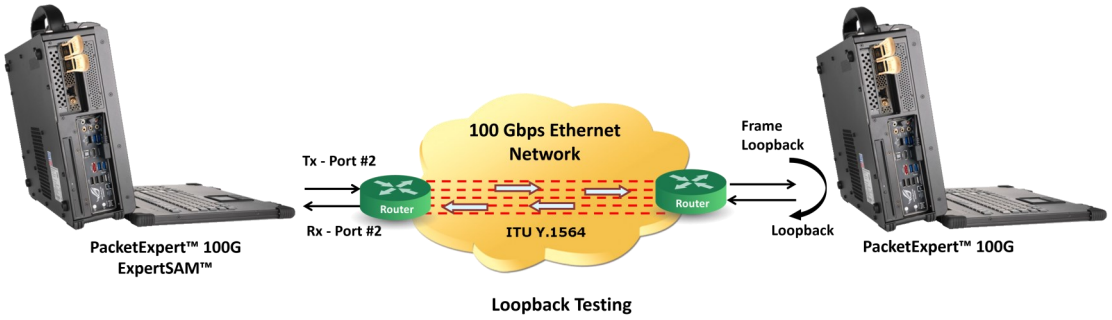
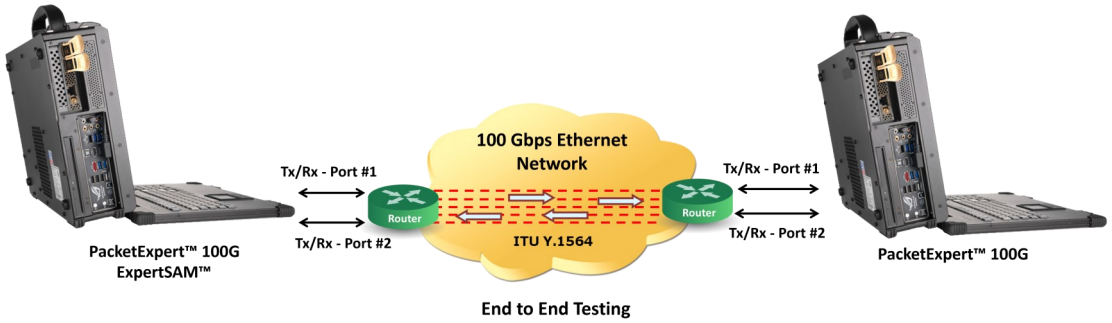
ExpertSAM™ - PacketExpert™ 100G

Validate Ethernet Service Level Agreements per ITU-T Y.1564



Loopback Testing



End to End Testing

Overview

GL's **ExpertSAM™** is a basic application available within the PacketExpert™ 100G. ExpertSAM™ is designed for multiservice applications to measure the maximum performance of a Device or the Network Under Test. It consists of a set of procedures that assess the capability of Ethernet-based services to handle various types of traffic (voice, data, and video) at specified performance levels. Specifically, it aims to overcome the limitations of traditional RFC 2544 test procedures, particularly in the context of Service Level Agreements (SLA).

In ExpertSAM™ test methodology Bandwidth CIR/EIR/Overshoot traffic, Frame Loss, Frame Delay and Frame Delay Variation are measured and compared to the expected values for each service ensuring it is within its committed range or the threshold defined for guaranteed traffic such as CIR (Committed Information Rate).

For more information, please visit PacketExpert™ - ExpertSAM™ (ITU-T Y.1564) webpage.

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
- Each port supports up to 16 streams, allowing the device to handle a total of 32 services with varying performance requirements under full load conditions.
- Supported EMIX (Ether MIX) frame sizes up to 5 frame sizes per service
- Support for frame lengths from 64 bytes to Jumbo frames (up to 16000 bytes)
- Information Rate (IR) or Throughput, Frame Loss Ratio (FLR), Frame Transfer Delay (FTD) or Latency, and Frame Delay Variation (FDV) or Jitter, measured simultaneously for multi streams, and Pass/Fail verdict declared
- Simultaneous validation of all the services for quality over the time
- Test automation and regression testing via Python and REST APIs

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ITU-T Y.1564 ExpertSAM™

The ITU-T Y.1564 is based on two primary subtests: the Service Configuration Test and the Service Performance Test.

- **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 confirming all traffic is able to transverse the network under full load with the SLA parameters.

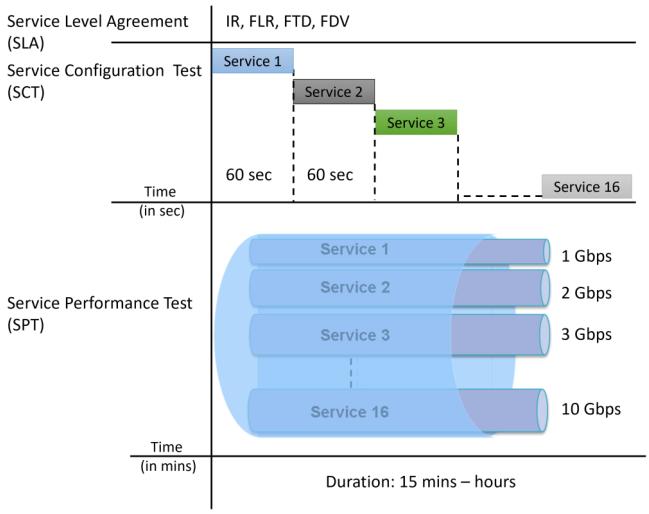


Figure: Working Principle

Service Configuration

The Service Configuration Summary provides a quick overview of all the configured parameters, allowing users to view the settings at a glance. Each Service can be configured for various attributes like the Frame Size(s), Header Parameters (including VLAN Tag Information), the Bandwidth profile (CIR, EIR and Policing Rates), Color Method and Service Level Agreements (SLA) parameters.

