



Ethernet Packet Generator  
**TCL TEST SUITE  
USER GUIDE**

Version 1.2.1



**APG4 APG8 APG200 APG208**

## Software Revisions

This document applies to the following software versions:

<b>APG Unit Firmware</b>	<b>Version 2.3</b>
<b>APG Processing Core</b>	<b>Version 6.010E (10Gbps)</b> <b>Version 7.0103 (1Gbps)</b> Datecode: 01 March 2019
<b>APG TCL API</b>	<b>Version 1.2.2</b>
<b>APG TCL TS API</b>	<b>Version 1.1.1</b>
<b>APG TS RFC2544</b>	<b>Version 1.1.1</b>

## Revision History

Date	Version	Changes
8 February 2018	1.0	<ul style="list-style-type: none"> <li>First release</li> </ul>
8 August 2018	1.1	<ul style="list-style-type: none"> <li>Typo Corrections</li> </ul>
27 January 2019	1.2	<ul style="list-style-type: none"> <li>Added Management over USB Interface</li> <li>Added support for 1000Base-X transceivers</li> <li>Added support for 10/100/1000Base-T and 1G/10GBase-T copper transceivers</li> </ul>
4 September 2019	1.2.1	<ul style="list-style-type: none"> <li>Default LATENCY_MODE changed to "First bit transmitted to first bit received" (Section 4.3.3.2)</li> <li>Fixed LATENCY_MODE behaviour (Section 4.3.3.2)</li> <li>Adjusted default Latency Offset values (Section 3.1.2)</li> <li>Added Latency Offsets for 100Mbps and 10Mbps LATENCY_100M_INT and LATENCY_10M_INT (Sections 3.1.2 and 4.3.3.2)</li> </ul>

## Document Conventions



**INFORMATION:**  
Additional information to clarify functionality or usability



**WARNING:**  
Clarification of unexpected or restricted functionality

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## Preface

### About This Document

This manual describes the structure and commands of the Axtrinet TCL Test Suite API, and contains the following sections:

Section	Description
1. INTRODUCTION	Summary of the APG Test Suite
2. INSTALLATION	Installation procedures for the APG Test Suite for Microsoft™ Windows™ and Linux environments
3. RFC 2544	Getting Started and RFC 2544 test overview
4. API COMMANDS	TCL Test Suite API Commands

### Related Documentation

- [1] APG-UG            Axtrinet User Guide (including APG Control Interface)
- [2] APG-TCL-UG    Axtrinet TCL User Guide
- [3] APG-TS-UG     Axtrinet Test Suite User Guide
- [4] APG-SW-TC     Axtrinet APG Software License Terms And Conditions

Visit [www.axtrinet.com/documentation](http://www.axtrinet.com/documentation) for the latest documentation.

### References

- [5] RFC 1242 Benchmarking Terminology for Network Interconnect Devices. July 1991  
<https://www.ietf.org/rfc/rfc1242.txt>
- [6] RFC 2544 Benchmarking Methodology for Network Interconnect Devices, March 1999  
<https://www.ietf.org/rfc/rfc2544.txt>

## Glossary

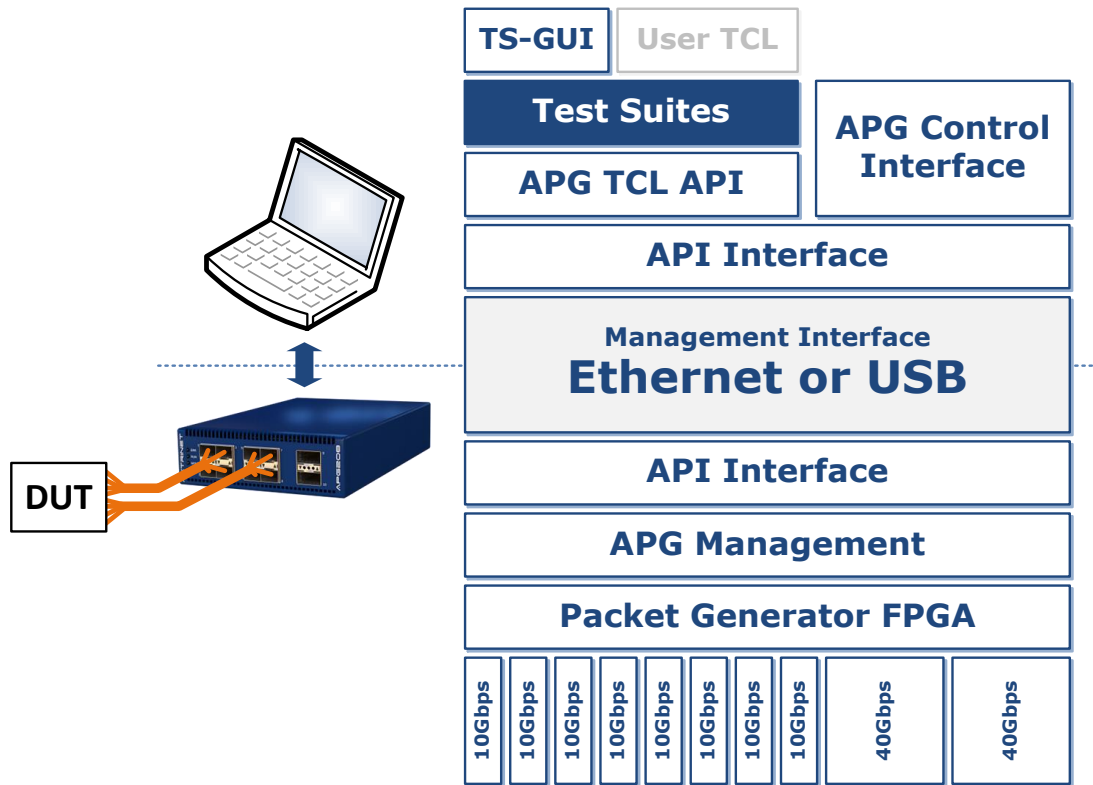
APG	Axtrinet Packet Generator
API	Application Programming Interface
DA	Destination Address
DUT	Device Under Test
GUI	Graphical User Interface
LAN	Local Area Network
MAC	Media Access Controller
MPLS	Multiprotocol Label Switching
pps	Packets per Second
QSFP+	Quad Small Form-Factor Pluggable (40Gbps)
SA	Source Address
SERDES	SERialiser/DESerialiser
SFP	Small Form-Factor Pluggable (1Gbps)
SFP+	Small Form-Factor Pluggable (10Gbps)
TCL	Tool Command Language
TS	Test Suite
VLAN	Virtual LAN

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# 1. INTRODUCTION

The APG Test Suite provides configuration and control of the RFC2544 Test Suite within the APG TCL environment.



## 1.1 TEST SUITES

The APG Test Suite supports:

- RFC2544 Benchmarking Methodology for Network Interconnect Devices, March 1999

## 1.2 TEST ENVIRONMENT

The Test Suite Test Environment consists of a single Axtrinet Packet Generator, managed from a single APG TCL environment.

## 1.3 SOFTWARE LICENCES AND SUPPORT

See the Axtrinet APG Software License Terms & Conditions [4]

Email based software support is included in the purchase price for the first 12 months after delivery. Extended Software Support is available for purchase; please contact Axtrinet or your reseller for more information.

