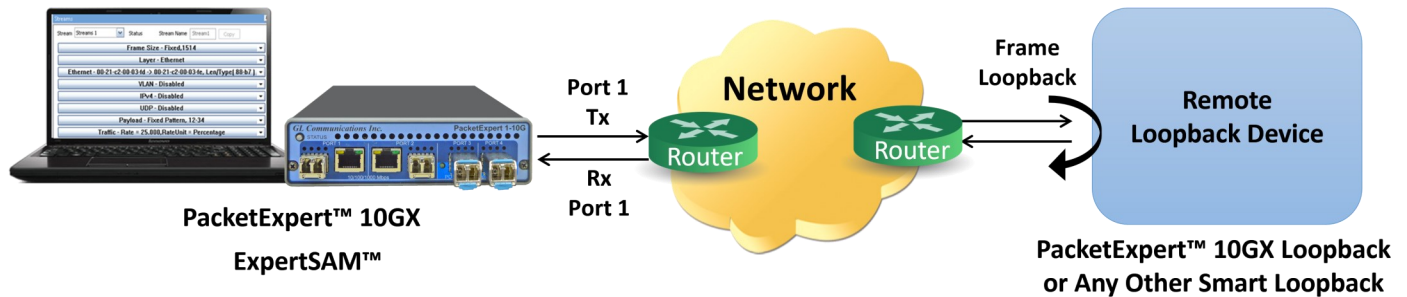


ExpertSAM™ - PacketExpert™ 10GX

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



Overview

The [ExpertSAM \(ITU-T Y.1564\)](#) is a basic application available within the [PacketExpert™ 10GX](#) (PXN100) platform. **ExpertSAM** is designed for multiservice testing to measure the maximum performance of the Device or the Network Under Test. ExpertSAM is a set of procedures that test the ability of Ethernet-based services to carry a variety of traffic (voice, data, and video) at defined performance levels. In particular, it is aimed at addressing limitations of legacy RFC 2544 test procedures, especially for 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).

PacketExpert™ 10GX (PXN100) has two 10/1 Gbps Optical/Electrical ports, two 1000 Mbps Electrical/Optical ports. The 10 Gbps ports can be down-shifted to 1Gbps using Electrical to SFP transceivers, thus offering all 4 Electrical/Optical 1G ports for testing. The same two 10 Gbps ports can also be converted to 2.5 Gbps ports with appropriate SFP. It requires additional **PXN101** license installation to run the tests on 10G and 2.5G ports. PacketExpert™ 10GX is available in portable as well as mTOP™ rack-mount platforms. Each GigE port provides independent Ethernet/IP testing at wire speed for applications such as BERT, RFC 2544, SmartLoopback, ExpertSAM™, Record Playback, PacketBroker, Multi-stream Traffic Generator and Analyzer and ExpertTCP™.

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
- Supports multiple services (up to 16 services) with varying performance requirements that meets full load conditions
- KPIs like 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
- 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
- Support for frame lengths from 64 bytes to Jumbo frames (up to 16000 bytes)
- 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
- EMIX (Ether MIX) frame sizes supported per service – up to 5 frame sizes can be defined per service
- 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
- Command Line Interface for automated testing and remote accessibility
- With PXN101 licensing, the unit supports testing on 10G optical ports



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ITU-T Y.1564 ExpertSAM™

The ITU-T Y.1564 is built around two key 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.