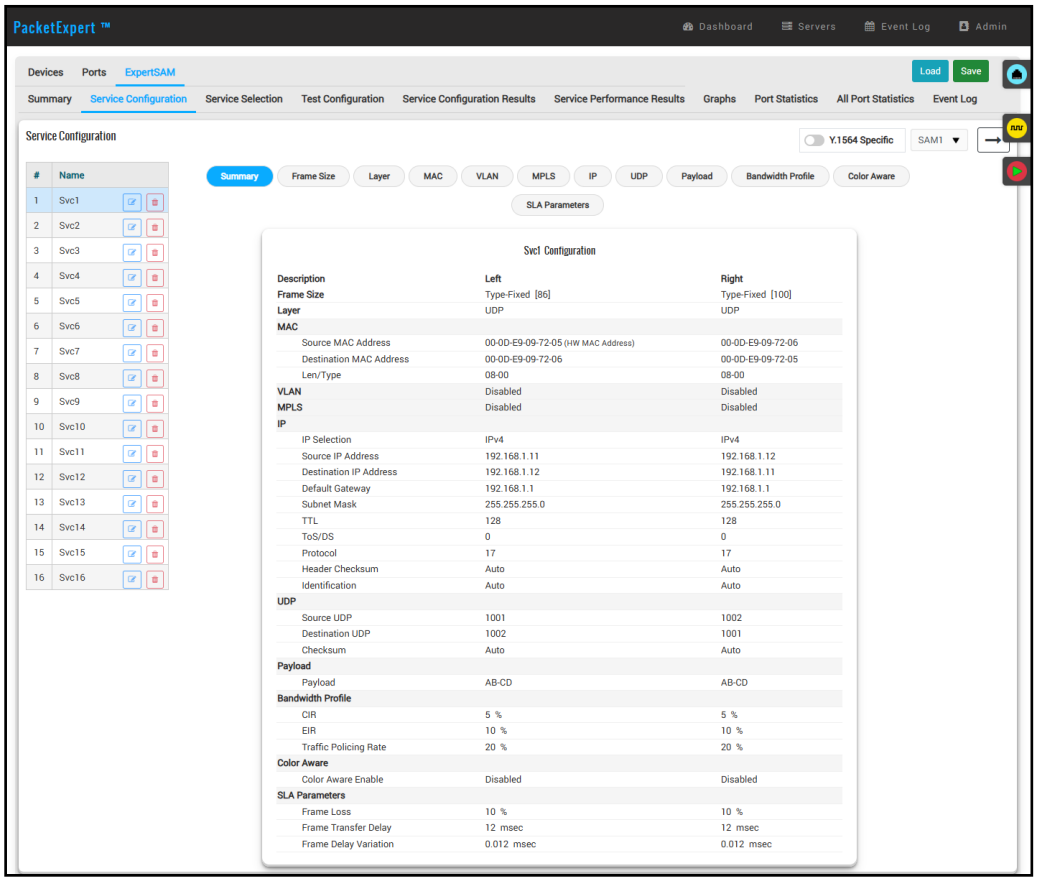


Figure: Service Configuration Summary

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 two byte VLAN segment Tag Control Information (TCI) includes 3 bit Carry Priority Information (PCP) field which indicates traffic priorities, which the user can configure.

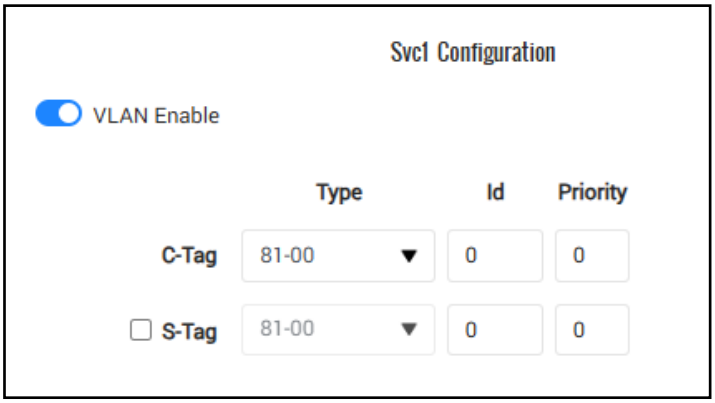
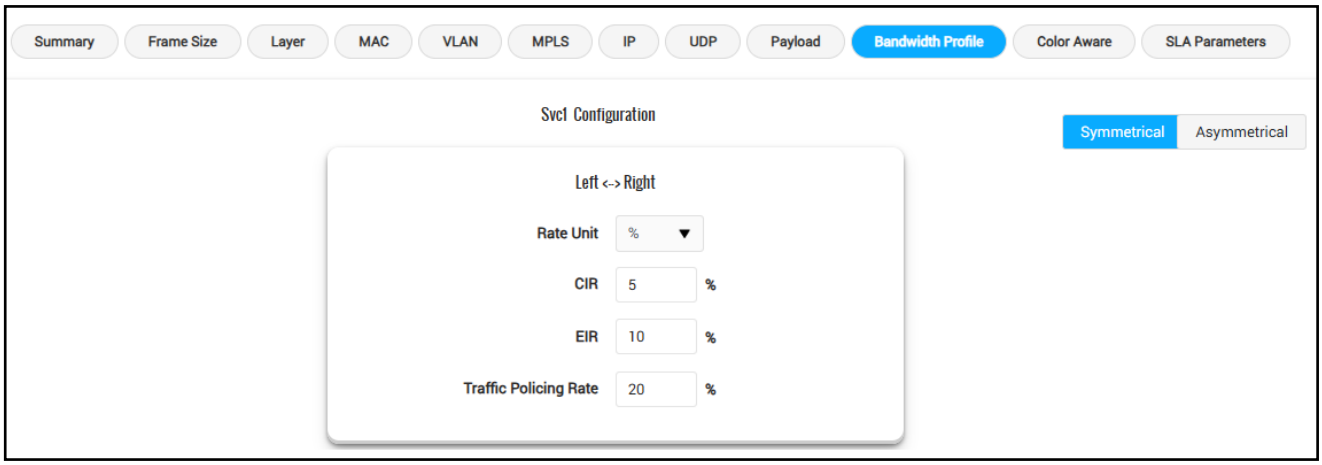


Figure: VLAN C-Tag Configuration

Bandwidth (BW) Profile Configuration

Customer traffic is classified into three classes, and each is assigned a specific color:

- **Committed information rate (CIR), or green traffic:** guaranteed bandwidth available at all times for a specific service
- **Excess information rate (EIR), or yellow traffic:** excess bandwidth above CIR that may be available depending on network usage
- **Traffic Policing, or yellow traffic:** traffic exceeding the CIR or CIR/EIR rate that cannot be forwarded without impacting other services is classified as yellow traffic and is subsequently discarded.



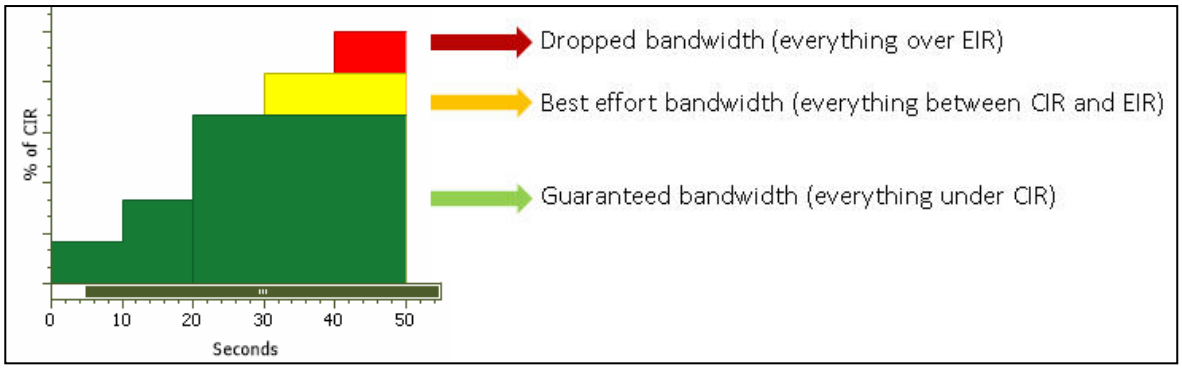


Figure: Bandwidth Profile Configuration

VLAN C-Tag Color Method Configuration

Color aware is a bandwidth profile property where a pre-determined level of bandwidth profile compliance for each service frame is taken into account when determining the level of compliance for each service frame.