## 1.4 CONTACT DETAILS

Technical assistance is available from Axtrinet at the following address:

**Address:** Xentech Solutions  
Suite 6 Stanta Business Centre  
3 Soothouse Spring  
St Albans  
AL3 6PF  
UK

**Phone:** +44 (0)1727 867795

**Email:**  
Technical Support: [support@axtrinet.com](mailto:support@axtrinet.com)  
Sales: [sales@axtrinet.com](mailto:sales@axtrinet.com)

**Web Site:** [www.axtrinet.com](http://www.axtrinet.com)



## 2. INSTALLATION

The APG Test Suite is installed as part of the standard installation process as described in the APG User Guide [1] Section 2.

### 2.1 PREREQUISITES

#### 2.1.1 Windows Environment

- A TCL distribution (such as Activestate® ActiveTcl) must be installed before using the APG TCL TS API.
- The PDF Report Generation uses **pdflatex**, included in appropriate latex package. **TeX Live for Windows** or **MiKTeX** are recommended, but any working **pdflatex** should be acceptable.

#### 2.1.2 Linux Environment

- The TCL package for your 8.6.x distribution must be installed before using the APG TCL TS API.
- The PDF Report Generation uses **pdflatex**, included in appropriate latex package for your distribution. **TeX Live** is recommended, but any working **pdflatex** should be acceptable.

Likely suitable packages are: on Arch, texlive-bin; on Fedora/Centos, texlive-latex; and on on Debian/Ubuntu, texlive.

### 2.2 TESTING THE INSTALLATION

#### 2.2.1 Windows Environment

The Axtrinet TCL package is installed in **C:\Program Files\Axtrinet\APG\tcllib**

To test the installation, run "test\_ts.tcl" in the \examples directory:

```
% cd C:\Program Files\Axtrinet\APG\examples\  
% tclsh test_ts.tcl  
APG TS API V1.1.0  
Build Date 1551204569  
Target API Version 161016
```

The Axtrinet TCL TS API has been successfully installed if test\_ts.tcl completes without errors, and displays the TS version, build data and target API version.

#### 2.2.2 Linux Environment

The Axtrinet TCL package is installed in **/usr/share/axtrinet/apg/**

To test the installation, run "test\_ts.tcl" in the /examples directory:

```
$ ./usr/share/axtrinet/apg/examples/test.tcl  
APG TS API V1.1.0  
Build Date 1551204569  
Target API Version 161016
```

The Axtrinet TCL TS API has been successfully installed if test\_ts.tcl completes without errors, and displays the API version, build data and target API version.

## 2.3 API INITIALISATION

The Axtrinet APG TCL TS API is initialised by sourcing the `axtrinetTestSuite.tcl` file that contains:

- Path to the APG TCL TS API
- "package require" declaration
- Import APG TCL TS API Commands

### 2.3.1 Windows Environment

The APG TCL TS API is 'sourced' in the Windows environment with the following commands:

```
# Instantiate APG TCL API
source "C:/Program Files/Axtrinet/APG/axtrinetApi.tcl"           ← Load API
source "C:/Program Files/Axtrinet/APG/axtrinetTestSuite.tcl"   ← Load TS API

# Display TCL Version Info
puts "[apgGetTsApiVersion DESCRIPTION] [apgGetTsApiVersion VERSION]" → APG TCL API V1.1.0
puts "Build Date [apgGetTsApiVersion BUILD_DATE]"                → Build Date 1551204569
puts "Target API Version [apgGetTsApiVersion API_VERSION]"      → Target API Version 161016
```

### 2.3.2 Linux Environment

The APG TCL TS API is 'sourced' in the Linux environment with the following commands:

```
# Instantiate APG TCL TS API
source "/usr/share/axtrinet/apg/axtrinetApi.tcl"               ← Load API
source "/usr/share/axtrinet/apg/axtrinetTestSuite.tcl"        ← Load TS API

# Display TCL Version Info
puts "[apgGetTsApiVersion DESCRIPTION] [apgGetTsApiVersion VERSION]" → APG TCL API V1.1.0
puts "Build Date [apgGetTsApiVersion BUILD_DATE]"                → Build Date 1551204569
puts "Target API Version [apgGetTsApiVersion API_VERSION]"      → Target API Version 161016
```

## 2.4 EXAMPLE FILES

Example files are provided in the examples directory that can be run within your TCL environment:

1. `test_ts.tcl` Display the TCL TS API version
2. `test_ts_rfc2544.tcl` Example RFC2544 configuration script

### 3. RFC2544

The following steps should be completed to run the RFC2544 Tests:

**a) Configure Headers & Payload**

The RFC2544 tests configure the MAC Destination (DA) and Source (SA) addresses while the test is running, without affecting the remainder of the packet header. For example, VLAN tags, MPLS tags, or IPV4 headers can be configured without affecting the test configuration.

The payload type (eg FIXED, RANDOM) is not affected by the test configuration.

**b) Set APG Test Ports**

The RFC2544 tests are performed on the APG ports identified by **apgSetTS GLOBAL APGPORTS** command. The default is "{1 1} {1 2}".

**c) Set Test Direction**

The RFC2544 tests are point-to-point tests, run with unidirectional traffic only, configured using the by the **apgSetTS RFC2544 DIRECTION** command. The default is UNI.

**d) Set the Global Test Parameters**

Set the frame sizes, test duration and number of MAC addresses using the **apgSetTS GLOBAL** commands.

**e) Set DUT and Report Information**

Set the DUT and Report information using the **apgSetTS DUT**, **apgSetTS PORTMAP** and **apgSetTS REPORT** commands.

**f) Enable Tests**

The RFC2544 tests are enabled with the **apgSetTS RFC2544 ENABLE** command, where:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Not Used	Not Used	System Reset (26.6)	System Recovery (26.5)	Back-to-Back Frames (26.4)	Frame Loss Rate (26.3)	Latency (26.2)	Throughput (26.1)

Each test is enabled by setting the bit to 1, and disabled by setting the bit to 0.

For example: **apgSetTS RFC2544 ENABLE 0x13**

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	1	0	0	1	1

- Enables Throughput, Latency and System Recovery Tests
- Disables Frame Loss Rate, Back-to-Back Frames and System Reset Tests

Where a test configuration is dependent on the results from a previous test (eg Latency Tests require Throughput measurements), the preceding test is automatically enabled.

**g) Run RFC2544 Tests**

The RFC2544 tests are run with the **apgRunTS RFC2544** command.

**h) View Reports**

The Test Suite generates an ASCII LOG file and PDF report for the enabled tests.

See Section 3.2.

### 3.1 TEST DESCRIPTION

#### 3.1.1 Throughput Test

The Throughput Test measures the maximum input data rate between the test ports at each specified frame size where no packet loss occurs.

