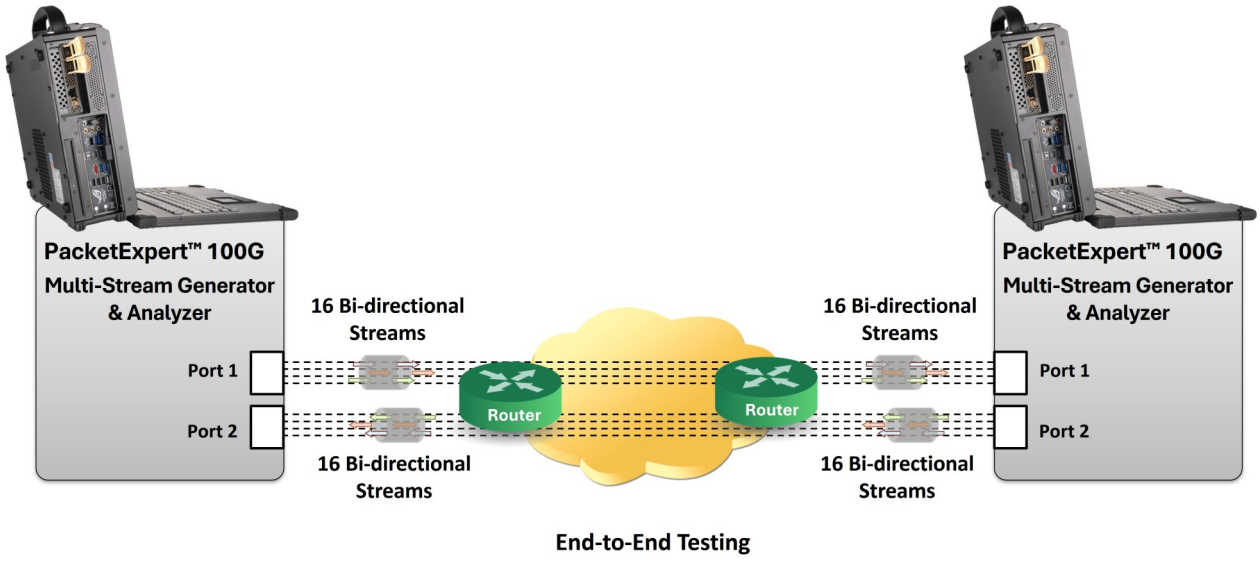
Multi-Stream Ethernet Traffic Generation & Analysis

PacketExpert™ 100G (1G/10G/25G/40G/50G/100G)



End-to-End Testing

Overview

The Multi Stream Traffic Generator and Analyzer is a basic application available within the PacketExpert™ 100G platform. This Ethernet tester can generate multi-stream Ethernet traffic with varying protocol headers, packet lengths, payloads and analyze traffic, making it an excellent tool for comprehensive end-to-end testing of Wide Area Networks at speeds up to 100 Gbps.

As depicted in the network diagram, up to 16 traffic streams per port can be generated according to user-defined configurations, including MAC/VLAN/IP/UDP headers, rate, and frame size. Different traffic classes (such as voice, video, and data) can be prioritized based on the configured frame size and rate. The system offers a graphical view of live Packet Loss, Round Trip, Delay and Jitter for all streams to monitor performance.

For more information, please visit Multi Stream Traffic Generator and Analyzer webpage.

Main Features

- Generates traffic from Layer 2 to Layer 4 at up to 100 Gbps with varying protocol headers and packet sizes
- Accommodates frame lengths ranging from 64 bytes to 16,000 bytes (Jumbo frames)
- Generate and analyze packets up to 100Gbps line rates, with zero packet loss
- Supports up to 16 streams per port, enabling the device to handle a total of 32 streams
- Test automation and regression testing via Python and REST APIs
- **Traffic Generation:**
  - Generates multiple streams with customizable protocol headers, packet sizes and payloads
  - Streams can be defined with various header fields like Source and Destination MAC Address, VLAN and MPLS tags , Source and Destination IP Address, Source and Destination UDP ports
  - 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)
- **Traffic Analysis:**
  - 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

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Traffic Generation

Stream Configuration

The stream configuration summary offers a quick view of all the 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.

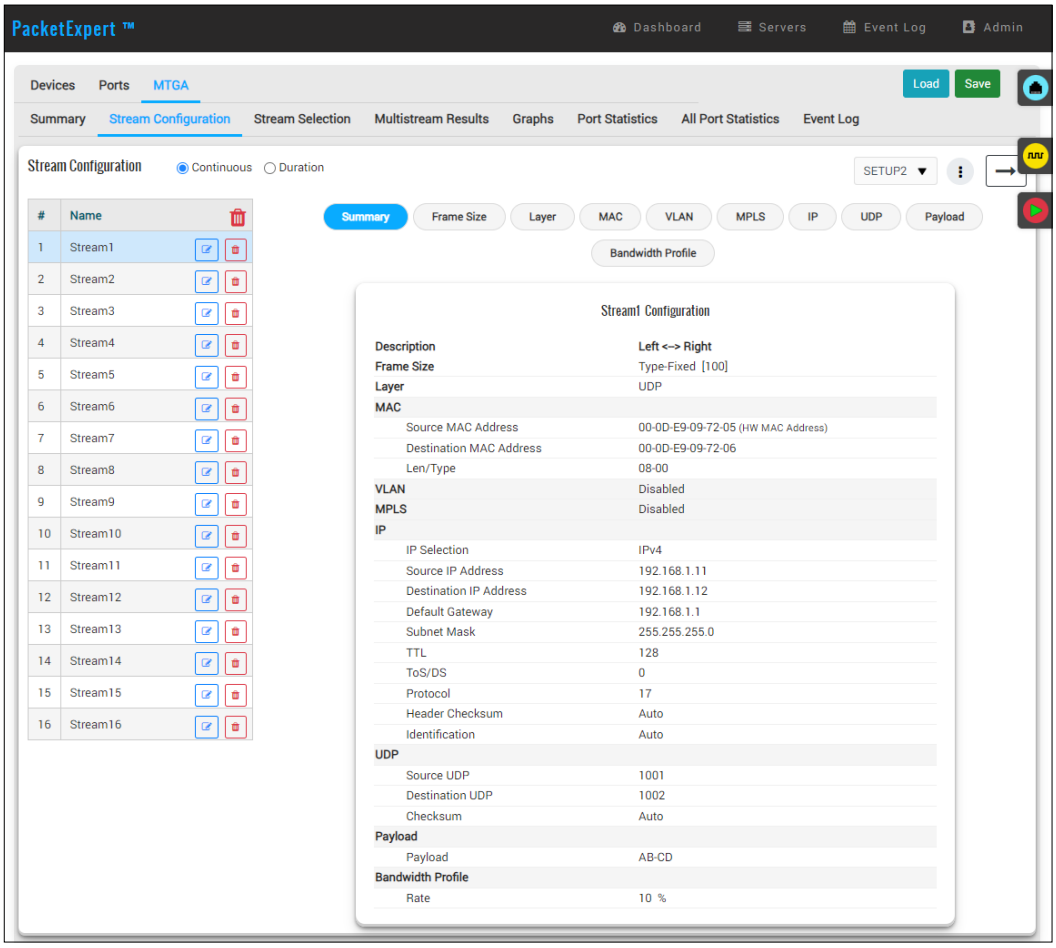


Figure: Stream Configuration Collapsed Summary View

Ethernet VLAN C-TAG Configuration

User can enable VLAN configuration and set the C-Tag (Customer Tag) and S-Tag (Service Tag) VLAN Type, Id, and Priority.