The VLAN C-Tag PCP field is assigned priority level from 1 to 4 to be considered as green frames equivalent to CIR and priority level from 5 to 7 to be considered as yellow frames equivalent to EIR.

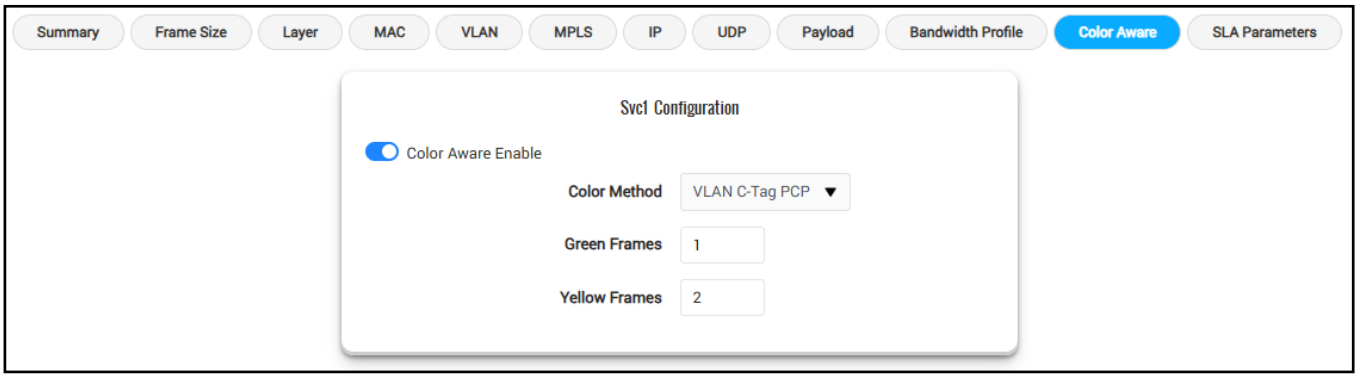


Figure: VLAN C-Tag PCP Color Method Configuration

SLA Parameter Configuration

The SLA (Service Level Agreement) defines the requirements for the network path under test, including Frame Transfer Delay (FTD), Frame Delay Variation (FDV), and Frame Loss Ratio (FLR).

- **FLR**: FLR parameter is typically expressed as a ratio, this is a measurement of the number of packets lost over the total number of packets sent. The Parameter is configured in % units.
- **FTD**: FTD parameter is also known as latency, this is a measurement of the time delay between the transmission and the reception of a frame. The parameter is configured in msec units.
- **FDV**: FDV parameter is also known as packet jitter, this is a measurement of the variations in the time delay between packet deliveries. The parameter is configured in msec units.

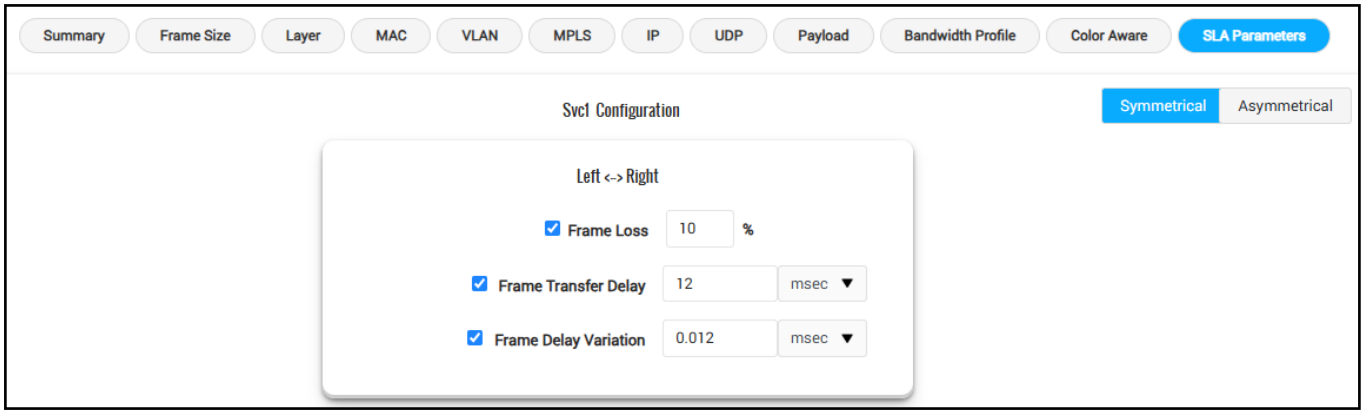


Figure: SLA Parameter Configuration

Service Selection

Service selection enables user to choose any configured service or all available services (up to 16) for testing. The SLA parameters are measured and compared to the configured values for each service to validate the guaranteed traffic. Additionally, users can modify the necessary configurations as needed.