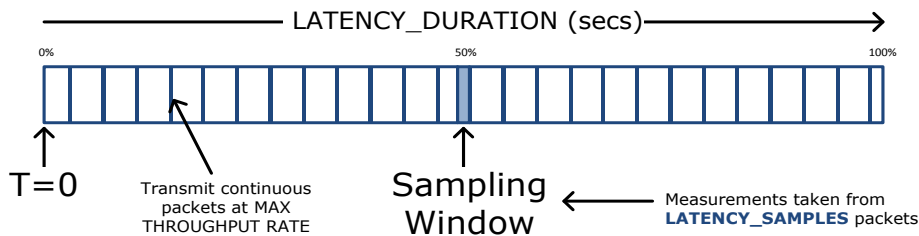
The test reports the throughput rate for each **FRAME\_SIZE**.

#### 3.1.2 Latency Test

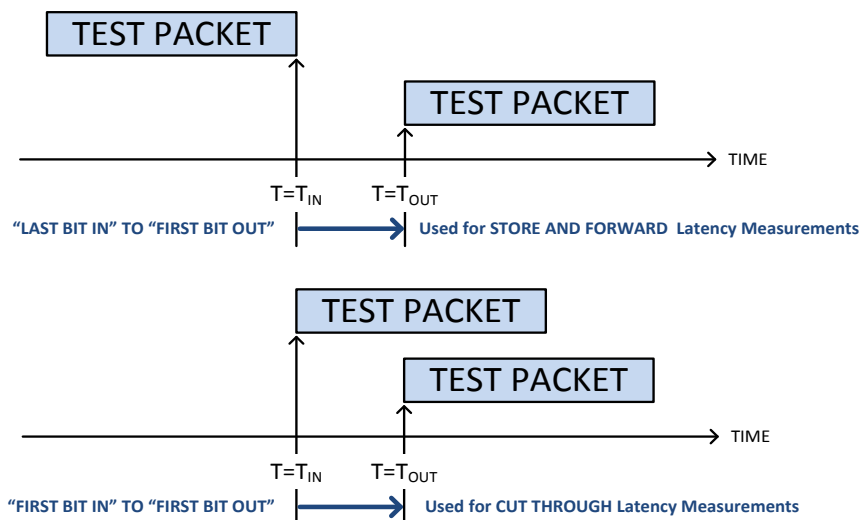
The Latency Test measures the delay through the test ports at each specified **FRAME\_SIZE**.

The Latency Test requires the Throughput Test to be run first to determine the throughput rate of the test port. The Throughput Test will be run automatically if not selected.

**LATENCY\_DURATION** specifies the length of each latency test in seconds. The measurement window occurs after half of the **LATENCY\_DURATION** has elapsed, when **LATENCY\_SAMPLES** timing samples are taken from the received packet stream.



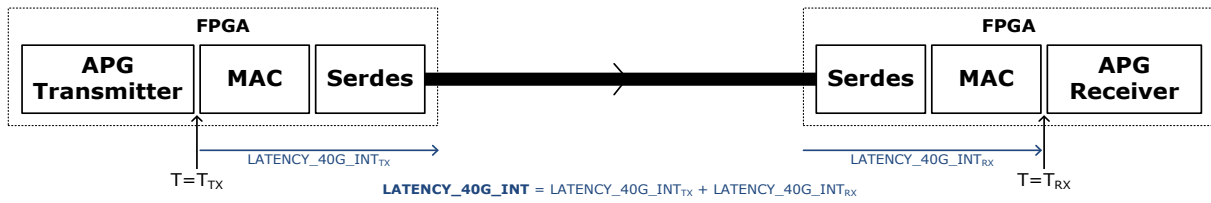
**MODE** sets the measurement type for "Store and Forward" or "Cut Through" devices, and changes the way the latency is measured:



The latency tests capture packets and post-process the extracted timestamp information at the end of each test.

The Axtrinet APG timestamps the transmitted packet as it left the Packet Generator Engine, **and** the received packet as it enters the Receiver. The latency through the transmitter MAC / SERDES and receiver SERDES / MAC are known, and are subtracted from the calculated transmit-to-receive latency.

For example, for a 40Gbps QSFP+ connection:

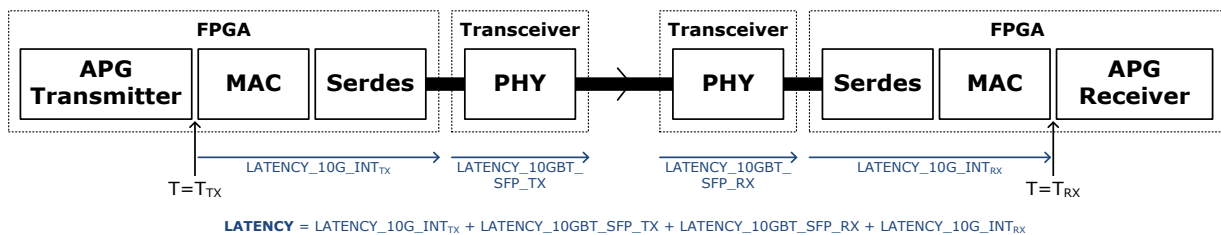


The table below shows the delays through the transmitter MAC / SERDES and receiver SERDES / MAC at all supported speeds. The delays are measured in 8ns clock cycles.

Rate	Internal Latency
<b>10Mbps</b>	<b>LATENCY_10M_INT</b> = <b>1978</b> ± 1 clock cycles x 8ns = 15.824µs ± 8ns
<b>100Mbps</b>	<b>LATENCY_100M_INT</b> = <b>318</b> ± 1 clock cycles x 8ns = 2.544µs ± 8ns
<b>1Gbps</b>	<b>LATENCY_1G_INT</b> = <b>148</b> ± 1 clock cycles x 8ns = 1.184µs ± 8ns
<b>10Gbps</b>	<b>LATENCY_10G_INT</b> = <b>58</b> ± 1 clock cycles x 8ns = 464ns ± 8ns
<b>40Gbps</b>	<b>LATENCY_40G_INT</b> = <b>62</b> ± 1 clock cycles x 8ns = 496ns ± 8ns

Optical transceivers and Direct Attach (DA) cables transmit the serial data stream from the SERDES directly, and do not add to the internal latency.

Inserting 10GBase-T or 1000Base-T transceivers into the SFP+/SFP ports adds an additional delay as the packet passes through the device. For example, for a 10GBase-T transceiver:



Since the transceiver may not be connected to another Axtrinet port, the separate transmit and receive delays are configurable using the **10GBT\_SFP\_TX** and **10GBT\_SFP\_RX** latency values. The default values were measured using Prolabs SFP-10G-T-NC 10GBase-T transceivers, and are measured in 8ns clock cycles.

For 1000Base-T transceivers, the corresponding delays are configurable using the **1GBT\_SFP\_TX** and **1GBT\_SFP\_RX** latency values. The default values were measured using Finisar FCMJ-8521-3 1000Base-T transceivers, and are measured in 8ns clock cycles.

Some 1000Base-T transceivers (including the Finisar FCMJ-8521-3) will also operate in 10/100Base-T mode (so the 10M and 100M internal latencies apply). The corresponding delays are configurable using the **100BT\_SFP\_TX** / **100GBT\_SFP\_RX** and **10BT\_SFP\_TX** / **10GBT\_SFP\_RX** latency values.



**The default latency offsets are calculated using the Finisar FCMJ-8521-3 and may need to be adjusted for different SFP transceivers.**

The latency tests automatically subtract the known latencies from the overall latency measurement.

The test is run **TEST\_RUN** times.