The 2 byte VLAN segment Tag Control Information (TCI) includes a 3-bit Carry Priority Information (PCP) field which indicates traffic priorities, which can be user-configurable.

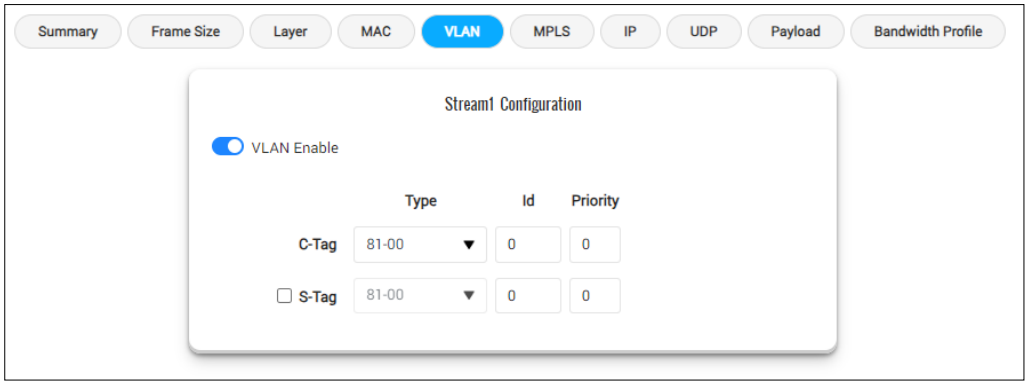


Figure: VLAN C-Tag Configuration

Stream Configuration *(Contd.)*

Payload Configurations

A 2-byte hex payload can be configured for the test packet, which will be repeated throughout the entire frame payload.

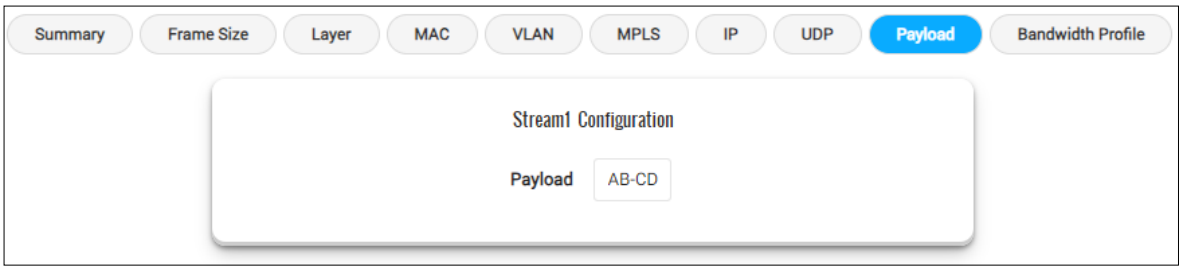


Figure: Payload Configuration

Frame Size Configuration

Users have the flexibility to configure frame sizes in bytes for each stream, choosing between Fixed and EMIX (Ethernet Mix) Frame Size types. For Fixed frame sizes, users can select any value within the range from just above 64 bytes to a maximum of 1518 bytes for standard frames, or up to 16,000 bytes for Jumbo frames. Additionally, a single Test Flow can incorporate up to five different frame sizes, known as EMIX, to simulate diverse real-time traffic scenarios.

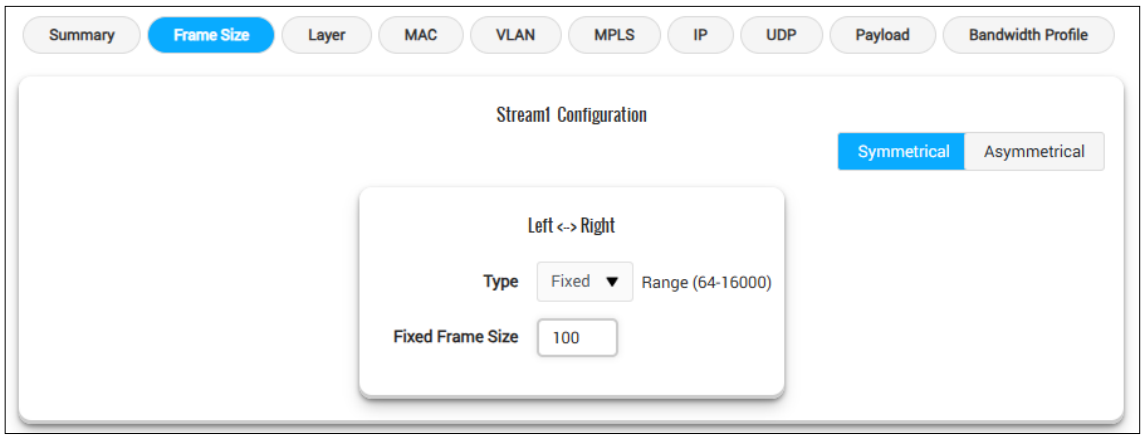


Figure: Frame Size Configuration

Bandwidth Profile Configurations

This option allows you to set the frame generation rate using various units, such as a percentage (%) of link speed, Mbps , and Gbps.

