PacketExpert™ (1 Gbps) - Ethernet Tester

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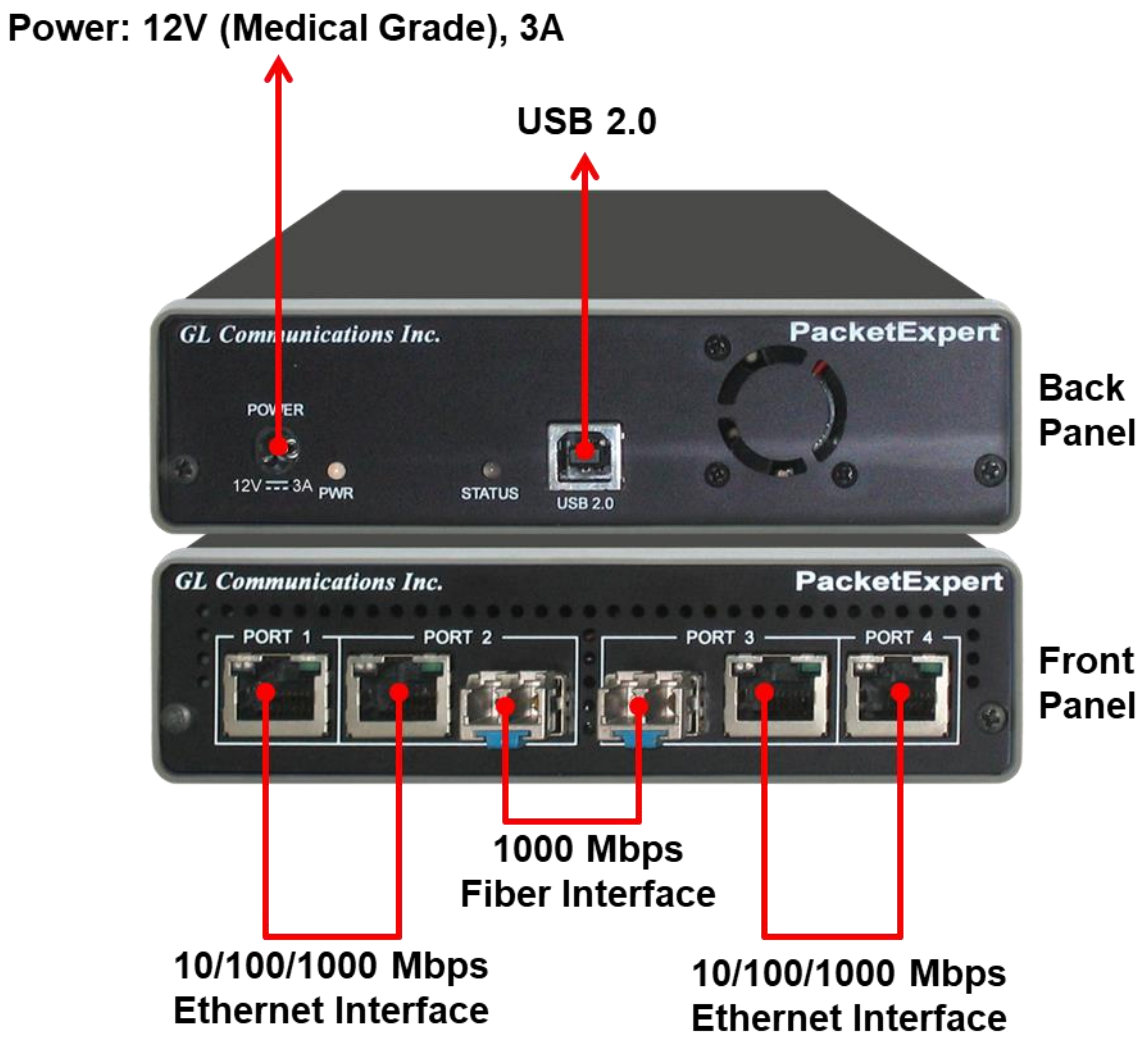
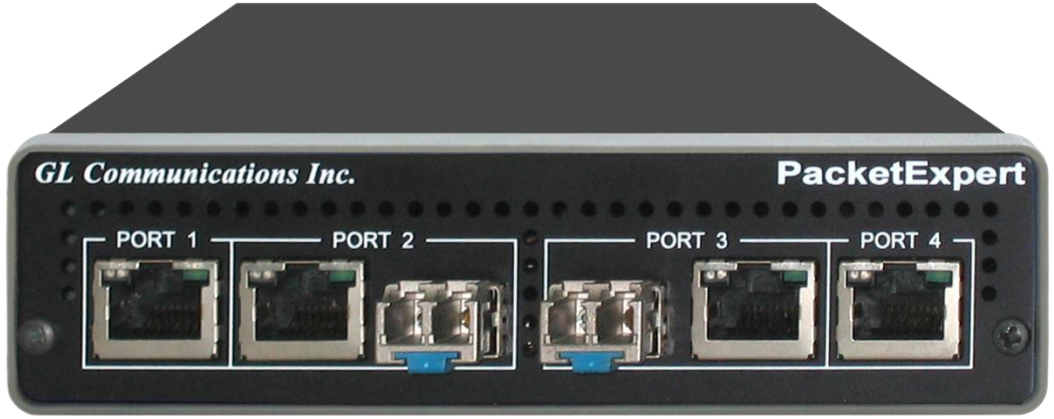
Portable Unit