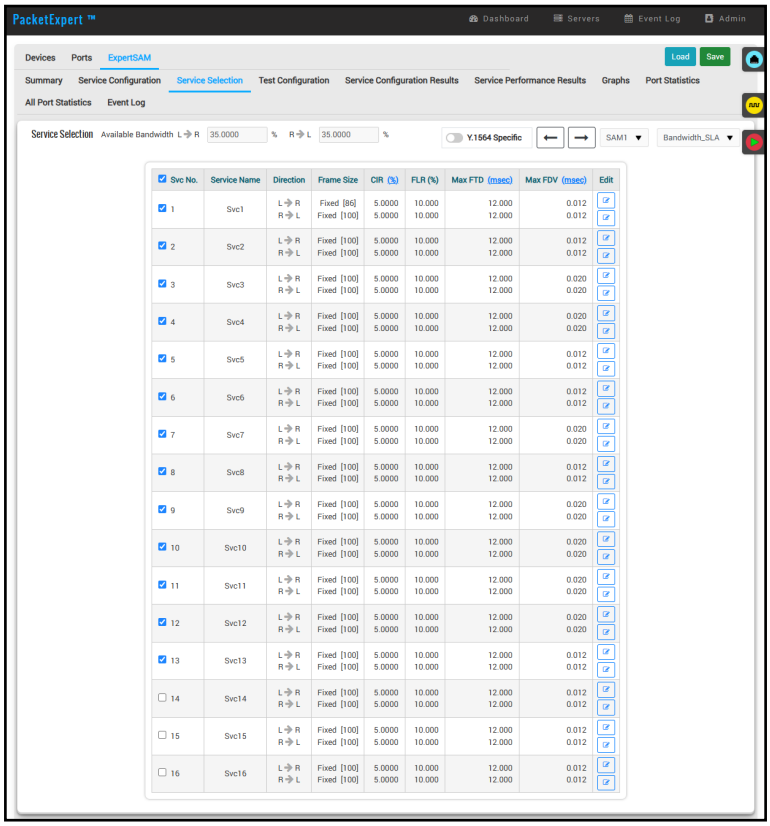


Figure: Service Selection

Test Configuration

CIR, EIR and Traffic Policing are the three phases of Service Configuration Test performed per service sequentially, which can be configured in steps. The Service Configuration step is executed for each service within the specified step duration.

Once the configuration of each service is validated, the service performance test simultaneously validates the quality of all the services over the specified time duration.

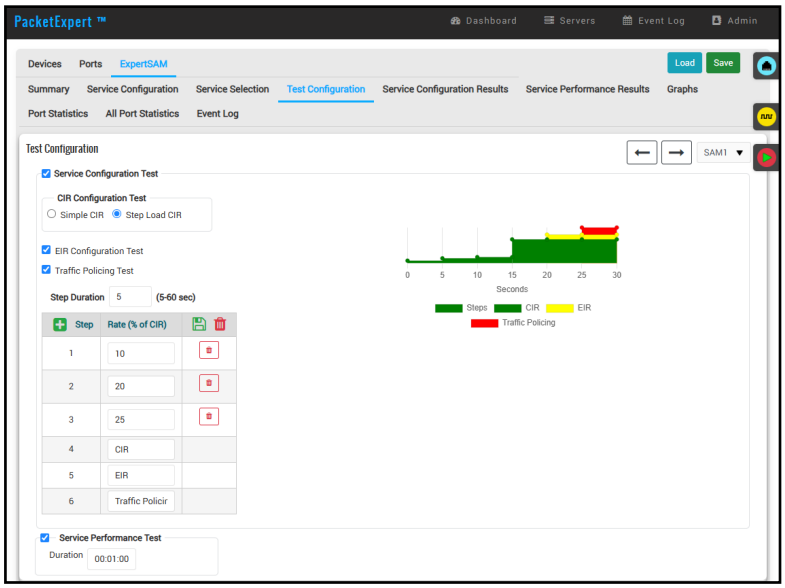
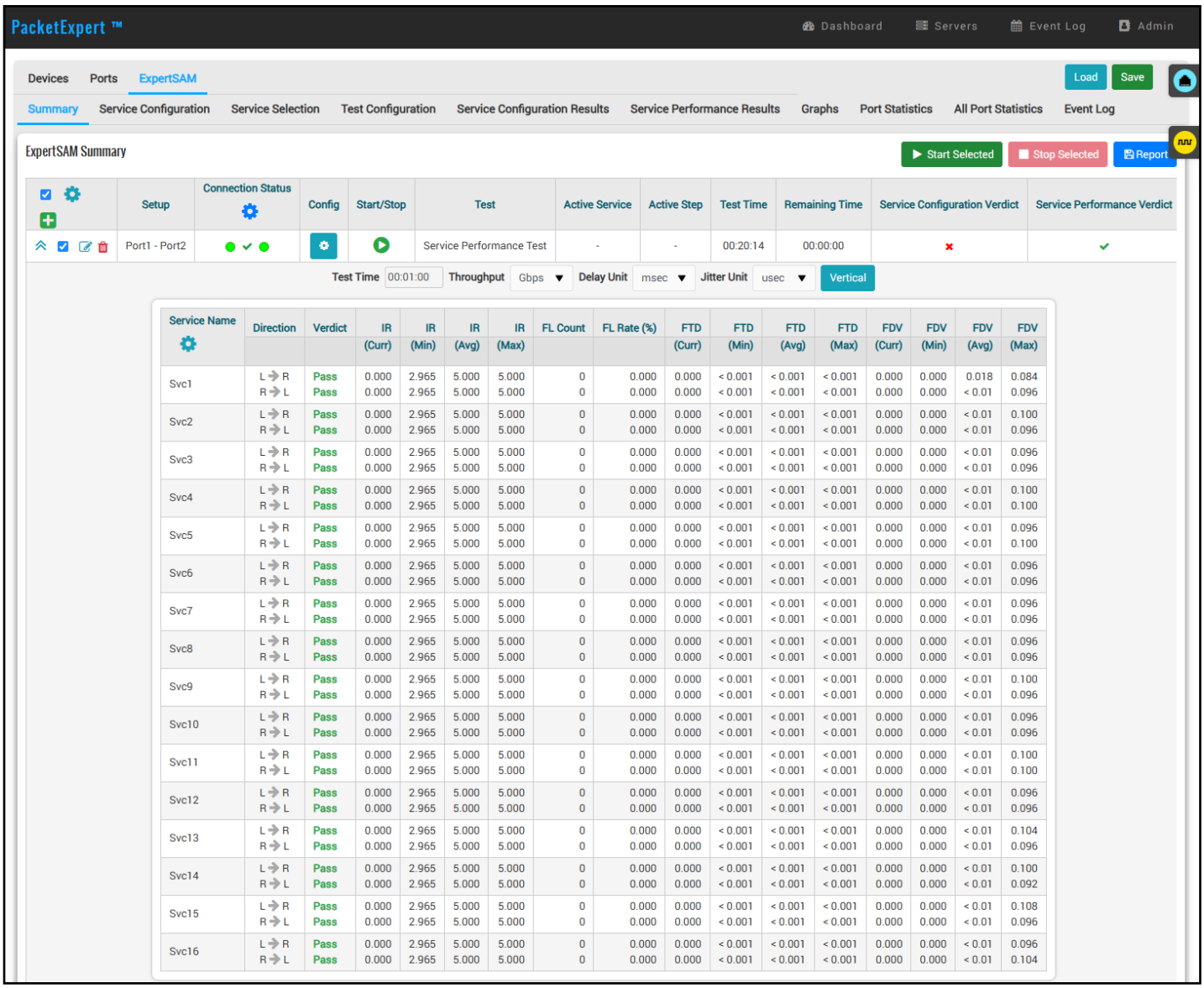


Figure: Test Configuration

Results

Result Summary:

The result summary offers a quick view of the test's overall outcome and status.