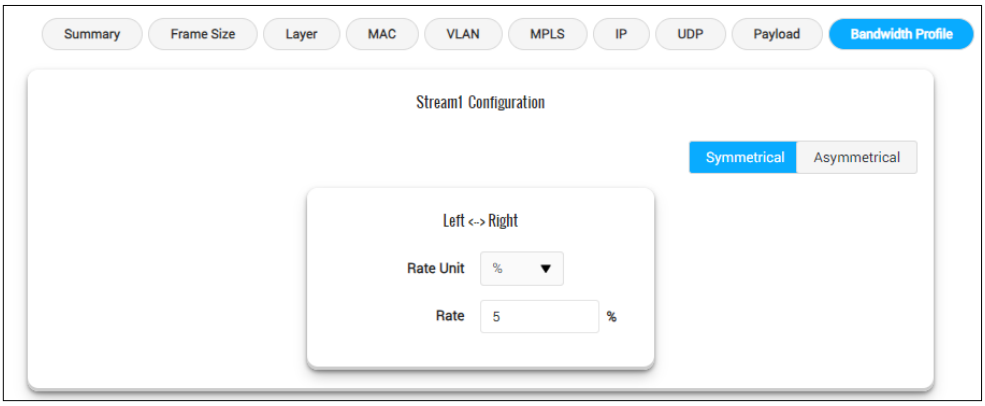
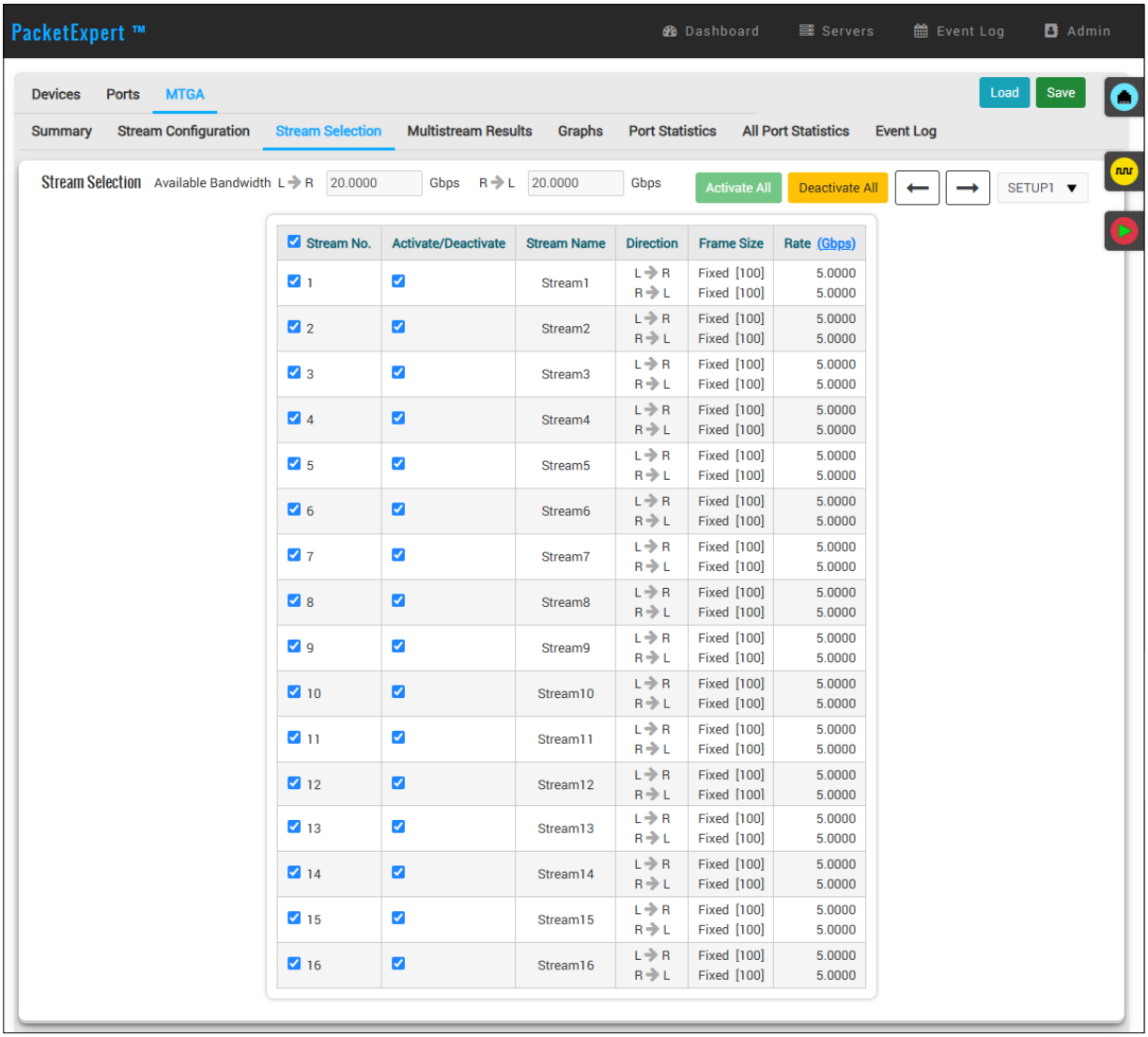


Figure: Bandwidth Profile Configuration

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 (Mbps) for each stream are displayed, and the test is conducted simultaneously on all selected streams within the specified time duration until users stop the test.