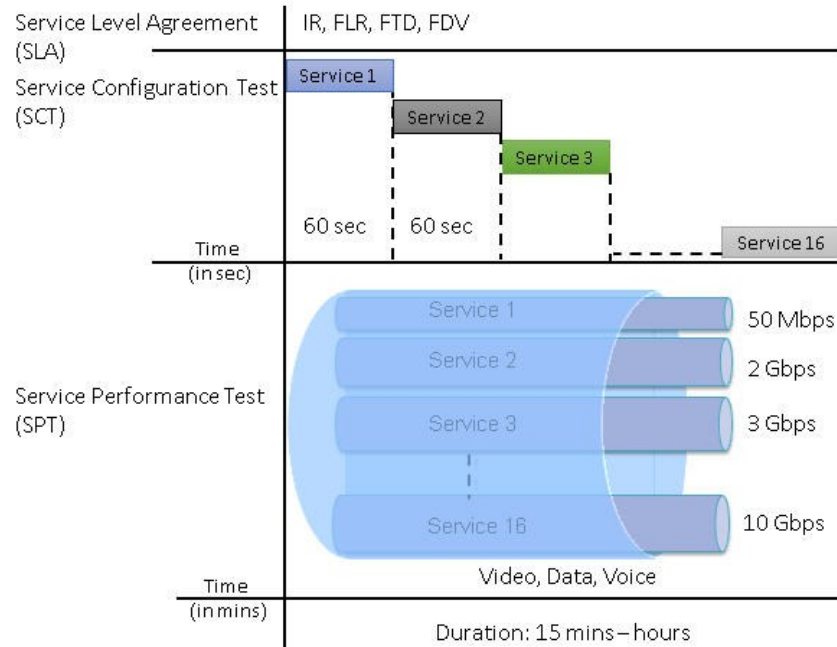


Figure: Working Principle

Service Configuration

The Service configuration summary can be viewed at a glance by collapsing the configuration panes.

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 Acceptance Criteria (SAC) parameters.

The screenshot shows the 'Services' configuration window. At the top, there is a 'Service' dropdown menu set to 'Services 1' and a 'Copy' button. Below this, there are several configuration parameters, each with a dropdown arrow:

- Frame Size - Fixed, 512
- Layer - Ethernet, VLAN, IPv4, UDP
- Ethernet - 00-21-c2-00-2c-80 -> 00-00-00-00-01-01, Len/Type[08-00]
- VLAN - C-Tag, S-Tag
- IPv4 - 192.168.1.11 -> 192.168.1.12 Protocol (UDP)
- UDP - 1101 -> 1201
- Payload - Fixed Pattern, 12-34
- BW Profile - CIR = 60.000 Mbps, EIR = 80.000 Mbps, Policing Rate = 100.000
- Color Aware = On, Color Method = VLAN S-Tag PCP
- SAC Parameters - FLR = 1.000 %, FTD = 5.000 msec, FDV = 5.000 msec

Figure: Service 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 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 red traffic: traffic above the CIR or the CIR/EIR rate, and that cannot be forwarded without disrupting other services; red traffic is therefore discarded