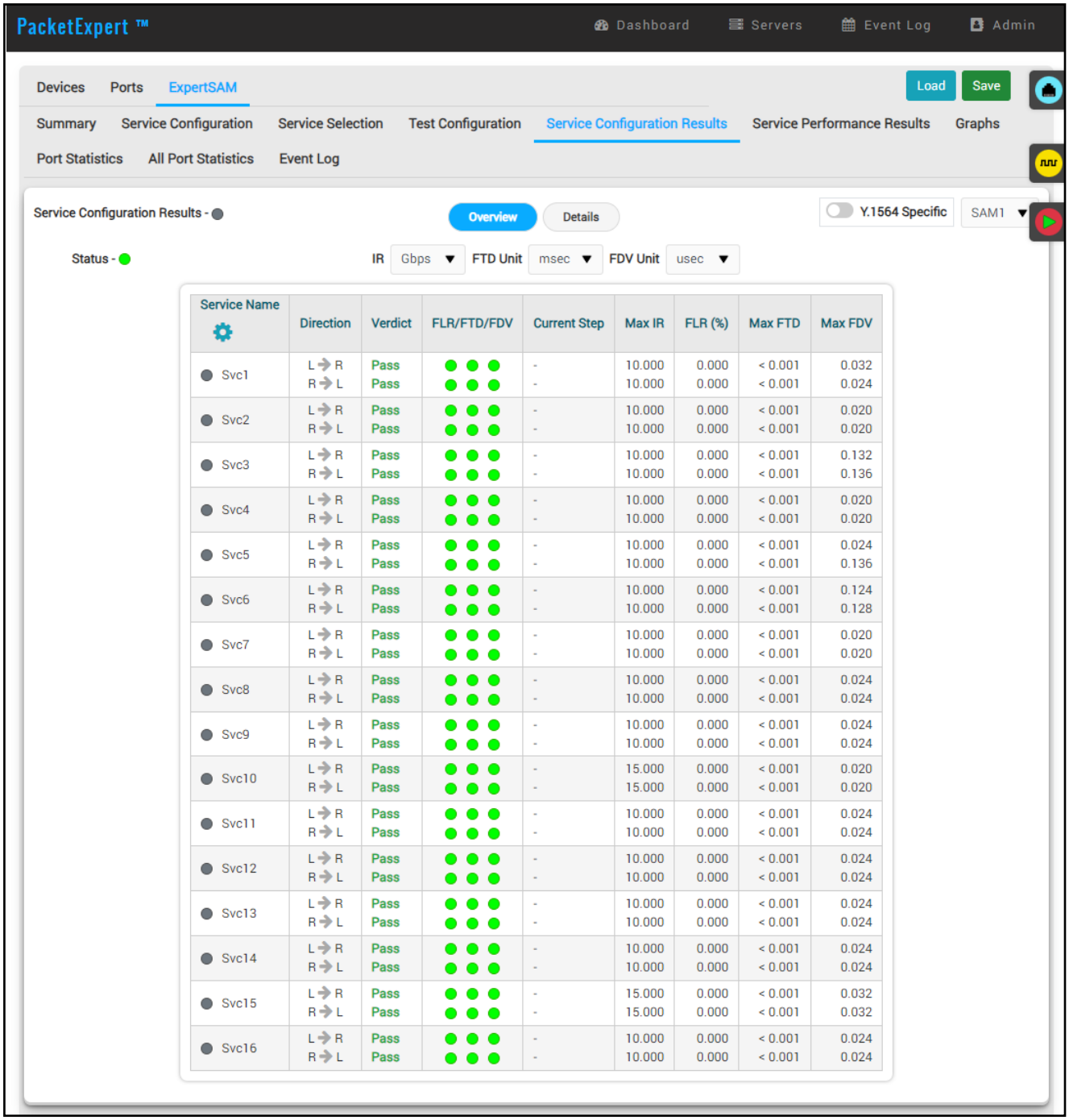
Service Name	Direction	Verdict	IR (Curr)	IR (Min)	IR (Avg)	IR (Max)	FL Count	FL Rate (%)	FTD (Curr)	FTD (Min)	FTD (Avg)	FTD (Max)	FDV (Curr)	FDV (Min)	FDV (Avg)	FDV (Max)
Svc1	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	0.018	0.084
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
Svc2	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.100
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
Svc3	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
Svc4	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.100
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.100
Svc5	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.100
Svc6	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
Svc7	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
Svc8	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
Svc9	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.100
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
Svc10	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
Svc11	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.100
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.100
Svc12	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
Svc13	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.104
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
Svc14	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.100
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.092
Svc15	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.108
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
Svc16	L→R	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.096
	R→L	Pass	0.000	2.965	5.000	5.000	0	0.000	0.000	< 0.001	< 0.001	< 0.001	0.000	0.000	< 0.01	0.104

Figure: General Port Statistics

Service Configuration Test Results

The Service Configuration Results Overview pane displays the Service Name for which the test is running, the Verdict of the configuration test, Current Step of the service (CIR/EIR/Traffic Policing), Max IR (Mbps), FLR (%), Max FTD (msec), and Max FDV (msec) parameters for each configured service.

Each Service Configuration test result is detailed with IR (Mbps), FLR (%), FTD (msec), and FDV (msec) parameter measurement display. For each measured parameter, the min, mean and max values are displayed. Green and Yellow frames measurements are provided separately (for Color Aware mode). The verdict for each step for each service is reported after the completion of the test.

