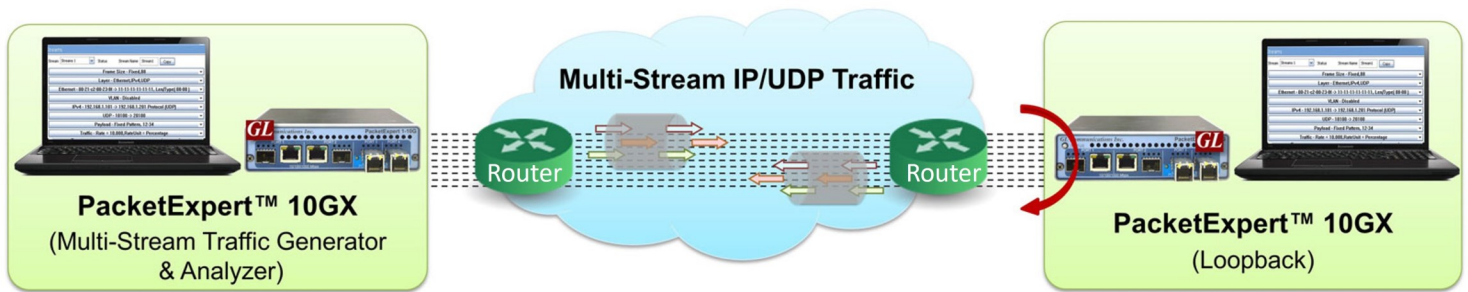# Multi-Stream Ethernet Traffic Generation & Analysis

PacketExpert™ 10GX (1G/10G)

Overview

The Multi Stream Traffic Generator and Analyzer is available as an optional software with PacketExpert™ 10GX platform. It is capable of generating multi-stream Ethernet traffic of varying packet length and also analyze the loopback traffic. This flexibility allows engineers to simulate network traffic very similar to a real world traffic. With loopback option, this tool finds its use in end-to-end testing of 10/1 Gbps LAN or WAN (Wide Area Networks).

As depicted in the network diagram above, the multiple traffic streams (16 streams over 10G ports) are generated as per the user defined configurations - MAC/VLAN/IP/UDP header, the rate and the frame size. Based on the Frame size, and Rate configured different classes of traffic (voice, video, data, etc) can be prioritized. Easily monitor the bandwidth performance using live **Throughput (IR)** consolidated graphical view for all the streams (12 streams over 1G ports). It also provides **Frame Loss Ratio** (FLR), **Frame Transfer Delay** (FTD) and **Frame Delay Variation** (FDV) graphical view for all the 12 streams.

PacketExpert™ 10GX (PXN100) has two 10/1 Gbps Optical/Electrical ports, and two 1G 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 now be converted to 2.5 Gbps ports with appropriate SFP. It requires additional **PXN101** license installation to run the tests on 2.5G/10G ports. PacketExpert™ 10GX is available in portable as well as mTOP™ Rack-mount platforms.

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

Main Features

- Test tool with both Ethernet traffic generation and analysis capabilities in one-box
- Support for frame lengths from 78 bytes to Jumbo frames (up to 16000 bytes)
- Generate and analyze packets at 1GigE and 10GigE line rates, with zero packet loss
- Traffic Generation -
  - Supports multiple streams with varying test configurations
  - Streams can be defined with various header fields like Source/Destination MAC Address, VLAN Id, Source/Destination Ipv4 Address, Source/Destination UDP ports
  - EMIX frame sizes supported per service - up to 5 frame sizes can be defined per stream
  - Stacked VLAN supported - C-Tag and S-Tag to simulate Carrier Ethernet traffic
- Traffic Analysis -
  - 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
  - Easily monitor the bandwidth performance using live throughput consolidated graphical view for all the streams (16 streams over 1G / 10G ports)
  - Detailed per stream statistics for unique streams
  - Provides per port frame statistics - Total Frames/Bytes Received, Rx Frame Rate, Rx Data Rate, etc
- Command Line Interface for automated testing and remote accessibility