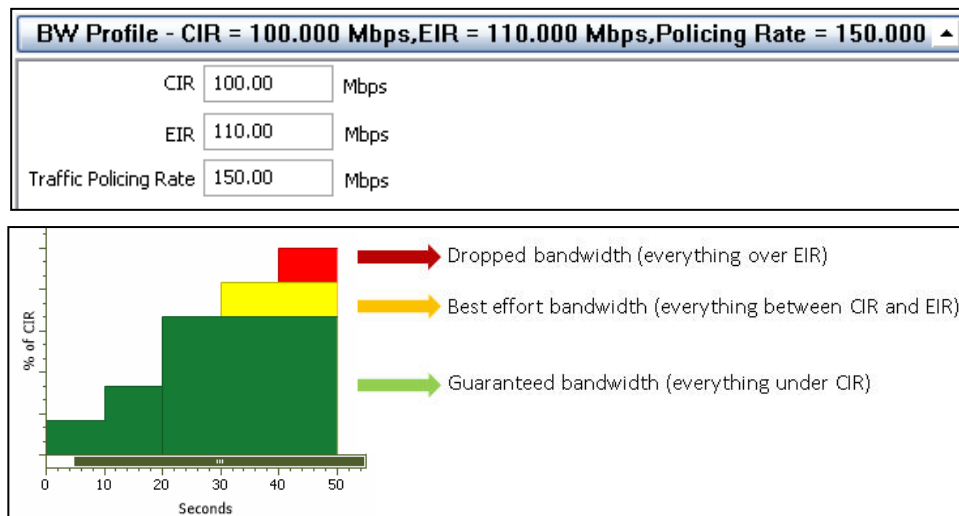


Figure: Bandwidth Profile Configuration

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

SAC Parameter Configuration

SAC (Service Acceptance Criteria) is the part of the network operators SLA which references the Frame Transfer Delay (FTD) in msec, Frame Delay Variations (FDV) in msec, and Frame Loss Ratio (FLR) requirements for the network path under test.

SAC Parameters - FLR = 90.000 %,FTD = 100.000 msec,FDV = 500.000 msec ▲		
Frame Loss Ratio	90.00	%
Frame Transfer Delay	100.000	msec
Frame Delay Variation	500.000	msec

Figure: SAC Parameter Configuration

Test Selection 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.

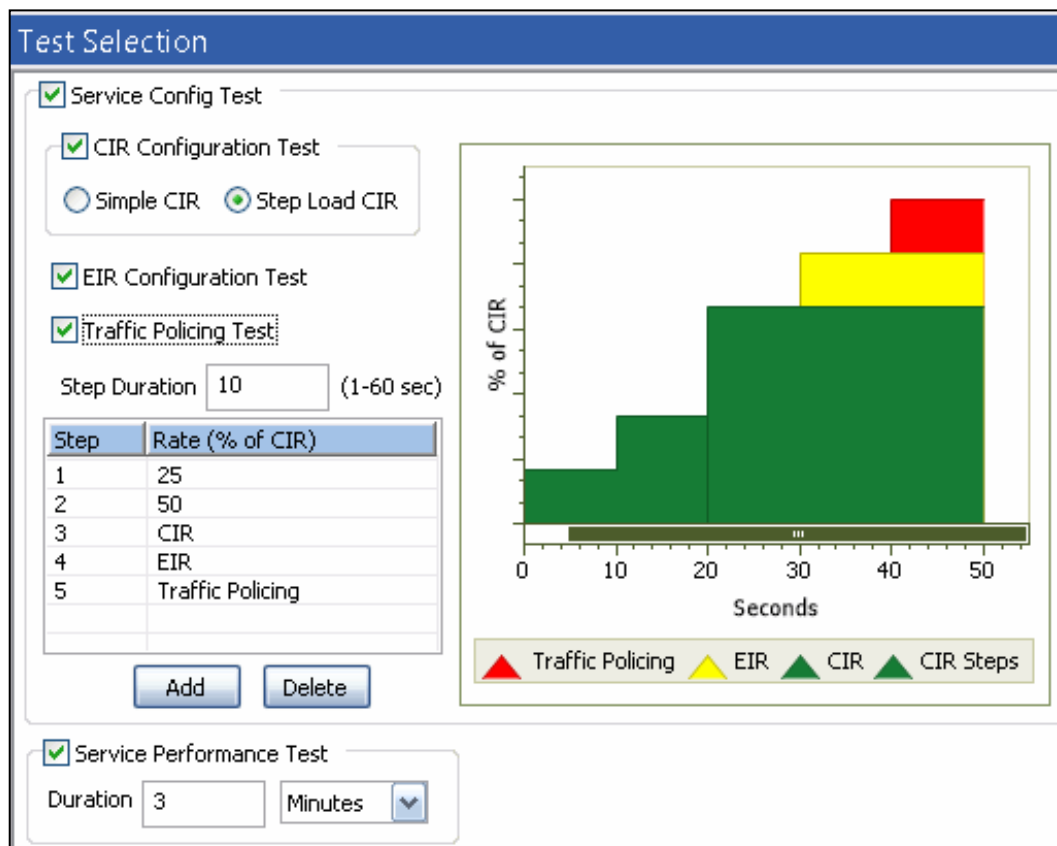


Figure: Test Selection

Tx and Rx Frame 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.