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

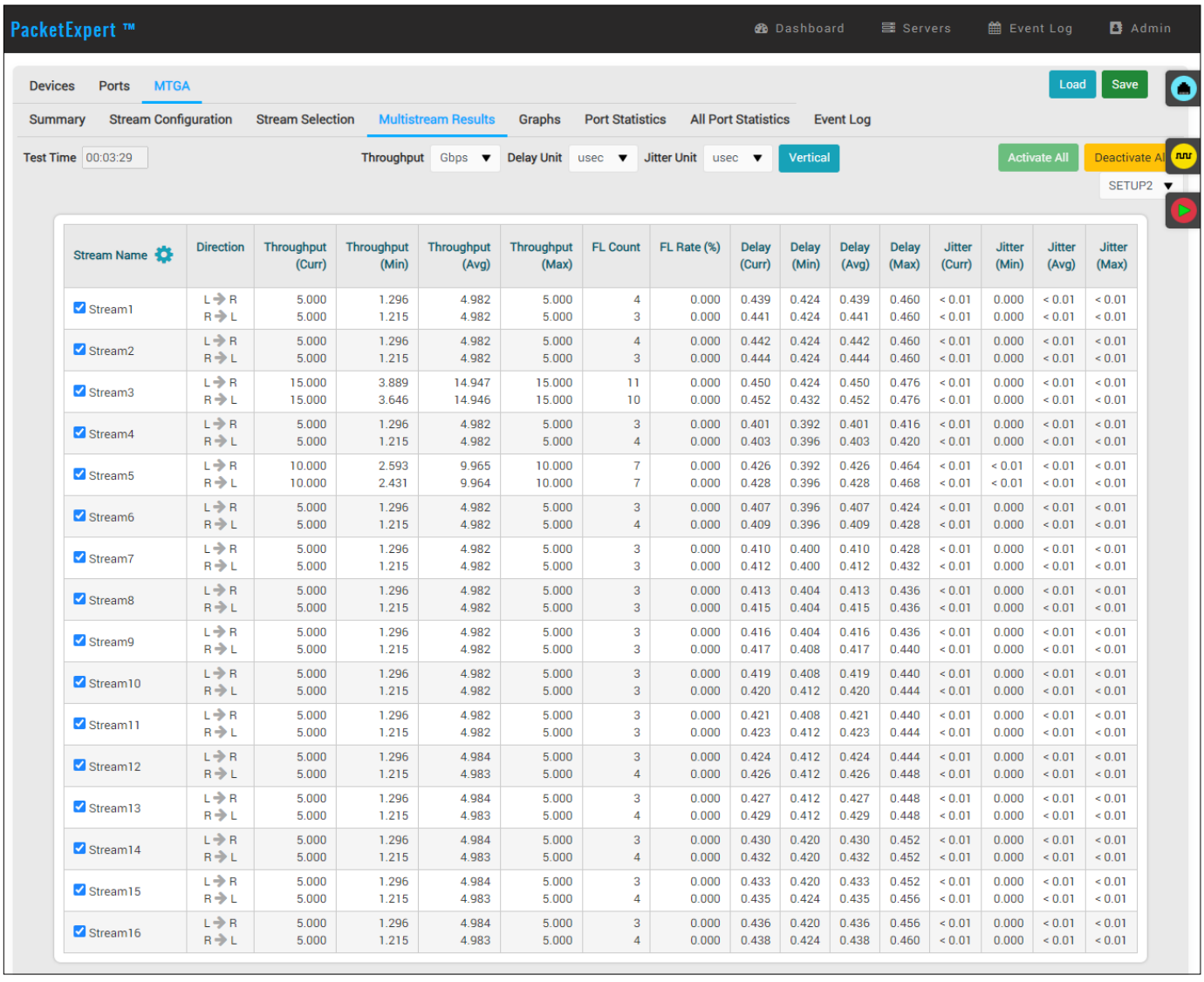
Figure: Stream Selection

Traffic Analysis

Results

The consolidated view of all the streams (16 streams) results are displayed for each configured stream, which includes Stream ID for which the test is running, Test duration in secs, TxRx Frames, Rx Bytes, and Current, Minimum, Maximum, and Average values of

- Frame Loss - Frame Loss Count, Frame Loss Rate - FLR (%)
- Information Rate - Throughput, IR (Gbps)
- Frame Transfer Delay - FTD, Delay (msec)
- Frame Delay Variations - FDV, Jitter (msec)



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	5.000	1.296	4.982	5.000	4	0.000	0.439	0.424	0.439	0.460	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.982	5.000	3	0.000	0.441	0.424	0.441	0.460	< 0.01	0.000	< 0.01	< 0.01
Stream2	L → R	5.000	1.296	4.982	5.000	4	0.000	0.442	0.424	0.442	0.460	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.982	5.000	3	0.000	0.444	0.424	0.444	0.460	< 0.01	0.000	< 0.01	< 0.01
Stream3	L → R	15.000	3.889	14.947	15.000	11	0.000	0.450	0.424	0.450	0.476	< 0.01	0.000	< 0.01	< 0.01
	R → L	15.000	3.646	14.946	15.000	10	0.000	0.452	0.432	0.452	0.476	< 0.01	0.000	< 0.01	< 0.01
Stream4	L → R	5.000	1.296	4.982	5.000	3	0.000	0.401	0.392	0.401	0.416	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.982	5.000	4	0.000	0.403	0.396	0.403	0.420	< 0.01	0.000	< 0.01	< 0.01
Stream5	L → R	10.000	2.593	9.965	10.000	7	0.000	0.426	0.392	0.426	0.464	< 0.01	< 0.01	< 0.01	< 0.01
	R → L	10.000	2.431	9.964	10.000	7	0.000	0.428	0.396	0.428	0.468	< 0.01	< 0.01	< 0.01	< 0.01
Stream6	L → R	5.000	1.296	4.982	5.000	3	0.000	0.407	0.396	0.407	0.424	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.982	5.000	4	0.000	0.409	0.396	0.409	0.428	< 0.01	0.000	< 0.01	< 0.01
Stream7	L → R	5.000	1.296	4.982	5.000	3	0.000	0.410	0.400	0.410	0.428	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.982	5.000	3	0.000	0.412	0.400	0.412	0.432	< 0.01	0.000	< 0.01	< 0.01
Stream8	L → R	5.000	1.296	4.982	5.000	3	0.000	0.413	0.404	0.413	0.436	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.982	5.000	3	0.000	0.415	0.404	0.415	0.436	< 0.01	0.000	< 0.01	< 0.01
Stream9	L → R	5.000	1.296	4.982	5.000	3	0.000	0.416	0.404	0.416	0.436	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.982	5.000	3	0.000	0.417	0.408	0.417	0.440	< 0.01	0.000	< 0.01	< 0.01
Stream10	L → R	5.000	1.296	4.982	5.000	3	0.000	0.419	0.408	0.419	0.440	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.982	5.000	3	0.000	0.420	0.412	0.420	0.444	< 0.01	0.000	< 0.01	< 0.01
Stream11	L → R	5.000	1.296	4.982	5.000	3	0.000	0.421	0.408	0.421	0.440	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.982	5.000	3	0.000	0.423	0.412	0.423	0.444	< 0.01	0.000	< 0.01	< 0.01
Stream12	L → R	5.000	1.296	4.984	5.000	3	0.000	0.424	0.412	0.424	0.444	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.983	5.000	4	0.000	0.426	0.412	0.426	0.448	< 0.01	0.000	< 0.01	< 0.01
Stream13	L → R	5.000	1.296	4.984	5.000	3	0.000	0.427	0.412	0.427	0.448	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.983	5.000	4	0.000	0.429	0.412	0.429	0.448	< 0.01	0.000	< 0.01	< 0.01
Stream14	L → R	5.000	1.296	4.984	5.000	3	0.000	0.430	0.420	0.430	0.452	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.983	5.000	4	0.000	0.432	0.420	0.432	0.452	< 0.01	0.000	< 0.01	< 0.01
Stream15	L → R	5.000	1.296	4.984	5.000	3	0.000	0.433	0.420	0.433	0.452	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.983	5.000	4	0.000	0.435	0.424	0.435	0.456	< 0.01	0.000	< 0.01	< 0.01
Stream16	L → R	5.000	1.296	4.984	5.000	3	0.000	0.436	0.420	0.436	0.456	< 0.01	0.000	< 0.01	< 0.01
	R → L	5.000	1.215	4.983	5.000	4	0.000	0.438	0.424	0.438	0.460	< 0.01	0.000	< 0.01	< 0.01

Figure: Stream Results

Stream-wise Throughput Graph

A real time display of throughput versus time for each stream.