The test reports the averaged latency for each **FRAME\_SIZE**.

### 3.1.3 Frame Loss Test

The Frame Loss Test measures the frame loss across the range of input data rates and **FRAME\_SIZES**. Each test passes if the number of consecutive **CLEAN\_RUNS** result in no packet loss.

The test reports the frame loss for each **FRAME\_SIZE** and frame rate.

### 3.1.4 Back-to-Back Frame Test

The Back-to-Back Frame Test characterises the ability of the DUT to process a burst of wirespeed packets at varying **FRAME\_SIZES**. On the first run, **MAX\_BURSTSIZE** packets are transmitted into the DUT. The burst size is adjusted until no packet are lost.

The test is run **TEST\_RUN** times.

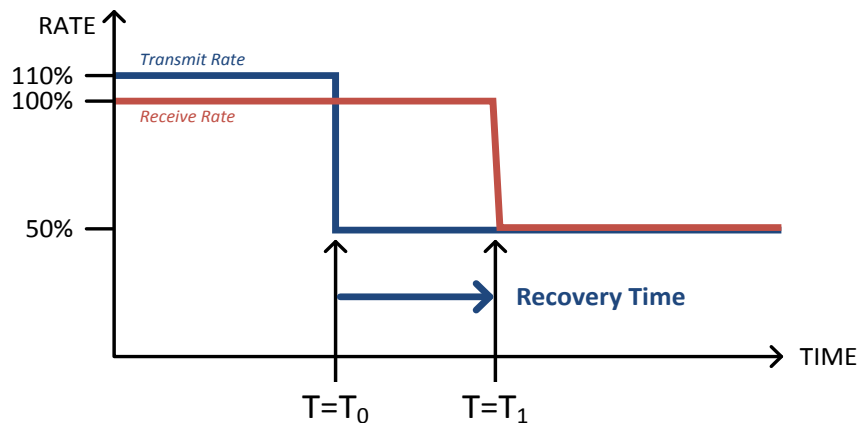
The test reports the averaged burst size for each **FRAME\_SIZE**.

### 3.1.5 Recovery Test

The Recovery Test requires the Throughput Test to be run first to determine the throughput rate of the test port. The Throughput Test will be run automatically if not selected.

The test is run if the throughput rate is not wirespeed, or the overload rate is calculated at less than wirespeed.

The test requires the port to be saturated with traffic at a rate of 110% of the recorded throughput for an **OVERLOAD** duration of at least 60 seconds, then reduced to 50% of the recorded throughput. The recovery time is the measured between the transmit rate dropping to 50% and the receive rate dropping to 50%.



The test is run **TEST\_RUN** times.

The test reports the averaged recovery time for each **FRAME\_SIZE**.

### 3.1.6 Reset Test

The Reset Test requires the Throughput Test to be run first to determine the throughput rate of the test port. The Throughput Test will be run automatically if not selected. Only the first specified **FRAME\_SIZE** is used for this test.

The Reset Test measures the time the DUT takes to recover from a power cycle:

1. Transmit timestamped frames at the known **FRAME\_SIZE** and throughput rate.
2. Cut the power to the DUT (manually or **POWERDOWN\_SCRIPT**)
3. Monitor the timestamp of the last received packet from the DUT.

4. Wait for reset **RESET\_DELAY**
5. Apply power to the DUT (manually or **POWERUP\_SCRIPT**)
6. Start transmitting traffic to the DUT
7. Monitor the time it takes for the ports to link up
8. Monitor the timestamp of the first received packet from the DUT.

The test is run **TEST\_RUN** times.

The test reports the averaged link-up and first packet times.

## 3.2 REPORTS

### 3.2.1 Test Suite Results Directory

#### 3.2.1.1 Windows Environment

The APG Test Suite creates the RFC 2544 results directory in:

**C:\Users\[USER]\Documents\APG-Test-Suite-Results\RFC2544**

where it creates the results directory for the DUT.

#### 3.2.1.2 Linux Environment

The APG Test Suite creates the RFC 2544 results directory in:

**/usr/[USER]/apg/APG-Test-Suite-Results/RFC2544**

where it creates the results directory for the DUT.

### 3.2.2 DUT Directory

If either of the DUT [MODEL] and [SERIAL] fields are set, the results directory is:

**/[MODEL]-[SERIAL]**

otherwise the results directory is:

**/DUT**

### 3.2.3 Output Files

Each test run creates an ASCII log file and a PDF Report in the DUT Directory.

If either of the DUT [MODEL] and [SERIAL] fields are set, the output files are:

**[MODEL]-[SERIAL]-[TIMESTAMP].log**

**[MODEL]-[SERIAL]-[TIMESTAMP].pdf**

otherwise the output files are:

**DUT-[TIMESTAMP].log**

**DUT-[TIMESTAMP].pdf**

Where [TIMESTAMP] is local [DATE] and [TIME] that the test started.

Example PDF and LOG file can be downloaded from [www.axtrinet.com/documentation](http://www.axtrinet.com/documentation)

## 4. API COMMANDS

The following commands are used to control the Test Suite:

<b>apgGetTsApiVersion</b>	<b>apgGetTsApiVersion</b>
<b>apgInitTS</b>	<b>apgInitTS</b>
<b>apgSetTS</b>	<b>apgSetTS REPORT [VAR] [VAL]</b> <b>apgSetTS DUT [VAR] [VAL]</b> <b>apgSetTS GLOBAL [VAR] [VAL]</b> <b>apgSetTS PORTMAP [PORTID] [VAL]</b> <b>apgSetTS RFC2544 [VAR] [VAL]</b>
<b>apgGetTS</b>	<b>apgGetTS REPORT [VAR]</b> <b>apgGetTS DUT [VAR]</b> <b>apgGetTS GLOBAL [VAR]</b> <b>apgGetTS PORTMAP [PORTID]</b> <b>apgGetTS RFC2544 [VAR]</b>
<b>apgRunTS</b>	<b>apgRunTS RFC2544</b>

### 4.1 GET TEST SUITE VERSION – APGGETTSAPIVERSION

Get (read) the APG TCL API versions.



A **LOAD** command is not required before the **apgGetTsApiVersion**

**apgGetTsApiVersion** returns the variable value if successful, otherwise the command will display an error message and exit the TCL environment.

[VAR]	LENGTH	DESCRIPTION	Example
<b>COMPANY</b>	21 char	Xentech Solutions Ltd	
<b>BRAND</b>	8 char	Axtrinet	
<b>DESCRIPTION</b>	11 char	APG TCL TS API	
<b>VERSION</b>	10 char	Axtrinet TCL Test Suite API Version	V1.1.1
<b>RFC2544_VERSION</b>	10 char	RFC2544 Test Suite Version	V1.1.1
<b>BUILD_DATE</b>	32 bits	Build date of the TCL TS API	1567509757
<b>API_VERSION</b>	6 char	Target API Version	161016

### 4.2 INITIALISE TEST SUITE VARIABLES - APGINITTS

**apgInitTS** initialises the RFC Configuration to default values (see Section 4.3), and should be the first command.

Initialisation will occur automatically if **apgSetTS** or **apgGetTS** are called before **apgInitTS**.