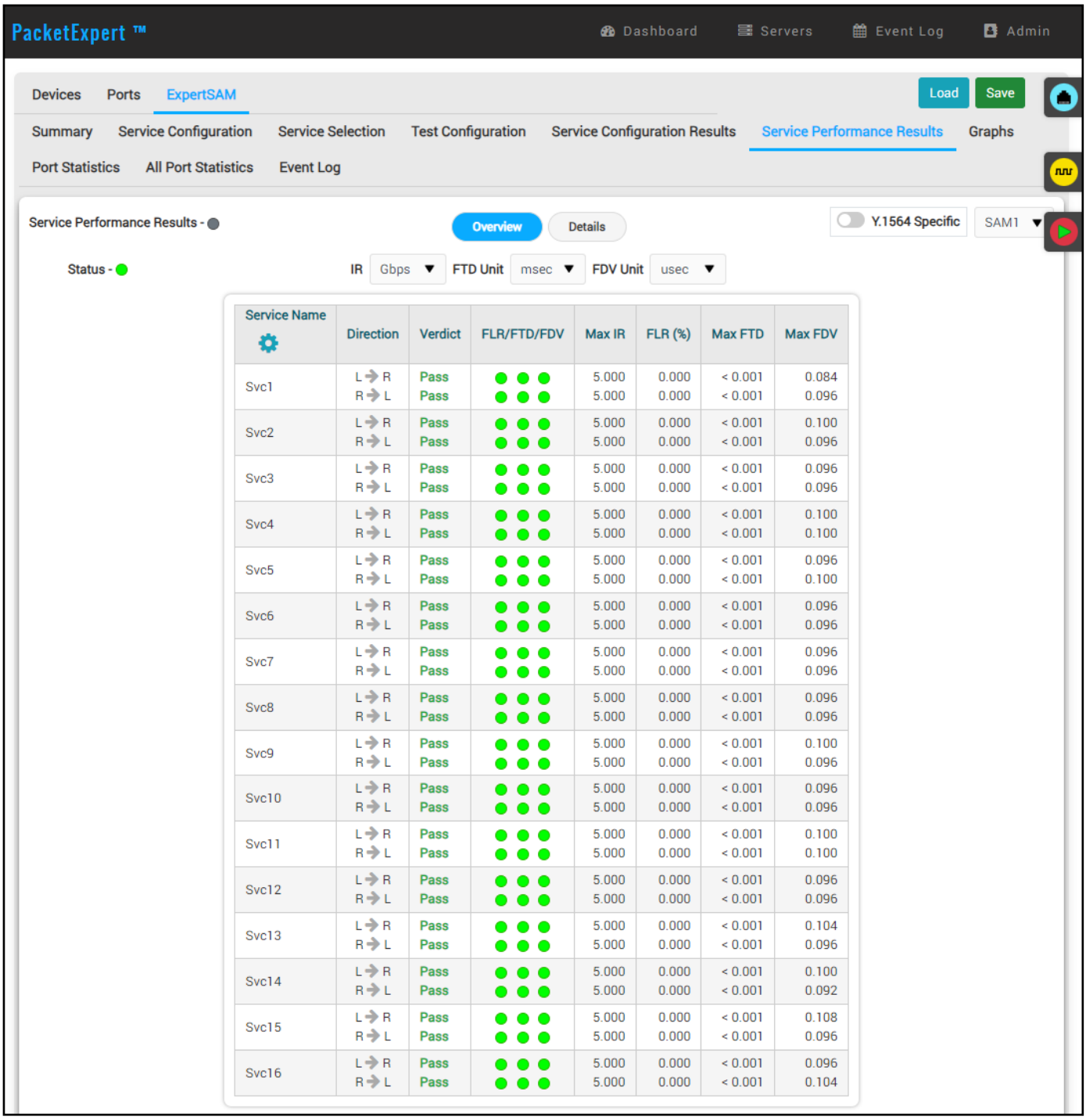


Service Name	Direction	Verdict	FLR/FTD/FDV	Current Step	Max IR	FLR (%)	Max FTD	Max FDV
Svc1	L → R	Pass		-	10.000	0.000	< 0.001	0.032
	R → L	Pass		-	10.000	0.000	< 0.001	0.024
Svc2	L → R	Pass		-	10.000	0.000	< 0.001	0.020
	R → L	Pass		-	10.000	0.000	< 0.001	0.020
Svc3	L → R	Pass		-	10.000	0.000	< 0.001	0.132
	R → L	Pass		-	10.000	0.000	< 0.001	0.136
Svc4	L → R	Pass		-	10.000	0.000	< 0.001	0.020
	R → L	Pass		-	10.000	0.000	< 0.001	0.020
Svc5	L → R	Pass		-	10.000	0.000	< 0.001	0.024
	R → L	Pass		-	10.000	0.000	< 0.001	0.136
Svc6	L → R	Pass		-	10.000	0.000	< 0.001	0.124
	R → L	Pass		-	10.000	0.000	< 0.001	0.128
Svc7	L → R	Pass		-	10.000	0.000	< 0.001	0.020
	R → L	Pass		-	10.000	0.000	< 0.001	0.020
Svc8	L → R	Pass		-	10.000	0.000	< 0.001	0.024
	R → L	Pass		-	10.000	0.000	< 0.001	0.024
Svc9	L → R	Pass		-	10.000	0.000	< 0.001	0.024
	R → L	Pass		-	10.000	0.000	< 0.001	0.024
Svc10	L → R	Pass		-	15.000	0.000	< 0.001	0.020
	R → L	Pass		-	15.000	0.000	< 0.001	0.020
Svc11	L → R	Pass		-	10.000	0.000	< 0.001	0.024
	R → L	Pass		-	10.000	0.000	< 0.001	0.024
Svc12	L → R	Pass		-	10.000	0.000	< 0.001	0.024
	R → L	Pass		-	10.000	0.000	< 0.001	0.024
Svc13	L → R	Pass		-	10.000	0.000	< 0.001	0.024
	R → L	Pass		-	10.000	0.000	< 0.001	0.024
Svc14	L → R	Pass		-	10.000	0.000	< 0.001	0.024
	R → L	Pass		-	10.000	0.000	< 0.001	0.024
Svc15	L → R	Pass		-	15.000	0.000	< 0.001	0.032
	R → L	Pass		-	15.000	0.000	< 0.001	0.032
Svc16	L → R	Pass		-	10.000	0.000	< 0.001	0.024
	R → L	Pass		-	10.000	0.000	< 0.001	0.024

Figure: Service Configuration Test Result- Overview

Service Performance Test Results

Once the configuration of each service is validated, the service performance test simultaneously validates the quality of all the services over time. The service performance results display includes all Key Performance Indicators (KPIs) parameter results for each service - IR, FLR, FTD, FDV (Current, Minimum, Mean, & Maximum).



Service Name	Direction	Verdict	FLR/FTD/FDV	Max IR	FLR (%)	Max FTD	Max FDV
Svc1	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.084 0.096
Svc2	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.100 0.096
Svc3	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.096 0.096
Svc4	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.100 0.100
Svc5	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.096 0.100
Svc6	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.096 0.096
Svc7	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.096 0.096
Svc8	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.096 0.096
Svc9	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.100 0.096
Svc10	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.096 0.096
Svc11	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.100 0.100
Svc12	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.096 0.096
Svc13	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.104 0.096
Svc14	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.100 0.092
Svc15	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.108 0.096
Svc16	L→R R→L	Pass Pass	● ● ● ● ● ●	5.000 5.000	0.000 0.000	< 0.001 < 0.001	0.096 0.104

Figure: Service Performance Test Result - ()

Port Statistics

Detailed statistics per port are provided, parameters include Frame Count, Frame Rate, Link Utilization, others are provided based on various categories like 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 also displayed for the configured stacks.