Traffic Generation

Stream Configuration

The Stream configuration summary can be viewed at a glance by collapsing the configuration panes. Each Stream can be configured for various attributes such as the Frame Size(s), MAC, VLAN, IP, UDP Header Parameters (including VLAN Tag Information), Payload and Traffic rate parameters.
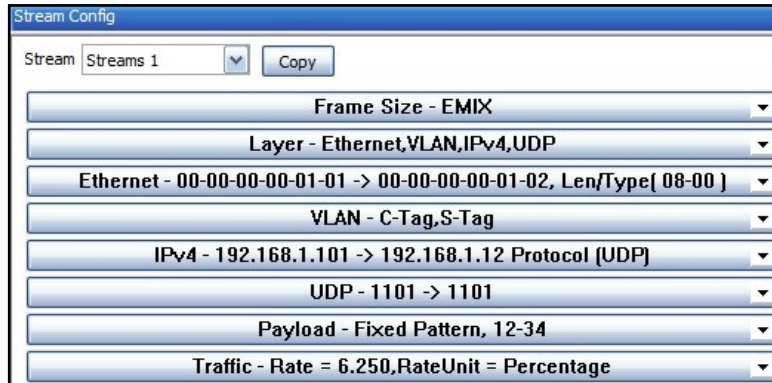

Figure: Stream Configuration Collapsed Summary View

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.
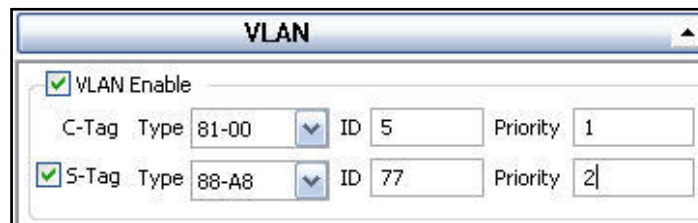

Figure: VLAN C-Tag Configuration

Payload and Traffic 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.
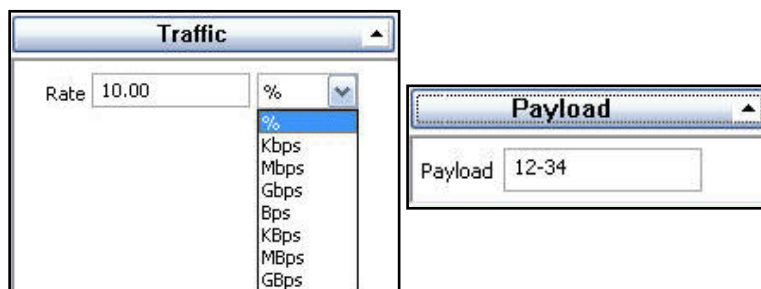

Figure: Payload Configuration

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Stream Configuration *(Contd.)*

Frame Size Configuration

Users can configure frame sizes in bytes for each stream, which includes Fixed and EMix Frame Size types. Fixed frame size can be set to any value between min (>78) and max frame size (1518 for normal frame sizes and up to 16000 bytes for Jumbo frames) range. A single Test Flow can also consist of up to 5 different frame sizes called an EMIX (Ethernet Mix), simulating real-time traffic.

Figure: Frame Size Configuration

Stream Selection

Stream selection provides an option to select any configured stream to run the test (or) select all the streams (16 streams are supported) to perform the test. The configured Frame Size and the Rate (Mbps) for the stream is also displayed for each stream. The test is performed on all the selected streams simultaneously within the specified time duration.

Figure: Stream Selection

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Traffic Analysis

Stream-wise Throughput Graph

A real time display of Throughput for each stream is plotted as the Information Rate (Mbps) against Time (Sec), in the form of a line graph. Consolidated view of throughput graph for all the streams (16 streams on 10G ports) is displayed. The total throughput of all the 16 streams together will sum up to 10000 Mbps on 10G ports.