## 4.3 SET TEST SUITE VARIABLE - **apgSetTS**

The Test Suite configuration variables are set using the **apgSetTS** commands:

The **apgSetTS** should be preceded by **apgInitTS**, although if called before initialising the Test Suite configuration, **apgInitTS** will be called automatically to initialise the variables to default values.

**apgSetTS** returns [VAL] if successful, otherwise the command will display an error message and exit the TCL environment.

### 4.3.1 **apgSetTS REPORT [VAR] [VAL]**

The REPORT variables can be set using the **apgSetTS REPORT** command.

**apgSetTS REPORT** returns the string [VAL] if successful, otherwise the command will display an error message and exit the TCL environment.

**VERBOSE** controls the test status display output on the screen. Default is enabled.

**REPORT** controls the report contents. If **REPORT** is not set (0), only the test results are included in the report. If **REPORT** is set, each test output additionally includes the test descriptions and configuration.

The values can be read using the **apgGetTS REPORT** command.

<b>[VAR]</b>	<b>DESCRIPTION</b>
<b>VERBOSE</b>	1=Display Status (Default) 0=Silent
<b>FULL</b>	1=Full Report 0=Summary Report (Default)
<b>PAPERSIZE</b>	"A4" (Default) or "Letter". Note: <b>PAPERSIZE</b> will default to "A4" if [VAL] is not recognised.
<b>AUTHOR</b>	String, default ""
<b>COMPANY</b>	String, default ""
<b>CLASSIFICATION</b>	Document Classification in report footer. The default classification is "Commercial-In-Confidence"

### 4.3.2 apgSetTS DUT [VAR] [VAL]

The DUT variables can be set using the **apgSetTS DUT** command.

**apgSetTS DUT** returns the string [VAL] if successful, otherwise the command will display an error message and exit the TCL environment.

All [VAR] are strings, default "", and are displayed only on the report title page if [VAL] is set.

The values can be read using the **apgGetTS DUT** command.

[VAR]	DESCRIPTION
<b>MODEL</b>	DUT Model
<b>SERIAL</b>	DUT Serial Number
<b>REVISION</b>	DUT Revision
<b>HWVERSION</b>	DUT Hardware Version
<b>FWVERSION</b>	DUT Firmware Version
<b>SWVERSION</b>	DUT Software Version
<b>TESTPORTS</b>	DUT Test Ports (Note: Descriptive string only)
<b>NOTES</b>	Notes

### 4.3.3 apgSetTS GLOBAL [VAR] [VAL]

The global test variables can be set using the **apgSetTS GLOBAL** command. These variables are common across the Test Suites.

**apgSetTS GLOBAL** returns the string [VAL] if successful, otherwise the command will display an error message and exit the TCL environment.

The values can be read using the **apgGetTS GLOBAL** command.

#### 4.3.3.1 Global Configuration Variables

[VAR]	DESCRIPTION
<b>APGPORTS</b>	TCL List of APG Test Ports to be used during the tests. (Default "{1 1} {1 2}")
<b>FRAME_SIZE</b>	TCL List of Frame Sizes (Default "64 128 256 512 1024 1280 1518")
<b>NUM_ADDR</b>	Number of Addresses per Port (Default 1)
<b>DURATION</b>	Test Duration (secs) (Default 30)

**APGPORTS** is a TCL list of APG ports to be used during the tests. **APGPORTS** is processed for each test to determine the transmit and receive ports for uni-directional point-to-point paths.

**FRAME\_SIZE** is a TCL list of packet lengths, between 64 – 16K bytes. Each **FRAME\_SIZE** is tested in each test.

**NUM\_ADDR** defines the number of addresses per port, between 1 (default) – 65535 (16 bits). The lower 2 bytes in the DA (Destination Address) and SA (Source Address) are used for the port address range.

**DURATION** is the test duration in seconds for each test condition. Note: the test time will increase significantly with longer test times.

### 4.3.3.2 Global Latency Variables

[VAR]	DESCRIPTION
<b>LATENCY_MODE</b>	0=Last bit transmitted to first bit received (Store and Forward devices) 1=First bit transmitted to first bit received (Default) (Bit Forwarding or Cut-Through devices)
<b>LATENCY_40G_INT</b>	Axtrinet APG Offset for 40Gbps Ports (Default 62)
<b>LATENCY_10G_INT</b>	Axtrinet APG Offset for 10Gbps Ports (Default 58)
<b>LATENCY_10GBT_SFP_TX</b>	Additional <b>transmit</b> delay through a 10GBase-T SFP (Default 40). Note: measured using Prolabs SFP-10G-T-NC
<b>LATENCY_10GBT_SFP_RX</b>	Additional <b>receive</b> delay through a 10GBase-T SFP (Default 145). Note: measured using Prolabs SFP-10G-T-NC
<b>LATENCY_1G_INT</b>	Axtrinet APG Offset for 1Gbps Ports (Default 148)
<b>LATENCY_1GBT_SFP_TX</b>	Additional <b>transmit</b> delay through a 1000Base-T SFP (Default 12). Note: measured using Finisar FCMJ-8521-3
<b>LATENCY_1GBT_SFP_RX</b>	Additional <b>receive</b> delay through a 1000Base-T SFP (Default 36). Note: measured using Finisar FCMJ-8521-3
<b>LATENCY_100M_INT</b>	Axtrinet APG Offset for 100Mbps Ports (Default 318)
<b>LATENCY_100BT_SFP_TX</b>	Additional <b>transmit</b> delay through a 100Base-T SFP (Default 19). Note: measured using Finisar FCMJ-8521-3
<b>LATENCY_100BT_SFP_RX</b>	Additional <b>receive</b> delay through a 100Base-T SFP (Default 57). Note: measured using Finisar FCMJ-8521-3
<b>LATENCY_10M_INT</b>	Axtrinet APG Offset for 10Mbps Ports (Default 1978)
<b>LATENCY_10BT_SFP_TX</b>	Additional <b>transmit</b> delay through a 10Base-T SFP (Default 112). Note: measured using Finisar FCMJ-8521-3
<b>LATENCY_10BT_SFP_RX</b>	Additional <b>receive</b> delay through a 10Base-T SFP (Default 338). Note: measured using Finisar FCMJ-8521-3

**LATENCY\_MODE** sets the measurement type for "Store and Forward" or "Cut Through" devices.

### 4.3.4 apgSetTS PORTMAP [PORTID] [VAL]

The PORTMAP variable can be set using the **apgSetTS PORTMAP** command.

**[PORTID]** is a list in the APG TCL PORTID format eg Unit 1, Port 3 is {1 3}, and **[VAL]** is a quoted string.

**apgSetTS PORTMAP** returns the string **[VAL]** if successful, otherwise the command will display an error message and exit the TCL environment.

The values can be read using the **apgGetTS PORTMAP** command.

### 4.3.5 apgSetTS RFC2544 [VAR] [VAL]

The test variables specific to the RFC2544 tests can be set using the **apgSetTS RFC2544** command.

**apgSetTS RFC2544** returns the string [VAL] if successful, otherwise the command will display an error message and exit the TCL environment.

