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# PacketExpert™ 100G: Comprehensive Ethernet and IP Test Solution

## 1 Gbps up to 100 Gbps

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# Ethernet / IP Testing: Scope

- **What to test?**
  - Cables, switches, routers, gateways, VLAN, VPN, client to server, client to client, end-to-end networks
- **When to test? What frequency?**
  - Time of day, under high/low stress, after an infrastructure change, circuit handover, acceptance testing, benchmark testing
- **How to test?**
  - At different speeds, frame sizes, packet types
- **What to Measure?**
  - Bit errors, frame loss, throughput, latency, etc.

# Real World Examples

## (from Existing Customers)

- **Service Level Agreement (SLA) Verification**
  - Service Provider: During cutover or troubleshooting times
  - Customer: Verification that SLA is being met on mission critical circuits
- **Equipment Manufacturer Testing**
  - Development: Troubleshooting during R&D
  - Regression: Longer-term thorough testing that can be accurately repeated
  - Production: Validating that equipment is ready for shipment
- **Precision Delay Testing** - Packet traversing times through equipment or network
- **Test Bed (Lab) Applications**
  - Traffic Generators
  - Network Emulators

# What Test Device is Needed?

- Flexible (e.g., different interfaces: 1 Gbps, 10 Gbps, 25 Gbps, 40 Gbps, 50 Gbps, 100 Gbps)
- Multiuser capability
- Portable or stationary?
- Cover many tests: Bit Error Rates, RFC 2544, ITU-T Y.1564, Loopback and Multi Stream Traffic Generator and Analyzer
- Automation (run scripts!)
- Graphical user interface
- Cost effective



# Current Key Features

- Supports 1G, 10G, 25G, 40G, 50G, and 100G rates with IEEE 802.3-compliant
- Offers various applications as standard including BERT, Smart Loopback, RFC 2544, Y.1564 testing and Multi Stream Traffic Generator and Analyzer
- Forward Error Correction (FEC), including Fire Code and RS-FEC (528, 514) and RS-FEC (544, 514)
- Test automation and regression testing via Python and REST APIs
- Scales from 2 to 8 ports
- Offers multi-user and multi-chassis support through a single web-based user interface
- Inserts Layer 1 alarms and errors

# Upcoming Features

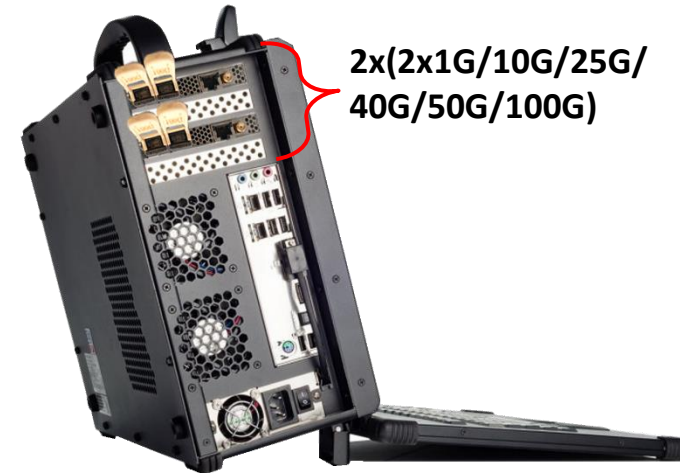
- One-Way Delay Measurement by synchronizing clocks using PTP Protocol (IEEE 1588)
- Multiport Support - 4x10G/25G
- SyncE (Synchronous Ethernet)

# Hardware Specifications – Portable Platforms



2x1G/10G/25G/  
40G/50G/100G

**Portable PacketExpert™ 100G  
(Lunchbox)**



2x(2x1G/10G/25G/  
40G/50G/100G)

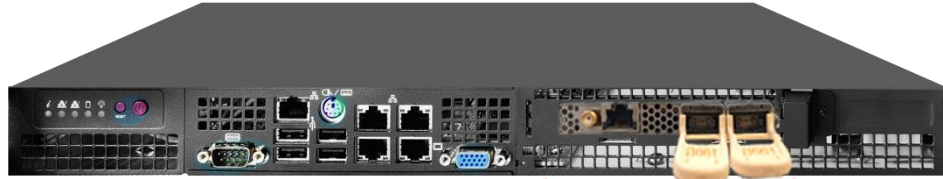
**Portable PacketExpert™ 100G  
(Lunchbox)**



4x(2x1G/10G/25G/  
40G/50G/100G)

**Portable PacketExpert™ 100G  
(Lunchbox)**

# Hardware Specifications – Rackmount Platforms



2x1G/10G/25G/40G/50G/100G

**PacketExpert™ 100G – 1U Rack-mount PC**



2x(2x1G/10G/25G/40G/50G/100G)

**PacketExpert™ 100G – 2U Rack PC**



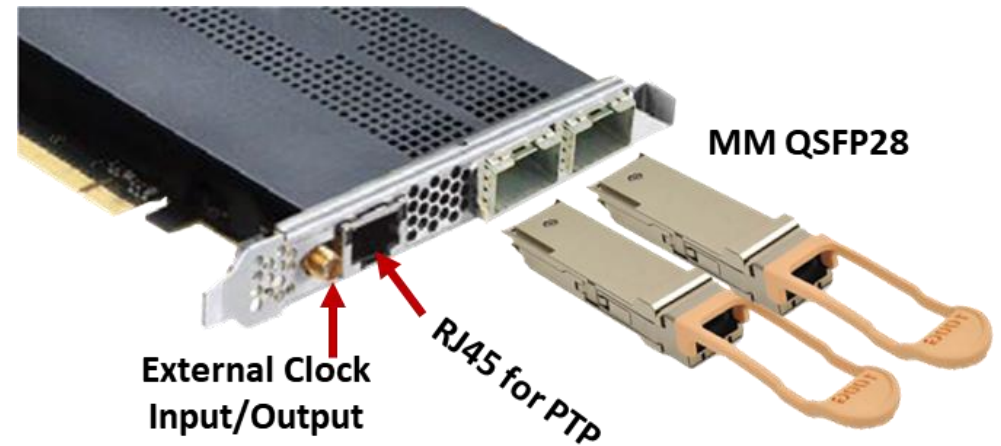
4x(2x1G/10G/25G/40G/50G/100G)

**PacketExpert™ 100G – 4U Rack-mount PC**

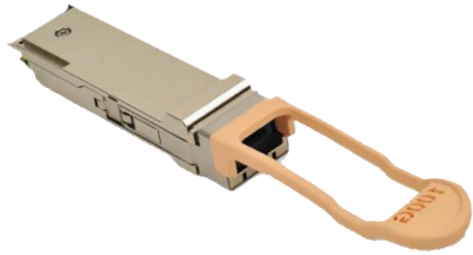
# PacketExpert™ 100G - Specifications (Per Card)

<b>Optics</b>	<ul style="list-style-type: none"><li>• 2 x QSFP28 cages for 2 x 100 GbE, 2 x 50GbE, and 2 x 40 GbE</li><li>• Supports 2 x 25 GbE, 2 x 10 GbE, and 2 x 1 GbE with QSFP-to-SFP adapter</li></ul>
<b>PCIe</b>	PCIe Gen 3, 16 lanes
<b>RAM</b>	8 GBytes DDR4 SDRAM
<b>1000Base-T Port</b>	RJ45 for IEEE1588v2
<b>Single-ended Coaxial I/O</b>	SMA connector, 50 Ohms for External Clock Input/Output
<b>Temperature Range</b>	0 °C to 45 °C
<b>Operating Humidity</b>	20% to 80%
<b>Storage</b>	-10 to 60 °C
<b>Oscillator Accuracy</b>	+/- 4.6ppm

**SmartNIC Card 2x100G**



# Optical Connectors and SFP Transceivers



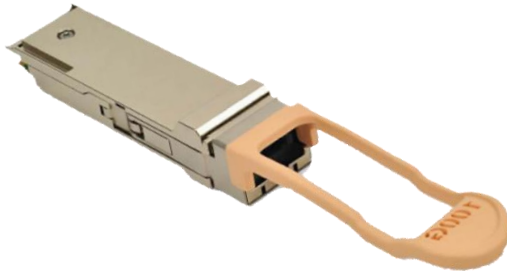
**100G QSFP28 Optical Transceiver**



**50G QSFP28 Optical Transceiver**



**SFP28 Optical Transceiver**



**40BASE-SR4 QSFP+ Gen4 Optical Transceiver**



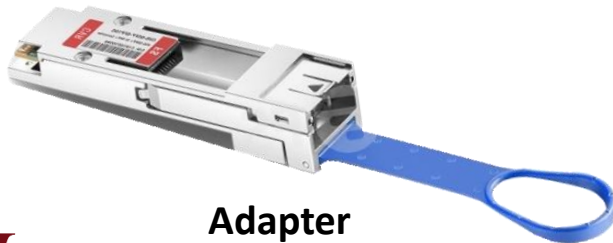
**40G QSFP+ Transceiver**



**SFP+ Optical Transceiver**



**RJ45 1/10G -10GBASE-T SFP+ Copper RJ-45**



**Adapter**

# Optical Connectors and SFP Transceivers (Contd.)



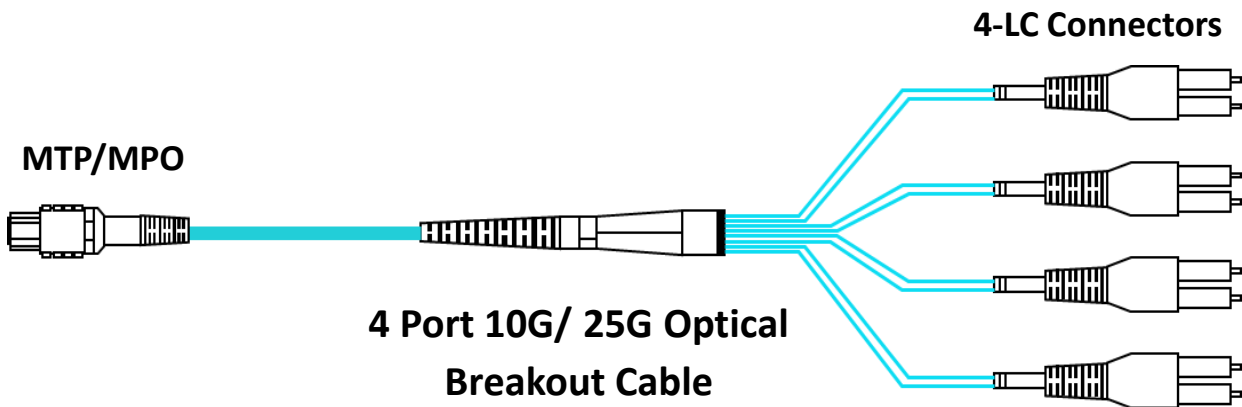
MTP/MPO Connector



LC Connector



LC to SC Fiber Cable

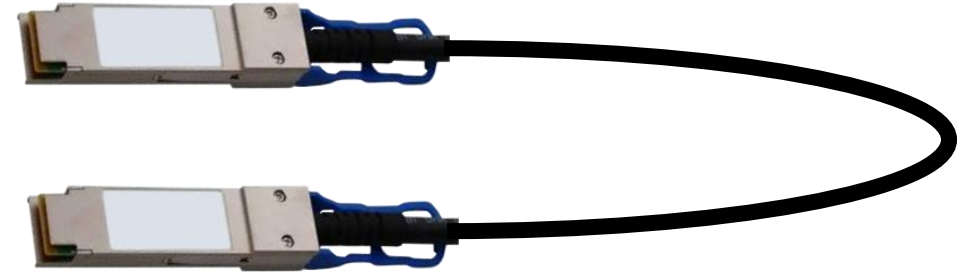


4-LC Connectors

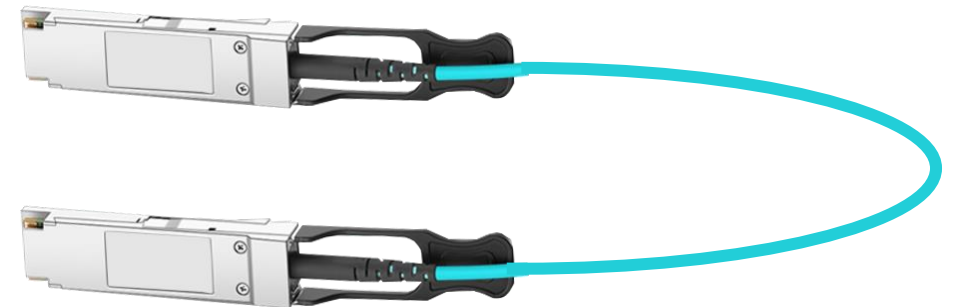
4 Port 10G/ 25G Optical Breakout Cable



RJ45 Connector



DAC Cable

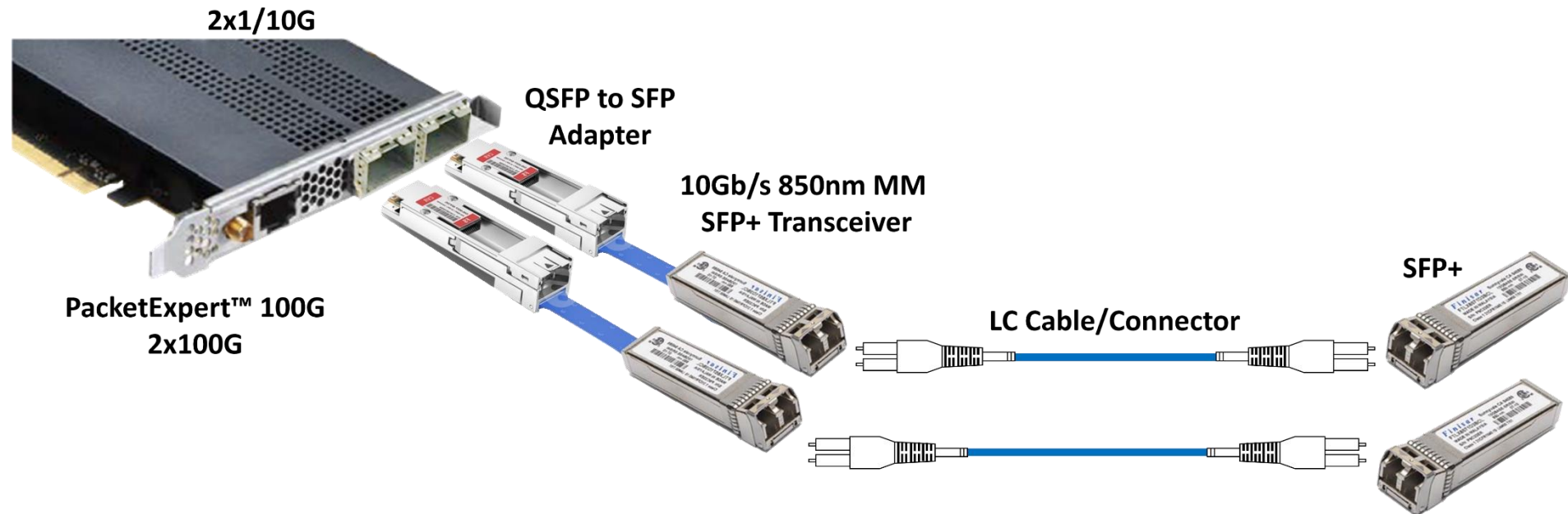
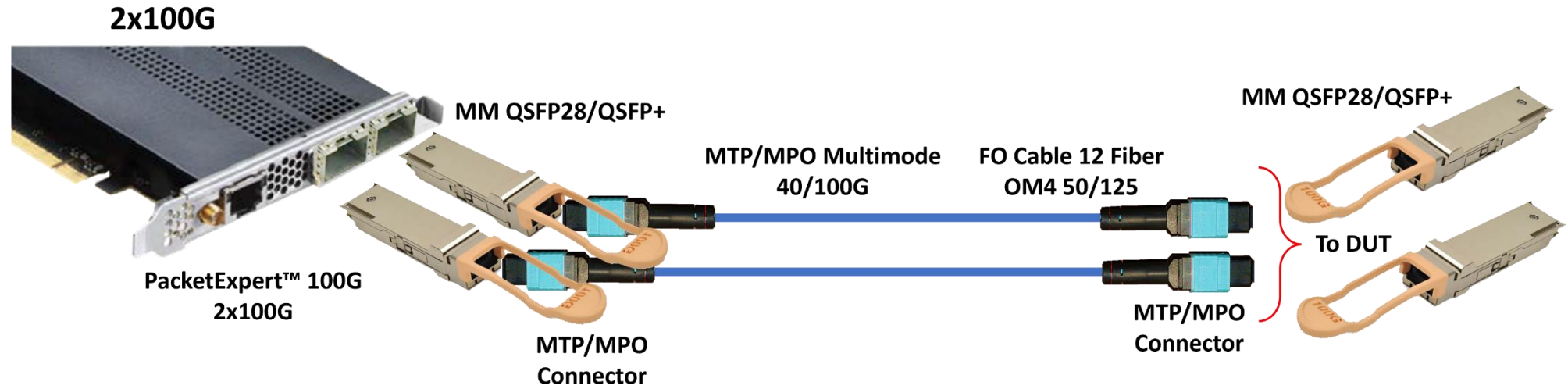