Figure: Stream Throughput Graph

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 Ratio - FLR (%)
- Information Rate - IR (Mbps)
- Frame Transfer Delay - FTD (msec)
- Frame Delay Variations - FDV (msec)

Multi-Stream Traffic Generator & Analyzer Results

Stream No	Seconds	TxFrames	RxFrames	RxBytes	FL Count	FLR	IR (Curr)	IR (Min)	IR (Max)	IR (Avg)	FTD	FTD	FTD	FTD	FDV (Curr)	FDV (Min)	FDV (Max)	FDV (Avg)
1	55	1 146 226	1 125 387	679 852 618	20 839	1.818	104.05	104.03	104.06	133.78	0.002	0.001	0.003	0.002	< 1us	0.000	0.001	< 1us
2	55	1 278 940	1 255 686	642 911 232	23 254	1.818	98.97	98.94	98.97	127.24	0.002	0.001	0.003	0.002	< 1us	0.000	0.001	< 1us
3	55	5 832 149	5 726 109	7 902 030 420	106 040	1.818	1187.65	1187.30	1187.65	1526.96	0.002	0.002	0.003	0.002	< 1us	0.000	< 1us	< 1us
4	55	1 214 894	1 192 804	1 646 069 520	22 090	1.818	247.40	247.33	247.41	318.08	0.002	0.002	0.003	0.002	< 1us	< 1us	< 1us	< 1us
5	55	155 163	152 342	157 521 628	2 821	1.818	23.79	23.79	23.80	30.58	0.002	0.002	0.003	0.002	< 1us	< 1us	< 1us	< 1us
6	55	18 212 176	17 881 043	2 324 535 590	331 133	1.818	397.36	397.24	397.36	510.89	0.002	0.001	0.003	0.002	< 1us	0.000	0.001	< 1us
7	55	14 585 983	14 320 782	19 762 679 160	265 201	1.818	2970.25	2969.39	2970.26	3818.88	0.002	0.002	0.003	0.002	< 1us	0.000	< 1us	< 1us
8	55	5 216 779	5 121 928	5 244 854 272	94 851	1.818	792.20	791.97	792.20	1018.53	0.002	0.002	0.003	0.002	< 1us	0.000	< 1us	< 1us
9	55	1 535 124	1 507 212	771 692 544	27 912	1.818	118.79	118.76	118.79	152.73	0.002	0.001	0.003	0.002	< 1us	0.000	0.001	< 1us
10	55	3 434 715	3 372 265	674 453 000	62 450	1.818	109.91	109.88	109.91	141.31	0.002	0.001	0.003	0.002	< 1us	0.000	0.001	< 1us
11	55	3 176 550	3 118 794	405 443 220	57 756	1.818	69.31	69.29	69.31	89.11	0.002	0.001	0.003	0.002	< 1us	0.000	0.001	< 1us
12	55	9 085 290	8 920 101	1 159 613 130	165 189	1.818	198.22	198.17	198.23	254.86	0.002	0.002	0.003	0.002	< 1us	0.000	< 1us	< 1us
13	55	9 844 599	9 665 605	5 841 891 662	178 994	1.818	894.11	893.85	894.12	1149.56	0.002	0.001	0.003	0.002	< 1us	0.000	0.001	< 1us
14	55	27 539 785	27 039 059	16 342 406 346	500 726	1.818	2501.23	2500.50	2501.23	3215.84	0.002	0.001	0.003	0.002	< 1us	0.000	0.001	< 1us
15	55	395 501	388 310	793 705 640	7 191	1.818	118.74	118.71	118.74	152.66	0.003	0.002	0.003	0.003	< 1us	0.000	< 1us	< 1us
16	55	1 090 764	1 090 764	658 606 880	0	0.000	98.97	98.94	98.98	129.60	0.002	0.002	0.003	0.002	< 1us	0.000	< 1us	< 1us