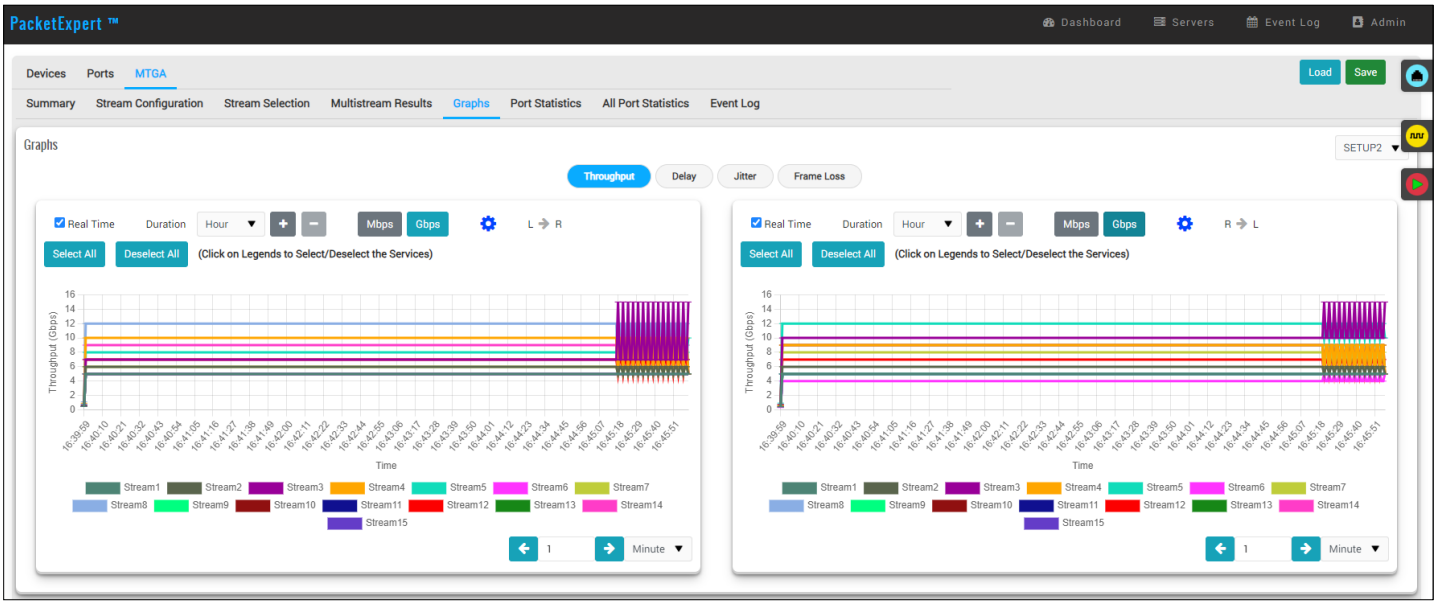


Figure: Stream Throughput Graph

FLR Graph

A real time display of packet loss versus time.

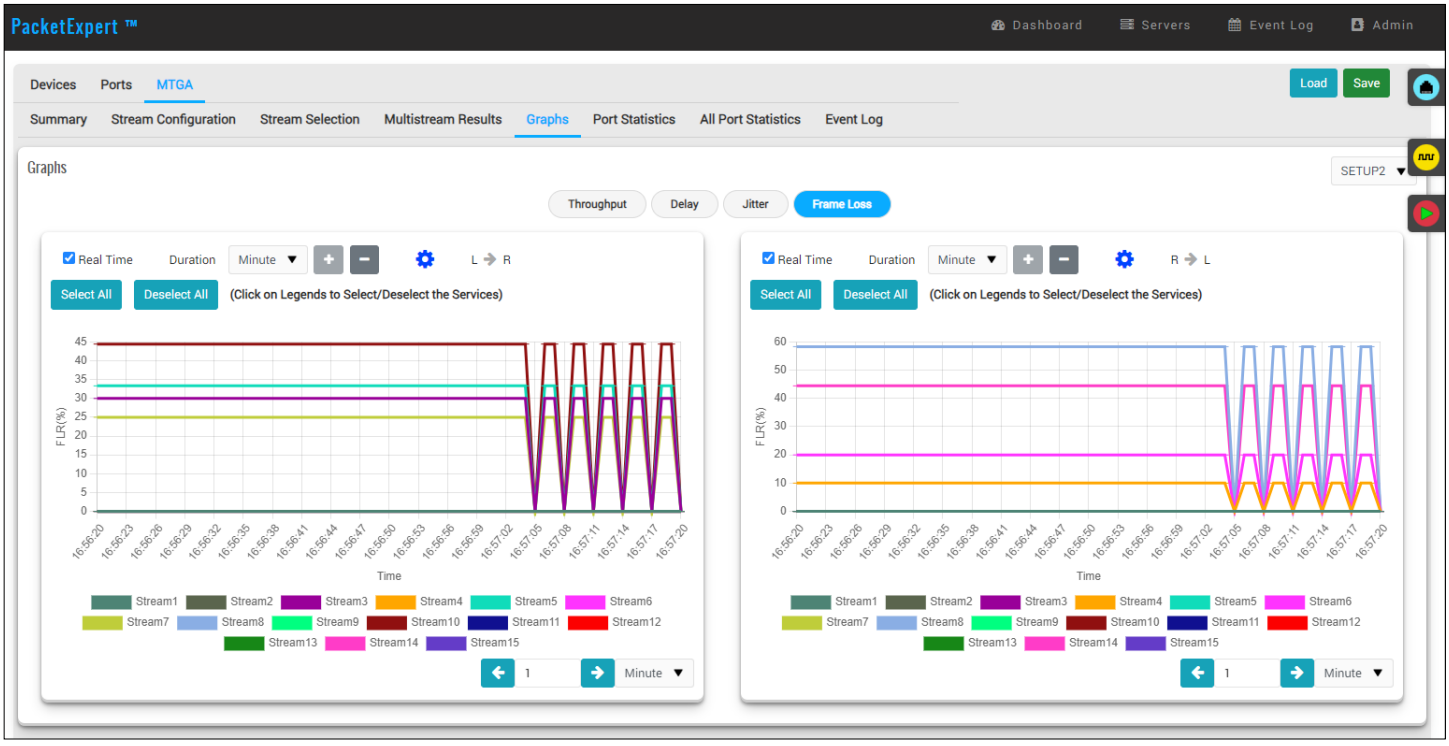


Figure: Frame Loss Graph

Port Statistics

Detailed statistics per port are provided including Frame Count, Frame Rate, Link Utilization, etc. based on various categories such as Frame Type (Unicast/Broadcast/Multicast, VLAN), frame lengths (64, 65-127, 1024-1518, Oversized, Undersized), Protocol Type (IPv4, IPv6, UDP, TCP, ICMP, IGRP, etc). VLAN Statistics (per Stack position) are displayed for the configured stacks.