AOC Cable

- Many More Optical Connectors and SFP Transceivers can be used

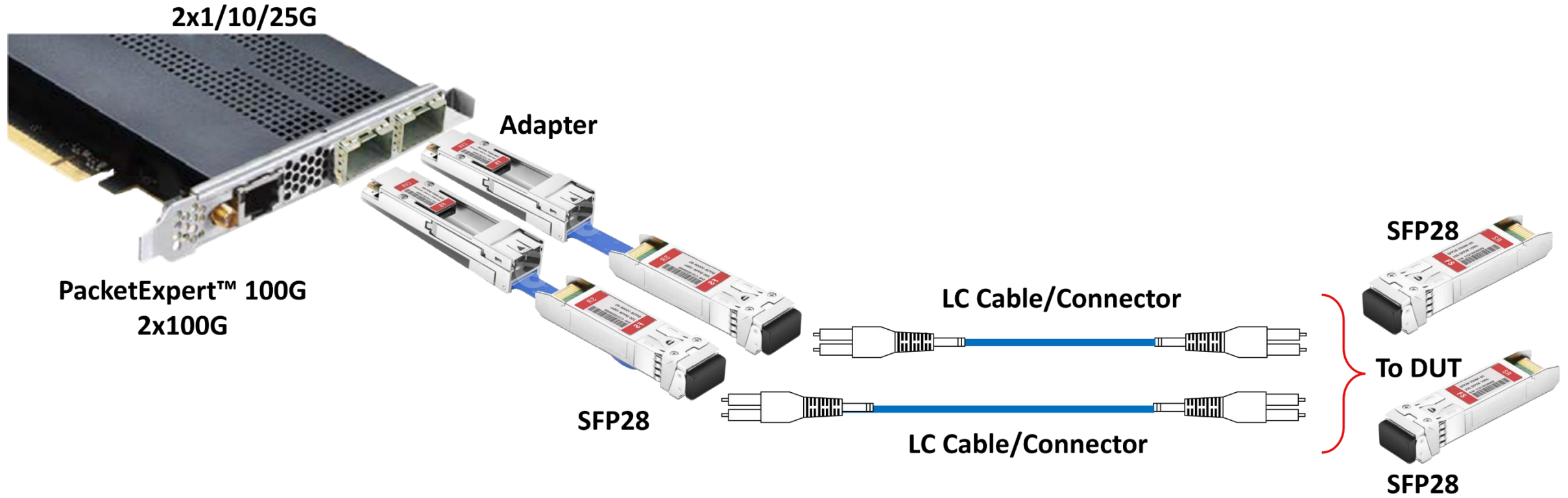


# 2x1/10, 2x40, 2x50, 2x100 Configuration

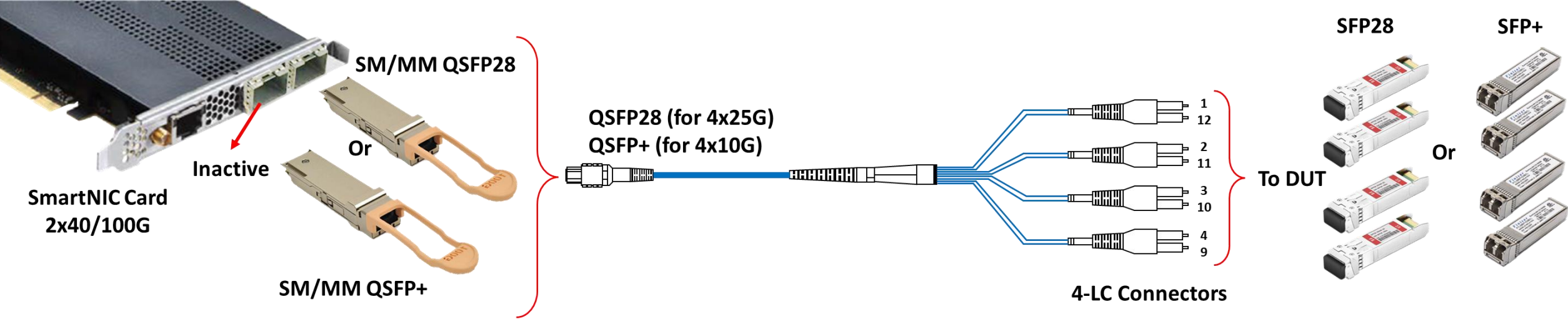




# 2x1/10/25G Configuration



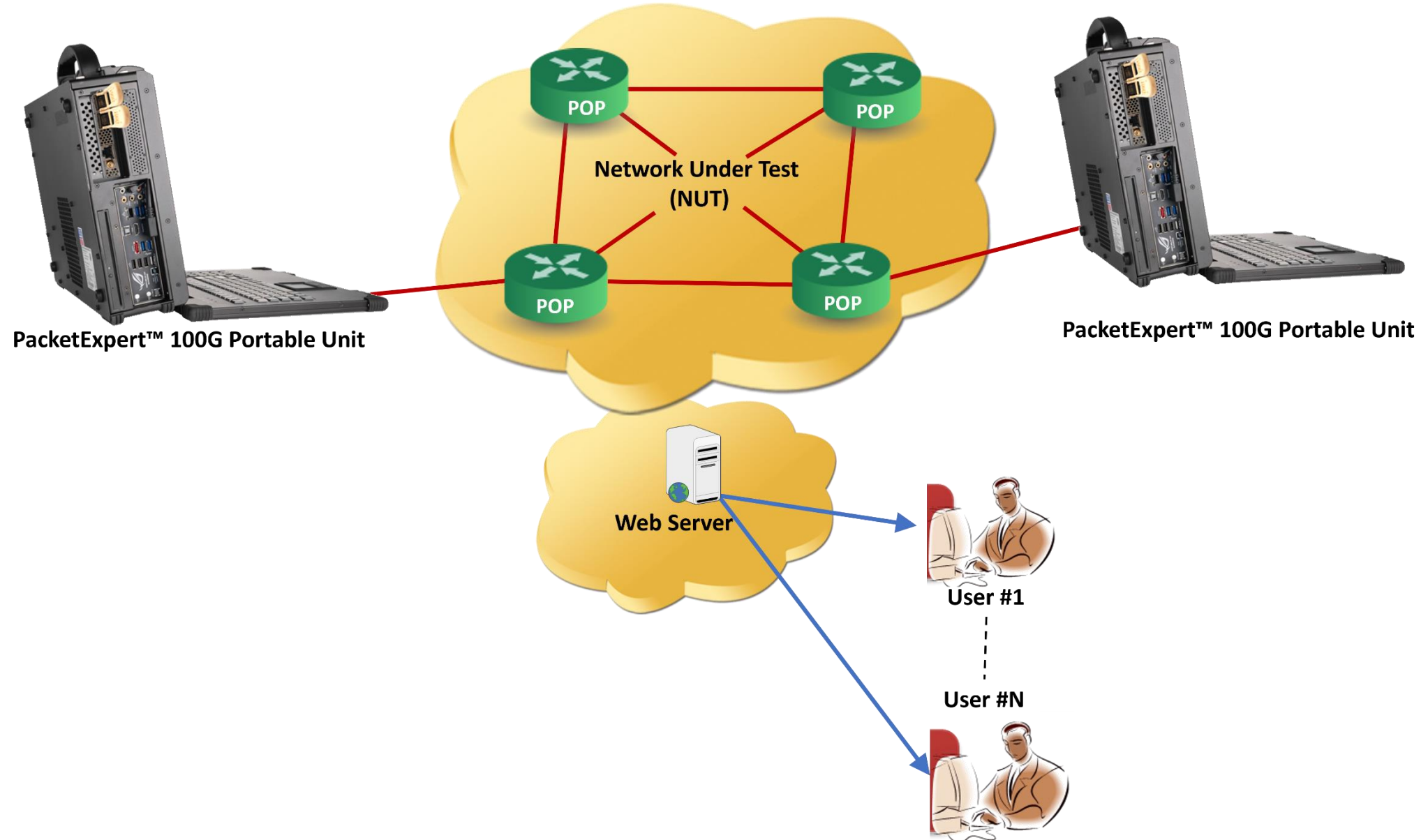
# 4x10G/25G Configuration



# Supported Forward Error Correction (FEC) Types

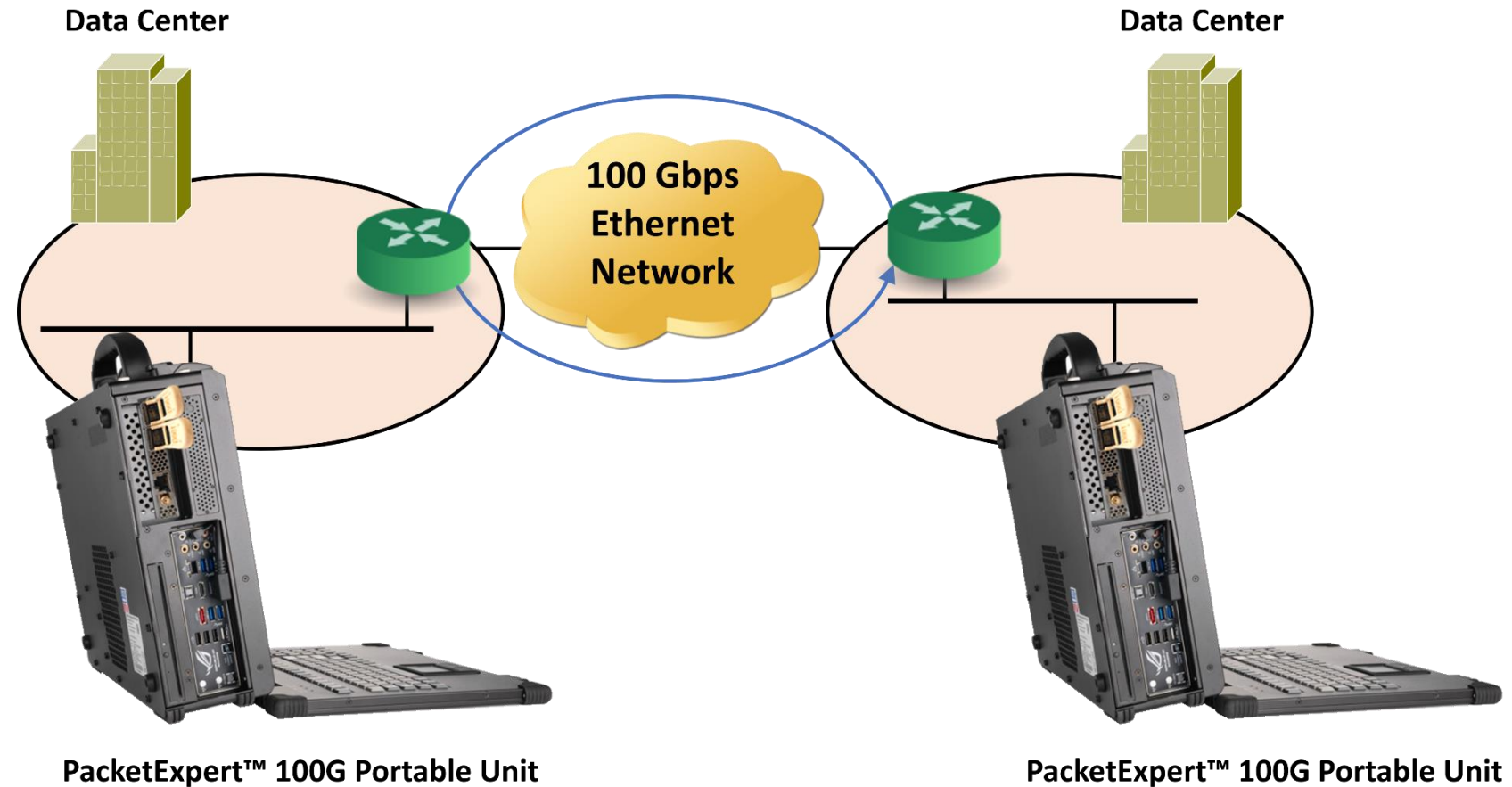
<b>100G</b>	<ul style="list-style-type: none"><li>• Clause 91 RS-FEC(528,514)</li></ul>
<b>50G</b>	<ul style="list-style-type: none"><li>• Clause 134 RS-FEC(544,514)</li><li>• Clause 91 RS-FEC(528,514) - (Ethernet Consortium specification)</li><li>• Clause 74 Fire Code FEC - Used for DAC cables and AOC cables (Ethernet Consortium specification)</li></ul>
<b>40G</b>	<ul style="list-style-type: none"><li>• Clause 74 Fire Code FEC - Used for DAC cables and AOC cables</li></ul>
<b>25G</b>	<ul style="list-style-type: none"><li>• Clause 108 RS-FEC(528,514)</li><li>• Clause 74 Fire Code FEC - Used for DAC cables and AOC cables</li></ul>
<b>10G</b>	<ul style="list-style-type: none"><li>• Clause 74 Fire Code FEC - Used for DAC cables and AOC cables</li></ul>

# Network Diagram



# Key Network Performance Challenges Solved by BERT

- Ensuring Signal Integrity
- Optimizing Channel Performance
- Guaranteeing System Reliability
- Maximizing Error Correction Effectiveness
- Rigorous Equipment Testing
- Proactive Network Maintenance and Efficient Troubleshooting
- Implementing Quality of Service (QoS)



# Bit Error Rate Testing

# PacketExpert™ 100G - BER Test Setup at Layer 3 / 4

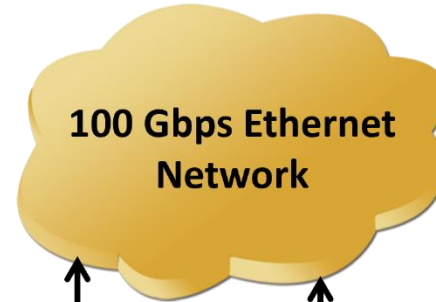
Layer 3 Testing between PacketExpert™ located in different IP Networks

PacketExpert™ 100G

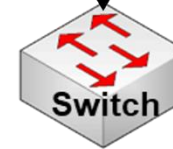


Network 1

Source IP address = 192.168.1.11 (Port 1)



100 Gbps Ethernet Network



Network 2

PacketExpert™ 100G



Destination IP address = 192.168.2.12 (Port 1)

- BERT test can be performed on various link speed such as **1G, 10G, 25G, 40G, 50G or 100G**
- PacketExpert™ 100G can perform BERT across networks

# BERT Features

- **Bit Error Rate Testing (BERT)** supports industry standard PRBS patterns –  $2^9-1$ ,  $2^{11}-1$ ,  $2^{15}-1$ ,  $2^{20}-1$ ,  $2^{23}-1$ ,  $2^{29}-1$ ,  $2^{31}-1$ , All Ones, All Zeroes, Alternate Ones and Zeroes, and User Defined pattern
- BERT is applicable for Ethernet (Layer 2), up to 3 Stacked VLAN (Q-in-Q), up to 3 Stacked MPLS (Layer 2.5), IPv4/IPv6 (Layer 3) and UDP (Layer 4)
- Intentionally introduce single bit errors individually or at a desired rate
- User-defined header parameters for MAC, VLAN, MPLS, IPv4/IPv6 and UDP layers
- Multi-device support for wire-speed BERT and simultaneous BERT/Loopback applications to increase the number of parallel BERT tests
- Real-time graphical representation of the combined Throughput and Bit Error rate can be plotted over time for BERT testing



# BERT Configuration - Summary

PacketExpert™

Dashboard Servers Event Log Admin

Devices Ports **BERT**

Summary **Configuration** Statistics Graph All Ports Statistics Event Log

BERT Configuration ● Idle

Port2 ☒ Tx/Rx Coupled

**Summary** Layer MAC VLAN MPLS IP UDP BERT Traffic

Description	Tx/Rx
<b>Layer</b>	UDP
<b>MAC</b>	
Source MAC Address	00-0D-E9-08-D2-EC (HW MAC Address)
Destination MAC Address	00-0D-E9-08-D2-EB
Len/Type	88-47
<b>VLAN</b>	Enabled
VLAN #1 Type	81-00
VLAN #1 Id	0
VLAN #1 Priority	0
VLAN #2 Type	88-A8
VLAN #2 Id	0
VLAN #2 Priority	0
VLAN #3 Type	91-00
VLAN #3 Id	0
VLAN #3 Priority	0
<b>MPLS</b>	Enabled
MPLS #1 Label	111111
MPLS #1 CoS	1
MPLS #1 TTL	128
MPLS #2 Label	222222
MPLS #2 CoS	1
MPLS #2 TTL	128
MPLS #3 Label	333333
MPLS #3 CoS	1
MPLS #3 TTL	128
<b>IP</b>	
IP Selection	IPv4
Source IP Address	192.168.1.12
Destination IP Address	192.168.1.11
Default Gateway	192.168.1.1
Subnet Mask	255.255.255.0
TTL	128
ToS/DS	0
Protocol	17
Header Checksum	Auto
Identification	Auto
<b>UDP</b>	
Source UDP	1002
Destination UDP	1001
Checksum	Auto
<b>BERT</b>	
BERT Pattern	2*9-1
Invert Pattern	Disabled
Sequence Number	Enabled
Reverse Bits	Disabled
Process FCS Error Frames	Disabled
Threshold for Verdict (Pass/Fail)	Bit Error Rate (1.0E-14)

- Display BERT Summary for various packet configurations

# BERT Summary

Devices Ports **BERT**

Load Save

**Summary** Configuration Statistics Graph All Ports Statistics Event Log

## BERT Summary

Statistics ☒ View1 ☒ View2 ☒ Graph ▶ Start Selected ■ Stop Selected Reset Selected Report

<input checked="" type="checkbox"/> Port ⚙	Config	Start/Stop <input checked="" type="checkbox"/> Tx & Rx	Link Status	Verdict	Rate (Mbps)		Rx Alarm	Pat Sync	Bit Errors	Traffic Status	Out Of Sequence	Error Duration	Sync Loss Count	Sync Loss Duration	Instantaneous Bit Error Rate	Total Bit Error Count	Bit Error Duration
					Tx	Rx											
<input checked="" type="checkbox"/> Port1	Loop Up ⚙	⛔	●	Pass	98,699.607	98,699.607	No Alarms	●	●	●	●	00:00:00	0	00:00:00	0.00	0	00:00:00
<input checked="" type="checkbox"/> Port2	Loop Up ⚙	⛔	●	Pass	98,699.607	98,699.607	No Alarms	●	●	●	●	00:00:00	0	00:00:00	0.00	0	00:00:00

Port ⚙	Tx Total Frames	Rx Total Frames	Non Test Frames	FCS Error Frames	IP Checksum Errors	UDP Checksum Errors	Tx Link Utilization (%)	Rx Link Utilization (%)	Tx Frame Rate (frames/sec)	Rx Frame Rate (frames/sec)
Port1	133,721,374	133,678,461	0	0	0	0	100.000	100.000	8,127,438	8,127,438
Port2	133,691,451	133,698,684	0	0	0	0	100.000	100.000	8,127,438	8,127,438

Port ⚙	VLAN Frames	MPLS Frames	IPv4 Packets	IPv6 Packets	UDP Packets	ICMP Packets
Port1	133,678,460	133,678,460	133,678,460	0	133,678,460	0
Port2	133,698,682	133,698,682	133,698,682	0	133,698,682	0

# BERT Results

- Users can measure out of sequence packets and packet loss through optional sequence number insertion feature
- Provides detailed BERT statistics such as Bit Error Count, Bit Error Rate, Bit Error Seconds and more

The screenshot displays the PacketExpert™ BERT Results page. The interface includes a top navigation bar with 'Dashboard', 'Servers', 'Event Log', and 'Admin'. Below this, a sub-navigation bar shows 'Devices', 'Ports', and 'BERT' (selected). The 'BERT' section has tabs for 'Summary', 'Configuration', 'Statistics' (selected), 'Graph', 'All Ports Statistics', and 'Event Log'. A 'BERT Statistics' section shows 'No Alarms' with a green dot. A 'BERT Results' button is present. The main content area contains three tables:

**Alarms**

	Alarms	Count	Duration
Bit Errors	●	0	00:00:00
Pat Sync	●	0	00:00:00
Out Of Sequence	●	0	00:00:00
Traffic Status	●	-	00:00:00
Link Status	●	-	00:00:00

**Rx BERT Statistics**

	Bit Error Rate	Bit Error Count	Bits Received
Instantaneous	0.00	0	94,668,409,472
Total	0.00	0	2,250,516,334,976

**Test Duration**

	Duration
Total Duration	00:00:26
Error Duration	00:00:00
Error Free Duration	00:00:26

**Frames Statistics**

	Rx
Test Frames	193,210,537
Non Test Frames	0

# Port Statistics

Devices Ports **BERT** Load Save

Summary Configuration **Statistics** Graph All Ports Statistics Event Log

BERT Statistics ● No Alarms

BERT Results Port Statistics ⚙️

Port2 Reset

**Common Statistics**

Description	Tx	Rx
Link Utilization (%)	100.000	100.000
Data Rate (Mbps)	98,699.607	98,699.607
Bad Frames	0	0
Non Test Frames	-	0
FCS Error Frames	-	0
IP Checksum Errors	-	0
UDP Checksum Errors	-	0
Total Frames	697,248,872	697,270,267
Valid Frames	697,248,872	697,270,267
Number Of Bytes	1,058,423,787,696	1,058,456,265,306
Frame Rate (frames/sec)	8,127,438	8,127,438

**VLAN Statistics**

Description	Rx
1 Level Stacked VLAN Frames	0
2 Level Stacked VLAN Frames	0
3 Level Stacked VLAN Frames	0

**MPLS Statistics**

Description	
1 Level Stacked MPLS Frames	
2 Level Stacked MPLS Frames	
3 Level Stacked MPLS Frames	

**Packet Type Statistics**

Description	Tx	Rx
Broadcast Frames	0	0
Multicast Frames	0	0
Control Frames	0	0
VLAN Frames	0	0
Pause Frames	0	0

**Length Statistics**

Description	Tx	Rx
Undersized Frames	0	0
64 Bytes Length	0	0
65-127 Byte Length	0	0
128-255 Byte Length	0	0
256-511 Bytes Length	0	0
512-1023 Bytes Length	0	0
1024-1518 Byte Length	1,331,189,054	1,331,210,449
Oversized Frames	0	0

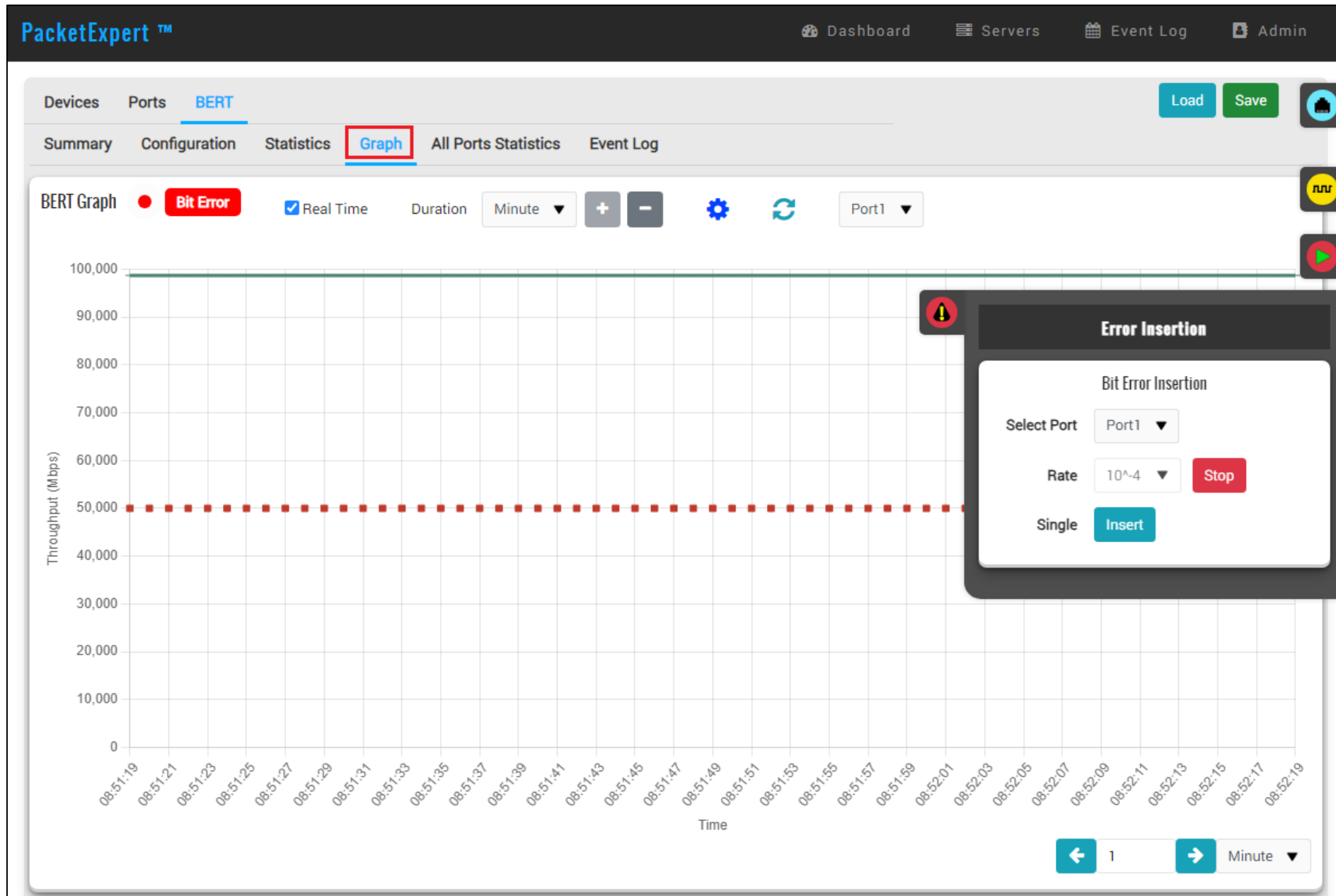
**IP Statistics**

Description	Rx
IP Checksum Errors	0
IPv4 Packets	1,331,210,447
IPv6 Packets	0
TCP Packets	0
ICMP Packets	0
IGMP Packets	0
IGRP Packets	0
Other Protocol IP Packets	0

**UDP Statistics**

Description	Rx
UDP Checksum Errors	0
UDP Packets	1,331,210,447

# BERT Graph with Bit Error Insertion



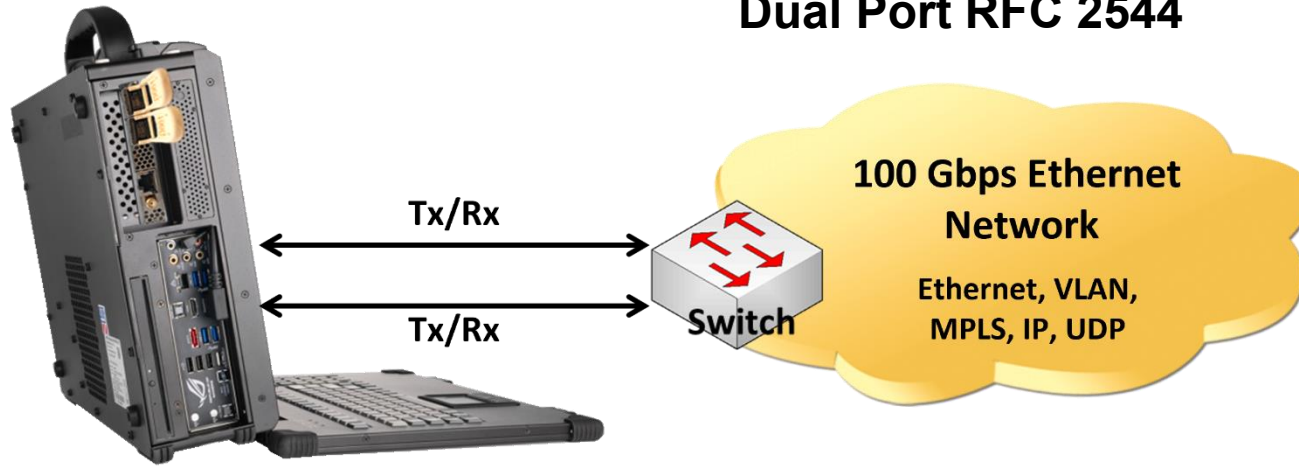
# RFC2544 Testing

# Benchmarking and Evaluating Network Device Performance

- Performance benchmarking
- Understanding the device capacity & limitations
- Ensuring the Quality of Service (QoS)
- Network capacity planning & upgrades
- Evaluating the reliability and robustness of the device
- Vendor Comparisons and SLA Verification
- Troubleshooting and Maintenance

# RFC 2544 Testing

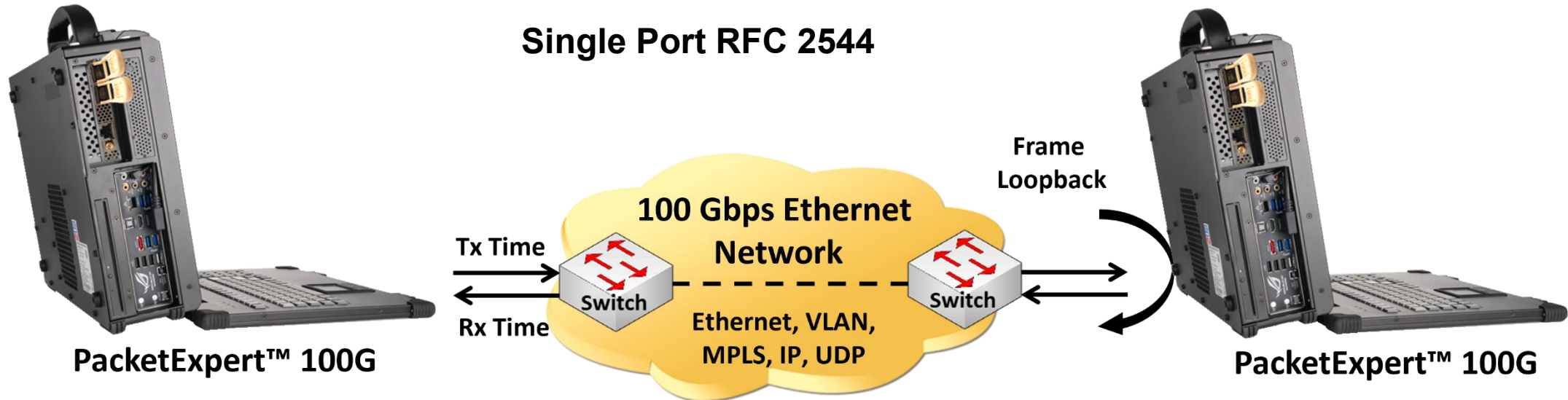
## Dual Port RFC 2544



PacketExpert™ 100G

- Performs Throughput, Latency, Frame Loss and Back-to-Back tests at 1G, 10G, 25G and 100G link speed with web-based user interface