Port Statistics			
Port Selection		Port 2	Reset
Description	Tx	Rx	
Total Frames	101 523 413	101 523 413	
Valid Frames	101 523 413	101 523 413	
Bad Frames	0	0	
Number Of Bytes	49 617 859 756	49 617 859 756	
Link Utilisation(%)	62.823	62.822	
Data Rate(Mbps)	6121.160	6121.088	
Frame Rate(Frames/sec)	1 007 039	1 006 899	
Non Test Frames	0	12 196 485	
Broadcast Frames	0	0	
Multicast Frames	101 523 413	0	
Control Frames	0	0	
VLAN Frames	15 150 409	15 150 409	
Pause Frames	0	0	
Wrong Opcode Frames	0	0	
Out of Bound Frames	0	0	
Length Type Out of Range Frames	0	0	
64 Byte Length Frames	0	0	
65-127 Byte Length Frames	1 079 939	1 079 939	
128-255 Byte Length Frames	625 868	625 868	
256-511 Byte Length Frames	10 852 568	10 852 568	
512-1023 Byte Length Frames	88 965 038	88 965 038	
1024-1518 Byte Length Frames	0	0	
Oversized Frames	0	0	
Undersized Frames	-	0	
FCS Error Frames	-	0	
1 Level Stacked VLAN Frames	-	2 740 811	
2 Level Stacked VLAN Frames	-	213 113	
3 Level Stacked VLAN Frames	-	12 196 485	
1 Level Stacked MPLS Frames	-	0	
2 Level Stacked MPLS Frames	-	0	
3 Level Stacked MPLS Frames	-	0	
IP Checksum Errors	-	0	
IPv4 Packets	-	0	
IPv6 Packets	-	0	
IP to IP Packets	-	0	

Figure: General Port Statistics

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.


Service Configuration Results Overview							
Overview 							
#	Service Name	Verdict	Current Step	Max IR(Mbps)	FLR(%)	Max FTD(msec)	Max FDV(msec)
1	Service1	✓	-	625.00	0.000	0.0014	0.000038
2	Service2	✓	-	625.00	0.000	0.0014	0.000038
3	Service3	✓	-	625.00	0.000	0.0014	0.000038
4	Service4	✓	-	625.00	0.000	0.0014	0.000038
5	Service5	✓	-	625.00	0.000	0.0014	0.000038
6	Service6	✓	-	625.00	0.000	0.0014	0.000038
7	Service7	✓	-	625.00	0.000	0.0014	0.000038
8	Service8	✓	-	625.00	0.000	0.0014	0.000038
9	Service9	✓	-	625.00	0.000	0.0014	0.000038
10	Service10	✓	-	625.00	0.000	0.0014	0.000038
11	Service11	✓	-	625.00	0.000	0.0014	0.000038
12	Service12	✓	-	625.00	0.000	0.0014	0.000038
13	Service13	✓	-	625.00	0.000	0.0014	0.000038
14	Service14	✓	-	625.00	0.000	0.0014	0.000038
15	Service15	✓	-	625.00	0.000	0.0014	0.000038
16	Service16	✓	-	625.00	0.000	0.0014	0.000038

Figure: Service Configuration Test Result

Results (Contd.)

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 Performance Results

IR(Mbps), FLR(%), FTD(msec), FDV(msec)