Portable Unit



Interfaces	• 2 x 10 / 100 / 1000 Base-T Electrical only • 2 x 100 Base-FX Optical only • 2 x 1000 Base-X Optical OR 10/100/1000 Base-T Electrical • Single Mode or Multi Mode Fiber SFP support with LC connector
Physical Specifications	• Length: 8.45 in (214.63 mm) • Width: 5.55 in (140.97 mm) • Height: 1.60 in (40.64 mm) • Weight: 1.66 lbs. (0.75 kg)
Power Supply	• +12 Volts (Medical Grade), 3 Amps
BUS Interface	• USB 2.0 or USB 3.0
Protocols	• RFC 2544 compliance

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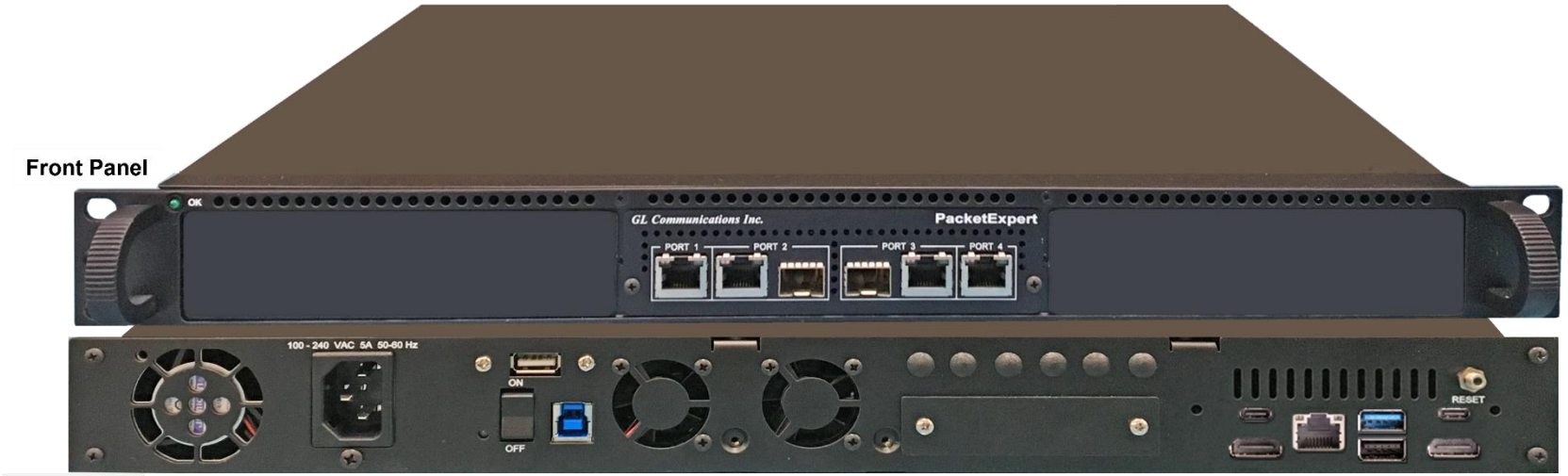
1U Rack-Mount Enclosure



- 19” rack option, w/ Embedded Single Board Computer (SBC)
- **SBC Specification**:
  - 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