## Single Port RFC 2544



PacketExpert™ 100G

PacketExpert™ 100G

(Latency = Rx Time – Tx Time)



# RFC 2544 Features

- RFC 2544 can be tested on Ethernet, VLAN, MPLS, IPv4 / IPv6 and UDP layers
- Supports Throughput, Latency, Frame Loss, and Back-to-Back performance tests
- Uni-directional and bi-directional RFC 2544 testing supported
- User-defined configuration parameters such as frame size, trial duration, number of trials, etc.
- User selectable single or dual ports RFC 2544 testing
- Multi-device support for multiple parallel RFC 2544 tests
- Graphs and Statistics for all the RFC 2544 tests

# RFC 2544 Configuration Summary

PacketExpert™

Dashboard Servers Event Log Admin

Devices Ports **RFC 2544** Load Save

Summary **RFC 2544 Configuration** Port Configuration Results Port Statistics Event Log

RFC 2544 Configuration ● Idle

Port1

**Summary** Global Configuration Test Configuration

Direction: East To East  
Framesizes: [64, 128, 256, 512, 1024, 1280, 1518]

Throughput: ✓

Description	Value
Trial Duration (sec)	10
Number Of Trials	1
Acceptable Frame Loss	0
Resolution (%)	2.5
<b>Bandwidth (%)</b>	<b>East ↻</b>
Min	10
Max	100

Latency: ✓

Description	Value
Trial Duration (sec)	10
Number Of Trials	1
<b>Description</b>	<b>East ↻</b>
Bandwidth (%)	100
Use Throughput Value	Enabled

FrameLoss: ✓

Description	Value
Trial Duration (sec)	10
Number Of Trials	1
<b>Rate (%)</b>	<b>East ↻</b>
Start	100
End	10
Step Size	10

BackToBack: ✓

Description	Value
Number Of Trials	1
Acceptable Frame Loss (%)	0
Resolution (frames)	1
<b>Burst Size (sec)</b>	<b>East ↻</b>
Min	2
Max	10

# RFC 2544 Port Configuration Summary

PacketExpert™

Dashboard Servers Event Log Admin

Devices Ports **RFC 2544** Load Save

Summary RFC 2544 Configuration **Port Configuration** Results Port Statistics Event Log

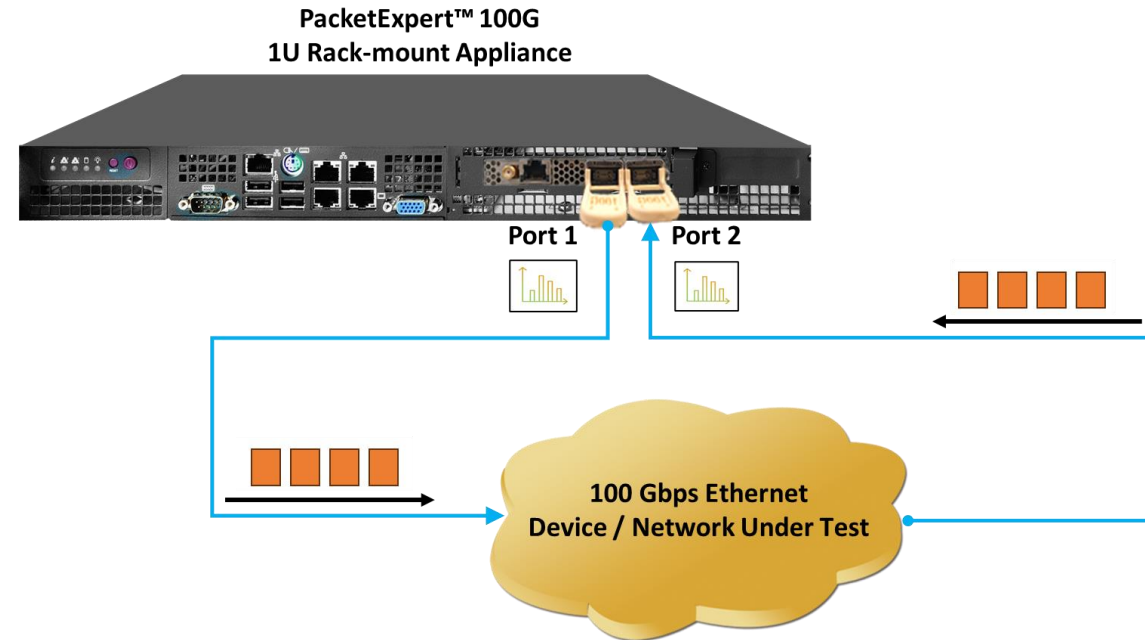
RFC 2544 Port Configuration ● Idle Select Port Port1-Port2 ☒ Symmetrical

Summary Layer MAC VLAN MPLS IP UDP Payload

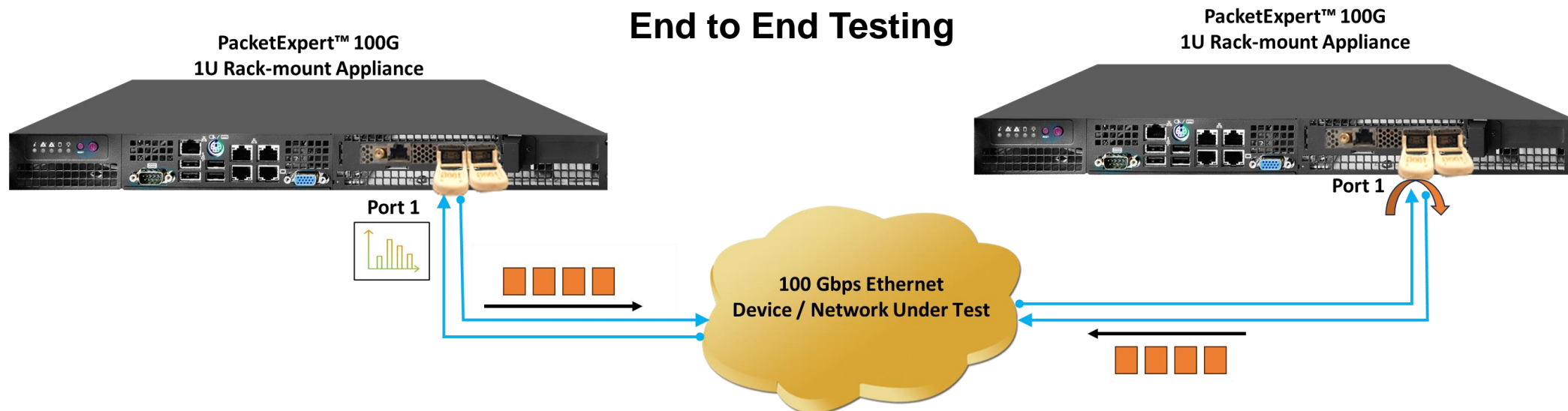
Description	East <=> West
<b>Layer</b>	
<b>MAC</b>	
Source MAC Address	00-0D-E9-08-D2-EB (HW MAC Address)
Destination MAC Address	00-0D-E9-08-D2-EC
Len/Type	88-47
<b>VLAN</b>	
Enabled	
VLAN #1 Type	81-00
VLAN #1 Id	0
VLAN #1 Priority	0
VLAN #2 Type	88-A8
VLAN #2 Id	0
VLAN #2 Priority	0
VLAN #3 Type	91-00
VLAN #3 Id	0
VLAN #3 Priority	0
<b>MPLS</b>	
Enabled	
MPLS #1 Label	111111
MPLS #1 CoS	1
MPLS #1 TTL	128
MPLS #2 Label	222222
MPLS #2 CoS	1
MPLS #2 TTL	128
MPLS #3 Label	333333
MPLS #3 CoS	1
MPLS #3 TTL	128
<b>IP</b>	
IP Selection	IPv4
Source IP Address	192.168.1.11
Destination IP Address	192.168.1.12
Default Gateway	192.168.1.1
Subnet Mask	255.255.255.0
TTL	128
ToS/DS	0
Protocol	17
Header Checksum	Auto
Identification	Auto
<b>UDP</b>	
Source UDP	1001
Destination UDP	1002
Checksum	Auto
<b>Payload</b>	
Payload	1234

# RFC 2544 Throughput Test Setup

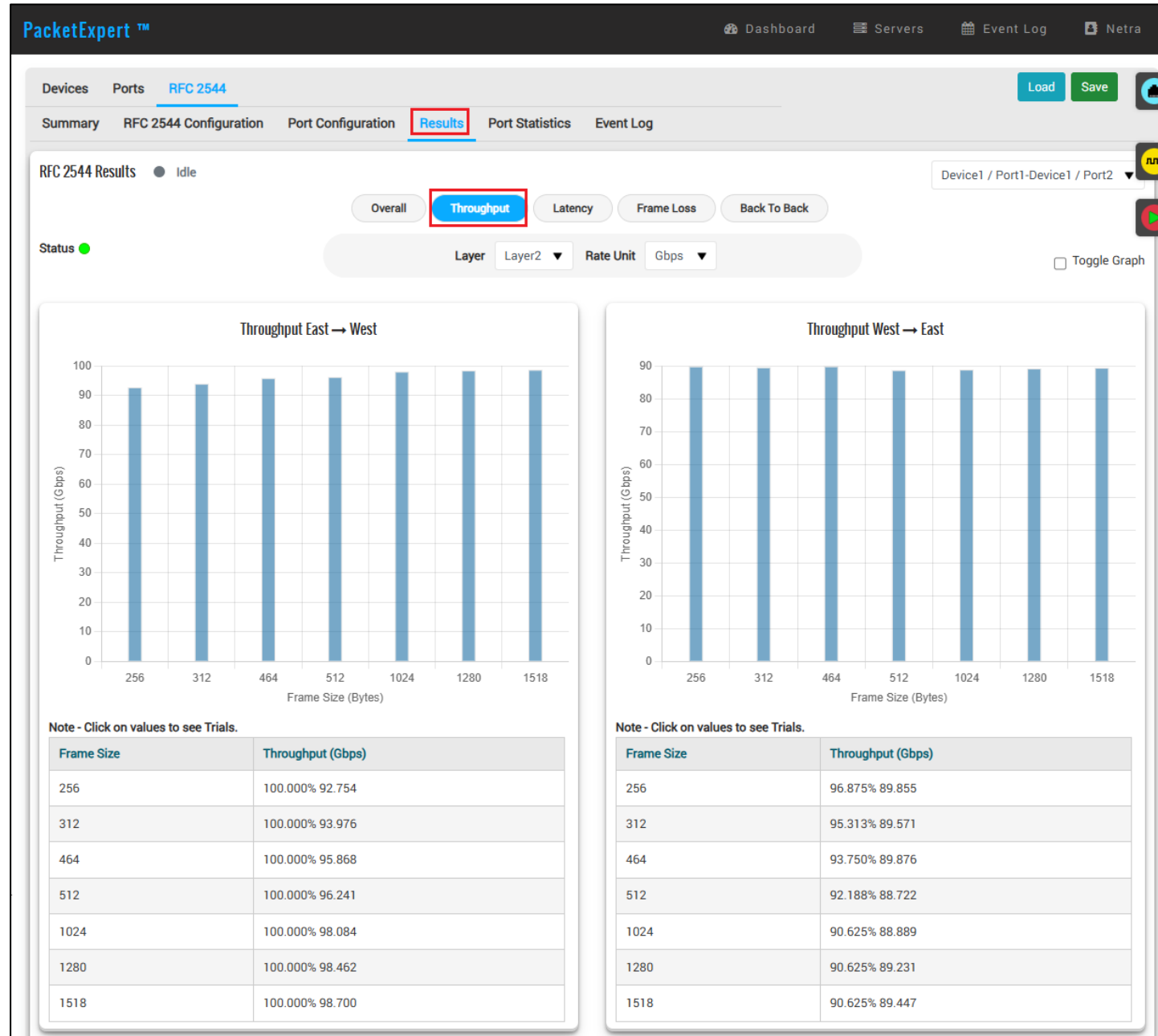
## Loopback Testing



## End to End Testing

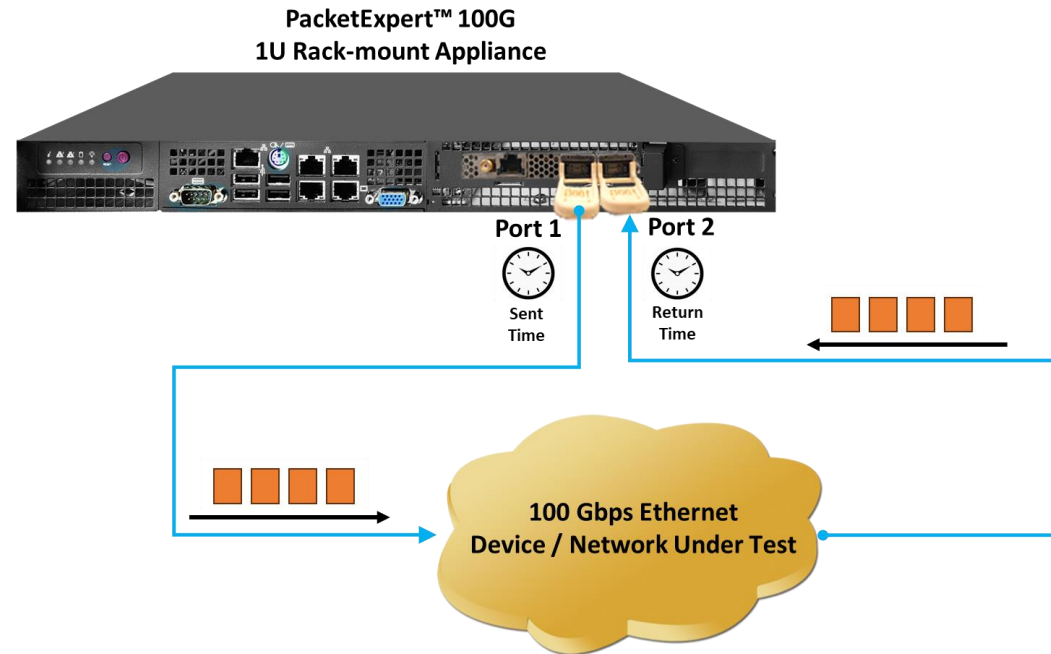


# RFC 2544 Results - Throughput

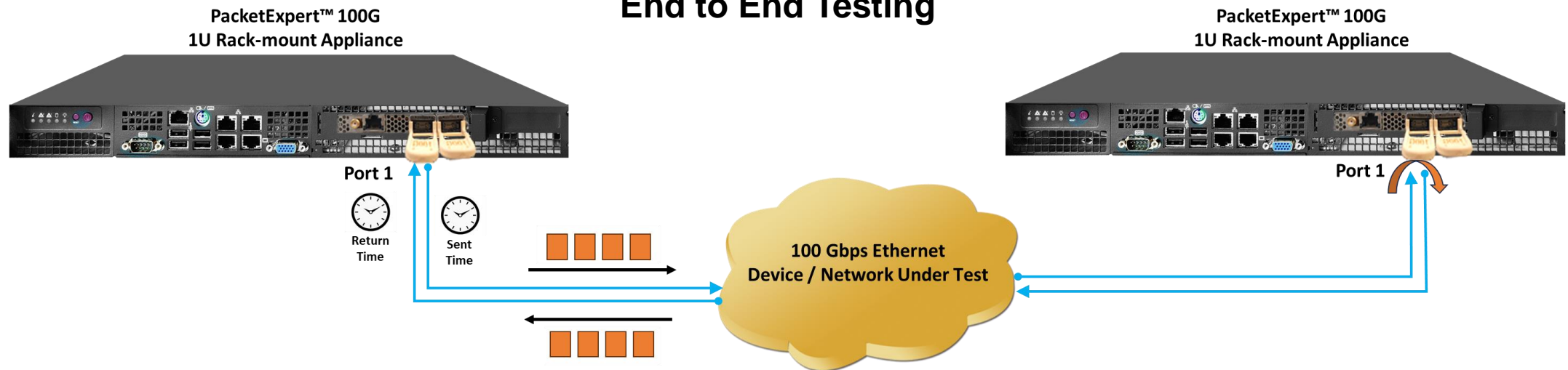


# RFC 2544 Latency Test Setup

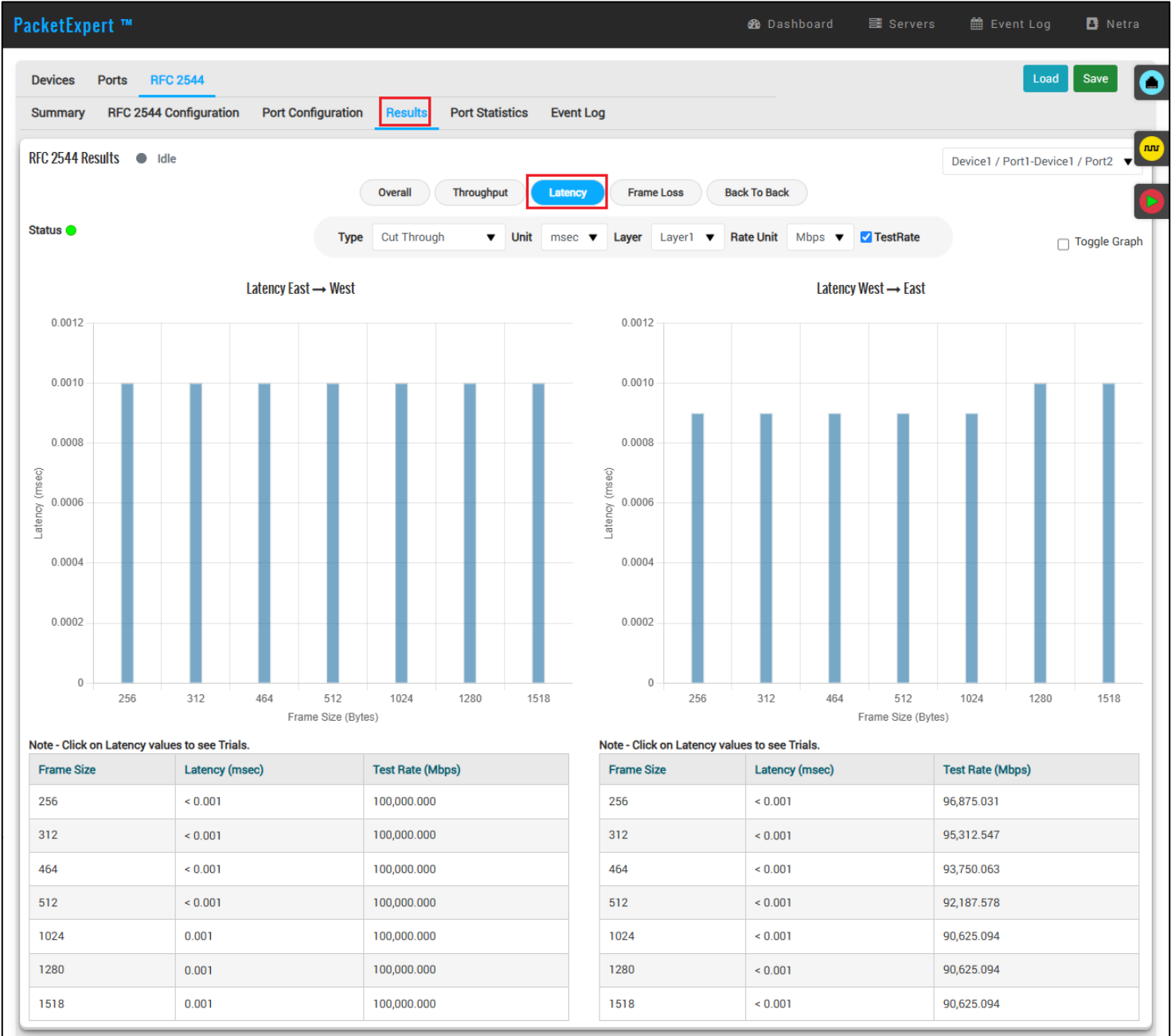
## Loopback Testing



## End to End Testing



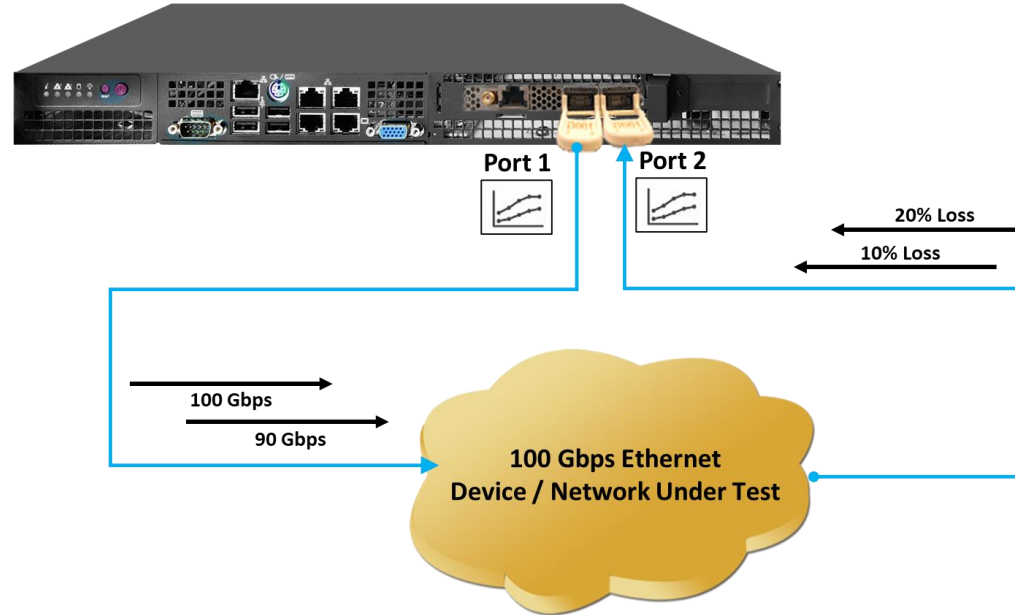
# RFC 2544 Results - Latency



# RFC 2544 Frame Loss Test Setup

## Loopback Testing

PacketExpert™ 100G  
1U Rack-mount Appliance

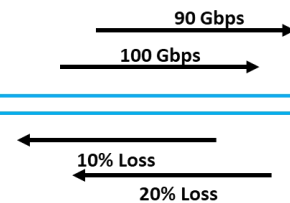


## End to End Testing

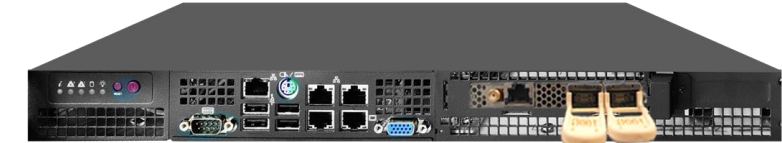
PacketExpert™ 100G  
1U Rack-mount Appliance