Test Time00:00:16

Vertical|||||

FTD Unitmsec

FDV Unitusec

Service	Verdict	IR (Curr)	IR (Min)	IR (Avg)	IR (Max)	FL (Count)	FLR (Rate)	FTD (Curr)	FTD (Min)	FTD (Avg)	FTD (Max)	FDV (Curr)	FDV (Min)	FDV (Avg)	FDV (Max)
1	PASS	625.00	625.00	625.00	625.00	2	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.122000
2	PASS	625.00	625.00	625.00	625.00	2	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.115000
3	PASS	625.00	625.00	625.00	625.00	3	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.115000
4	PASS	625.00	625.00	625.00	625.00	3	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.122000
5	PASS	625.00	625.00	625.00	625.00	3	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.122000
6	PASS	625.00	625.00	625.00	625.00	3	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.128000
7	PASS	625.00	625.00	625.00	625.00	3	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.115000
8	PASS	625.00	625.00	625.00	625.00	3	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.122000
9	PASS	625.00	625.00	625.00	625.00	3	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.122000
10	PASS	625.00	625.00	625.00	625.00	3	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.122000
11	PASS	625.00	625.00	625.00	625.00	3	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.115000
12	PASS	625.00	625.00	625.00	625.00	3	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.122000
13	PASS	625.00	625.00	625.00	625.00	3	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.122000
14	PASS	625.00	625.00	625.00	625.00	3	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.122000
15	PASS	625.00	625.00	625.00	625.00	2	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.122000
16	PASS	624.95	624.94	624.95	624.95	2	0.000	0.018	0.001	0.015	0.021	0.003000	0.003000	0.003000	8.128000

Figure: Service Performance Test Result

Over all test status provides a quick view of the test in the form of Alarm LEDs. Green LED indicates that the tests meet the Frame Loss Ratio (FLR), Frame Transfer Delay (FTD), and Frame Delay Variations (FDV) defined criteria. The overall global verdict (PASS/FAIL) of the tests is also reported.








Overall Status  Global Verdict PASS 			
Test	Stream No	Subtest	Step No
Service Performance Test	-	-	-
Alarm		Status	
Link Status			
IR			
FLR			
FTD			
FDV			

Figure: Service Performance Test Overall Status

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.

The screenshot shows a window titled "Reports" with the following fields and values:

- Choose Format: PDF
- Title: ExpertSAM
- User Comments: Service Configuration
- Header: GLComm
- Footer: ES
- User Logo: D:\Src\PacketExpert\
- File name: C:\Users\
- Generate Report button

Figure: Report Generation

Command Line Interface (CLI)

PacketExpert™ supports Command Line Interface (CLI) to access all the functionalities remotely using Python , C# clients and MAPS™ CLI Client Server architecture. The CLI supports all the PacketExpert™ applications including - All port Bert, All port Loopback, RFC 2544, IPLinkSim™, PacketBroker, Record/Playback, ExpertSAM™ Multi-stream Traffic Generator & Analyzer, and ExpertTCP™.

```
*Python 3.6.7rc2 Shell*
File Edit Shell Debug Options Window Help
RESTART: C:\Users\glitteam\Desktop\PythonClient3_6\AllPortBertSampleApplication.py
ALLPortBERT Test
Press any key to continue , 'q' to quit
a
Running BERT Test
Device Initialised
Module Initialised
Loading Configuration
Load Configuration Done
Start Bert.....
Bert Started
BERT STATISTICS
*****
TrafficStatus = No Rx Traffic
SyncStatus = Idle
BitErrorStatus = Idle
OutOfSequenceStatus = Idle
BERTStatus = No Rx Data
BERTTestTime = 00:00:00
BitsReceived = 0
BitErrorCount = 0
BitErrorRate = 0.000E+000
BitErrorSeconds = 0
SyncLossCount = 0
SyncLossSeconds = 0
OOSCount = 0
OOSSeconds = 0
ErrorFreeSeconds = 0
*****
```

