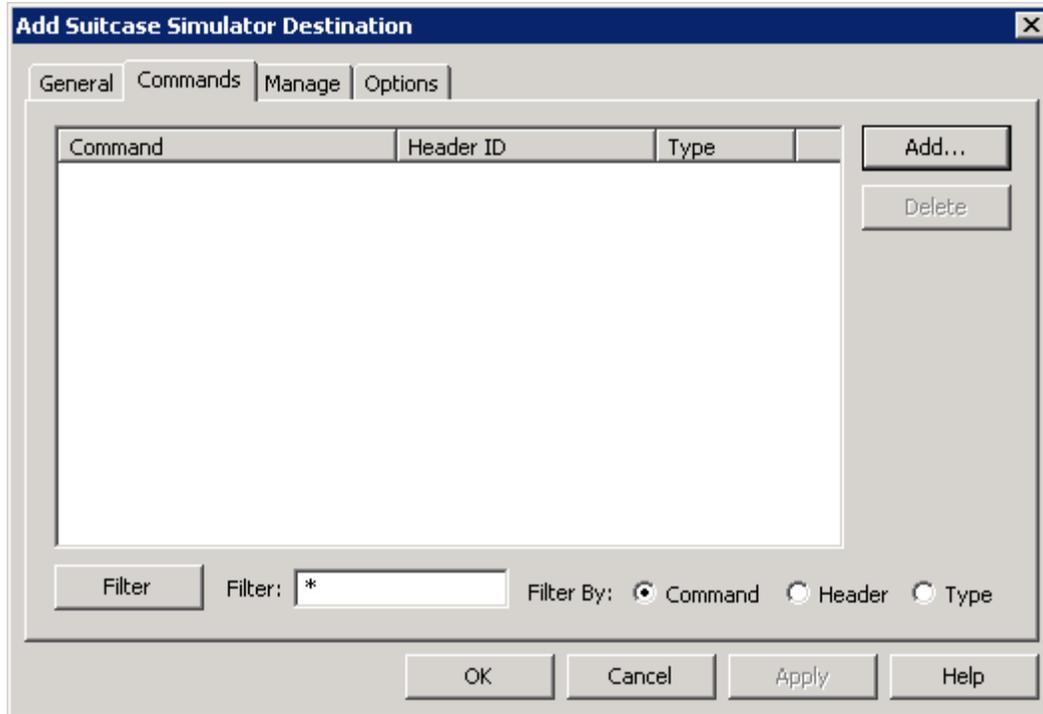


Figure 5 Add Suitcase Simulator Destination Dialog (Commands Tab)

Press the **Add** button on the right side of the dialog. In the Add Commands dialog, select **BIG_MOD_CMD** and press **OK**. The Commands tab will then appear as shown in Figure 6. On the Add Suitcase Simulator Destination dialog, press **OK**.