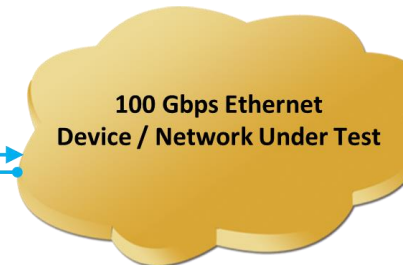
Port 1



PacketExpert™ 100G  
1U Rack-mount Appliance

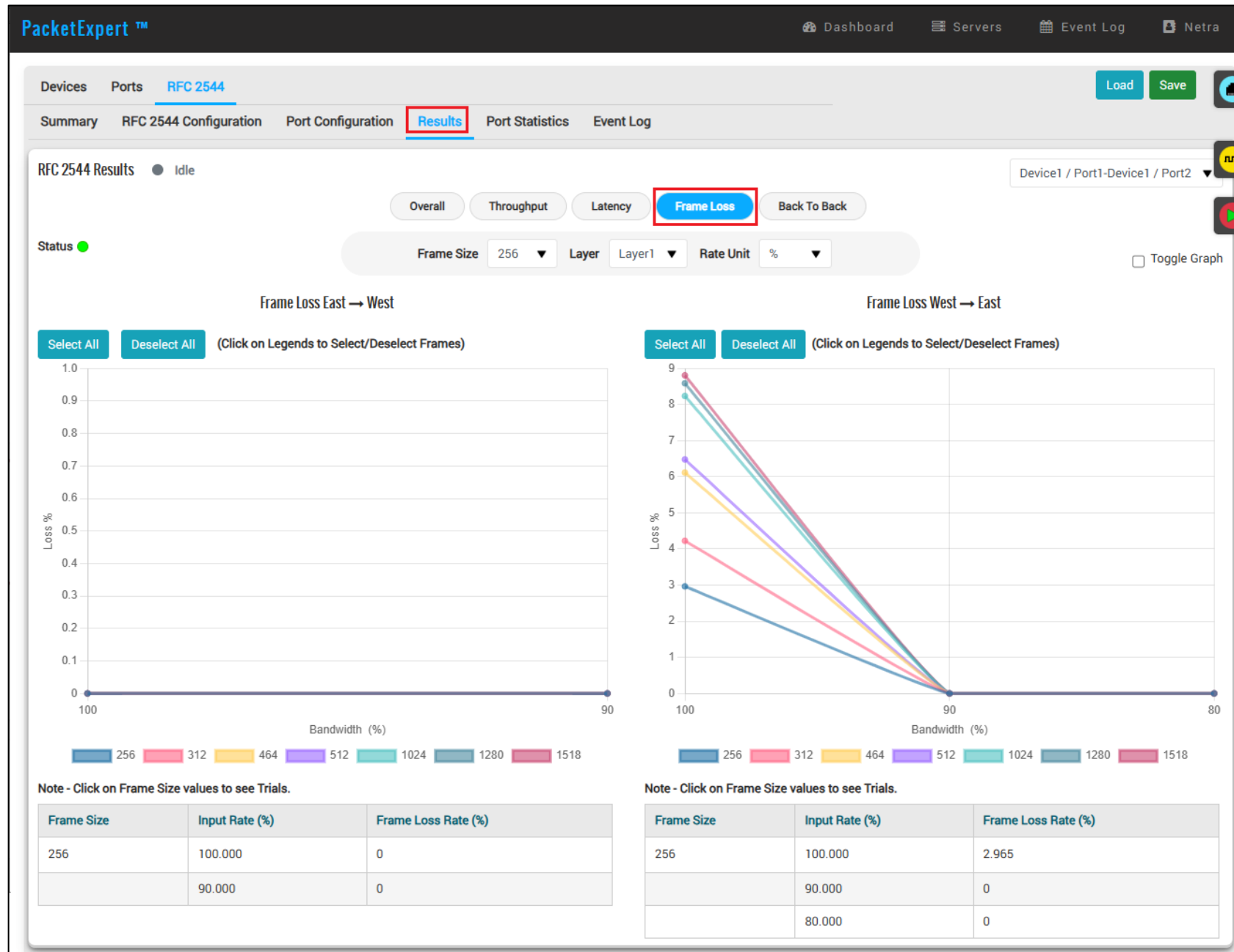


Port 1



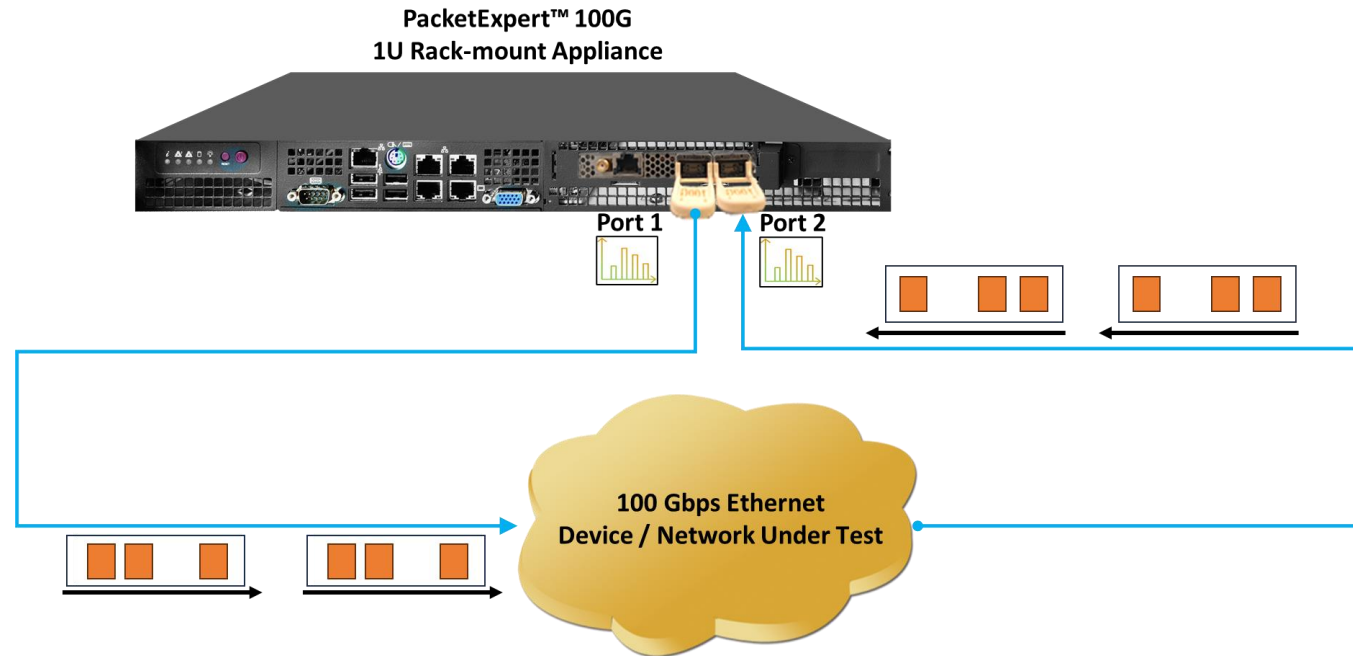


# RFC 2544 Results - Frame Loss

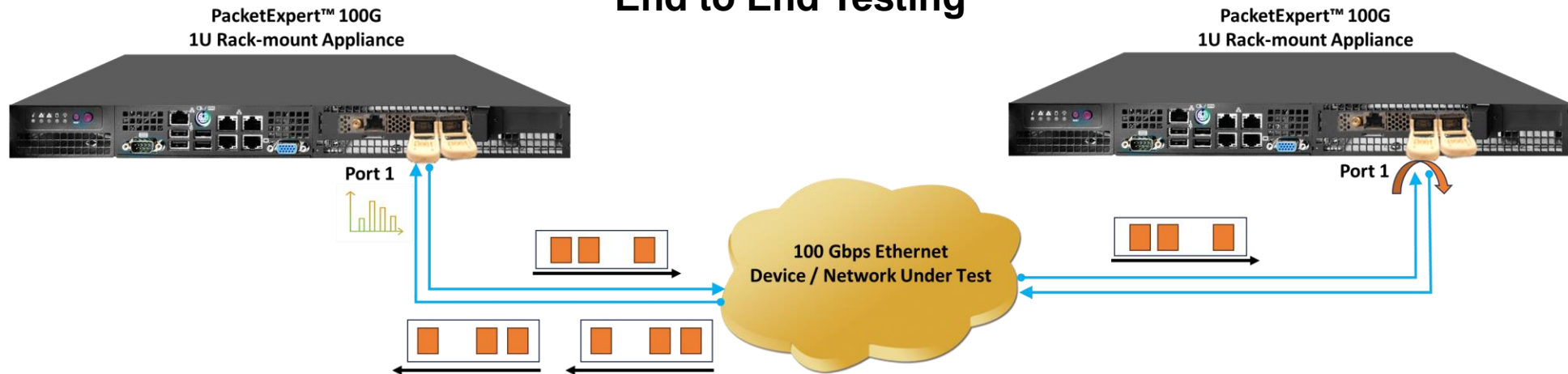


# RFC 2544 Back-to-Back Test Setup

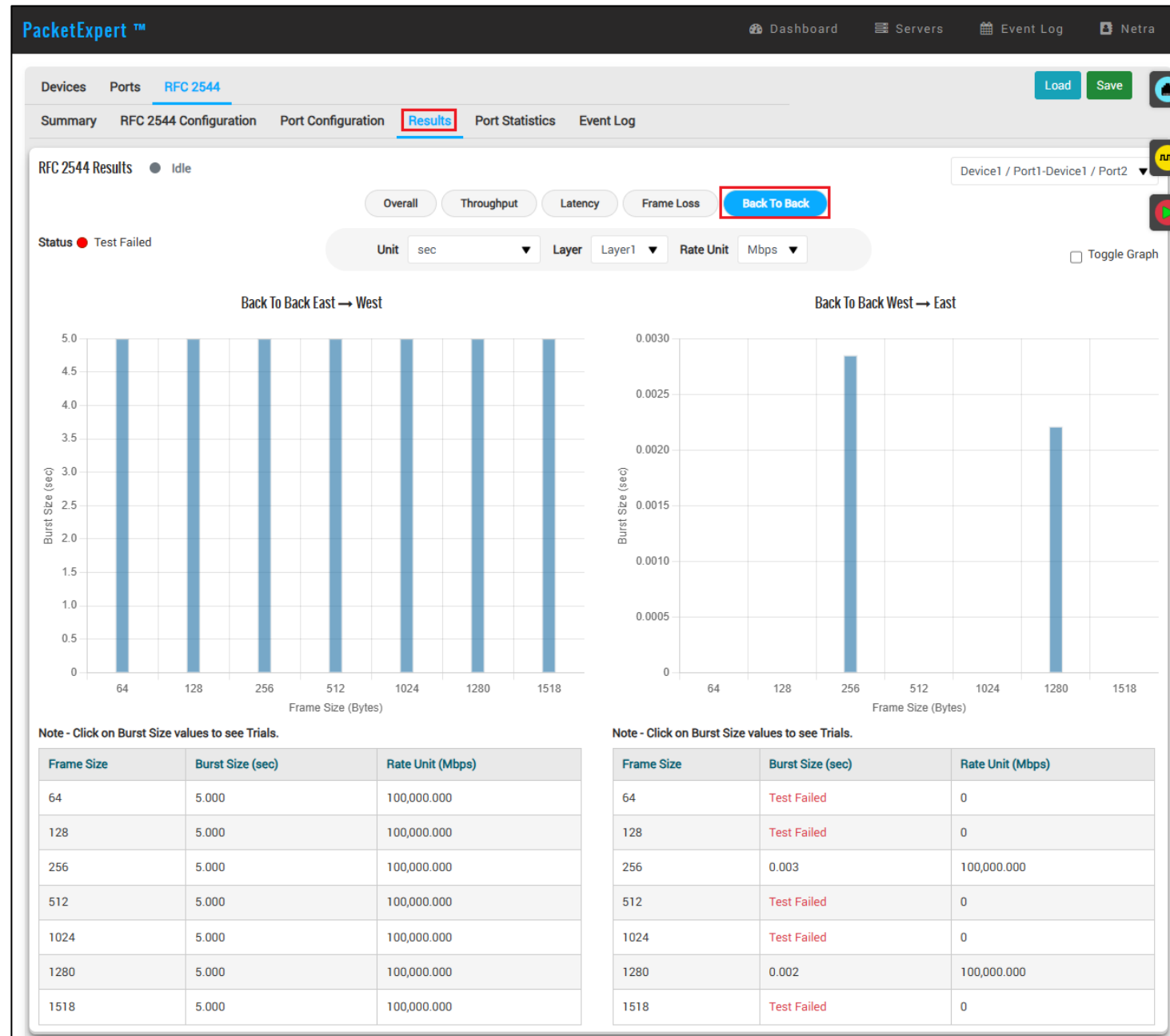
## Loopback Testing



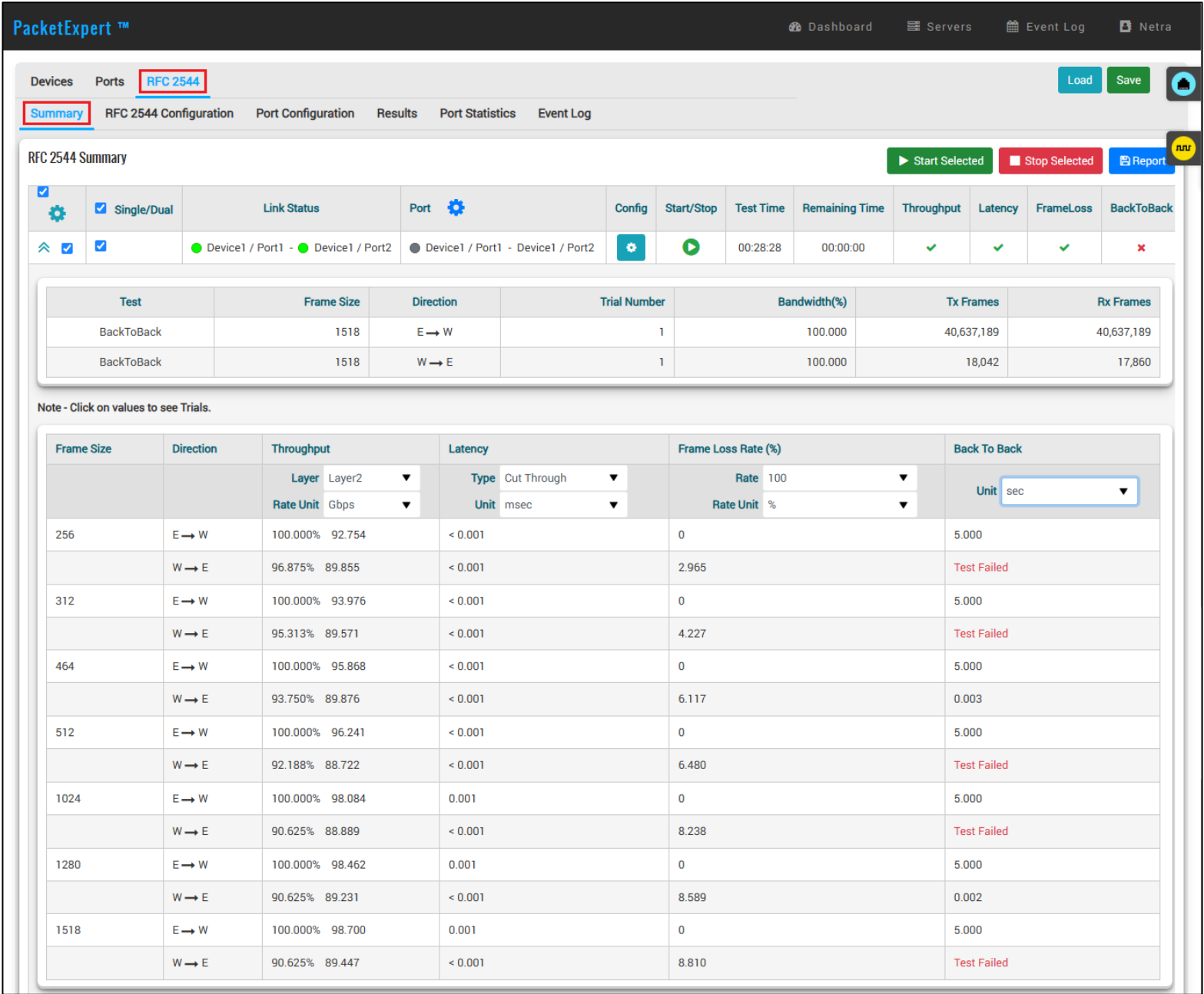
## End to End Testing



# RFC 2544 Results: Back-to-Back



# RFC 2544 Result Summary



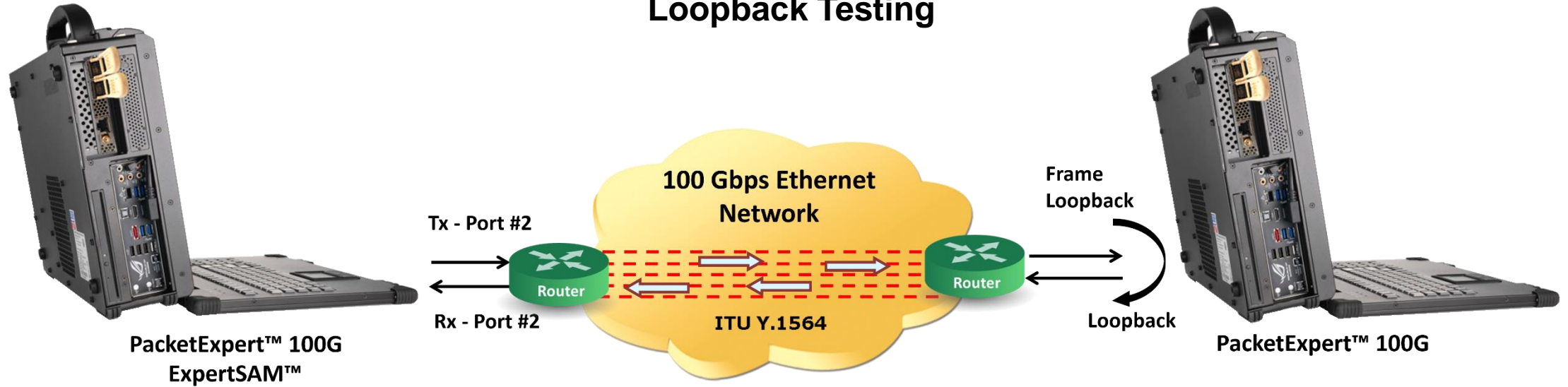
# Y.1564 (ExpertSAM™)

# Addressing Network Challenges with Y.1564 (ExpertSAM™)

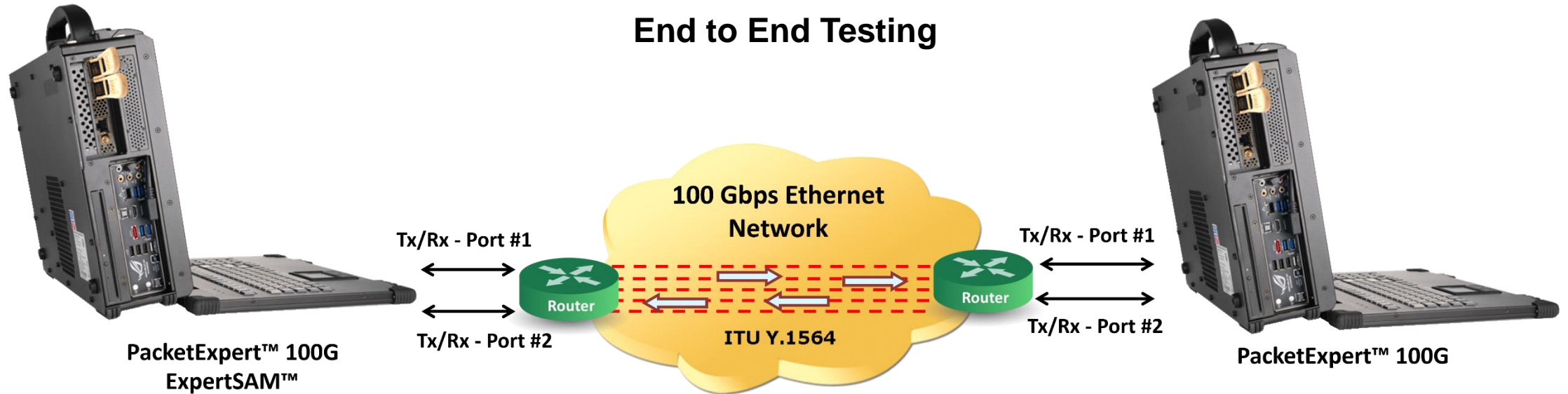
- Service Activation Verification
- Performance Measurement
- Service-Level Agreement (SLA) Conformance
- Multiple Service/stream Simultaneity
- Configuration Testing
- Network Troubleshooting and Optimization
- End-to-End Service Testing

# Ethernet Network Testing

## Loopback Testing



## End to End Testing



# Y.1564 Features

- Complete validation of Ethernet Service-Level Agreements (SLAs) in a single test
- Supports Service Configuration and Service Performance tests in compliance with ITU-T Y.1564 standard
- Capability to generate traffic at throughput of CIR (guaranteed traffic), EIR (best effort bandwidth) and Traffic Policing rates (dropped bandwidth) ensuring Key performance indicators (KPI) validation
- Color Aware mode supported – generates Green/Yellow color marked traffic at the configured rates and provides Green and Yellow measurements separately. VLAN PCP, IP TOS and IP DSCP color marking supported
- Stacked VLAN supported – C-Tag (Customer Tag) and S-Tag (Service Tag) to simulate Carrier Ethernet traffic
- Simultaneous validation of all the services for quality over the time



# Service Configuration Summary

PacketExpert™

DashboardServersEvent LogAdmin

DevicesPortsExpertSAM

SummaryService ConfigurationService SelectionTest ConfigurationService Configuration ResultsService Performance ResultsGraphsPort Statistics

All Port StatisticsEvent Log

Service Configuration

Y.1564 Specific

SAM1

Summary

Frame Size

Layer

MAC

VLAN

MPLS

IP

UDP

Payload

Bandwidth Profile

Color Aware

SLA Parameters

#	Name	
1	Svc1	
2	Svc2	
3	Svc3	
4	Svc4	
5	Svc5	
6	Svc6	
7	Svc7	
8	Svc8	
9	Svc9	
10	Svc10	
11	Svc11	
12	Svc12	
13	Svc13	
14	Svc14	
15	Svc15	
16	Svc16	

Svc1 Configuration

Description

Left <--> Right

Frame Size

Type: Fixed [100]

Layer

UDP

MAC

Source MAC Address

00-0D-E9-08-D2-EB (HW MAC Address)