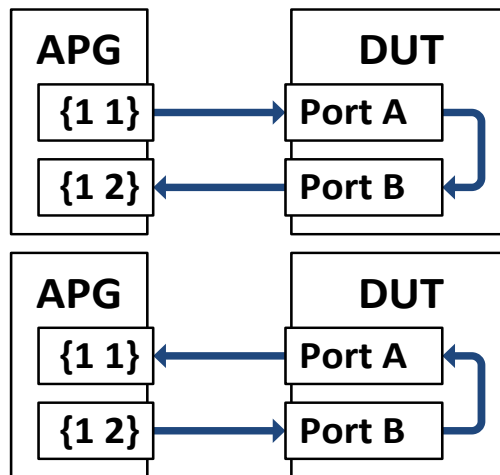
The values can be read using the **apgGetTS RFC2544** command.

#### 4.3.5.1 Global Variables

[VAR]	DESCRIPTION
<b>ENABLE</b>	RFC2544 Test Enable/Disable 1=Enable; 0=Disable Bit 0 = Throughput (26.1) (Default) Bit 1 = Latency (26.2) Bit 2 = Frame Loss Rate (26.3) Bit 3 = Back-to-back Frames (26.4) Bit 4 = Not Used - reserved for System Recovery (26.5) Bit 5 = Reset (26.6) Bit 7:6 = Not Used
<b>DIRECTION</b>	UNI = Run Unidirectional Traffic Tests (Default)
<b>CLEAN_RUNS</b>	Number of clean runs (default 2)
<b>TEST_RUNS</b>	Number of test runs (default 50)

Where a test configuration is dependent on the results from a previous test (eg Latency Tests require Throughput measurements), the preceding test is automatically enabled.

The RFC2544 tests are point-to-point tests, run with unidirectional traffic, configured using the by the **apgSetTS RFC2544 DIRECTION** command.



a) Uni-directional Tests



RFC2544 multiport mesh tests are not supported in this release.

**APGPORTS** **must** contain more than one port, and can contain more than two ports. If more than two ports are specified, the Test Suite will run each combination of port pairs for each test.

For example:


---

APGPORTS = "{1 1} {1 2}" DIRECTION=UNI	→	Test 1 = {1 1} → {1 2} Test 2 = {1 2} → {1 1}
---	---	--

---

APGPORTS = "{1 1} {1 2} {1 3}" DIRECTION=UNI	→	Test 1 = {1 1} → {1 2} Test 2 = {1 1} → {1 3} Test 3 = {1 2} → {1 3} Test 4 = {1 2} → {1 1} Test 5 = {1 3} → {1 1} Test 6 = {1 3} → {1 2}
---	---	--

---

 **It is not recommended to specify more than 4 test ports in APGPORTS as the number of tests (and time) will increase exponentially.**

**CLEAN\_RUNS** specifies the number of clean runs where multiple runs are required to validate the behaviour (eg RFC2544 Frame Loss Rate).

**TEST\_RUNS** specifies the number of test runs where multiple runs are required to validate the behaviour (eg RFC2544 Latency).

#### 4.3.5.2 RFC2544 Load Variables

[VAR]	DESCRIPTION
<b>ILOAD_MAX</b>	Maximum Input Load (%) (default 100)
<b>ILOAD_MIN</b>	Minimum Input Load (%) (default 1)
<b>ILOAD_MAXSTEP</b>	Input Load Step Size (default 10)
<b>ILOAD_MINSTEP</b>	Input Load Step Size (default 1)

The **ILOAD** variables define the rate range and steps when determining load limits.

#### 4.3.5.3 Throughput Test and Variables

The Throughput Test measures the maximum input data rate between the test ports at each specified frame size where no packet loss occurs.

The test reports the throughput rate for each **FRAME\_SIZE**.

#### 4.3.5.4 Latency Variables

[VAR]	DESCRIPTION
<b>LATENCY_DURATION</b>	Latency Test Duration (secs) Note: Latency measurements are taken after half of the time has elapsed. (Default 120)
<b>LATENCY_SAMPLES</b>	Maximum number of latency measurements taken each TESTRUN. (Default 1)

**LATENCY\_DURATION** specifies the length of each latency test in seconds. The measurement window occurs after half of the **LATENCY\_DURATION** has elapsed, when **LATENCY\_SAMPLES** timing samples are taken from the received packet stream.

#### 4.3.5.5 Frame Loss Variables

There are no variables specific to the Frame Loss Tests.

#### 4.3.5.6 Back-to-Back Frame Variables

[VAR]	DESCRIPTION
<b>MAX_BURSTSIZE</b>	Maximum burst size (packets) used at the start of the test. (Default 10000000)

#### 4.3.5.7 System Recovery Variables

There are no variables specific to the System Recovery Tests.

#### 4.3.5.8 Reset Variables

[VAR]	DESCRIPTION
<b>POWERDOWN_SCRIPT</b>	Path to shell script to power down the DUT
<b>POWERUP_SCRIPT</b>	Path to shell script to power up the DUT
<b>RESET_DELAY</b>	Default 0

## 4.4 GET TEST SUITE VARIABLE - APGGETTS

The Test Suite configuration variables are read using the **apgGetTS** commands.

The **apgGetTS** should be preceded by **apgInitTS**, although if called before initialising the Test Suite configuration, **apgInitTS** will be called automatically to initialise the variables to default values.

**apgGetTS** returns [VAL] if successful, otherwise the command will display an error message and exit the TCL environment.

### 4.4.1 apgGetTS REPORT [VAR]

The Test Suite Report variables are read using the **apgGetTS REPORT** command.

The [VAR] options are defined in Section 4.3.1.

### 4.4.2 apgGetTS DUT [VAR]

The Test Suite DUT variables are read using the **apgGetTS DUT** command.

The [VAR] options are defined in Section 4.3.2.

### 4.4.3 apgGetTS GLOBAL [VAR]

The Test Suite Global variables are read using the **apgGetTS GLOBAL** command.

The [VAR] options are defined in Section 4.3.3.

### 4.4.4 apgGetTS PORTMAP [PORTID]

The Test Suite Port Map variables are read using the **apgGetTS PORTMAP** command.

The [VAR] options are defined in Section 4.3.4.

### 4.4.5 apgGetTS RFC2544 [VAR]

The Test Suite RFC2544 variables are read using the **apgGetTS RFC2544** command.

The [VAR] options are defined in Section 4.3.5.

## 4.5 RUN TEST SUITE - APGRUNTS

The Test Suites are run using the **apgRunTS** command.

See Section 3.2.

### 4.5.1 apgRunTS RFC2544

The RFC2544 Tests are run using the **apgRunTS RFC2544** command.