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PacketExpert™ High-Density 12/24 GigE Ports mTOP™ Rack

PacketExpert™ SA (PXE112)

PacketExpert™ SA (PXE124)

	1U Rack	2U Rack
Physical Specifications	• Length: 16 in (406.4), Width: 19 in (482.6), Height: 1U / 2U • mTOP™ System (embedded SBC, 3x PacketExpert 1G)	• Length: 16 in (406.4), Width: 19 in (482.6), Height: 1U / 2U • mTOP™ System (embedded SBC, 6x PacketExpert 1G)
External Power Supply	• ATX Power Supply	• ATX Power Supply
BUS Interface	• 1U HD PacketExpert™ 1G mTOP™ (12 Total Ethernet Ports)– ➢ mTOP™ System (embedded SBC, 3x PXE100) ➢ 6x 1000 Base-X Optical OR 10/100/1000 Base-T Electrical ➢ 6x 100 Base-FX Optical only ➢ 6x (10/100/1000) Base-T Electrical	• 2U HD PacketExpert™ 1G mTOP™ (24 Total Ethernet Ports)– ➢ mTOP™ System (embedded SBC, 6x PXE100) ➢ 12x 1000 Base-X Optical OR 10/100/1000 Base-T Electrical ➢ 12x 100 Base-FX Optical only ➢ 12x (10/100/1000) Base-T Electrical
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	• 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

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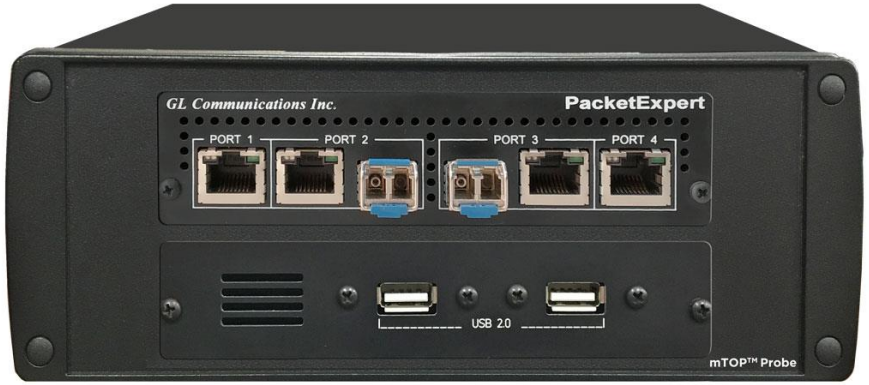
PacketExpert™ mTOP™ Probe