Destination MAC Address

00-0D-E9-08-D2-EC

Len/Type

88-47

VLAN

Enabled

C-Tag Type

81-00

C-Tag Id

0

C-Tag Priority

0

S-Tag

Enabled

S-Tag Type

88-A8

S-Tag Id

0

S-Tag Priority

0

MPLS

Enabled

MPLS #1 Label

111111

MPLS #1 CoS

1

MPLS #1 TTL

128

MPLS #2 Label

222222

MPLS #2 CoS

1

MPLS #2 TTL

128

MPLS #3 Label

333333

MPLS #3 CoS

1

MPLS #3 TTL

128

IP

IP Selection

IPv4

Source IP Address

192.168.1.11

Destination IP Address

192.168.1.22

Default Gateway

192.168.1.1

Subnet Mask

255.255.255.0

TTL

128

ToS/DS

0

Protocol

17

Header Checksum

Auto

Identification

Auto

UDP

Source UDP

1001

Destination UDP

1002

Checksum

Auto

Payload

Payload

AB-CD

Bandwidth Profile

CIR

5 %

EIR

10 %

Traffic Policing Rate

20 %

Color Aware

Color Aware Enable

Disabled

SLA Parameters

Frame Loss

10 %

Frame Transfer Delay

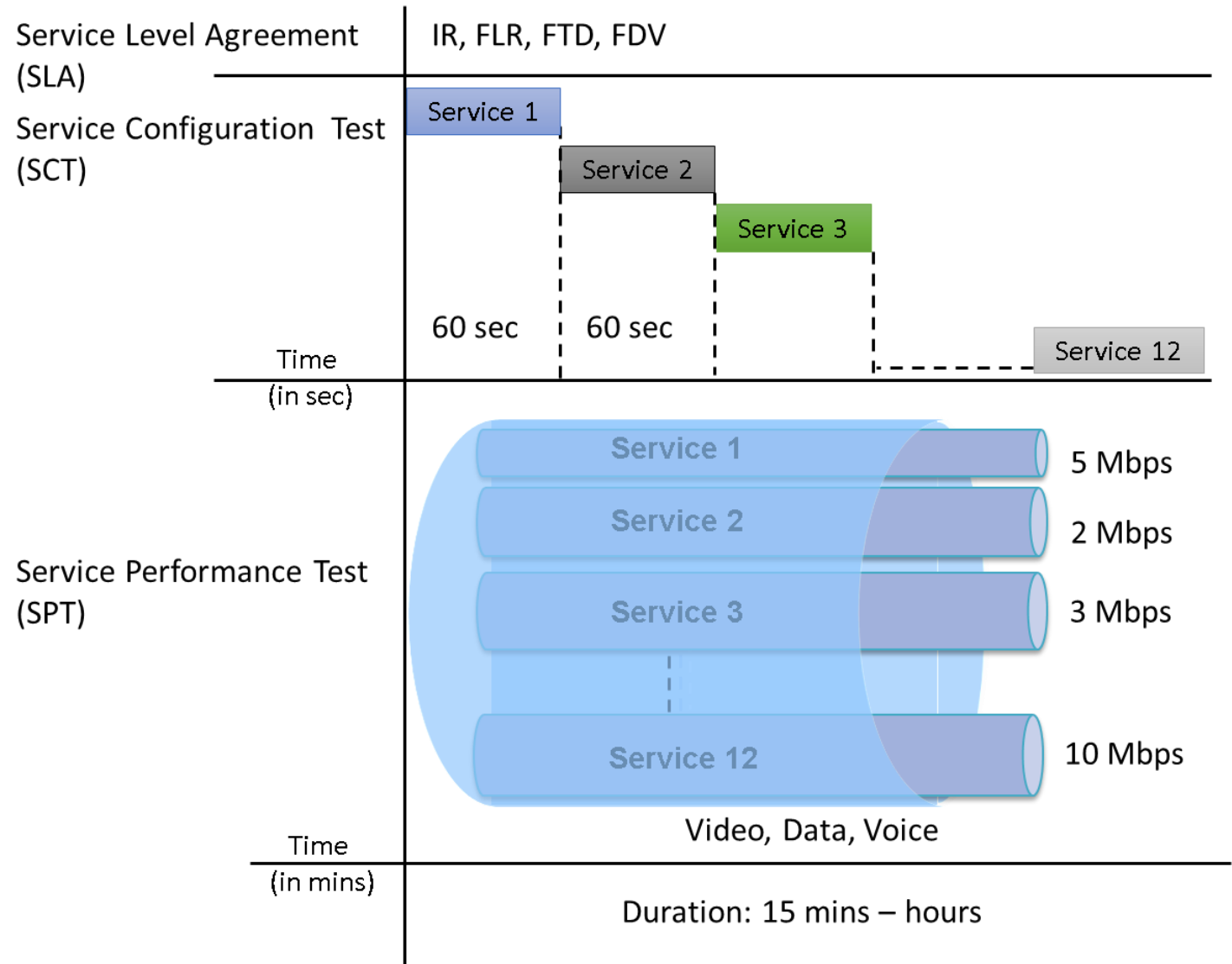
12 msec

Frame Delay Variation

12 usec

# Test Configuration

- **Service Configuration Test** - confirms the end-to-end configuration with the SLA parameters for all configured traffic streams
- **Service Performance Test** - transmits all configured traffic streams simultaneously at the committed information rate (CIR), confirming all traffic is able to transverse the network under full load with the above-mentioned parameters



# Test Configuration (Contd.)

PacketExpert™

Dashboard Servers Event Log Admin

Devices Ports ExpertSAM Load Save

Summary Service Configuration Service Selection **Test Configuration** Service Configuration Results Service Performance Results Graphs Port Statistics

All Port Statistics Event Log

### Test Configuration

← → SAM1 ▶

☒ Service Config Test

**CIR Configuration Test**

☐ Simple CIR ☒ Step Load CIR

☒ EIR Configuration Test

☐ Traffic Policing Test

Step Duration  (5-60 sec)

**Steps**

+	Step	Rate (% of CIR) (1-100)	⬇	⬆
	1	<input type="text" value="5"/>	⬇	⬆
	2	<input type="text" value="10"/>	⬇	⬆
	3	<input type="text" value="15"/>	⬇	⬆
	4	<input type="text" value="20"/>	⬇	⬆
	5	<input type="text" value="25"/>	⬇	⬆
	6	<input type="text" value="30"/>	⬇	⬆
	7	<input type="text" value="35"/>	⬇	⬆
	8	<input type="text" value="CIR"/>		
	9	<input type="text" value="EIR"/>		

**Graph**

Seconds

Steps CIR EIR

**Service Performance Test**

Duration

# Service Configuration Results

PacketExpert™

Dashboard

Servers

Event Log

Admin

Devices

Ports

ExpertSAM

Load

Save

Summary

Service Configuration

Service Selection

Test Configuration

Service Configuration Results

Service Performance Results

Graphs

Port Statistics

All Port Statistics

Event Log

Overview

Details

Y.1564 Specific

SAM1

Service

Svc1

Test Time : 00:01:18

IR

Gbps

FTD Unit

usec

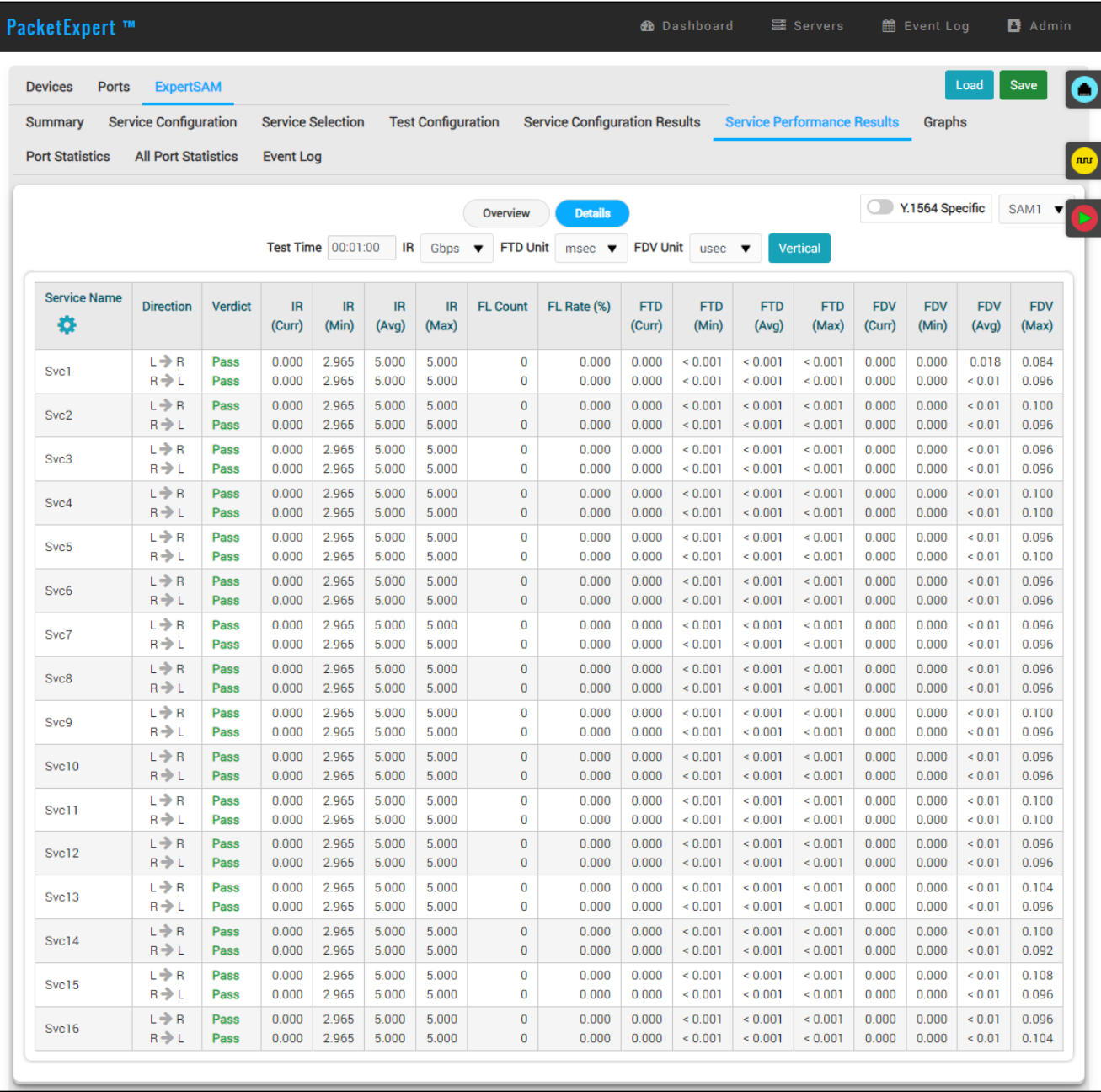
FDV Unit

usec

Vertical

Test	Direction	Verdict	Tx Frames	Rx Frames	Tx Bytes	Rx Bytes	IR (Curr)	IR (Min)	IR (Avg)	IR (Max)	FL Count	FL Rate(%)	FTD (Curr)	FTD (Min)	FTD (Avg)	FTD (Max)	FDV (Curr)	FDV (Min)	FDV (Avg)	FDV (Max)
Step1	L → R	Pass	3,142,002	3,142,002	314,200,200	314,200,200	0.000	0.002	0.282	0.500	0	0.000	0.000	0.396	0.400	0.416	0.000	0.000	< 0.01	0.020
	R → L	Pass	3,133,776	3,133,776	313,377,600	313,377,600	0.000	0.014	0.281	0.500	0	0.000	0.000	0.388	0.321	0.408	0.000	0.000	< 0.01	0.020
Step2	L → R	Pass	9,391,221	9,391,221	939,122,100	939,122,100	0.000	0.082	0.596	1.000	0	0.000	0.000	0.396	0.400	0.416	0.000	0.000	< 0.01	0.020
	R → L	Pass	9,610,832	9,610,832	961,083,200	961,083,200	0.000	0.082	0.647	1.000	0	0.000	0.000	0.388	0.392	0.408	0.000	0.000	< 0.01	0.020
Step3	L → R	Pass	18,790,380	18,790,380	1,879,038,000	1,879,038,000	0.000	0.194	0.896	1.500	0	0.000	0.000	0.396	0.400	0.416	0.000	0.000	< 0.01	0.020
	R → L	Pass	19,010,010	19,010,010	1,901,001,000	1,901,001,000	0.000	0.194	0.896	1.500	0	0.000	0.000	0.388	0.392	0.408	0.000	0.000	< 0.01	0.020
Step4	L → R	Pass	31,353,449	31,353,449	3,135,344,900	3,135,344,900	0.000	0.292	1.197	2.000	0	0.000	0.000	0.396	0.400	0.416	0.000	0.000	< 0.01	0.020
	R → L	Pass	31,573,044	31,573,044	3,157,304,400	3,157,304,400	0.000	0.291	1.197	2.000	0	0.000	0.000	0.388	0.392	0.408	0.000	0.000	< 0.01	0.020
Step5	L → R	Pass	47,015,575	47,015,575	4,701,557,500	4,701,557,500	0.000	0.386	1.492	2.500	0	0.000	0.000	0.396	0.400	0.416	0.000	0.000	< 0.01	0.020
	R → L	Pass	47,235,055	47,235,055	4,723,505,500	4,723,505,500	0.000	0.386	1.492	2.500	0	0.000	0.000	0.388	0.392	0.408	0.000	0.000	< 0.01	0.020
Step6	L → R	Pass	65,862,514	65,862,514	6,586,251,400	6,586,251,400	0.000	0.200	1.801	3.000	0	0.000	0.000	0.396	0.400	0.416	0.000	0.000	< 0.01	0.020
	R → L	Pass	66,082,040	66,082,040	6,608,204,000	6,608,204,000	0.000	0.200	1.801	3.000	0	0.000	0.000	0.388	0.392	0.408	0.000	0.000	< 0.01	0.020
Step7	L → R	Pass	87,850,190	87,850,190	8,785,019,000	8,785,019,000	0.000	0.234	2.101	3.500	0	0.000	0.000	0.396	0.400	0.416	0.000	0.000	< 0.01	0.020
	R → L	Pass	88,070,495	88,070,495	8,807,049,500	8,807,049,500	0.000	0.234	2.101	3.500	0	0.000	0.000	0.388	0.392	0.408	0.000	0.000	< 0.01	0.020
CIIR	L → R	Pass	119,259,273	119,259,273	11,925,927,300	11,925,927,300	0.000	0.332	3.001	5.000	0	0.000	0.000	0.396	0.400	0.416	0.000	0.000	< 0.01	0.020
	R → L	Pass	119,479,812	119,479,812	11,947,981,200	11,947,981,200	0.000	0.332	3.001	5.000	0	0.000	0.000	0.388	0.392	0.408	0.000	0.000	< 0.01	0.020
EIR	L → R	Pass	182,079,074	182,079,074	18,207,907,400	18,207,907,400	0.000	0.668	6.003	10.000	0	0.000	0.000	0.396	0.400	0.416	0.000	0.000	< 0.01	0.020
	R → L	Pass	182,298,699	182,298,699	18,229,869,900	18,229,869,900	0.000	0.667	6.002	10.000	0	0.000	0.000	0.388	0.392	0.408	0.000	0.000	< 0.01	0.020
Traffic Policing	L → R	Fail	308,367,406	308,367,406	30,836,740,600	30,836,740,600	0.000	1.332	12.077	20.000	0	0.000	0.000	0.396	0.257	0.416	0.000	0.000	< 0.01	0.020
	R → L	Fail	308,590,834	308,590,834	30,859,083,400	30,859,083,400	0.000	1.335	12.078	20.000	0	0.000	0.000	0.388	0.248	0.408	0.000	0.000	< 0.01	0.020

# Service Performance Results



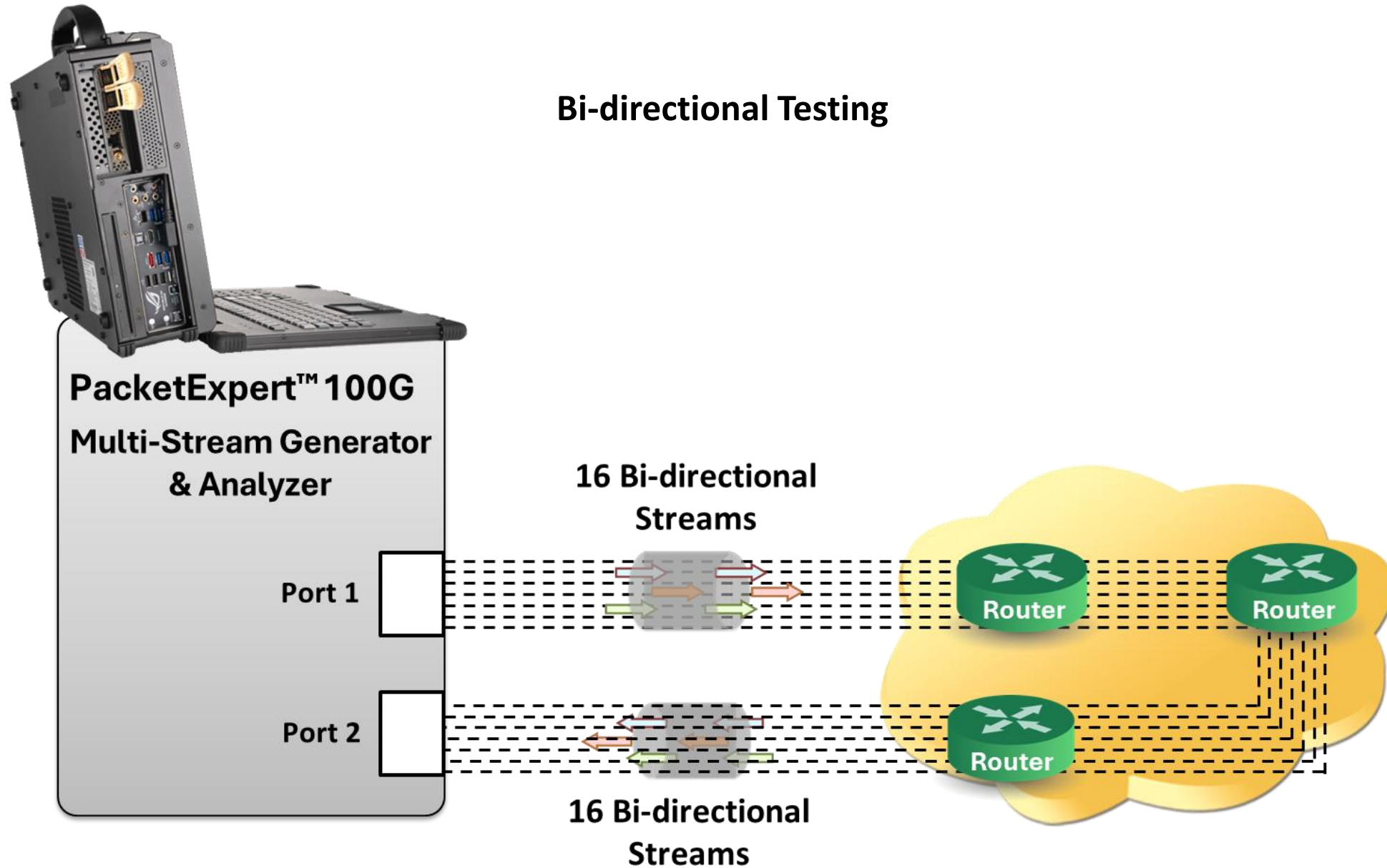
# Multi Stream Traffic Generator and Analyzer (MTGA)

# Enhancing Network Testing with Multi-Stream Traffic Generation

- Simultaneous Multi-Stream Testing
- Simplified Traffic Testing – Eliminates service configuration and performance test, color aware complexities
- Real-Time Performance Metrics – Measures all key Y.1564 (ExpertSAM) parameters (latency, frame loss, jitter, throughput)
- End-to-End Network Validation
- SLA Compliance Verification

# Multi Stream Traffic Generator and Analyzer

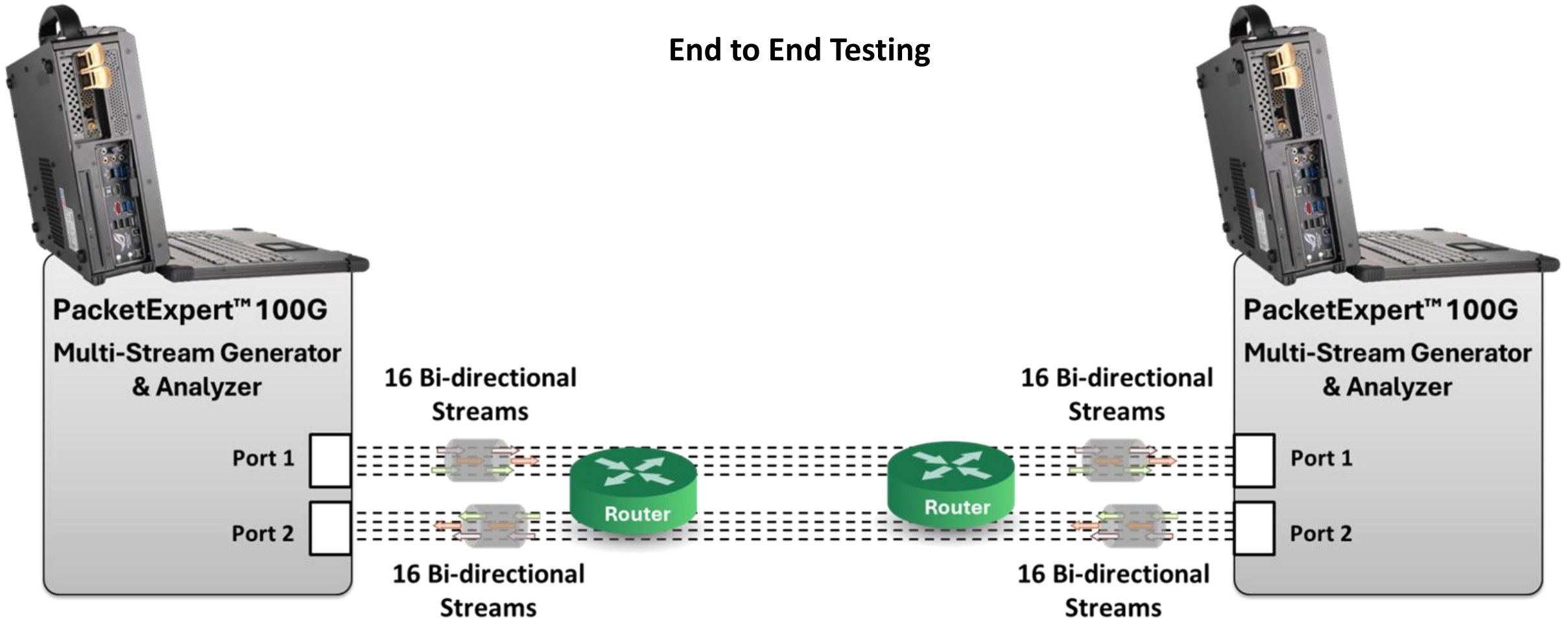
## Bi-directional Testing





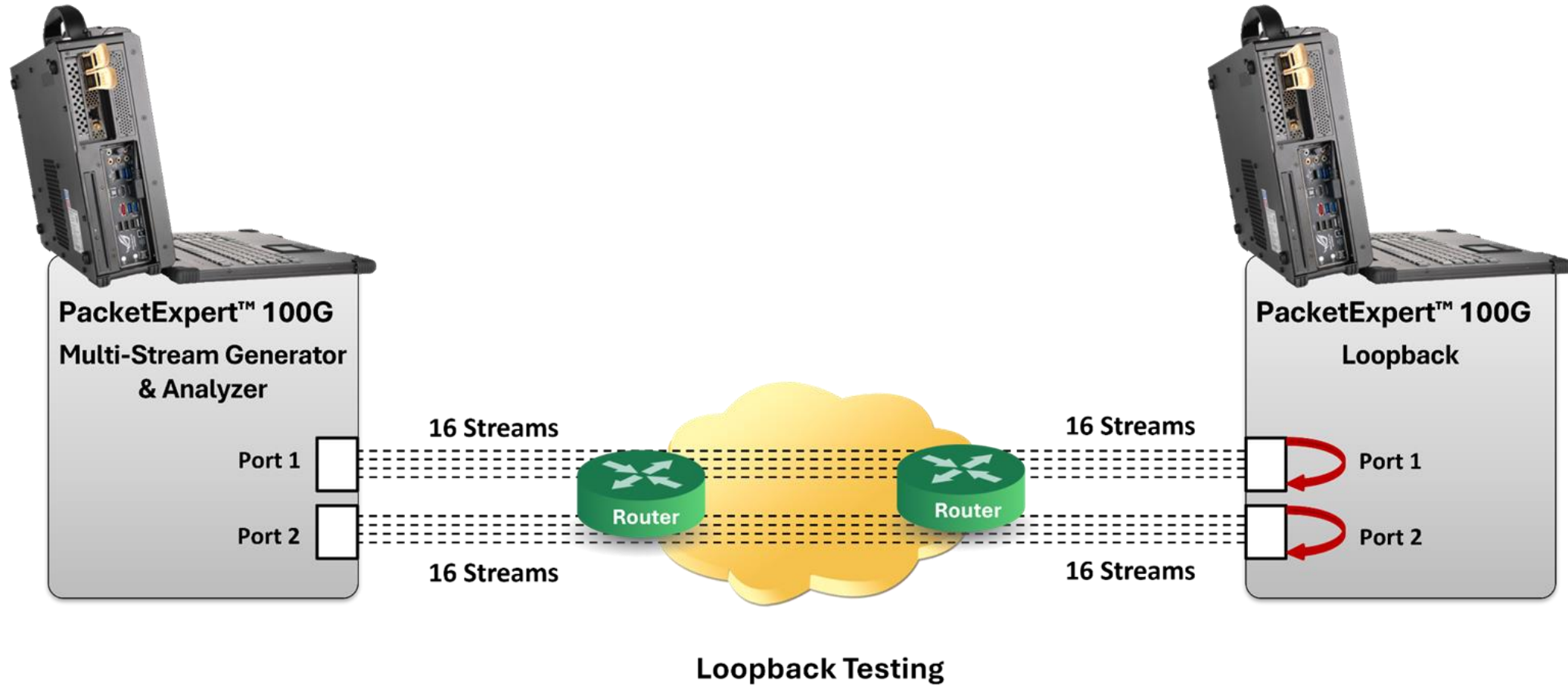
# Multi Stream Traffic Generator and Analyzer

End to End Testing



# Multi Stream Traffic Generator and Analyzer

## Loopback Testing



# Main Feature

- Generates traffic from Layer 2 to Layer 4 at up to 100 Gbps with varying protocol headers and packet sizesLatency/Frame Transfer Delay (FTD)
- Provides packet loss, round trip delay and jitter measurements for each stream. Provides graphs for all streams
- Supports multiple streams with customizable configurations, including MAC/VLAN/IP/UDP headers, rate, and frame size, allowing prioritization of different traffic types (e.g., voice, video, data)
- Supports up to 16 streams per port
- Accommodates frame lengths ranging from 64 bytes to 16,000 bytes (Jumbo frames)
- Each stream can include a mixture of different frames sizes (up to 5)
- Emulate Carrier Ethernet traffic with stacked VLANs (C-Tag and S-Tag)
- Real-time statistics of throughput, packet loss, round-trip delay, and jitter across multiple streams
- Real-time graphs of all statistics mentioned above, for each stream
- Comprehensive statistics for individual streams
- Delivers per-port frame statistics such as Total Frames and Bytes Received, Rx Frame Rate, and Rx Data Rate

# Stream Configuration Summary

- The stream configuration summary offers a quick view of all current settings
- Each stream can be customized with attributes such as frame size, header parameters (including VLAN tag details), IP and UDP layer settings, payload patterns, and traffic rate

The screenshot displays the PacketExpert web interface for stream configuration. The top navigation bar includes 'Dashboard', 'Servers', 'Event Log', and 'Admin'. The main header shows 'Devices', 'Ports', and 'MTGA' (selected). Below this, a tabbed interface includes 'Summary', 'Stream Configuration' (active), 'Stream Selection', 'Multistream Results', 'Graphs', 'Port Statistics', 'All Port Statistics', and 'Event Log'. The 'Stream Configuration' section has radio buttons for 'Continuous' (selected) and 'Duration', along with a 'Quick Configuration' button and a 'SETUP1' dropdown. A row of buttons allows switching between configuration views: 'Summary' (active), 'Frame Size', 'Layer', 'MAC', 'VLAN', 'MPLS', 'IP', 'UDP', and 'Payload'. A 'Bandwidth Profile' button is also present. On the left, a table lists 16 streams, each with a 'No', 'Name', and edit/delete icons. On the right, a detailed configuration panel for 'Stream1' is shown, organized into sections: Description, Frame Size, Layer, MAC, VLAN, MPLS, IP, UDP, Payload, and Bandwidth Profile. Each section contains specific configuration parameters and their values.