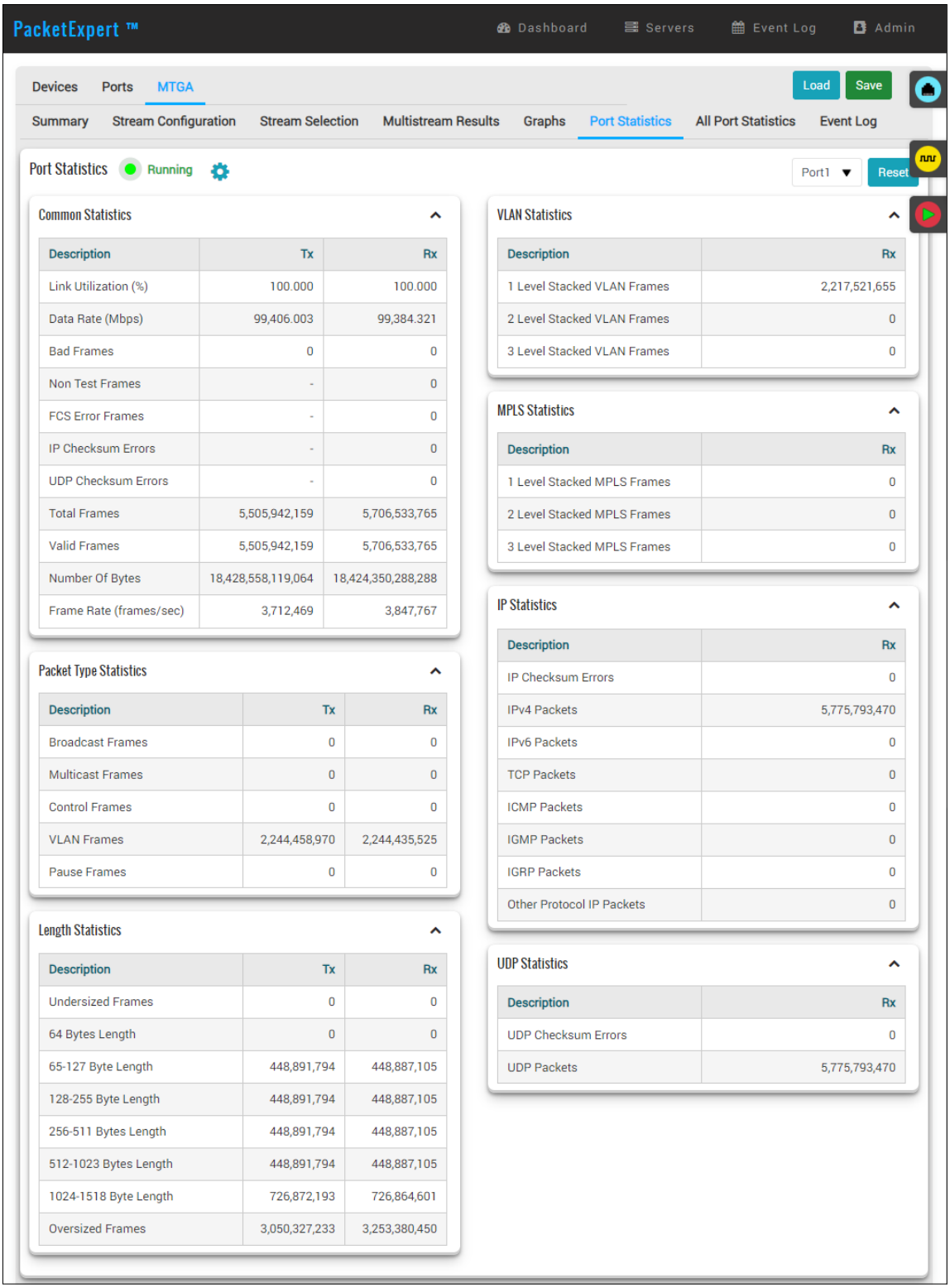


Figure: Port Statistics

Report Generation

The Report Generation option allows to create detailed test report in PDF and CSV formats. This window lets the user configure the report file details.

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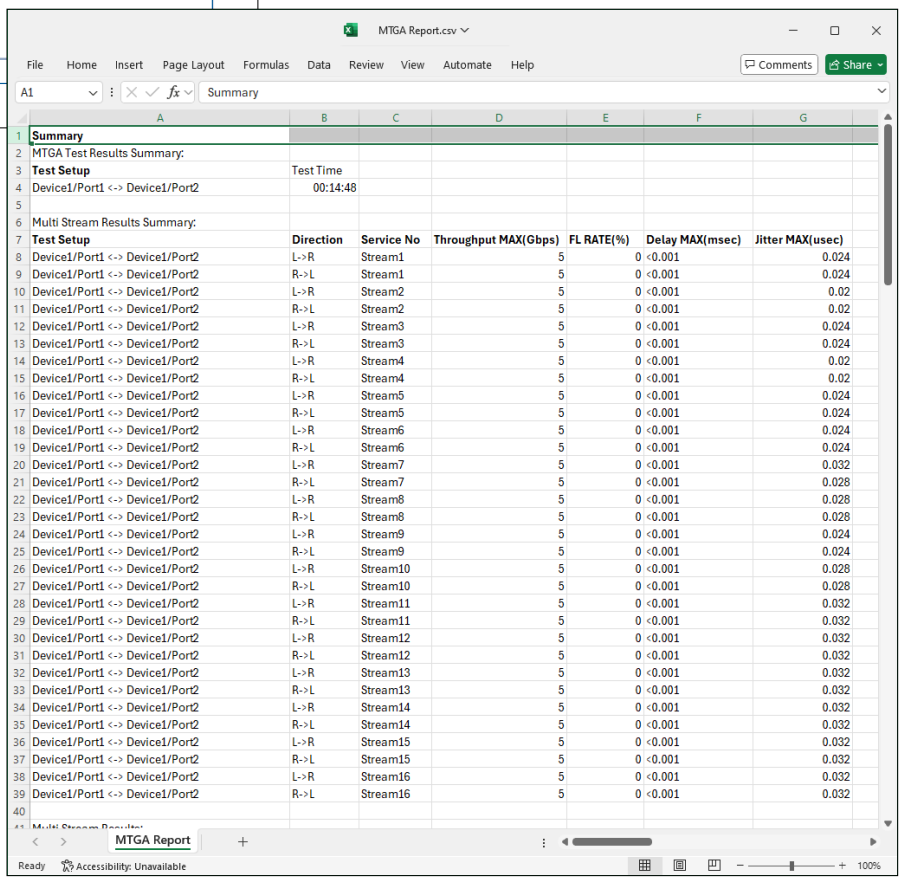
PacketExpert Report