Figure: Horizontal Stream Result View

Results *(Contd.)*

Stream No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Stream Sel…	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Seconds	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117
TxFrames	2 438 342	2 720 661	12 406 605	2 584 417	330 075	38 742 374	31 028 451	11 097 542	3 265 635	7 306 595	6 757 407	19 326 942	20 942 205	58 584 795	841 340	2 320 357
RxFrames	2 438 342	2 720 661	12 406 605	2 584 417	330 075	38 742 374	31 028 451	11 097 542	3 265 635	7 306 595	6 757 407	19 326 942	20 942 204	58 584 795	841 340	2 320 357
RxBytes	1 473 018 618	1 392 978 432	17 121 114	3 566 495 460	341 297 550	5 036 508 620	42 819 262	11 363 883	1 672 005 120	1 461 319 000	878 462 910	2 512 502 460	12 657 467	35 408 650	1 719 698 960	1 401 040 198
FL Count	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
FLR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IR (Curr)	104.05	98.97	1187.65	247.40	23.79	397.36	2970.26	792.20	118.79	109.91	69.31	198.23	894.10	2501.23	118.74	98.97
IR (Min)	104.03	98.94	1187.30	247.33	23.79	397.24	2969.39	791.97	118.76	109.88	69.29	198.17	893.85	2500.50	118.71	98.94
IR (Max)	104.06	98.97	1187.65	247.41	23.80	397.36	2970.26	792.20	118.79	109.91	69.31	198.23	894.12	2501.24	118.74	98.98
IR (Avg)	136.79	130.10	1561.28	325.23	31.27	522.37	3904.70	1041.42	156.16	144.49	91.11	260.59	1175.40	3288.12	156.09	130.11
FTD (Curr)	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002
FTD (Min)	0.001	0.001	0.002	0.002	0.002	0.001	0.002	0.002	0.001	0.001	0.001	0.002	0.001	0.001	0.002	0.002
FTD (Max)	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
FTD (Avg)	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002
FDV (Curr)	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us
FDV (Min)	0.000	0.000	0.000	< 1us	< 1us	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
FDV (Max)	0.001	0.001	< 1us	< 1us	< 1us	0.001	< 1us	< 1us	0.001	0.001	0.001	< 1us	0.001	0.001	< 1us	< 1us
FDV (Avg)	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us

Figure: Vertical Stream Result View

Port Statistics

Detailed Tx Rx frame statistics per port are provided. In addition to statistics like Frame Count, Frame Rate, Link Utilization, other statistics like Frame Type (Unicast/Broadcast/Multicast, VLAN), frame lengths (64, 65-127, 1024-1518, Oversized, Undersized), and FCS Error Frames are also provided.

Port Selection: Port 1

Description	Tx	Rx
Total Frames	25 105 412	25 108 149
Valid Frames	25 105 412	25 108 149
Bad Frames	0	0
Number Of Bytes	10 614 792 960	10 615 950 296
Link Utilisation(%)	25.425	25.522
Data Rate(Mbps)	2427.666	2436.925
Frame Rate(Frames/sec)	717 717	720 454
Non Test Frames	0	0
Broadcast Frames	0	0
Multicast Frames	9 327 223	0
Control Frames	0	0
VLAN Frames	7 193 056	7 196 520
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	1 416 832	1 417 535
128-255 Byte Length Frames	14 044 921	14 051 681
256-511 Byte Length Frames	2 150 532	2 151 568
512-1023 Byte Length Frames	1 788 028	1 788 888
1024-1518 Byte Length Frames	6 307 703	6 310 740
Oversized Frames	0	0
Undersized Frames	-	0
FCS Error Frames	-	0
1 Level Stacked VLAN Frames	-	4 215
2 Level Stacked VLAN Frames	-	7 195 402
3 Level Stacked VLAN Frames	-	0
1 Level Stacked MPLS Frames	-	0
2 Level Stacked MPLS Frames	-	0
3 Level Stacked MPLS Frames	-	0
IP Checksum Errors	-	0
IPv4 Packets	-	32 947 936
IPv6 Packets	-	0
IP in IP Packets	-	0
UDP in IP Packets	-	32 949 476
TCP in IP Packets	-	0
ICMP in IP Packets	-	0
IGMP in IP Packets	-	0
IGRP in IP Packets	-	0
Other Protocol in IP Packets	-	0
UDP Checksum Errors	-	0
UDP Packets	-	32 954 516