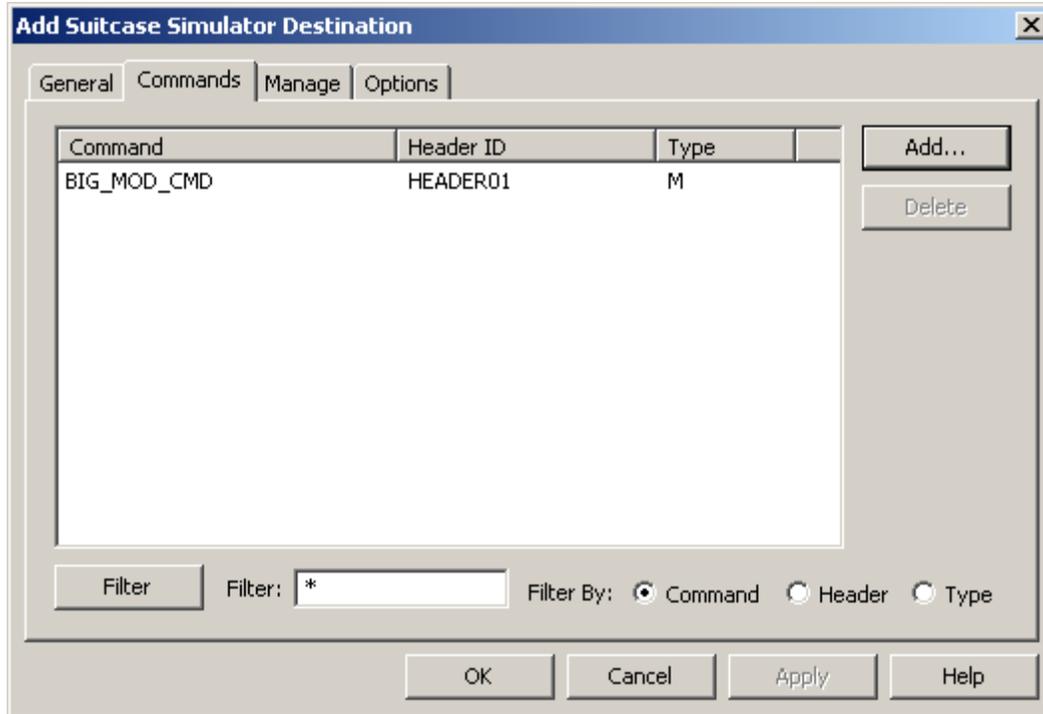


Figure 6 Add Suitcase Simulator Destination Dialog (Commands Tab) with BIG_MOD_CMD

Step 3 – Activate the Suitcase Simulator Destination

There should now be a single destination in the TReK Command Processing main window. Select the destination and activate it by going to the **Destination** menu and selecting **Activate Destination**.

Step 4 – Save the Configuration

You can save the TReK Command Processing configuration by selecting **Save** from the **File** menu and choosing a filename. The next time you need to run the Command Bridge you just need to open the saved configuration and activate the destination.

You can iconify the TReK Command Processing main window.

5.2 Step 5 – Start TReK Telemetry Processing

The Command Bridge is able to configure TReK Telemetry Processing automatically, so you will only need to start the application.

Step 5 – Start TReK Telemetry Processing

Start the TReK Telemetry Processing application from the Windows Start menu. The TReK Telemetry Processing main window as shown in Figure 7 will appear.

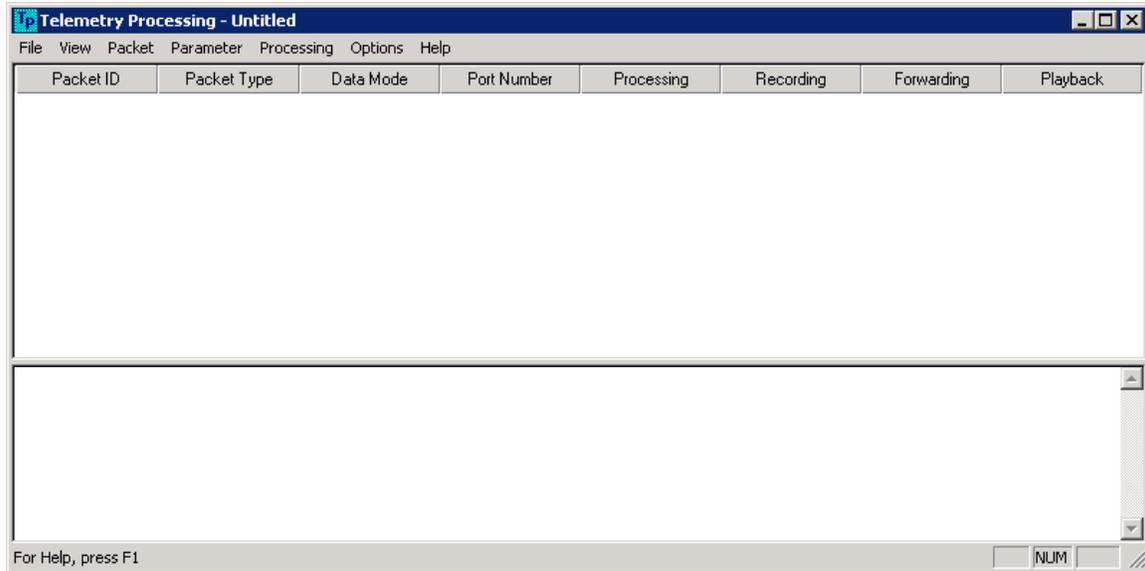


Figure 7 TReK Telemetry Processing Main Window

You can iconify the TReK Telemetry Processing main window.

5.3 Steps 6 through 10 – Running the Command Bridge

Now that Telemetry Processing and Command Processing are configured, all that is left is the Command Bridge.