**apgRunTS** runs the tests enabled by **RFC2544 ENABLE**.

## APPENDIX A - EXAMPLE CONFIGURATION SCRIPT

```
#!/usr/bin/tclsh
#
# Test script Axtrinet Packet Generator Test Suite
#
if { $tcl_platform(platform) == "unix" } {
    source "/usr/share/axtrinet/apg/axtrinetApi.tcl"
    source "/usr/share/axtrinet/apg/axtrinetTestSuite.tcl"
}
if { $tcl_platform(platform) == "windows" } {
    source "C:/Program Files/Axtrinet/APG/axtrinetApi.tcl"
    source "C:/Program Files/Axtrinet/APG/axtrinetTestSuite.tcl"
}
```

*Source the Axtrinet API and Test Suite libraries*

```
# Define Configuration Variables
```

```
apgSetTS REPORT FULL 0
apgSetTS REPORT VERBOSE 1

apgSetTS REPORT AUTHOR "A.N.Engineer"
apgSetTS REPORT COMPANY "A.Company Ltd"

apgSetTS DUT MODEL "DXS-1210-10TS"
apgSetTS DUT SERIAL "S34G1FA000171"
apgSetTS DUT HWVERSION "A1"
apgSetTS DUT FWVERSION "V1.00.021"
apgSetTS DUT SWVERSION ""
apgSetTS DUT REVISION ""
apgSetTS DUT NOTES "BOOT PROM Version 1.00.004"
apgSetTS DUT TESTPORTS "Ports 7,8"

apgSetTS PORTMAP {1 1} "Port 7"
apgSetTS PORTMAP {1 3} "Port 8"

apgSetTS GLOBAL APGPORTS {{1 1} {1 3}}
apgSetTS GLOBAL FRAME_SIZE "64 512 1024"
apgSetTS GLOBAL DURATION 3
apgSetTS GLOBAL NUM_ADDR 1
apgSetTS GLOBAL LATENCY_MODE 0
apgSetTS GLOBAL TIMEOUT 60
```

*Set report strings*

*Define port mapping between Axtrinet & DUT*

*Test ports 1 & 3  
Three Packet lengths only  
3sec duration  
1 MAC Address  
"Store & Forward" Mode*

```
### RFC2544 Configuration
```

```
apgSetTS RFC2544 DIRECTION "UNI"
apgSetTS RFC2544 LATENCY_DURATION 5
apgSetTS RFC2544 LATENCY_SAMPLES 10
apgSetTS RFC2544 OVERLOAD_DURATION 3
apgSetTS RFC2544 POWERDOWN_SCRIPT "/home/user/axtrinet/powerdownlink"
apgSetTS RFC2544 POWERUP_SCRIPT "/home/user/axtrinet/poweruplink"
apgSetTS RFC2544 TEST_RUNS 10
```

```
# Bit 0 : 0x01 RFC2544 Throughput Tests
# Bit 1 : 0x02 RFC2544 Latency Tests
# Bit 2 : 0x04 RFC2544 Frame Loss Rate Tests
# Bit 3 : 0x08 RFC2544 Back-To-Back Frames Tests
# Bit 4 : 0x10 RFC2544 System Recovery Tests
# Bit 5 : 0x20 RFC2544 Reset Tests
```

```
apgSetTS RFC2544 ENABLE 0x02
```

*Latency Tests Only*

```
# Define Test Port configurations
# Note: Stream 0 used for main test stream (defined here), 1-7 used for
# additional test packets (defined during the test)
```

```
if { [apgGetTS RFC2544 ENABLE] > 0 } {
    foreach PORTID [apgGetTS GLOBAL APGPORTS] {
        for { set ST 0 } { $ST <= 7 } { incr ST } {
            set STREAMID [list [concat $PORTID $ST]]
            apgLoadStream $STREAMID INFO
            apgSetStream $STREAMID CONFIG ENABLE 0
            apgApplyStream $STREAMID
        }

        switch [llength $PORTID] {
            2 { scan $PORTID "%d %d" UN PO ; set SP 0 }
            3 { scan $PORTID "%d %d %d" UN PO SP }
            default { puts "++++ ERROR - Invalid PORTID length" }
        }

        set STREAMID [list [concat $PORTID 0]]

        # Header Configuration for the RFC testing
        apgSetStream $STREAMID HEADER MACHEADER DA \
            [format "08:%1X%1X:%1X0:00:00:01" $UN $PO $SP ]
        apgSetStream $STREAMID HEADER MACHEADER SA \
            [format "08:%1X%1X:%1X0:00:00:00" $UN $PO $SP ]
    }
}
```

*Configure streams on selected port*

*Disable all streams*

*Test for sub-ports  
ie on 40G ports*

*For Stream 0 ...*

*Set MAC DA & SA*



```
# Stream Configuration setting are modified during the tests
apgSetStream $STREAMID CONFIG ENABLE 1
apgSetStream $STREAMID CONFIG TX_MODE BURST
apgSetStream $STREAMID CONFIG RATE_MODE PERCENT
apgSetStream $STREAMID CONFIG RATE_VALUE 100000
apgSetStream $STREAMID CONFIG SIZE_MODE FIXED
apgSetStream $STREAMID CONFIG PACKET_SIZE 64
```

*Enable stream & set transmit parameters*

```
# Write stream to APG
apgApplyStream $STREAMID
```

*Apply the Stream 0 configuration to the unit.*

```
# Run the tests
```

```
    apgRunTS RFC2544
```