Figure: Port Statistics

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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.
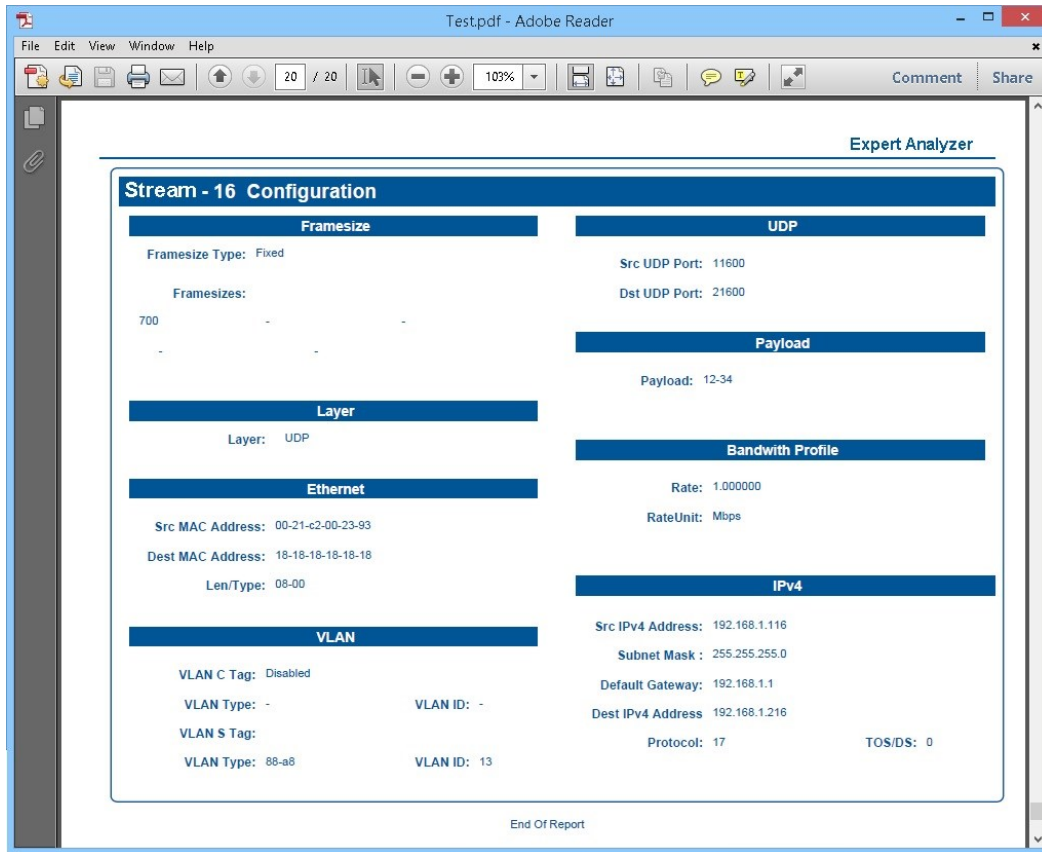

Figure: PDF Report Sample

Traffic Generation over Satellite Networks

Users can generate traffic over satellite networks using PacketExpert™ 10GX and measure the subsequent throughput, round-trip delay, packet loss, jitter, and more. Using the Multi-Stream UDP/TCP Traffic Generator and Analyzer feature, the PacketExpert™ 10GX can create multiple streams of traffic, such as voice, video, and data, over satellite links.