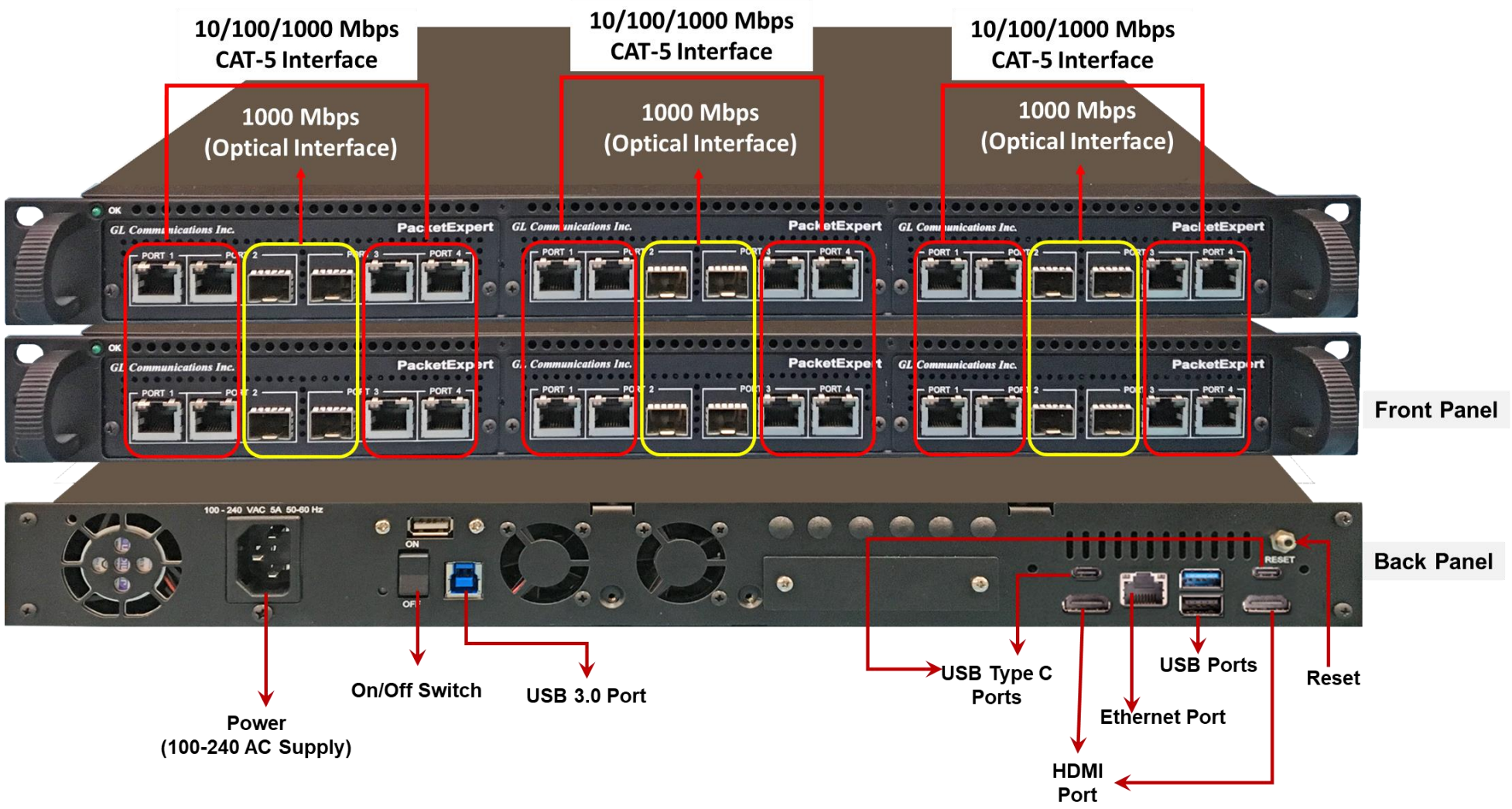
Front Panel View



Rear Panel View

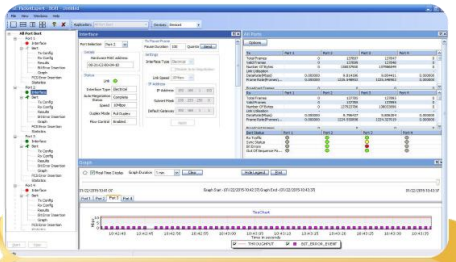
- Portable Quad Port Ethernet/VLAN/MPLS/IP/UDP Tester with 4 Electrical Ethernet Ports (10/100/1000 Mbps) and 2 Optical Ports (100/1000 Mbps). Embedded with Single Board Computer (SBC)
- **SBC Specs**: Intel Core i3 or optional i7 NUC Equivalent, Windows® 11 64-bit Pro Operating System, USB 3.0 and USB 2.0 Ports, ATX Power Supply, USB Type C Ports, Ethernet 2.5GigE port, 256 GB Hard drive, 8G Memory (Min), Two HDMI ports
- Each GigE port provides independent Ethernet/VLAN/MPLS/IP/UDP testing at wire speed for applications such as BERT, RFC 2544, and Loopback.
- RFC 2544 is applicable for Layers 2, 2.5, and 3, and Loopback is applicable for Layers 2, 3, and 4

PacketExpert™ 24 Ports – Hardware Specifications



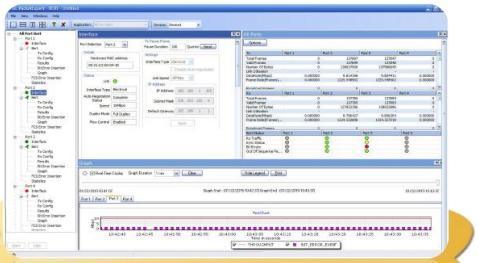
Different Applications loaded on same Platform