No	Name	
1	Stream1	
2	Stream2	
3	Stream3	
4	Stream4	
5	Stream5	
6	Stream6	
7	Stream7	
8	Stream8	
9	Stream9	
10	Stream10	
11	Stream11	
12	Stream12	
13	Stream13	
14	Stream14	
15	Stream15	
16	Stream16	

### Stream1 Configuration

Description	Left <--> Right
Frame Size	Type-Fixed [1518]
Layer	UDP
<b>MAC</b>	
Source MAC Address	00-0D-E9-08-D2-EB (HW MAC Address)
Destination MAC Address	00-0D-E9-08-D2-EC
Len/Type	08-00
<b>VLAN</b>	
VLAN	Disabled
<b>MPLS</b>	
MPLS	Disabled
<b>IP</b>	
IP Selection	IPv4
Source IP Address	192.168.1.11
Destination IP Address	192.168.1.12
Default Gateway	192.168.1.1
Subnet Mask	255.255.255.0
TTL	128
ToS/DS	0
Protocol	17
Header Checksum	Auto
Identification	Auto
<b>UDP</b>	
Source UDP	1001
Destination UDP	1002
Checksum	Auto
<b>Payload</b>	
Payload	AB-CD
<b>Bandwidth Profile</b>	
Rate	5 %

# Stream Selection

- Stream selection allows you to choose any configured stream or select all streams for testing
- Each port supports up to 16 streams per port at 1G, 10G, 25G, 40G, 50G, or 100G speeds
- If selecting all streams, ensure the total bandwidth does not exceed 100Gbps link speed
- The configured Frame Size and Rate (Gbps) for each stream are displayed, and the test is conducted simultaneously on all selected streams within the specified time duration or until the user stops the test

The screenshot displays the PacketExpert MTGA interface for stream selection. The top navigation bar includes 'Dashboard', 'Servers', 'Event Log', and 'Admin'. The main menu has 'Devices', 'Ports', and 'MTGA'. The 'MTGA' section is active, showing 'Stream Selection' as the selected tab. Below the tabs, there are input fields for 'Available Bandwidth' (L → R: 20.0000 Gbps) and 'R → L: 20.0000 Gbps', along with 'Activate All' and 'Deactivate All' buttons. A table lists 16 streams, each with a checkbox for selection, an 'Activate/Deactivate' checkbox, a 'Stream Name', 'Direction', 'Frame Size', and 'Rate (Gbps)'. All streams are currently selected and active.

Stream No.	Activate/Deactivate	Stream Name	Direction	Frame Size	Rate (Gbps)
1	<input checked="" type="checkbox"/>	Stream1	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
2	<input checked="" type="checkbox"/>	Stream2	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
3	<input checked="" type="checkbox"/>	Stream3	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
4	<input checked="" type="checkbox"/>	Stream4	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
5	<input checked="" type="checkbox"/>	Stream5	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
6	<input checked="" type="checkbox"/>	Stream6	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
7	<input checked="" type="checkbox"/>	Stream7	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
8	<input checked="" type="checkbox"/>	Stream8	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
9	<input checked="" type="checkbox"/>	Stream9	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
10	<input checked="" type="checkbox"/>	Stream10	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
11	<input checked="" type="checkbox"/>	Stream11	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
12	<input checked="" type="checkbox"/>	Stream12	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
13	<input checked="" type="checkbox"/>	Stream13	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
14	<input checked="" type="checkbox"/>	Stream14	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
15	<input checked="" type="checkbox"/>	Stream15	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000
16	<input checked="" type="checkbox"/>	Stream16	L → R R → L	Fixed [100] Fixed [100]	5.0000 5.0000



# Multistream Results - Vertical View

PacketExpert™

Dashboard Servers Event Log Admin

Devices Ports **MTGA** Load Save

Summary Stream Configuration Stream Selection **Multistream Results** Graphs Port Statistics All Port Statistics Event Log

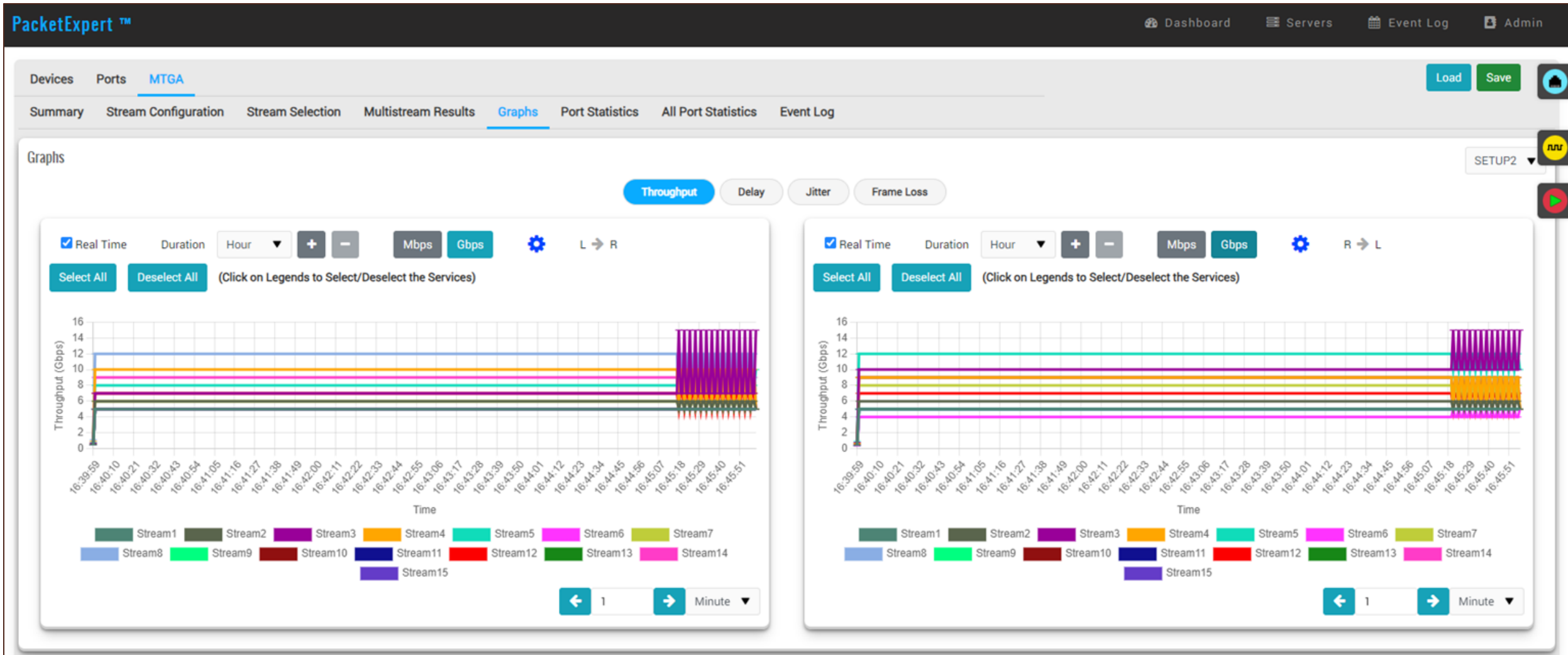
Test Time 00:03:29 Throughput Gbps Delay Unit usec Jitter Unit usec Vertical Activate All Deactivate All SETUP2

Stream Name	Direction	Throughput (Curr)	Throughput (Min)	Throughput (Avg)	Throughput (Max)	FL Count	FL Rate (%)	Delay (Curr)	Delay (Min)	Delay (Avg)	Delay (Max)	Jitter (Curr)	Jitter (Min)	Jitter (Avg)	Jitter (Max)
<input checked="" type="checkbox"/> Stream1	L → R R → L	5.000 5.000	1.296 1.215	4.982 4.982	5.000 5.000	4 3	0.000 0.000	0.439 0.441	0.424 0.424	0.439 0.441	0.460 0.460	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream2	L → R R → L	5.000 5.000	1.296 1.215	4.982 4.982	5.000 5.000	4 3	0.000 0.000	0.442 0.444	0.424 0.424	0.442 0.444	0.460 0.460	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream3	L → R R → L	15.000 15.000	3.889 3.646	14.947 14.946	15.000 15.000	11 10	0.000 0.000	0.450 0.452	0.424 0.432	0.450 0.452	0.476 0.476	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream4	L → R R → L	5.000 5.000	1.296 1.215	4.982 4.982	5.000 5.000	3 4	0.000 0.000	0.401 0.403	0.392 0.396	0.401 0.403	0.416 0.420	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream5	L → R R → L	10.000 10.000	2.593 2.431	9.965 9.964	10.000 10.000	7 7	0.000 0.000	0.426 0.428	0.392 0.396	0.426 0.428	0.464 0.468	< 0.01 0.000	< 0.01 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream6	L → R R → L	5.000 5.000	1.296 1.215	4.982 4.982	5.000 5.000	3 4	0.000 0.000	0.407 0.409	0.396 0.396	0.407 0.409	0.424 0.428	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream7	L → R R → L	5.000 5.000	1.296 1.215	4.982 4.982	5.000 5.000	3 3	0.000 0.000	0.410 0.412	0.400 0.400	0.410 0.412	0.428 0.432	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream8	L → R R → L	5.000 5.000	1.296 1.215	4.982 4.982	5.000 5.000	3 3	0.000 0.000	0.413 0.415	0.404 0.404	0.413 0.415	0.436 0.436	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream9	L → R R → L	5.000 5.000	1.296 1.215	4.982 4.982	5.000 5.000	3 3	0.000 0.000	0.416 0.417	0.404 0.408	0.416 0.417	0.436 0.440	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream10	L → R R → L	5.000 5.000	1.296 1.215	4.982 4.982	5.000 5.000	3 3	0.000 0.000	0.419 0.420	0.408 0.412	0.419 0.420	0.440 0.444	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream11	L → R R → L	5.000 5.000	1.296 1.215	4.982 4.982	5.000 5.000	3 3	0.000 0.000	0.421 0.423	0.408 0.412	0.421 0.423	0.440 0.444	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream12	L → R R → L	5.000 5.000	1.296 1.215	4.984 4.983	5.000 5.000	3 4	0.000 0.000	0.424 0.426	0.412 0.412	0.424 0.426	0.444 0.448	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream13	L → R R → L	5.000 5.000	1.296 1.215	4.984 4.983	5.000 5.000	3 4	0.000 0.000	0.427 0.429	0.412 0.412	0.427 0.429	0.448 0.448	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream14	L → R R → L	5.000 5.000	1.296 1.215	4.984 4.983	5.000 5.000	3 4	0.000 0.000	0.430 0.432	0.420 0.420	0.430 0.432	0.452 0.452	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream15	L → R R → L	5.000 5.000	1.296 1.215	4.984 4.983	5.000 5.000	3 4	0.000 0.000	0.433 0.435	0.420 0.424	0.433 0.435	0.452 0.456	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000
<input checked="" type="checkbox"/> Stream16	L → R R → L	5.000 5.000	1.296 1.215	4.984 4.983	5.000 5.000	3 4	0.000 0.000	0.436 0.438	0.420 0.424	0.436 0.438	0.456 0.460	< 0.01 0.000	0.000 0.000	< 0.01 0.000	< 0.01 0.000

# Overall Result Summary - Vertical View

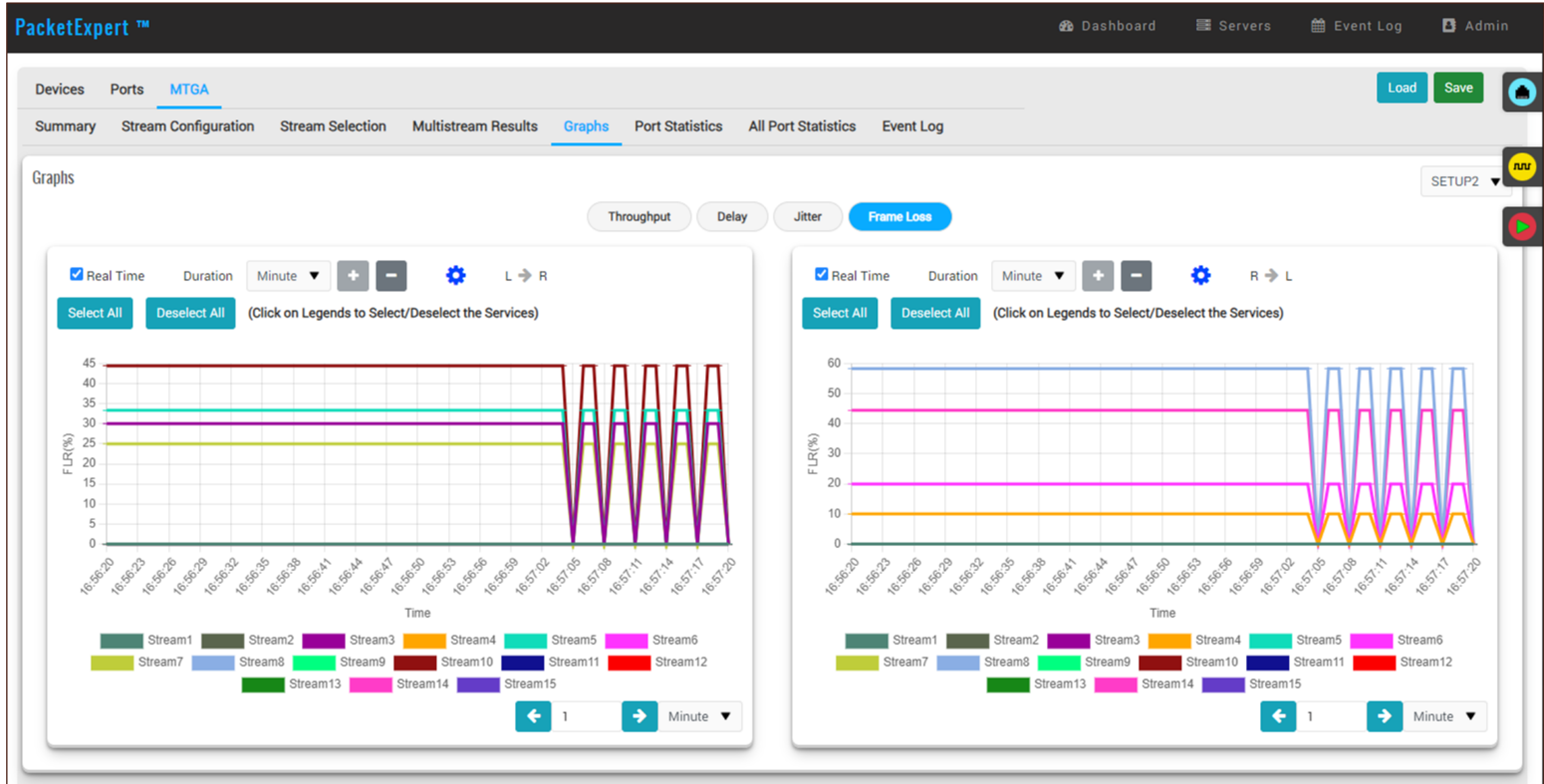
PacketExpert™															
Dashboard Servers Event Log Admin															
Devices Ports MTGA Load Save Export															
Summary Stream Configuration Stream Selection Multistream Results Graphs Port Statistics All Port Statistics Event Log															
MTGA Summary Start Selected Stop Selected Report															
Setup Connection Status Config Start/Stop Test Time															
Port1 - Port2															
Multistream Results															
Test Time 00:33:12 Throughput Mbps Delay Unit usec Jitter Unit usec Vertical Activate All Deactivate All															
Stream Name	Direction	Throughput (Curr)	Throughput (Min)	Throughput (Avg)	Throughput (Max)	FL Count	FL Rate (%)	Delay (Curr)	Delay (Min)	Delay (Avg)	Delay (Max)	Jitter (Curr)	Jitter (Min)	Jitter (Avg)	Jitter (Max)
Stream1	L → R	8,000.004	5,908.304	7,994.929	8,000.132	0	0.000	0.525	0.400	0.525	0.592	< 0.01	0.000	< 0.01	< 0.01
	R → L	7,999.985	6,654.524	7,995.304	8,000.069	9	0.000	0.516	0.384	0.516	0.580	< 0.01	0.000	< 0.01	< 0.01
Stream2	L → R	5,000.034	3,692.674	4,996.830	5,000.034	0	0.000	0.525	0.500	0.524	0.588	< 0.01	0.000	< 0.01	< 0.01
	R → L	5,000.034	4,159.048	4,997.065	5,000.034	0	0.000	0.508	0.384	0.508	0.576	< 0.01	0.000	< 0.01	< 0.01
Stream3	L → R	8,000.010	5,908.432	7,994.929	8,000.074	39	0.000	0.532	0.400	0.532	0.596	< 0.01	0.000	< 0.01	< 0.01
	R → L	8,000.004	6,654.452	7,995.304	8,000.132	1	0.000	0.509	0.388	0.509	0.576	< 0.01	0.000	< 0.01	< 0.01
Stream4	L → R	5,000.034	3,692.674	4,996.830	5,000.034	0	0.000	0.523	0.400	0.523	0.592	< 0.01	0.000	< 0.01	< 0.01
	R → L	4,999.906	4,159.048	4,997.065	5,000.034	1	0.000	0.504	0.484	0.504	0.532	< 0.01	0.000	< 0.01	< 0.01
Stream5	L → R	7,999.929	5,908.432	7,994.928	8,000.163	176	0.000	0.540	0.400	0.540	0.596	< 0.01	0.000	< 0.01	< 0.01
	R → L	8,000.072	6,654.494	7,995.303	8,000.157	48	0.000	0.523	0.384	0.522	0.580	< 0.01	0.000	< 0.01	< 0.01
Stream6	L → R	5,000.012	3,692.762	4,996.831	5,000.042	1	0.000	0.534	0.400	0.534	0.596	< 0.01	0.000	< 0.01	< 0.01
	R → L	5,000.021	4,159.061	4,997.065	5,000.048	14	0.000	0.519	0.384	0.518	0.580	< 0.01	0.000	< 0.01	< 0.01
Stream7	L → R	8,000.056	5,908.393	7,994.929	8,000.056	0	0.000	0.531	0.400	0.530	0.592	< 0.01	0.000	< 0.01	< 0.01
	R → L	7,999.957	6,654.447	7,995.304	8,000.056	1	0.000	0.519	0.384	0.519	0.576	< 0.01	0.000	< 0.01	< 0.01
Stream8	L → R	4,999.994	3,692.770	4,996.831	5,000.043	2	0.000	0.529	0.404	0.529	0.596	< 0.01	0.000	< 0.01	< 0.01
	R → L	4,999.994	4,159.079	4,997.065	5,000.043	2	0.000	0.517	0.388	0.517	0.576	< 0.01	0.000	< 0.01	< 0.01
Stream9	L → R	8,000.005	5,908.398	7,994.979	8,000.076	2	0.000	0.528	0.404	0.528	0.592	< 0.01	0.000	< 0.01	< 0.01
	R → L	8,000.025	6,654.499	7,995.351	8,000.072	1	0.000	0.513	0.384	0.513	0.576	< 0.01	0.000	< 0.01	< 0.01
Stream10	L → R	4,999.986	3,692.770	4,996.862	5,000.044	23	0.000	0.533	0.400	0.533	0.592	< 0.01	0.000	< 0.01	< 0.01
	R → L	4,999.997	4,159.062	4,997.094	5,000.044	49	0.000	0.517	0.384	0.516	0.576	< 0.01	0.000	< 0.01	< 0.01
Stream11	L → R	6,999.977	5,169.878	6,995.607	7,000.065	24	0.000	0.532	0.400	0.531	0.596	< 0.01	0.000	< 0.01	< 0.01
	R → L	6,999.996	5,822.688	6,995.932	7,000.062	37	0.000	0.516	0.384	0.516	0.580	< 0.01	0.000	< 0.01	< 0.01
Stream12	L → R	4,999.996	3,692.762	4,996.862	5,000.044	9	0.000	0.529	0.400	0.529	0.596	< 0.01	0.000	< 0.01	< 0.01
	R → L	5,000.008	4,159.075	4,997.094	5,000.042	6	0.000	0.515	0.384	0.515	0.580	< 0.01	0.000	< 0.01	< 0.01
Stream13	L → R	8,000.004	5,908.432	7,994.979	8,000.132	1	0.000	0.530	0.400	0.530	0.592	< 0.01	0.000	< 0.01	< 0.01
	R → L	8,000.004	6,654.452	7,995.350	8,000.132	0	0.000	0.515	0.384	0.515	0.576	< 0.01	0.000	< 0.01	< 0.01
Stream14	L → R	5,000.034	3,692.674	4,996.862	5,000.034	0	0.000	0.530	0.464	0.529	0.592	< 0.01	0.000	< 0.01	< 0.01
	R → L	5,000.008	4,159.074	4,997.094	5,000.045	10	0.000	0.515	0.384	0.515	0.576	< 0.01	0.000	< 0.01	< 0.01
Stream15	L → R	5,000.034	3,692.674	4,996.862	5,000.034	0	0.000	0.522	0.500	0.522	0.548	< 0.01	0.000	< 0.01	< 0.01
	R → L	5,000.034	4,159.048	4,997.094	5,000.034	0	0.000	0.515	0.384	0.514	0.576	< 0.01	0.000	< 0.01	< 0.01
Stream16	L → R	4,999.988	3,692.770	4,996.862	5,000.059	23	0.000	0.533	0.400	0.533	0.596	< 0.01	0.000	< 0.01	< 0.01
	R → L	5,000.000	4,159.062	4,997.094	5,000.048	74	0.000	0.518	0.384	0.518	0.580	< 0.01	0.000	< 0.01	< 0.01