PacketExpert 100G MTGA Report

Conducted By :	Testers
Customer Name :	GL Communications
Operator Name :	Admin
Software Version :	24.9.3.0
Time Zone :	Eastern Standard Time
Start Date :	09-10-2024 07:10:55
End Date :	09-10-2024 07:10:55
Test Duration :	00:00:01
Test :	MTGA

Comments : Multi Stream Traffic Generator and Analyzer Report

Figure: PDF Report Sample



MTGA Report.csv

File Home Insert Page Layout Formulas Data Review View Automate Help Comments Share

A1 Summary

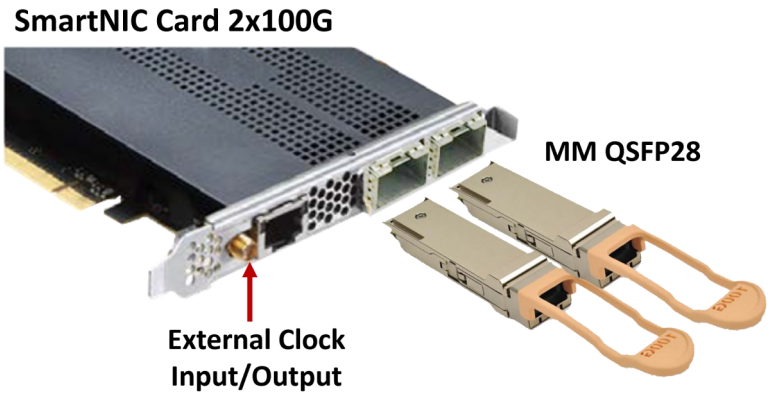
	A	B	C	D	E	F	G
1	**Summary**						
2	MTGA Test Results Summary:						
3	**Test Setup**	Test Time					
4	Device1/Port1 <-> Device1/Port2	00:14:48					
5							
6	Multi Stream Results Summary:						
7	**Test Setup**	**Direction**	**Service No**	**Throughput MAX(Gbps)**	**FL RATE(%)**	**Delay MAX(msec)**	**Jitter MAX(usec)**
8	Device1/Port1 <-> Device1/Port2	L->R	Stream1	5	0	<0.001	0.024
9	Device1/Port1 <-> Device1/Port2	R->L	Stream1	5	0	<0.001	0.024
10	Device1/Port1 <-> Device1/Port2	L->R	Stream2	5	0	<0.001	0.02
11	Device1/Port1 <-> Device1/Port2	R->L	Stream2	5	0	<0.001	0.02
12	Device1/Port1 <-> Device1/Port2	L->R	Stream3	5	0	<0.001	0.024
13	Device1/Port1 <-> Device1/Port2	R->L	Stream3	5	0	<0.001	0.024
14	Device1/Port1 <-> Device1/Port2	L->R	Stream4	5	0	<0.001	0.02
15	Device1/Port1 <-> Device1/Port2	R->L	Stream4	5	0	<0.001	0.02
16	Device1/Port1 <-> Device1/Port2	L->R	Stream5	5	0	<0.001	0.024
17	Device1/Port1 <-> Device1/Port2	R->L	Stream5	5	0	<0.001	0.024
18	Device1/Port1 <-> Device1/Port2	L->R	Stream6	5	0	<0.001	0.024
19	Device1/Port1 <-> Device1/Port2	R->L	Stream6	5	0	<0.001	0.024
20	Device1/Port1 <-> Device1/Port2	L->R	Stream7	5	0	<0.001	0.032
21	Device1/Port1 <-> Device1/Port2	R->L	Stream7	5	0	<0.001	0.028
22	Device1/Port1 <-> Device1/Port2	L->R	Stream8	5	0	<0.001	0.028
23	Device1/Port1 <-> Device1/Port2	R->L	Stream8	5	0	<0.001	0.028
24	Device1/Port1 <-> Device1/Port2	L->R	Stream9	5	0	<0.001	0.024
25	Device1/Port1 <-> Device1/Port2	R->L	Stream9	5	0	<0.001	0.024
26	Device1/Port1 <-> Device1/Port2	L->R	Stream10	5	0	<0.001	0.028
27	Device1/Port1 <-> Device1/Port2	R->L	Stream10	5	0	<0.001	0.028
28	Device1/Port1 <-> Device1/Port2	L->R	Stream11	5	0	<0.001	0.032
29	Device1/Port1 <-> Device1/Port2	R->L	Stream11	5	0	<0.001	0.032
30	Device1/Port1 <-> Device1/Port2	L->R	Stream12	5	0	<0.001	0.032
31	Device1/Port1 <-> Device1/Port2	R->L	Stream12	5	0	<0.001	0.032
32	Device1/Port1 <-> Device1/Port2	L->R	Stream13	5	0	<0.001	0.032
33	Device1/Port1 <-> Device1/Port2	R->L	Stream13	5	0	<0.001	0.032
34	Device1/Port1 <-> Device1/Port2	L->R	Stream14	5	0	<0.001	0.032
35	Device1/Port1 <-> Device1/Port2	R->L	Stream14	5	0	<0.001	0.032
36	Device1/Port1 <-> Device1/Port2	L->R	Stream15	5	0	<0.001	0.032
37	Device1/Port1 <-> Device1/Port2	R->L	Stream15	5	0	<0.001	0.032
38	Device1/Port1 <-> Device1/Port2	L->R	Stream16	5	0	<0.001	0.032
39	Device1/Port1 <-> Device1/Port2	R->L	Stream16	5	0	<0.001	0.032
40							