Figure: PacketExpert™ Python Client

Hardware Specifications

 <p>Portable 10GX Hardware Unit</p>	 <p>1U mTOP™ PacketExpert™ 10GX Rack-mount</p> <p>Stacked 1U mTOP™ PacketExpert™ 10GX Rack-mount</p>	 <p>PacketExpert™ 10GX mTOP™ Probe</p>
<p>Physical Specification: Length: 8.45 in. (214.63 mm) Width: 5.55 in. (140.97 mm) Height: 1.60 in. (40.64 mm) Weight: 1.713 lbs. (0.75 kg)</p>	<ul style="list-style-type: none"> • Dimension: 1U/2U mTOP™ - 19" W x 16" L • 1U mTOP™ Rack-mount Enclosure can support up to 3 PXN100s • 2U mTOP™ Rack-mount Enclosure can support up to 6 PXN100s • Optional 4 to 12 Port SMA Jack Trigger Board (TTL Input/Output) • Weight: (not including the rails) 1U with 3x PXN100 : 11 lbs 2U with 6x PXN100 : 22 lbs 	<p>Physical Specification: Length: 10.4 in. (264.16 mm) Width: 8.4 in. (213.36 mm) Height: 3.0 in. (76.2 mm)</p>
<p>Bus Interface: USB 3.0 External Power Supply:</p> <ul style="list-style-type: none"> • +12 Volts (Medical Grade), 3 Amps (For portable units having serial number ≥ 188400) • +9 Volts, 2 Amps (For portable units having serial number < 188400) • Optional 4-Port SMA Jack Trigger Board (TTL Input/Output) 	<p>SBC Specifications:</p> <ul style="list-style-type: none"> • Intel Core i3 or optional i7 Equivalent, Windows® 11 64-bit Pro OS • USB 3.0 and USB 2.0 Hub, ATX Power Supply • USB Type C ports, Ethernet 2.5GigE port • 256GB Hard drive, 8G Memory (Min) • Two HDMI ports 	<p>SBC Specifications:</p> <ul style="list-style-type: none"> • Intel Core i3 or optional i7 NUC Equivalent, Windows® 11 64-bit Pro OS • USB 3.0 and USB 2.0 Hub, Power Supply +12 Volts, 3 Amps • USB Type C ports, Ethernet 2.5GigE port • 256 GB Hard drive, 8G Memory (Min) • Two HDMI ports
<p>Temperature: Operating Temperature 0° C to +50° C (only up to operating altitude of 5000 feet, and for Optical SFPs only i.e. Non Electrical SFPs) +5° to +40° C (for operating altitude up to 10,000 feet, and for both Electrical and Optical SFPs) Non-Operating Temperature: -30° to +60° C</p> <p>Humidity: Operating Humidity: 0% to 80% RH Non-Operating Humidity: 0% to 95% RH</p> <p>Altitude: Operating Altitude: up to 10,000 feet Non-Operating Altitude: up to 50,000 feet</p> <p>Interfaces: 4 x 1G Base-X Optical OR 10/100/1000 Base-T Electrical 2 x 100Mbps Base-FX Optical 2 x 2.5 Gbps Electrical/Optical Interface 2 x 10G Base-SR, -LR -ER Electrical/Optical Interface Single Mode or Multi Mode Fiber SFP support with LC connector</p> <p>Protocols: IEEE 802.3ae LAN PHY compliance RFC 2544 compliance</p> <div data-bbox="1092 1486 1498 1927">  <p>Pelican Carry Case</p> </div>		

Buyer's Guide

Item No	Product Description
PXN100	PacketExpert™ 10GX
PXN101	10G and 2.5G option for PXN100
CXN100	CLI Server for PXN100
CXE100	CLI Server for PXE100

Item No	Related Hardware
PXE100	PacketExpert™ 1G
PXN112G	PacketExpert™ 10GX (12-Port) - Rack-mount
PXN124G	PacketExpert™ 10GX (24-Port) - Rack-mount
MT001	mTOP™ 1U Rack-mount Enclosure w/ SBC
MT002	mTOP™ 1U Rack-mount Enclosure w/o SBC

Item No	Related Software
PXN105	Wire speed Record /Playback 10GX
PXN107	PacketBroker 10GX
PXN108	Multi-Stream UDP/TCP Traffic Generator and Analyzer
IPN507	IPNetSim™ and IPLinkSim™ options for PXN100

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

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



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