# Stream wise Graph - Throughput Graph

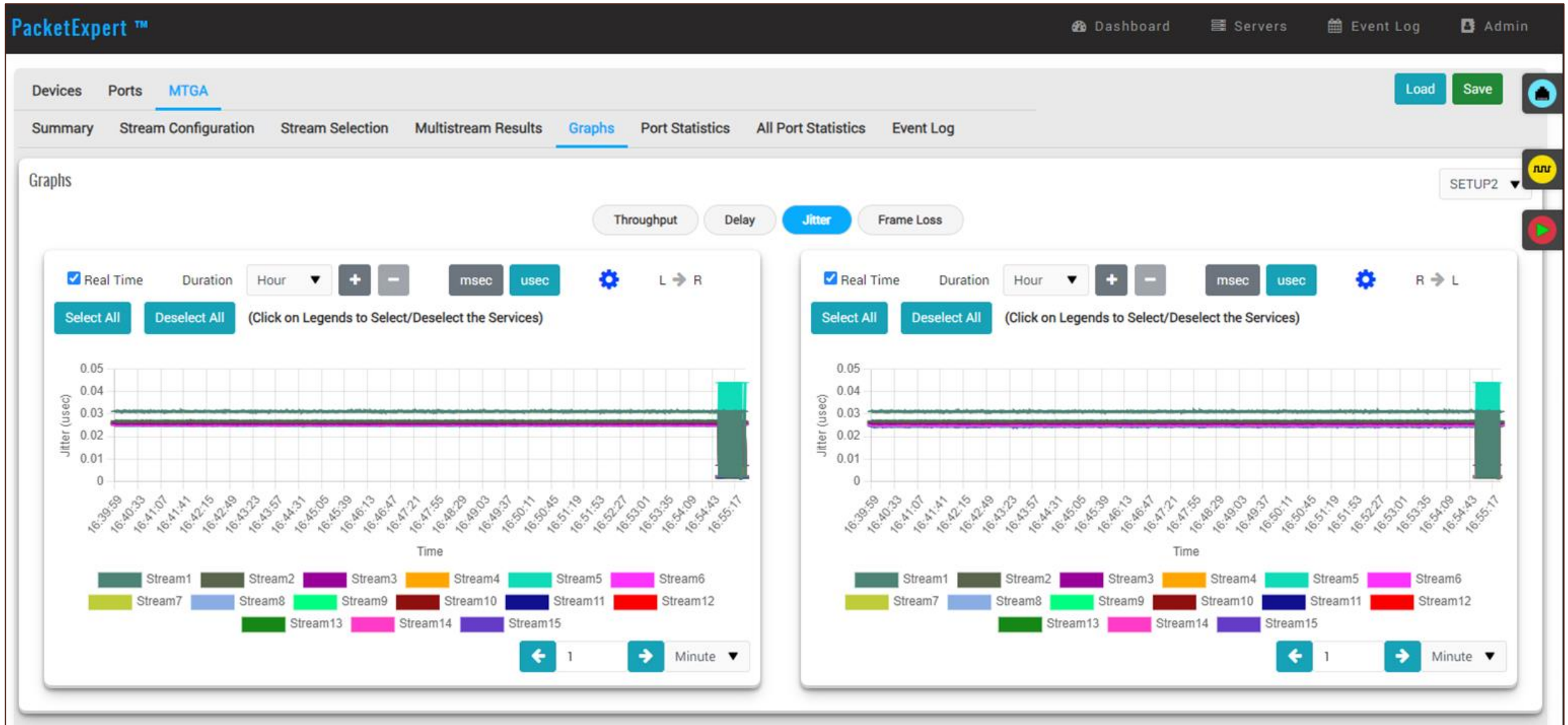




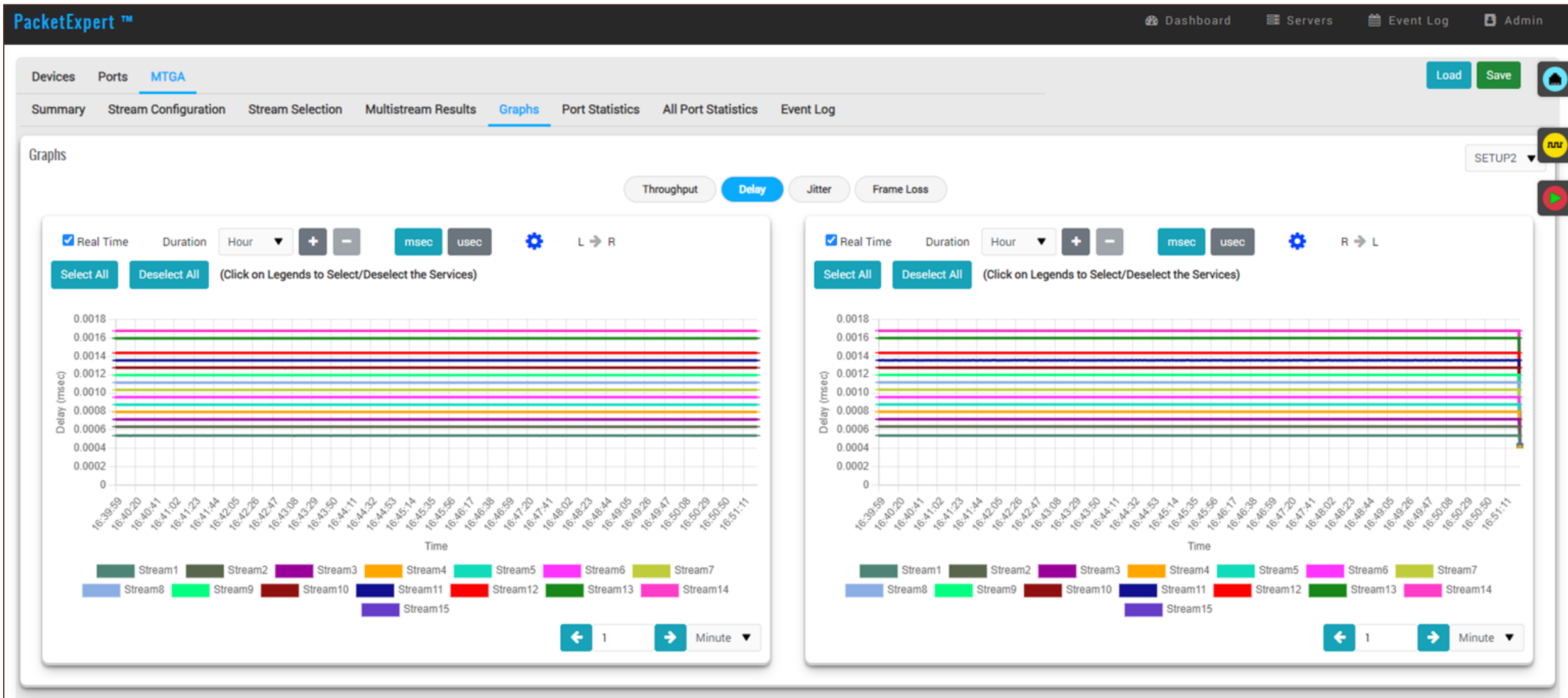
# Stream wise Graph - Packet Loss Graph



# Stream wise Graph - FDV (Jitter) Graph

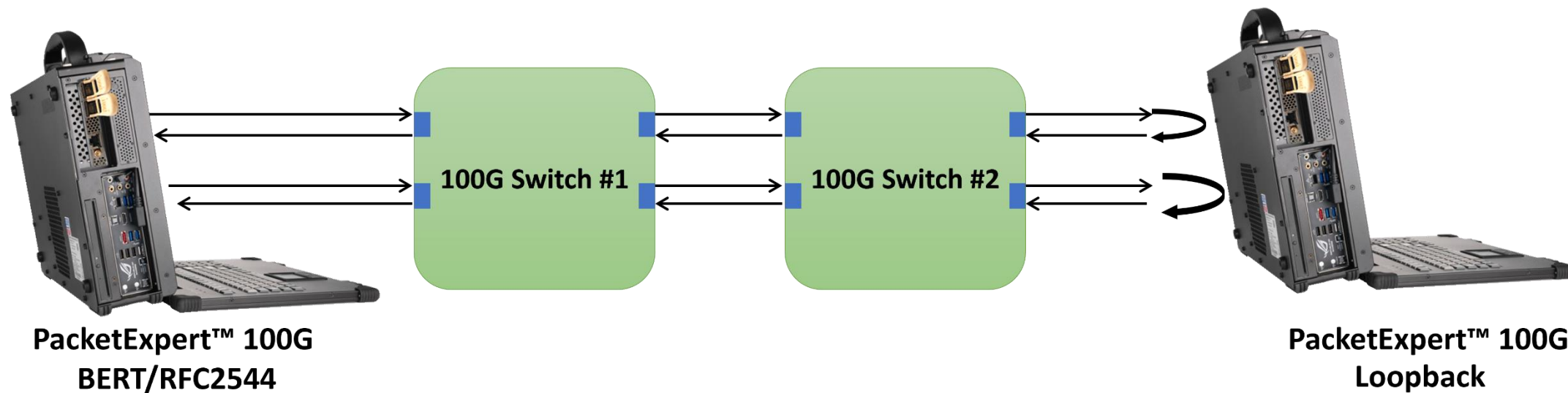


# Stream wise Graph - Delay Graph



# Loopback Testing

# Smart Loopback



**Example:**

**MAC address** - 00-00-00-00-00-01

**IP Address** - 192.168.1.100

**UDP Port** - 1000

**Example:**

**MAC address** - 00-00-00-00-00-02

**IP Address** - 192.168.1.200

**UDP Port** - 2000

- PacketExpert™ 100G has Loopback capability on both the ports
- PacketExpert™ 100G supports the Smart Loopback
- The above diagram depicts Loopback (Source and Destination MAC addresses swapped) prior to re-transmitting Ethernet frame

# Smart Loopback (Contd.)

Incoming Packet

Ethernet Destination MAC Address	Ethernet Source MAC Address	Ethernet Length/Type field		Source IP Address	Destination IP Address	IP Protocol		Source UDP Port	Destination UDP Port
00-00-00-00 00 02	00-00-00-00-00-01	08 00 (IP)	...	192.168.1.100	192.168.1.200	17 (UDP)	...	1000	2000

Outgoing Packet (after swapping Source/Destination MAC addresses, Source/Destination IP Addresses and Source/Destination UDP Ports)

Ethernet Destination MAC Address	Ethernet Source MAC Address	Ethernet Length/Type field		Source IP Address	Destination IP Address	IP Protocol		Source UDP Port	Destination UDP Port
00 00-00 00 00-01	00-00-00-00-00-02	08 00 (IP)	...	192.168.1.200	192.168.1.100	17(UDP)	....	2000	1000

Loopback

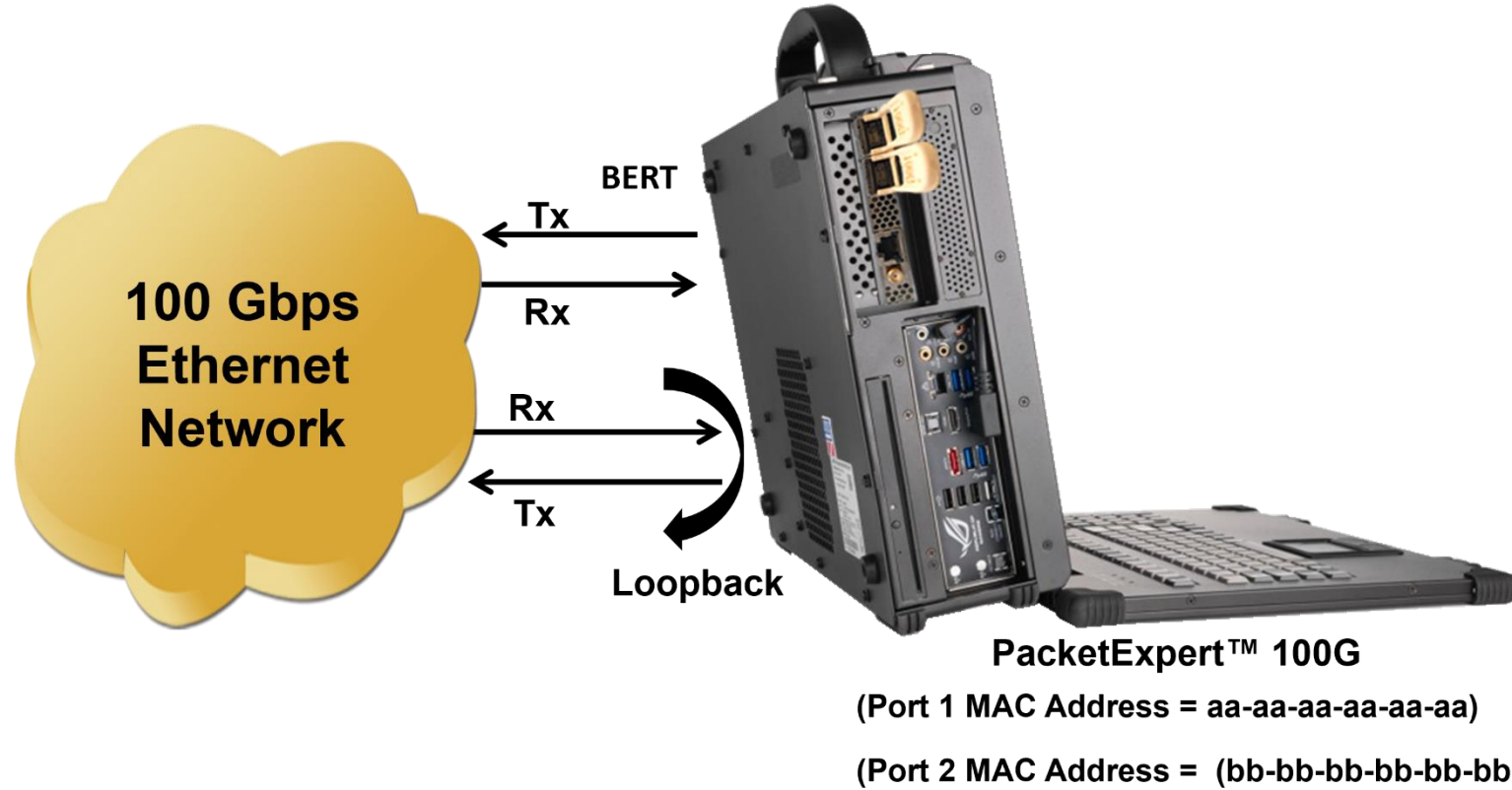
Rx

Tx



PacketExpert™ 100G

# BERT and Loopback



- For testing across a network, the remote PacketExpert™ 100G can be left in Loopback mode
- BERT is controlled by the local end PacketExpert™ 100G

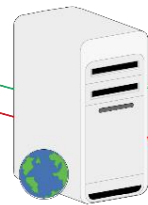
# Multi Device and Multi Users Support



# PacketExpert™ 100G Architecture



PacketExpert™ 100G

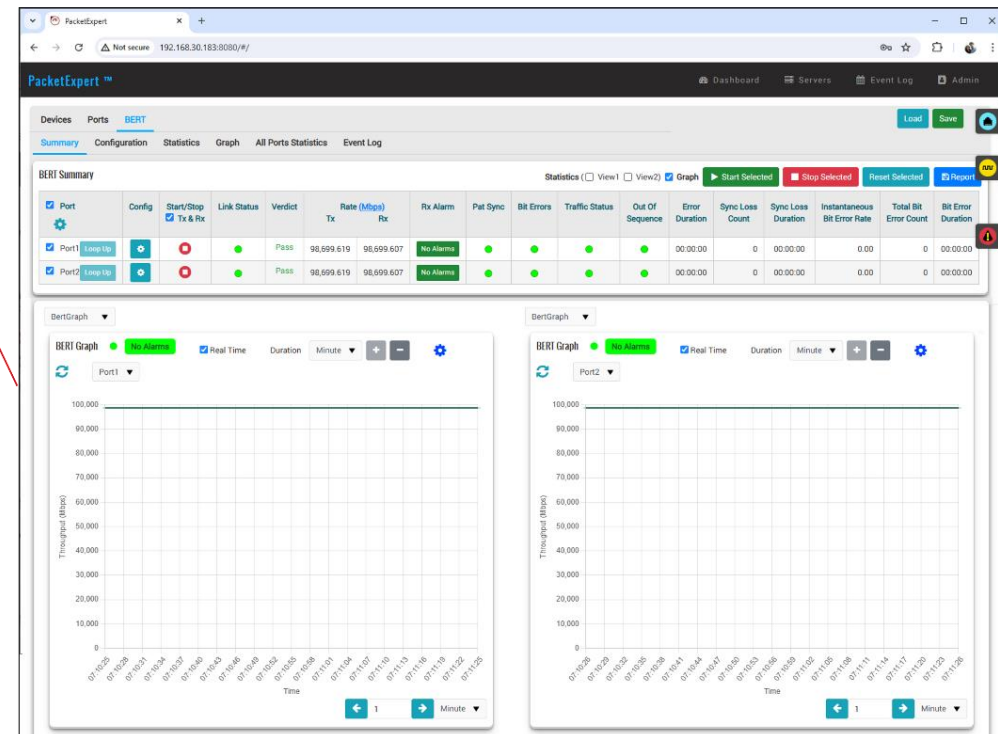
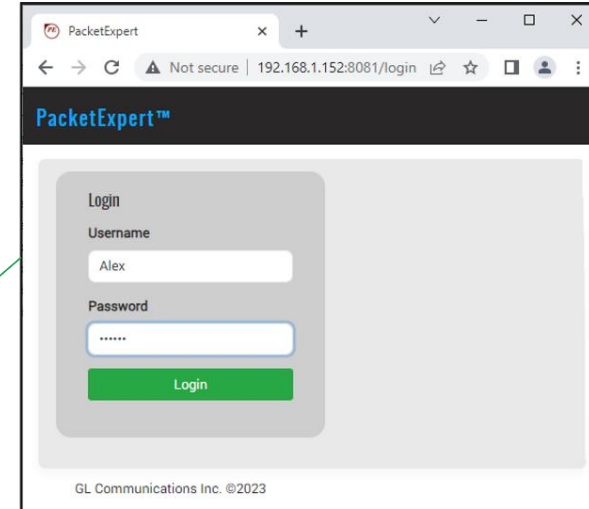


Web Server

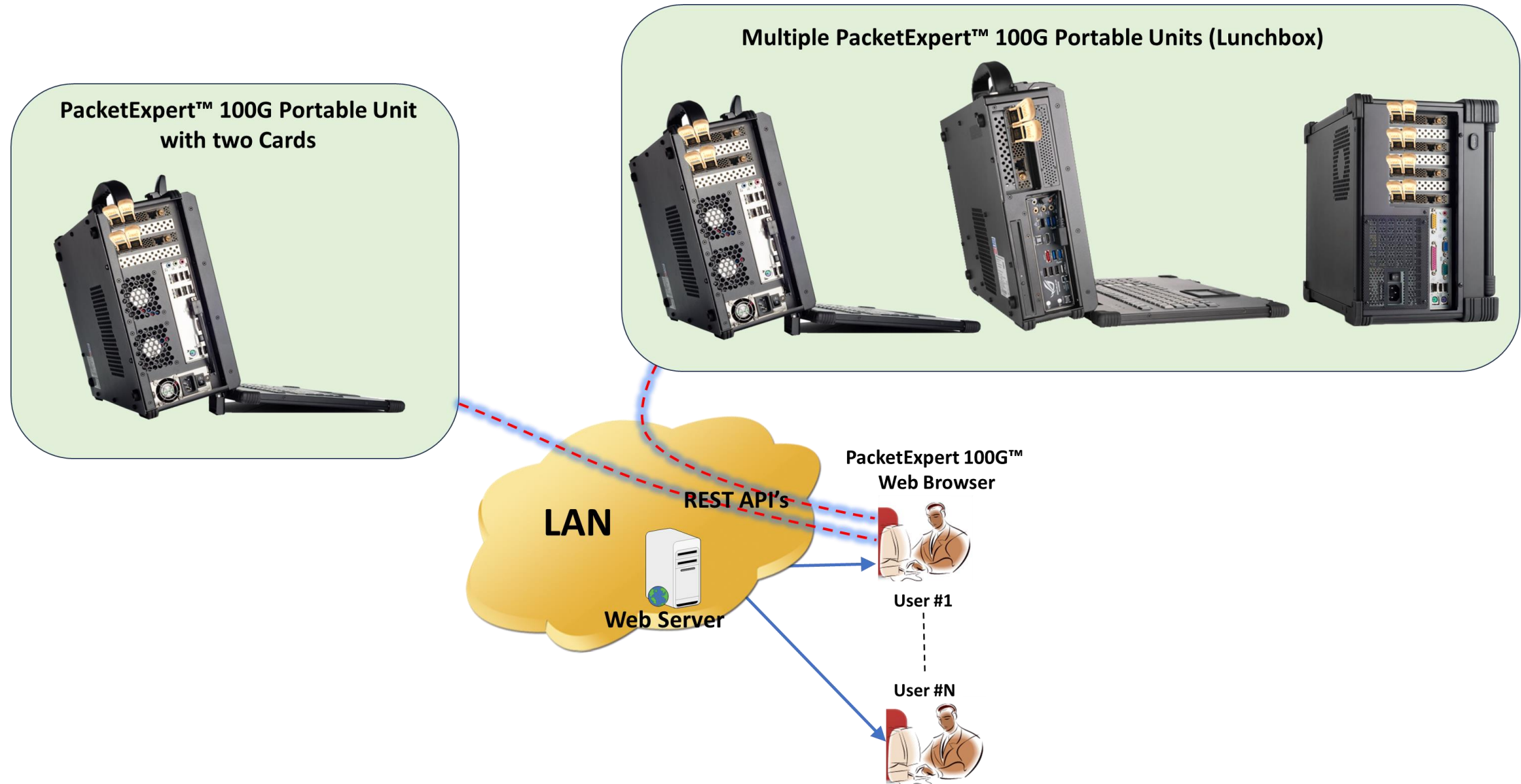
Alex on Web Browser



Bob on Web Browser



# PacketExpert™ 100G - Multiple Users with Multiple Servers and Devices



# Supported PacketExpert™ Applications

The screenshot displays the PacketExpert web interface. At the top, there's a navigation bar with links to Dashboard, Servers, Event Log, and Admin. Below this, a tabbed interface shows 'Devices', 'Ports', 'Loopback', and 'RFC 2544'. The 'Devices' tab is active, showing a table of devices. Red annotations highlight 'Multi Devices' (referring to the device list) and 'Multi Users' (referring to the 'User' column). A dropdown menu for 'Applications' is open, showing options like 'All Port BERT', 'BERT/Loopback', 'All Port Loopback', 'RFC 2544', 'ExpertSAM', and 'MTGA'. Other sections include 'License Details', 'MAC Addresses', 'System Monitor', and 'Version'.