MTGA Report

Ready Accessibility: Unavailable 100%

Figure: CSV Report Sample

Hardware Specifications



PacketExpert™ 100G SmartNIC

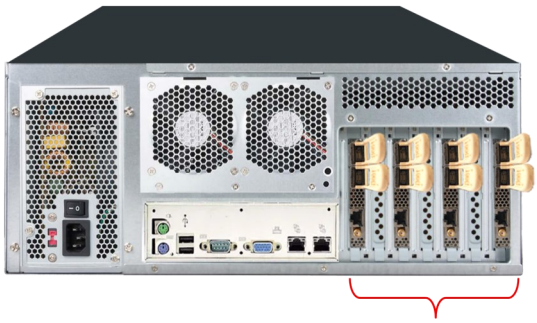
SmartNIC Specifications (Per Card)	
Optical Components	• 2 x QSFP28 cages for 2 x 100 GbE, 2 x 50GbE, and 2 x 40 GbE • Supports 2 x 25 GbE, 2 x 10 GbE, and 2 x 1 GbE with QSFP-to-SFP adapter
PCIe	PCIe Gen 3, 16 lanes
RAM	8 GBytes DDR4 SDRAM
1000Base-T Port	RJ45 for IEEE1588v2
Single-ended Coaxial I/O	SMA connector, 50 Ohms for External Clock Input/Output
Temperature Range	0C to 45C
Operating Humidity	20% to 80%
Storage	-10 to 60C
Oscillator Accuracy	+/- 4.6ppm

Hardware Specifications (*Contd.*)

PacketExpert™ 100G Rackmount Platforms

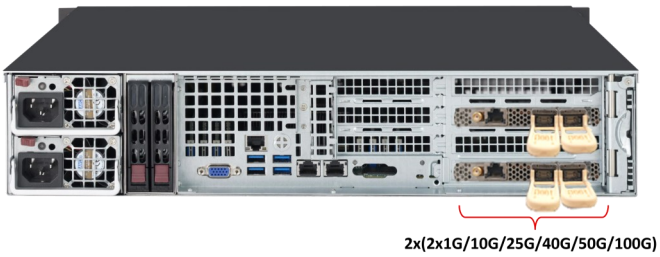
- Ideal for Lab environments that require centralized management of multiple servers and network devices
- Rackmount units offer flexibility for scaling up or down as needed by adding or removing individual units

PacketExpert™ 100G 4U Rack PC



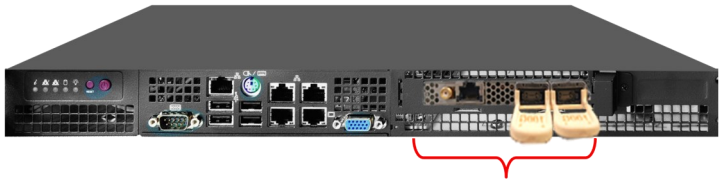
Specifications	
Dimensions	6.9” H x 16.9” W x 17.5” D
Weight	72 lbs.
Number of Supported Cards/Ports	Up to 7 Cards x (2x100G Ports), Maximum of 14 Ports
Power supply	800W

PacketExpert™ 100G 2U Rack PC



Specifications	
Dimensions	3.5” H x 17.2” W x 17.7” D
Weight	30 lbs.
Number of Supported Cards/Ports	Up to 2 Cards x (2x100G Ports), Maximum of 4 Ports
Power supply	800W

PacketExpert™ 100G 1U Rack PC



Specifications	
Dimensions	1.7” H x 17.2” W x 9.8” D
Weight	10 lbs.
Number of Supported Cards/Ports	1 x Full-height 1 Card x (2x100G Ports), Maximum of 2 Ports
Power supply	200W

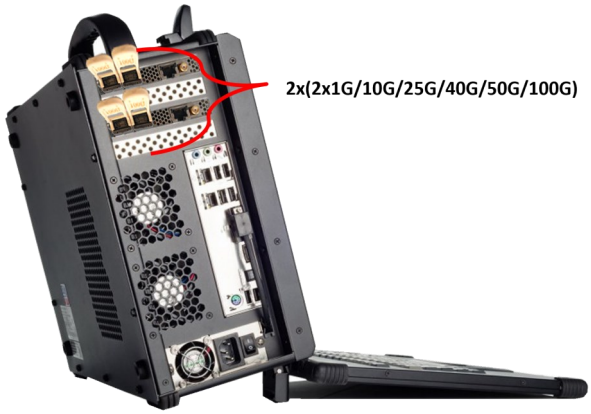
PacketExpert™ 100G Portable Platforms

- Ideal for field engineers, military personnel, or researchers who need a powerful and portable computing solution in remote or rugged locations
- Suitable for environments where traditional desktops or laptops may be too fragile or lack necessary durability

Ultra-Portable PacketExpert™ 100G (Lunchbox)

Specifications	
Dimensions	12.4” H x 16.41” W x 4.39” D
Display	17.3” 1920x1080
Weight	16.5 lbs.
Number of Supported Cards/Ports	Up to 2 Cards x (2x100G Ports), Maximum of 4 Ports
Power supply	400W (optional 500W)

Portable PacketExpert™ 100G (Lunchbox)



Specifications	
Dimensions	13.62” H x 16.50” W x 7.25” D
Display	17.3” 1920x1080
Weight	~23 lbs. (10.4kg)
Number of Supported Cards/Ports	Up to 3 Cards x (2x100G Ports), Maximum of 6 Ports
Power supply	680W 100/240VAC

PacketExpert™ 100G Portable Platform (Lunchbox)

Specifications	
Dimensions	17.06” x 13.67” x 9.02” (H x W x D)
Display	17.3” 1920x1080
Weight	~ 30 lbs.
Number of Supported Cards/Ports	Up to 6 Cards x (2x100G Ports), Maximum of 12 Ports
Power supply	1000W 100-240VAC

Buyer's Guide

Item No	Product Description
PXX100	PacketExpert™ 100G Platform (1G, 10G, 25G), All Port BERT, BERT/Loopback, RFC2544, Y.1564, MTGA
PXX101	Basic Software (Required for PXX100)
PXX103	Additional 2-port card with Basic Software (Up to 4, 2-Port Cards (including the basic 2-Port Card) total per system for 8-Port testing; required for PXX107)
PXX105	40G, 50G, 100G Optional Software
PXX106	PacketExpert™ 100 G – One card / 2 Port Platform with MM Kit
PXX107	PacketExpert™ 100G - Two Card / 4 Port Portable Platform
PXX108	PacketExpert™ 100 G – One card / 2 Port Platform with SM Kit
PXX109	Optional Software for CLI Support
PXX110	PacketExpert™ 100 G - Two Card / 4 Port Platform with SM Kit
PXX10X	PacketExpert 100 G – 4 Card Platform / 8 Port Platform
Item No	**Related Hardware and Software**
PXN100	PacketExpert™ 10GX
PXN101	10G option for PXN100

Note: PCs which include GL hardware/software require Intel or AMD processors for compliance.

For more information, visit PacketExpert™ 100G- Comprehensive Ethernet/IP Testing Solution webpage.

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