All Port BERT



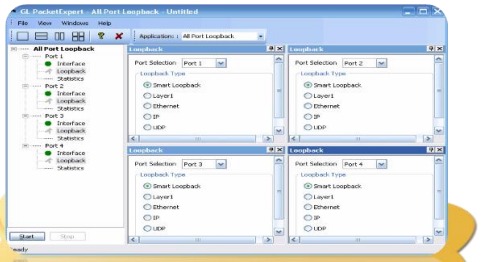
(12 ports, 4 ports per device)

BERT/Loopback



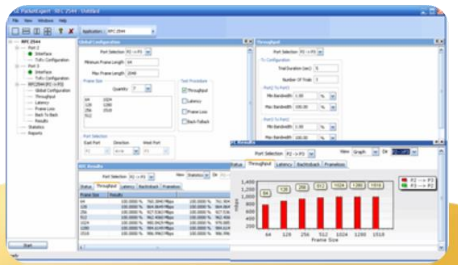
(12 ports, 2 ports BERT & 2 ports Loopback per device)

All Port Loopback



(12 ports, 4 ports per device)

RFC 2544

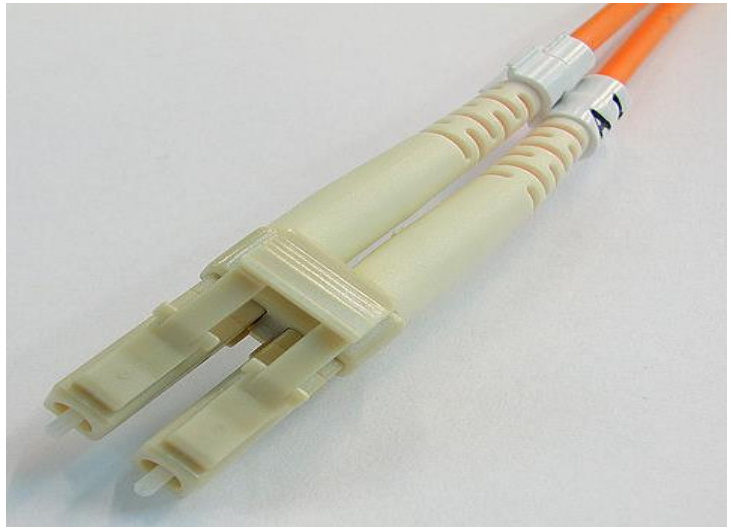


(6 Ports, 2 ports per device - Ports 2 & 3)

Note: Only one application can run at a time

Optical Connectors and SFP Transceivers

LC Connectors



850/1310 nm SFP Module

- PacketExpert™ supports LC connectors and 850/1310 nm SFP (Small Factor Pluggable) modules

Note: In case customer have different type of connectors, then we need converters like LC-to-SC, LC-to-FC and vice-versa

PacketExpert™ - 24 Ports Unit

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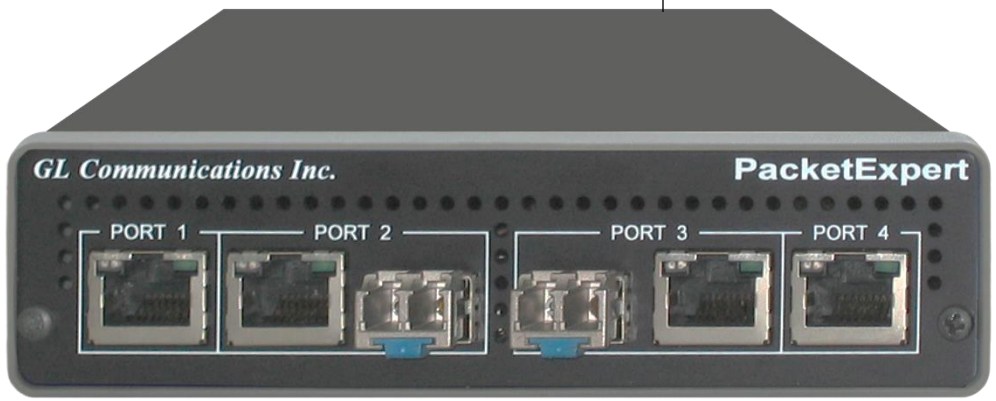
Applications



USB 2.0

PacketExpert™ 1G

- Bit Error Rate Testing
- RFC 2544
- Loopback
- ITU-T Y.1564

- Multi-Stream Traffic Generator
- RFC 6349
- Record and Playback Traffic
- Wirespeed Network Tap