Step 6 – Start the Command Bridge Application

Start the Command Bridge application by going to the Window's **Start** menu, select **Programs**, select **TReK**, and then select **Command Bridge**. The Command Bridge main window as shown in Figure 8 will appear.

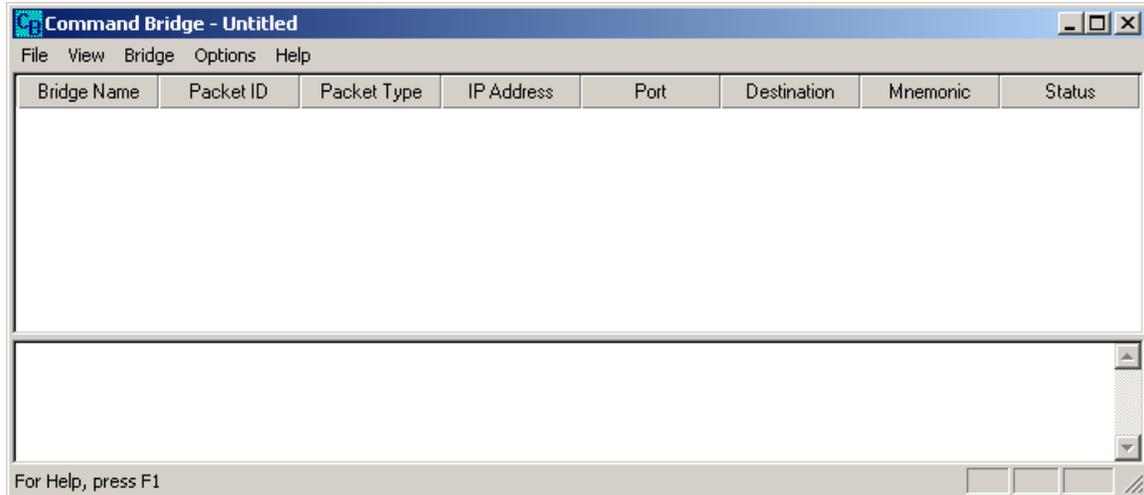


Figure 8 Command Bridge Main Window

Step 7 – Configure the Bridge

Go to the **Bridge** menu and select **Add Bridge**. The dialog shown in Figure 9 will be displayed. Use this dialog to configure the bridge settings as shown below. Once you've entered all the settings, push the OK button to add the bridge to the bridge list in the main window.

The fields on the dialog should be set as follows:

Name:	GSE_TO_SCS
Database:	Use the Browse button to select the TelemetryDatabase.mdb file that is delivered with TReK.
Packet ID (APID)	54
Packet Type	CCSDS
Local IP Address:	Use the Browse button to the right of the field to select your IP address.
Port	6300.
Destination	SCS. This name must match the name of the destination in the Command processing application.
Mnemonic	BIG_MOD_CMD

Add Bridge

General

Bridge Name: GSE_TO_SCS

Bridge From (Command Data flowing into TReK Telemetry Processing)

Telemetry Database: C:\TReK\database\TelemetryDatabase.mdb

Packet ID (APID): 54

Packet Type: CCSDS

IP Address: 127.0.0.1 Browse...

Port: 6300

Bridge To (TReK Command Processing)

Destination: SCS

Mnemonic: BIG_MOD_CMD

OK Cancel Help

Figure 9 Add Bridge Dialog Box

Step 8 – Activate the Bridge

Once the bridge is in the main window bridge list, select the bridge, go the **Bridge** menu, and select **Activate Bridge**. At this point, commands will be routed to the specified destination as they arrive. If logging is turned on, each command's hex pattern will be written to the log file. (Note: Logging can be turned on using the Set Command Bridge Options dialog under the Options menu).

Special Note: Be sure the port you select to use in Telemetry Processing is not in use. If it is already in use, the Command Bridge will not be able to add and activate your packet. This is likely the case if you see the message in Figure 10.

Activate Bridge Error!

Bridge GSE_TO_SCS could not be activated because of the following errors:

Bridge GSE_TO_SCS - packet could not be added for the following reason: Port Number Packet Type Conflict.

OK

Figure 10 Activate Bridge Error

Step 9 – Stopping the Bridge

To stop the bridge, select the bridge, go to the **Bridge** menu and select either **Deactivate Bridge** or **Delete Bridge**.

Step 10 - Exiting

You can exit the Command Bridge application by selecting **Exit** from the **File** menu.

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 PProcessing 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 from 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