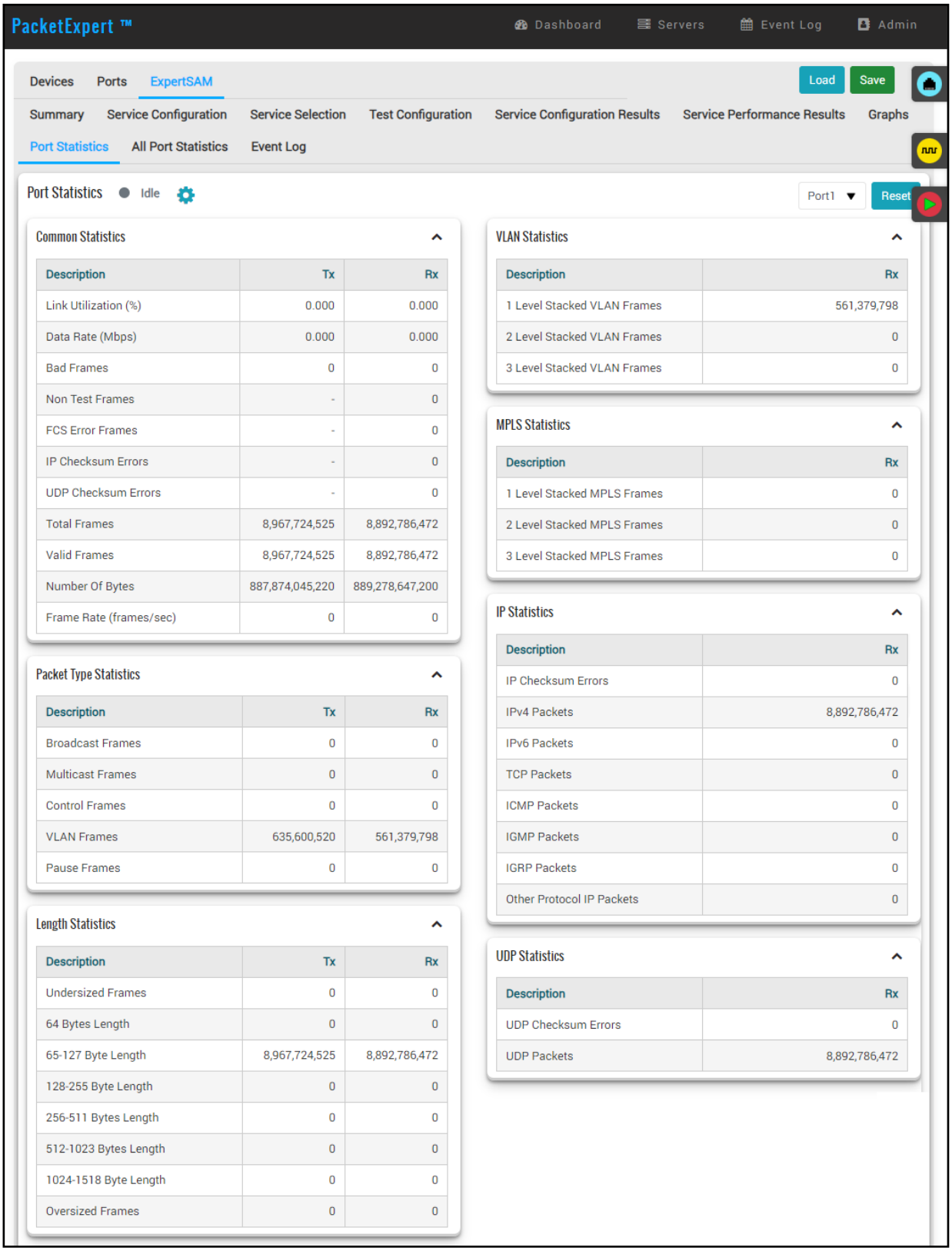


Figure: General Port Statistics

Graph

The graph illustrates test results for IR/FTD/FDV/Frame Loss with each of the 16 services represented by a unique color. Users can choose individual tests to view the corresponding graphs.

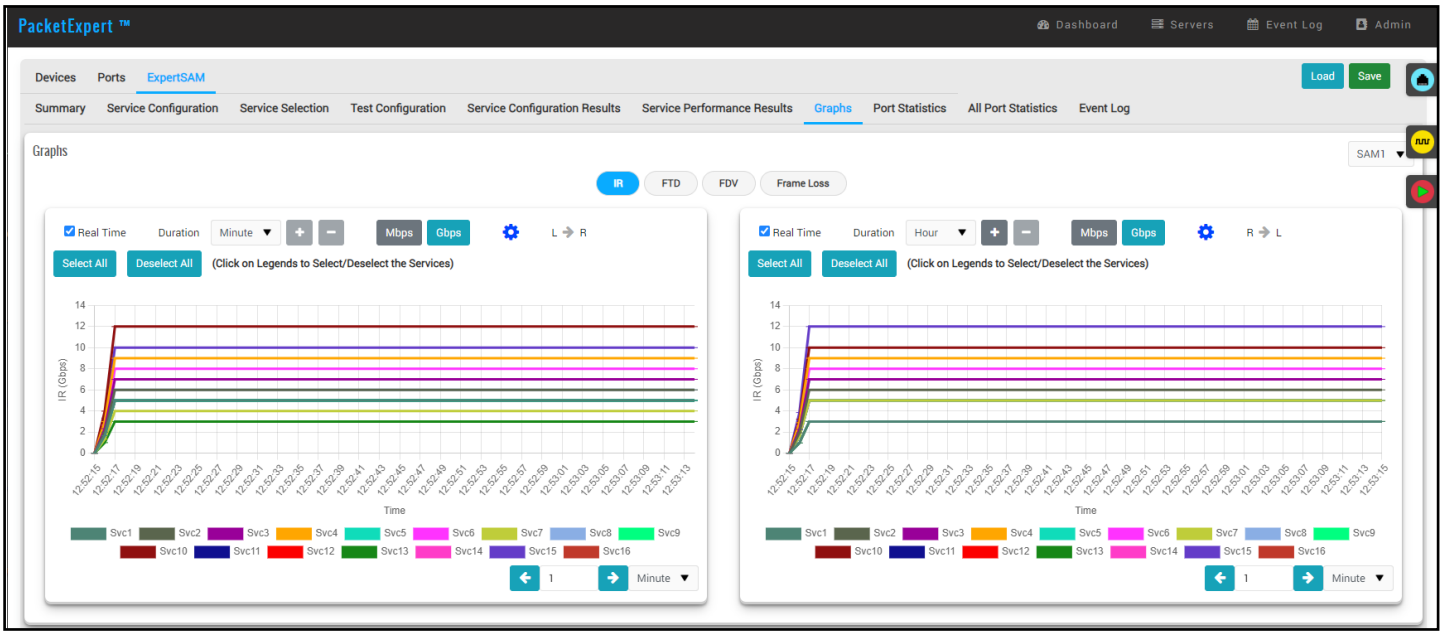


Figure: IR Graph

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.