*Run the RFC tests.*

## APPENDIX B - EXAMPLE SAVE FILE

```
#####
#
# FILENAME: /home/user/axtrinet/APG000010-TS.apg
#
# Generated on Tue, 16 Jan 2018 at 15:08:10
#
# AXTRINET APG000010 TEST SUITE CONFIGURATION FILE
#
#####
# UNIT CONSTRAINTS #####
#
# API_VERSION 161016
# PRODUCT      APG208
#
# TEST SUITE CONFIGURATION #####
#
# REPORT VARIABLES
apgSetTS REPORT VERBOSE 1
apgSetTS REPORT FULL 0
apgSetTS REPORT PAPERSIZE A4
apgSetTS REPORT AUTHOR {Chris Perkins}
apgSetTS REPORT COMPANY {Xentech Solutions}
apgSetTS REPORT CLASSIFICATION {Commercial In Confidence}
#
# DUT VARIABLES
apgSetTS DUT MODEL DXS-1210-10TS
apgSetTS DUT SERIAL S34G1FA000171
apgSetTS DUT HWVERSION A1
apgSetTS DUT FWVERSION V1.00.021
apgSetTS DUT NOTES {Boot PROM 1.00.004}
#
# GLOBAL VARIABLES
apgSetTS GLOBAL APGPORTS {{1 1} {1 3}}
apgSetTS GLOBAL FRAME_SIZE {64 128 }
apgSetTS GLOBAL NUM_ADDR 1
apgSetTS GLOBAL DURATION 5
apgSetTS GLOBAL TIMEOUT 60
apgSetTS GLOBAL LATENCY_MODE 0
apgSetTS GLOBAL LATENCY_10G_INT 58
apgSetTS GLOBAL LATENCY_40G_INT 62
apgSetTS GLOBAL LATENCY_10GBT_SFP_TX 40
apgSetTS GLOBAL LATENCY_10GBT_SFP_RX 145
apgSetTS GLOBAL NUM_VLAN_HDR 0
apgSetTS GLOBAL NUM_MPLS_HDR 2
apgSetTS GLOBAL PAYLOAD_TYPE Random
#
# PORTMAP VARIABLES
apgSetTS PORTMAP {1 1} "Port 7"
apgSetTS PORTMAP {1 3} "Port 8"
#
# RFC2544 VARIABLES
apgSetTS RFC2544 ENABLE 1
apgSetTS RFC2544 DIRECTION UNI
apgSetTS RFC2544 TEST_RUNS 5
apgSetTS RFC2544 CLEAN_RUNS 2
apgSetTS RFC2544 LATENCY_DURATION 5
apgSetTS RFC2544 LATENCY_SAMPLES 1
apgSetTS RFC2544 ILOAD_MAX 100
apgSetTS RFC2544 ILOAD_MIN 1
apgSetTS RFC2544 ILOAD_MAXSTEP 10
apgSetTS RFC2544 ILOAD_MINSTEP 1
apgSetTS RFC2544 MAX_BURSTSIZE 10000000
apgSetTS RFC2544 OVERLOAD_DURATION 30
apgSetTS RFC2544 POWERDOWN_SCRIPT /home/user/axtrinet/powerdownlink
apgSetTS RFC2544 POWERUP_SCRIPT /home/user/axtrinet/poweruplink
apgSetTS RFC2544 RESET_DELAY 0
#
# PORT 1.0 #####

set PORTID { UNITID 1 }

apgSetPort $PORTID TOPOLOGY 10G
apgSetPort $PORTID TXENABLE 1
apgSetPort $PORTID RATE 3

apgSetPort $PORTID LINKMODE SRLR
apgApplyPort $PORTID STATE

set PORTID { UNITID 1 0 }

# STREAM 1.0.0 -----

set STREAMID { UNITID 1 0 0 }

apgSetStream $STREAMID CONFIG ENABLE 1
apgSetStream $STREAMID CONFIG TX_MODE 0
apgSetStream $STREAMID CONFIG RATE_MODE 2
apgSetStream $STREAMID CONFIG SIZE_MODE 3
```

```

apgSetStream $STREAMID CONFIG TX_CONTROL 0
apgSetStream $STREAMID CONFIG RATE_VALUE 100000
apgSetStream $STREAMID CONFIG TX_BURST_SIZE 1
apgSetStream $STREAMID CONFIG TX_BURST_COUNT 1
apgSetStream $STREAMID CONFIG TX_IBG 0
apgSetStream $STREAMID CONFIG HEADER_SIZE 22
apgSetStream $STREAMID CONFIG PACKET_SIZE 64
apgSetStream $STREAMID CONFIG PACKET_SIZE_MAX 1518

apgSetStream $STREAMID HEADER HEADER_LIST "MACHEADER ETHERNET_II MPLS MPLS"

apgSetStream $STREAMID HEADER MACHEADER DA 08:01:01:00:08:00
apgSetStream $STREAMID HEADER MACHEADER SA 08:01:01:00:08:01

apgSetStream $STREAMID HEADER ETHERNET_II ETHERTYPE 0x8847

apgSetStream $STREAMID HEADER MPLS LABEL 1
apgSetStream $STREAMID HEADER MPLS TC 0
apgSetStream $STREAMID HEADER MPLS S 1
apgSetStream $STREAMID HEADER MPLS TTL 64

apgSetStream $STREAMID HEADER MPLS/2 LABEL 2
apgSetStream $STREAMID HEADER MPLS/2 TC 1
apgSetStream $STREAMID HEADER MPLS/2 S 1
apgSetStream $STREAMID HEADER MPLS/2 TTL 64

apgSetStream $STREAMID PAYLOAD PAYLOAD_DATA "00 01 02 03 04 05 06 07"
apgSetStream $STREAMID PAYLOAD DATA_CONTROL 3
apgSetStream $STREAMID PAYLOAD TS_ENABLE 1

apgApplyStream $STREAMID

# STREAM 1.0.1 -----
set STREAMID { UNITID 1 0 1 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# STREAM 1.0.2 -----
set STREAMID { UNITID 1 0 2 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# STREAM 1.0.3 -----
set STREAMID { UNITID 1 0 3 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# STREAM 1.0.4 -----
set STREAMID { UNITID 1 0 4 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# STREAM 1.0.5 -----
set STREAMID { UNITID 1 0 5 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# STREAM 1.0.6 -----
set STREAMID { UNITID 1 0 6 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# STREAM 1.0.7 -----
set STREAMID { UNITID 1 0 7 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# PORT 3.0 #####

set PORTID { UNITID 3 }

apgSetPort $PORTID TOPOLOGY 10G
apgSetPort $PORTID TXENABLE 1
apgSetPort $PORTID RATE 3

apgSetPort $PORTID LINKMODE SRLR
apgApplyPort $PORTID STATE

set PORTID { UNITID 3 0 }

# STREAM 3.0.0 -----

set STREAMID { UNITID 3 0 0 }

apgSetStream $STREAMID CONFIG ENABLE 1

```

```

apgSetStream $STREAMID CONFIG TX_MODE 0
apgSetStream $STREAMID CONFIG RATE_MODE 2
apgSetStream $STREAMID CONFIG SIZE_MODE 3
apgSetStream $STREAMID CONFIG TX_CONTROL 0
apgSetStream $STREAMID CONFIG RATE_VALUE 100000
apgSetStream $STREAMID CONFIG TX_BURST_SIZE 1
apgSetStream $STREAMID CONFIG TX_BURST_COUNT 1
apgSetStream $STREAMID CONFIG TX_IBG 0
apgSetStream $STREAMID CONFIG HEADER_SIZE 22
apgSetStream $STREAMID CONFIG PACKET_SIZE 64
apgSetStream $STREAMID CONFIG PACKET_SIZE_MAX 1518

apgSetStream $STREAMID HEADER HEADER_LIST "MACHEADER ETHERNET_II MPLS MPLS"

apgSetStream $STREAMID HEADER MACHEADER DA 08:01:03:00:08:00
apgSetStream $STREAMID HEADER MACHEADER SA 08:01:03:00:08:01

apgSetStream $STREAMID HEADER ETHERNET_II ETHERTYPE 0x8847

apgSetStream $STREAMID HEADER MPLS LABEL 1
apgSetStream $STREAMID HEADER MPLS TC 0
apgSetStream $STREAMID HEADER MPLS S 0
apgSetStream $STREAMID HEADER MPLS TTL 64

apgSetStream $STREAMID HEADER MPLS/2 LABEL 2
apgSetStream $STREAMID HEADER MPLS/2 TC 0
apgSetStream $STREAMID HEADER MPLS/2 S 1
apgSetStream $STREAMID HEADER MPLS/2 TTL 64

apgSetStream $STREAMID PAYLOAD PAYLOAD_DATA "00 01 02 03 04 05 06 07"
apgSetStream $STREAMID PAYLOAD DATA_CONTROL 3
apgSetStream $STREAMID PAYLOAD TS_ENABLE 1

apgApplyStream $STREAMID

# STREAM 3.0.1 -----
set STREAMID { UNITID 3 0 1 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# STREAM 3.0.2 -----
set STREAMID { UNITID 3 0 2 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# STREAM 3.0.3 -----
set STREAMID { UNITID 3 0 3 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# STREAM 3.0.4 -----
set STREAMID { UNITID 3 0 4 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# STREAM 3.0.5 -----
set STREAMID { UNITID 3 0 5 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# STREAM 3.0.6 -----
set STREAMID { UNITID 3 0 6 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# STREAM 3.0.7 -----
set STREAMID { UNITID 3 0 7 }
apgSetStream $STREAMID CONFIG ENABLE 0
apgApplyStream $STREAMID

# END OF FILE #####

```



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