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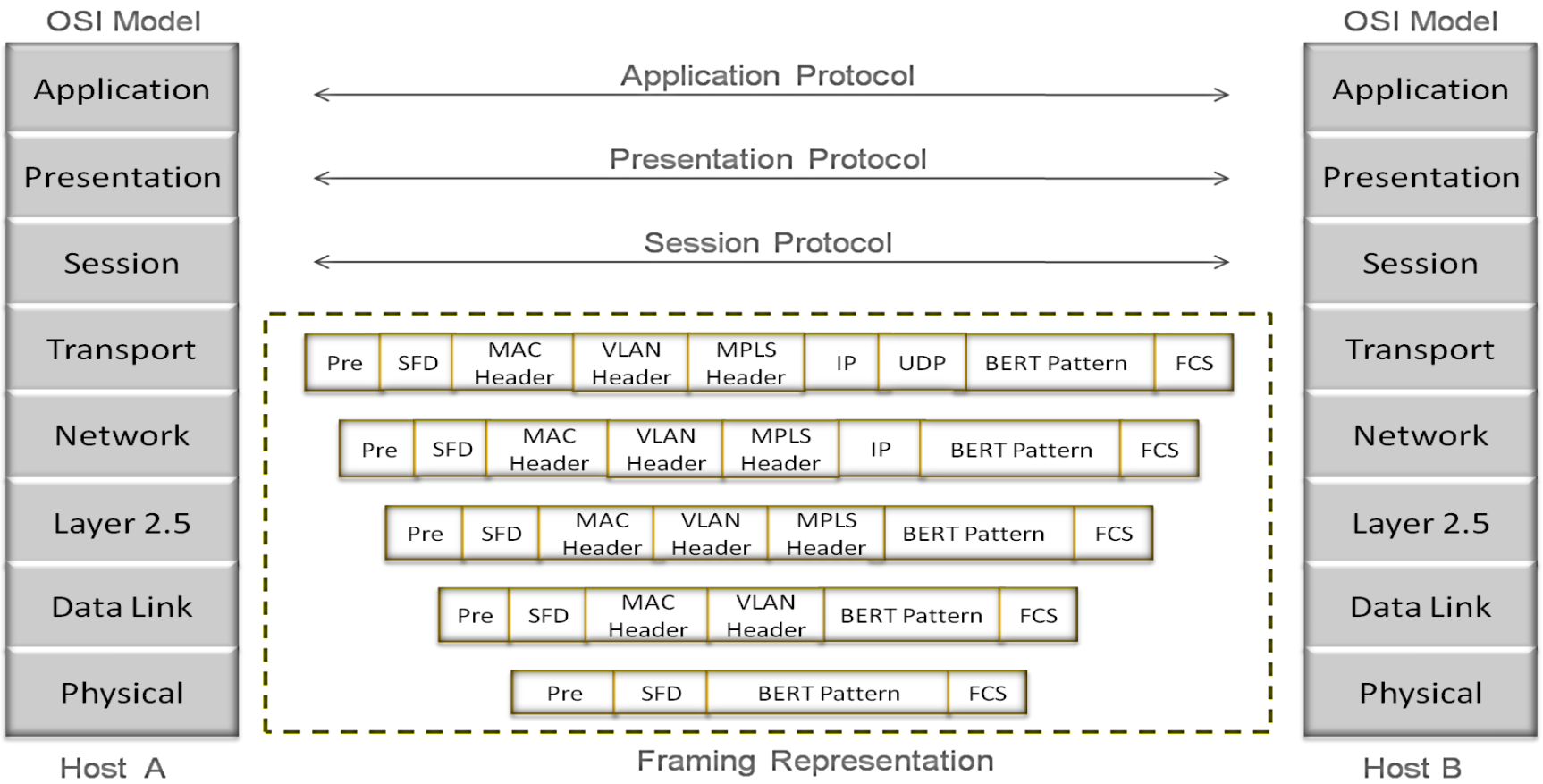
Applications