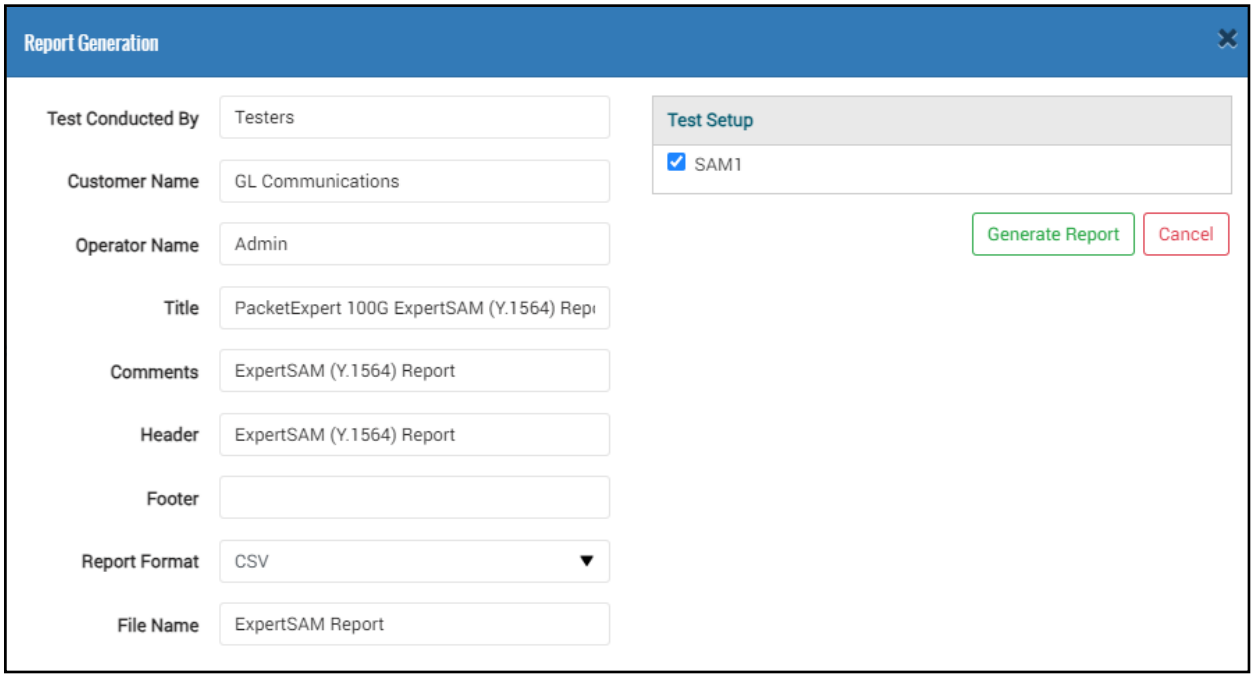
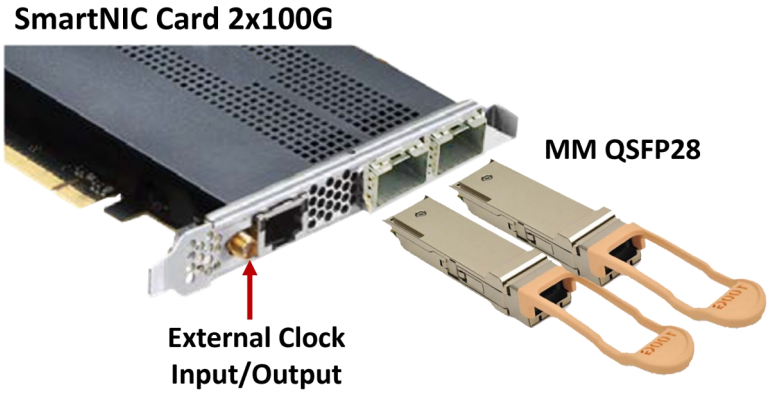


Figure: Report Generation

Hardware Specifications



PacketExpert™ 100G SmartNIC

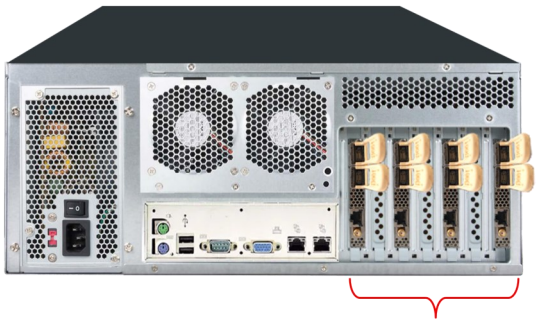
SmartNIC Specifications (Per Card)	
Optical Components	• 2 x QSFP28 cages for 2 x 100 GbE, 2 x 50GbE, and 2 x 40 GbE • Supports 2 x 25 GbE, 2 x 10 GbE, and 2 x 1 GbE with QSFP-to-SFP adapter
PCIe	PCIe Gen 3, 16 lanes
RAM	8 GBytes DDR4 SDRAM
1000Base-T Port	RJ45 for IEEE1588v2
Single-ended Coaxial I/O	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

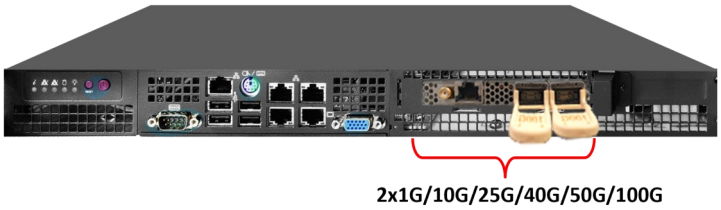


Specifications	
Dimensions	6.9” H x 16.9” W x 17.5” D
Weight	72 lbs.
Number of Supported Cards/Ports	Up to 7 Cards x (2x100G Ports), Maximum of 14 Ports
Power supply	800W

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

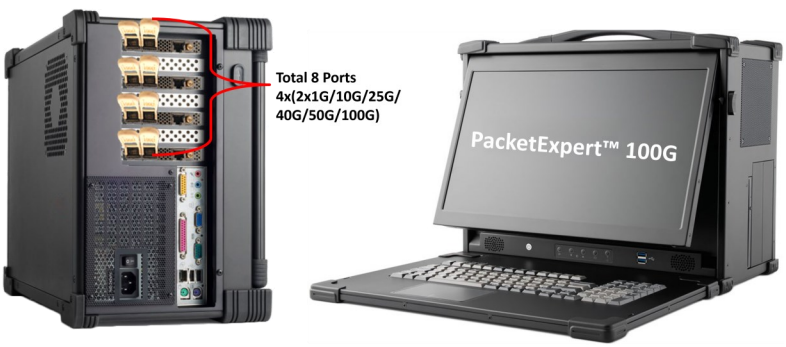
Ultra-Portable PacketExpert™ 100G (Lunchbox)

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
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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