**Devices Table:**

Device	Serial#	Availability	User	Speed	Application	Test Status
Device1	0000-271143	Reserved	Admin	1G	All Port Loopback	●
Device2	0000-273091	Reserved	Admin	1G	RFC 2544	●
Device3	0000-278732	Reserved	Admin	1G	All Port BERT	●

**License Details Table:**

Part Number	Description	Status
PXX101	PacketExpert 100G	✓
PXX105	PacketExpert 100G - Option for 100G, 40/50G	✓

**MAC Addresses Table:**

Port #1	Port #2
00-0D-E9-09-AE-4E	00-0D-E9-09-AE-4F

**System Monitor Table:**

Name	Value	Alarm
Temperature Monitor	41.5 °C	●
Over Temperature Monitor	47 °C	●
Internal Voltage	0 V	●
Auxiliary Voltage	0 V	●

**Version Table:**

Description	Value
FPGA Version	d0.7.5
Software Version	24.7.4.0

# Clock Frequency Measurement

PacketExpert™

DashboardServersEvent LogAdmin

DevicesPortsBERT

LoadSave

SummaryConfigurationStatisticsGraphAll Ports StatisticsEvent Log

BERT Summary

Statistics ( View1

<input checked="" type="checkbox"/> Port	Config	Start/Stop <input checked="" type="checkbox"/> Tx & Rx	Link Status	Verdict	Rate (Mbps)		Rx Alarm	Pat Sync	Bit Errors	Traffic Status	Out Of Sequence
					Tx	Rx					
<input checked="" type="checkbox"/> Port1	Loop Up			Pass	98,699.607	98,699.607	No Alarms				
<input checked="" type="checkbox"/> Port2	Loop Up			Pass	98,699.607	98,699.607	No Alarms				

Port Clock Status

Select PortPort1Reset

Clock SourceInternal

Offset0ppm0Hz+−

	Frequency (Hz)	Deviation (ppm)	Max Deviation (ppm)
Tx	103,125,015,360.000	0.15	0.25
Rx	103,125,015,680.000	0.15	-8.70

Port	Tx Total Frames	Rx Total Frames	Non Test Frames	FCS Error Frames	IP Checksum Errors	UDP Checksum Errors	Tx Link Utilization
Port1	481,706,667	481,664,995	0	0	0	0	100.000
Port2	481,673,306	481,683,987	0	0	0	0	100.000

Port	VLAN Frames	MPLS Frames	IPv4 Packets	IPv6 Packets	UDP Packets	ICMP Packets
Port1	0	0	481,664,993	0	481,664,993	0
Port2	0	0	481,683,985	0	481,683,985	0

# Layer 1 Alarms and Errors

PacketExpert™

Dashboard Servers Event Log Admin

Devices Ports ExpertSAM

Settings SFP Info SFP Monitor **Alarms/Errors** Graphs SyncE PTP

Alarms/Errors

Select Port Port1 ▼ Reset

Ethernet PCS Impairment

### Alarms

Description	Alarms	Duration
Link Status	●	00:00:00
Local Fault Detected	●	00:00:00
Local Fault Received	●	00:00:00
Remote Fault Detected	●	00:00:00
High BER	●	00:00:00

### Errors

Description	Status	Duration	Count	Rate
FCS Error Packets	●	00:00:00	0	0.000
Stomped FCS Error Packets	●	00:00:00	0	0.000
Code Violations	●	00:00:00	0	-
Jabber Packets	●	00:00:00	0	0.000
Too Long Packets	●	00:00:00	0	0.000
Runt Packets	●	00:00:00	0	0.000
Undersized Packets	●	00:00:00	0	0.000

# Report Generation

**Report Generation**

Test Conducted By  
Tester

Customer Name  
GL Communications

Operator Name  
Admin

Title  
Packetexpert™ 100G BERT

Comments  
BERT - Layer 4

Header  
Packetexpert™ 100G BERT Report

Footer  
Packetexpert™ 100G BERT Report

Report Format  
PDF

File Name  
CSV

Select Ports

Server 192.168.30.183

☒ Port1


☒ Port2

Generate Report

Cancel

Packetexpert 100G BERT Rep

Page 1 of 16



**PDF Report** **PacketExpert Report**

**Packetexpert 100G BERT**

Conducted By : Tester

Customer Name : GL Communications

Operator Name : Admin

Software Version : 24.7.5.0

Time Zone : Eastern Standard Time

Start Date : 07-09-2024 06:19:06

End Date : 07-09-2024 06:27:43

Test Duration : 00:08:36

Test : AllPortBERT

Comments : BERT - Layer4

Packetexpert 100G BERT Rep

07/09/2024 6:32:36

AutoSave

BERT Report (7)

Search

Srikanth Ramaprasad

FileHomeInsertPage LayoutFormulasDataReviewViewAutomateDeveloperHelp

CommentsShare

A1

Port

CSV Report

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	Port	Test Time	Bit Error C	Bit Error S	Sync Loss	Out Of Seq	Bits Recei	Bit Error R	Sync Loss	Out Of Seq	Error Free	Tx Link Ut	Rx Link Ut	Tx Data R	Rx Data R	Tx Bad Fra	Rx Bad Fra	Tx Non T	Rx Non T	Tx FCS Err	Rx FCS Err	Tx IP Chec
2	Port1	84:34:29	0	0	0	0	2.91E+14	0	0	0	304467	0	0	0	0	0	0	-	96	-	0	-
3	Port2	84:34:29	0	0	0	0	2.91E+14	0	0	0	304467	0	0	0	0	0	0	-	96	-	0	-
4																						

BERT Report (7)

Count: 83

Accessibility: Unavailable

# Event Log

**PacketExpert™**

DashboardServersEvent LogAdmin

DevicesPorts**BERT**

LoadSave

SummaryConfigurationStatisticsGraphAll Ports Statistics**Event Log**

Event Log

Port1▼Save As CSV

Id	Name	Start Time	Duration	Details
1	Start Rx	07-23-2024 11:52:03.899	00:00:01	-
2	Idle	07-23-2024 11:52:04.198	00:00:02	-
3	Start Tx	07-23-2024 11:52:06.008	00:00:01	-
4	Continuous Bit Error Insertion	07-23-2024 11:52:17.185	00:00:09	Rate : 10 <sup>-4</sup>
5	Stop Tx	07-23-2024 11:52:31.455	00:00:01	-
6	Stop Rx	07-23-2024 11:52:34.486	00:00:01	-

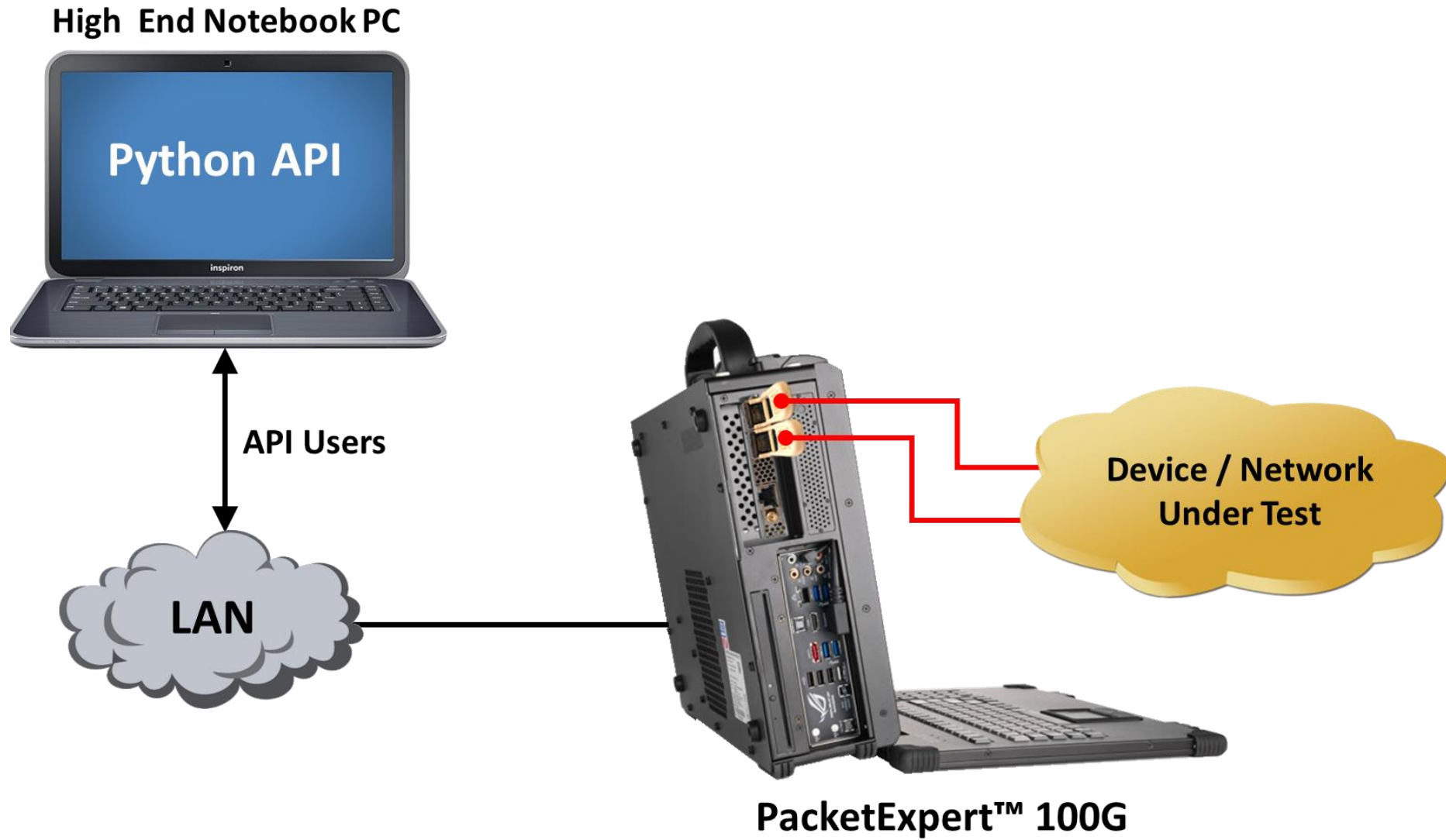
Port2▼Save As CSV

Id	Name	Start Time	Duration	Details
1	Start Rx	07-23-2024 11:52:05.969	00:00:01	-
2	Start Tx	07-23-2024 11:52:06.013	00:00:01	-
3	Bit Error	07-23-2024 11:52:17.191	00:00:11	Current:98,261,627/Total:98,261,627
4	Stop Tx	07-23-2024 11:52:31.456	00:00:01	-
5	Stop Rx	07-23-2024 11:52:33.471	00:00:01	-

# Python Client



# Python Client



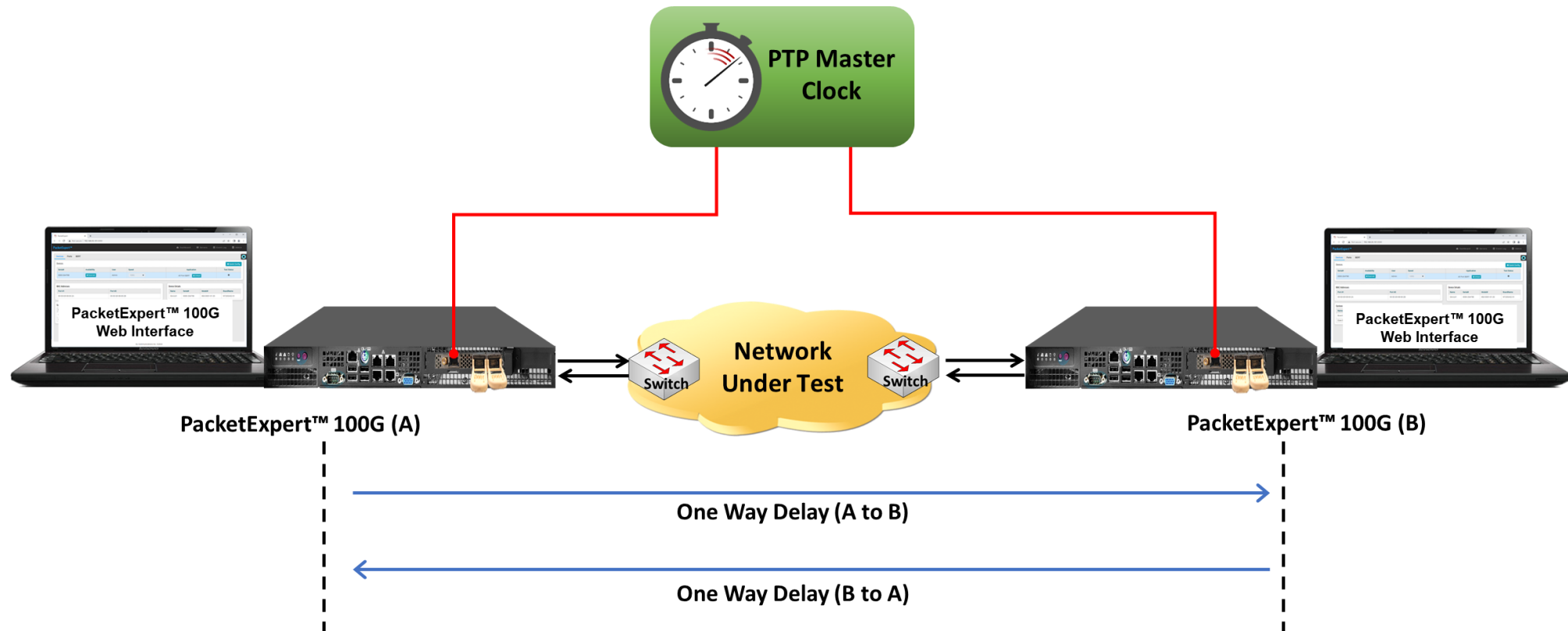
# Python Script

```
AllPortBert_Sample_app.py x
1  from Core.Utils import *
2  from PacketExpertTests import *
3  import time
4
5
6  def main():
7      # Specify server details and test configuration
8      server_ip = "192.168.1.152"
9      server_port = 3333
10     device_list = [1]
11     port_list = [1, 2]
12
13     err, device_test_configuration = set_device_traffic_config(device_list)
14
15     # Configure TC1 Bert Test Parameters
16
17     device_test_configuration[1].port_mode = PortMode.Gbps100
18     device_test_configuration[1].start_frame_size = 64
19     device_test_configuration[1].start_rate = 1
20     device_test_configuration[1].start_error_rate = 4 # Bit error insertion rate 10^-4
21
22     test_duration = 10
23
24     default_json_path = 'C:\\Users\\Desktop\\PXXPythonClient-Release\\JSON\\'
25     result_file_path = 'C:\\Users\\Desktop\\PXXPythonClient-Release\\Log\\'
26     result_file_name = "Bert_Results"
27
28     generate_report_info = GenerateReport()
29     generate_report_info.test_conducted_by = "GLIndia"
30     generate_report_info.filename = "Bert_Report"
31     generate_report_info.title = "All Port Bert"
32
33     generate_report_info.init_selected_ports(device_list, port_list, AppName.AllPortBERT)
34
35     enable_generate_report = True
```

# Upcoming Features

# One Way Delay Measurements (PTP)

- PacketExpert™ 100G utilizes Precision Time Protocol (PTP) messages received from a master clock connected to the network to achieve precise time synchronization across multiple devices, ensuring that all devices operate on a unified clock.
- This synchronization is critical for precise measurement of One-Way Delay (OWD), in RFC 2544 and ExpertSAM™



# PTP Settings

PacketExpert™

Dashboard

Servers

Event Log

Admin

Devices

Ports

RFC 2544

Load

Save

Export

Settings

SFP Info

SFP Monitor

Alarms/Errors

Graphs

SyncE

PTP

PTP Ports

Settings

Statistics

Link Status	Link Speed	MAC Address ✓ HW MAC Address	IP Address	Subnet Mask	Default Gateway	IPv6 Address	Edit
●	1 G	✓ 00-0D-E9-09-9F-56	192.168.1.11	255.255.255.0	192.168.1.1	1111:1111:1111:1111:1111:1111:1111:0011	

# PTP Statistics

*Continued.*

PacketExpert™

Dashboard Servers Event Log Admin

Devices Ports RFC 2544 Load Save Export

Settings SFP Info SFP Monitor Alarms/Errors Graphs SyncE PTP

PTP Ports

Settings Statistics

Description	PTP Port	PTP Port
	Tx	Rx
Link Utilization (%)	0.000	0.000
Data Rate (Gbps)	0.000	0.000
Bad Frames	0	0
Non Test Frames	-	0
FCS Error Frames	-	0
IP Checksum Errors	-	0
UDP Checksum Errors	-	0
Total Frames	710	81,837
Valid Frames	710	81,837
Number Of Bytes	61,612	7,451,998
Frame Rate (frames/sec)	0	0
Broadcast Frames	0	88
Multicast Frames	0	80,866
Control Frames	0	0
VLAN Frames	0	0
Pause Frames	0	0
Undersized Frames	0	0

64 Bytes Length	88	8,191
65-127 Byte Length	622	73,894
128-255 Byte Length	0	8
256-511 Bytes Length	0	0
512-1023 Bytes Length	0	0
1024-1518 Byte Length	0	0
Oversized Frames	0	0
1 Level Stacked VLAN Frames	-	0
2 Level Stacked VLAN Frames	-	0
3 Level Stacked VLAN Frames	-	0
1 Level Stacked MPLS Frames	-	0
2 Level Stacked MPLS Frames	-	0
3 Level Stacked MPLS Frames	-	0
IPv4 Packets	-	0
IPv6 Packets	-	0
TCP Packets	-	0
ICMP Packets	-	0
IGMP Packets	-	0
IGRP Packets	-	0
Other Protocol IP Packets	-	0
UDP Packets	-	0

# Multi Ports Support

- Supports 4×10G/25G multi-port configurations with breakout cables

**PacketExpert™** Dashboard Servers Event Log Admin

Devices Ports BERT Loopback Load Save Export Quick Config

### Devices

Device	Serial Number	Availability	User	Speed	Application	Test Status
Device1	0000-271143	Reserved	Admin	4x25G	All Port BERT Unload	
Device2	0000-273091	Reserved	Admin	4x25G	All Port Loopback Unload	
Device3	0000-278732	Reserved	Admin	100G	All Port BERT Load	

100G

50G(RS544)

50G(RS528,CL74)

40G

4x25G

2x25G

4x10G

2x10G

1G

### License Details

Part Number	Description
PXX101	PacketExpert 100G
PXX105	PacketExpert 100G - Option for 100G, 40/50G

### MAC Addresses

Port #1	Port #2
00-0D-E9-09-AE-4E	00-0D-E9-09-AE-4F

### System Monitor

Name	Value	Alarm
Board Temperature	34 °C	
Core Supply Temperature	38 °C	

### Device Details

Name	Serial Number	Model#	BoardName
Device3	0000-278732	860-0001-01-20	NT200A02-01

### Version

Description	Value
FPGA Version	25.2.10
Software Version	25.2.18.0

# Multi Ports- Port Information

PacketExpert™

Dashboard
Servers
Event Log
Admin

Devices

Ports

BERT
Loopback













Settings

SFP Info
SFP Monitor
Alarms/Errors
Graphs
SyncE

Load
Save
Export

Port Information

Quick Config

Device	Port	SFP Description	Link Speed	FEC	Laser	Equalization Mode	Remote Loopback	SyncE	MAC Address ✓ HW MAC Address	IP Address	Subnet Mask	Default Gateway	IPv6 Address
Device1	Port1	 QSFP28+SR	25 G	✗	ON	DFE	✗	OFF	✓ 00-0D-E9-08-F1-8D	192.168.1.11	255.255.255.0	192.168.1.1	1111:1111:1111:1111:1111:1111:0011
	Port2	 QSFP28+SR	25 G	✗	ON	DFE	✗	OFF	✓ 00-0D-E9-08-F1-8E	192.168.1.12	255.255.255.0	192.168.1.1	2222:2222:2222:2222:2222:2222:0012
	Port3	 QSFP28+SR	25 G	✗	ON	DFE	✗	OFF	✓ 00-0D-E9-08-F1-8F	192.168.1.13	255.255.255.0	192.168.1.1	1111:1111:1111:1111:1111:1111:0013
	Port4	 QSFP28+SR	25 G	✗	ON	DFE	✗	OFF	✓ 00-0D-E9-08-F1-90	192.168.1.14	255.255.255.0	192.168.1.1	2222:2222:2222:2222:2222:2222:0014
Device2	Port1	 QSFP28+SR	25 G	✗	ON	DFE	✗	OFF	✓ 00-0D-E9-09-28-A2	192.168.1.21	255.255.255.0	192.168.1.1	1111:1111:1111:1111:1111:1111:0021
	Port2	 QSFP28+SR	25 G	✗	ON	DFE	✗	OFF	✓ 00-0D-E9-09-28-A3	192.168.1.22	255.255.255.0	192.168.1.1	2222:2222:2222:2222:2222:2222:0022
	Port3	 QSFP28+SR	25 G	✗	ON	DFE	✗	OFF	✓ 00-0D-E9-09-28-A4	192.168.1.23	255.255.255.0	192.168.1.1	1111:1111:1111:1111:1111:1111:0023
	Port4	 QSFP28+SR	25 G	✗	ON	DFE	✗	OFF	✓ 00-0D-E9-09-28-A5	192.168.1.24	255.255.255.0	192.168.1.1	2222:2222:2222:2222:2222:2222:0024
Device3	Port1	 SFP/SFP+/SFP28+1000BASE-SX	10 G	✗	ON	DFE	✗	OFF	✓ 00-0D-E9-09-AE-4E	192.168.1.31	255.255.255.0	192.168.1.1	1111:1111:1111:1111:1111:1111:0031
	Port2	 SFP/SFP+/SFP28+1000BASE-SX	10 G	✗	ON	DFE	✗	OFF	✓ 00-0D-E9-09-AE-4F	192.168.1.32	255.255.255.0	192.168.1.1	2222:2222:2222:2222:2222:2222:0032
	Port3	 SFP/SFP+/SFP28+1000BASE-SX	10 G	✗	ON	DFE	✗	OFF	✓ 00-0D-E9-09-AE-50	192.168.1.33	255.255.255.0	192.168.1.1	1111:1111:1111:1111:1111:1111:0031
	Port4	 SFP/SFP+/SFP28+1000BASE-SX	10 G	✗	ON	DFE	✗	OFF	✓ 00-0D-E9-09-AE-51	192.168.1.34	255.255.255.0	192.168.1.1	2222:2222:2222:2222:2222:2222:0034



# SyncE (Synchronous Ethernet)

- SyncE enables the transmission of a precision frequency source over an Ethernet network
- PacketExpert™ 100G continuously monitors the clock Quality Level (QL) using a background "heart-beat" message
- Any QL change instantly triggers an event message to indicate the update

The screenshot shows the PacketExpert™ 100G web interface. The top navigation bar includes 'Dashboard', 'Servers', 'Event Log', and 'Admin'. Below this, a secondary navigation bar has 'Devices', 'Ports' (highlighted with a red box), and 'BERT'. On the right of this bar are 'Load', 'Save', and 'Export' buttons. A third navigation bar contains 'Settings', 'SFP Info', 'SFP Monitor', 'Alarms/Errors', 'Graphs', and 'SyncE' (highlighted with a red box). The main content area is titled 'SyncE' and features a 'Reset All' button. It contains a configuration table for Port1 and Port2, and a large monitoring table.

Description	Port1 ▼	Reset	Port2 ▼	Reset
	Selection		Selection	
Selection	ON ▼		ON ▼	
QL-TLV	QL-STU/UNK ▼		QL-STU/UNK ▼	
Interval	1		1	
	Tx	Rx	Tx	Rx
Total	99	81	81	97
Event	0	0	0	0
Information	99	81	81	97
Rate (packets/sec)	1	1	1	1
QL-STU/UNK	99	81	81	97
QL-PRS	0	0	0	0
QL-PRC	0	0	0	0
QL-INV3	0	0	0	0
QL-SSU-A/TNC	0	0	0	0
QL-INV5	0	0	0	0
QL-INV6	0	0	0	0
QL-ST2	0	0	0	0
QL-SSU-B	0	0	0	0
QL-INV9	0	0	0	0
QL-EEC2/ST3	0	0	0	0
QL-EEC1/SEC	0	0	0	0
QL-SMC	0	0	0	0
QL-ST3E	0	0	0	0
QL-PROV	0	0	0	0
QL-DNU/DNS	0	0	0	0

**Thank you**