- Test and verify QoS Parameters of network devices like Switches/Routers etc.
- End to end testing of network paths for QoS parameters
- In-depth troubleshooting of the Carrier network in the event of network failures or impairments
- QoS testing of Triple-play services to ensure that they fully qualify SLA parameters
- Terrestrial wireless, satellite, and other WAN technologies network validations
- Test VoIP network in real-time conditions to verify if it meets the quality requirements before you deploy
- Testing video on IP networks by emulating the loss and congestion characteristics
- SPF support can be used for Broadband aggregation applications, Metro edge switching, Metro and access multi-service platforms, and are suitable for Fast Ethernet applications

Wire-Speed BERT

OSI Model



Preamble – 7 Bytes
Start Frame Delimiter – (SFD)- 1 Byte
MAC Header –

- Dest/Src MAC Address – 6 Bytes
- Ether Length/Type – 2 Bytes (0x0800) IP
- VLAN Header – 4 bytes each

MPLS Header – 4 bytes each
IP Header – 20 Bytes
UDP Header – 8 Bytes
Payload – BER Test Pattern
Frame Check Sum – (FCS) – 4 Bytes

} Ethernet Payload

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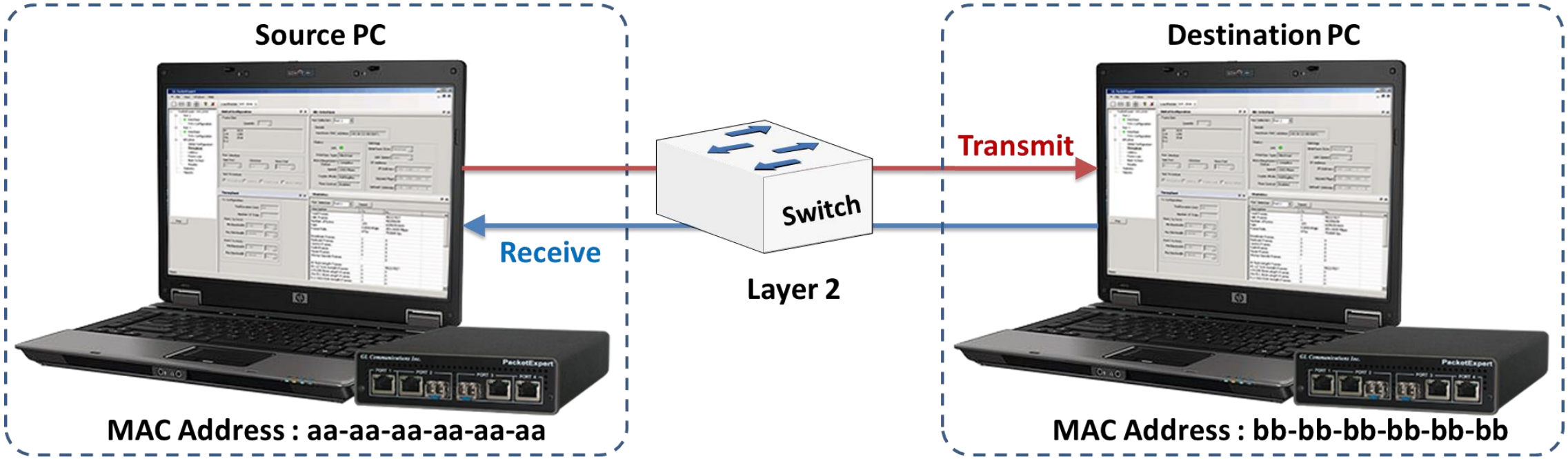
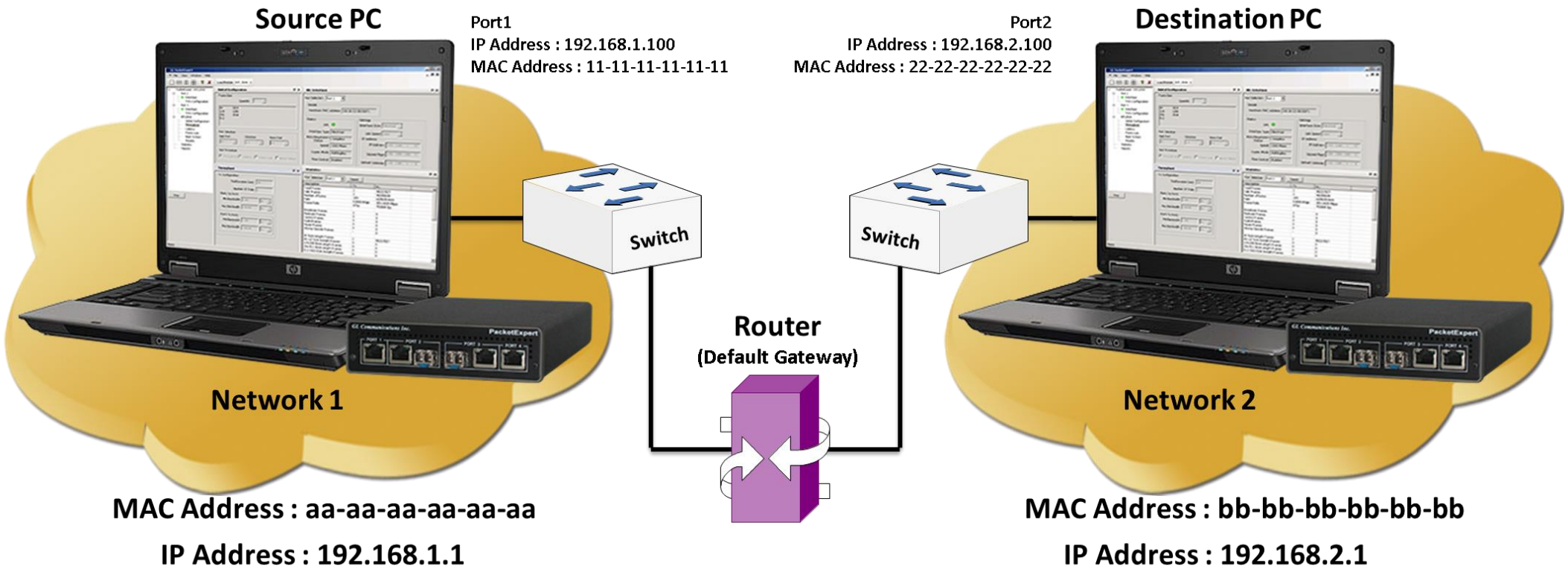
BER Testing at Layer 2