For each stream, the device measures the throughput, delay, packet loss, jitter, and other fundamental packet metrics. Satellite networks often have prioritization schemes for different traffic streams based on Class of Service (COS) or Differentiated Services Code Point (DSCP) tags in the Ethernet frame or IP header. The PacketExpert™ 10GX can test these prioritization schemes by generating streams with different protocol headers, COS and DSCP tags. Users can view real time graphs of throughput, latency (with nanosecond precision), packet loss, etc. for each stream independently.
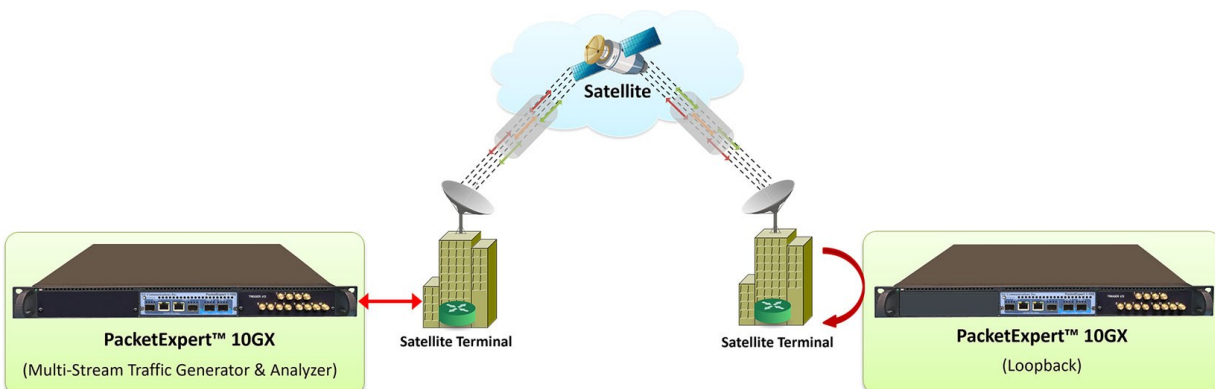

Figure: Traffic Generation over Satellite Networks

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Hardware Specifications

Portable 10GX Hardware Unit

1U mTOP™ PacketExpert™ 10GX Rack-mount

Stacked 1U mTOP™ PacketExpert™ 10GX Rack-mount

PacketExpert™ 10GX mTOP™ Probe

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)	• **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	**Physical Specification:** Length: 10.4 in. (264.16 mm) Width: 8.4 in. (213.36 mm) Height: 3.0 in. (76.2 mm)
Bus Interface: USB 3.0 **External Power Supply**: • +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)	**SBC Specifications:** • Intel Core i3 or optional i7 NUC Equivalent, • Windows® 11 64-bit Pro Operating System • USB 3.0 and USB 2.0 Ports, ATX Power Supply • USB Type C Ports, Ethernet 2.5GigE port • 256 GB Hard drive, 8G Memory (Min) • Two HDMI ports	**SBC Specifications:** • Intel Core i3 or optional i7 NUC Equivalent, • Windows® 11 64-bit Pro Operating System • USB 3.0 and USB 2.0 Ports • 12V/3A Power Supply • USB Type C Ports, Ethernet 2.5GigE port • 256 GB Hard drive, 8G Memory (Min) • Two HDMI ports

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

Humidity: Operating Humidity: 0% to 80% RH
Non-Operating Humidity: 0% to 95% RH

Altitude: Operating Altitude: up to 10,000 feet
Non-Operating Altitude: up to 50,000 feet

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
Protocols:
IEEE 802.3ae LAN PHY compliance
RFC 2544 compliance

Pelican Carry Case

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Buyer's Guide

Item No	Product Description
PXN108	Multi-Stream UDP/TCP Traffic Generator and Analyzer – for PXN100
PXN101	10G and 2.5G option for PXN100
CXN100	CLI Server for PXN100

Item No	Related Hardware
PXN100	PacketExpert™ 10GX
PXE100	PacketExpert™ 1G
PXN112G	PacketExpert™ 10GX (12-Port) - Rack-mount
PXN124G	PacketExpert™ 10GX (24-Port) - Rack-mount
MT001	mTOP™ 1U Rack-mount w/ SBC (with core i3)
MT001E	mTOP™ 1U Rack-mount w/ SBC (with core i7)
MT002	mTOP™ 1U Rack-mount w/o SBC

Item No	Related Software
PXN105	Wire speed Record /Playback 10GX
PXN107	PacketBroker 10GX

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

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