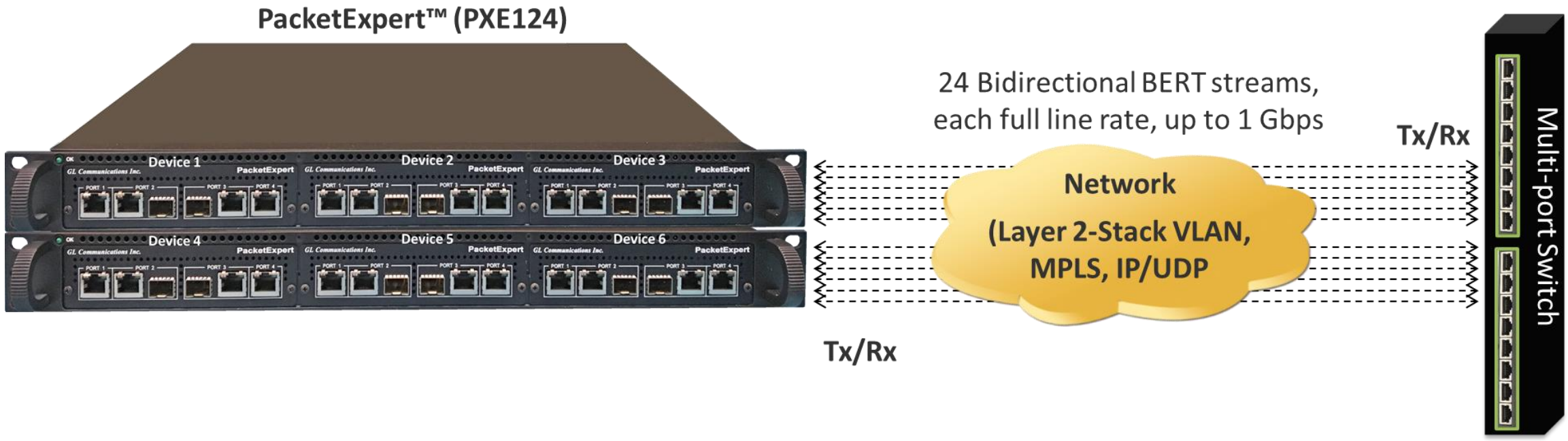
BER Test Setup at Layer 3/4

Layer 3 Testing between PacketExpert™ located in different IP Networks

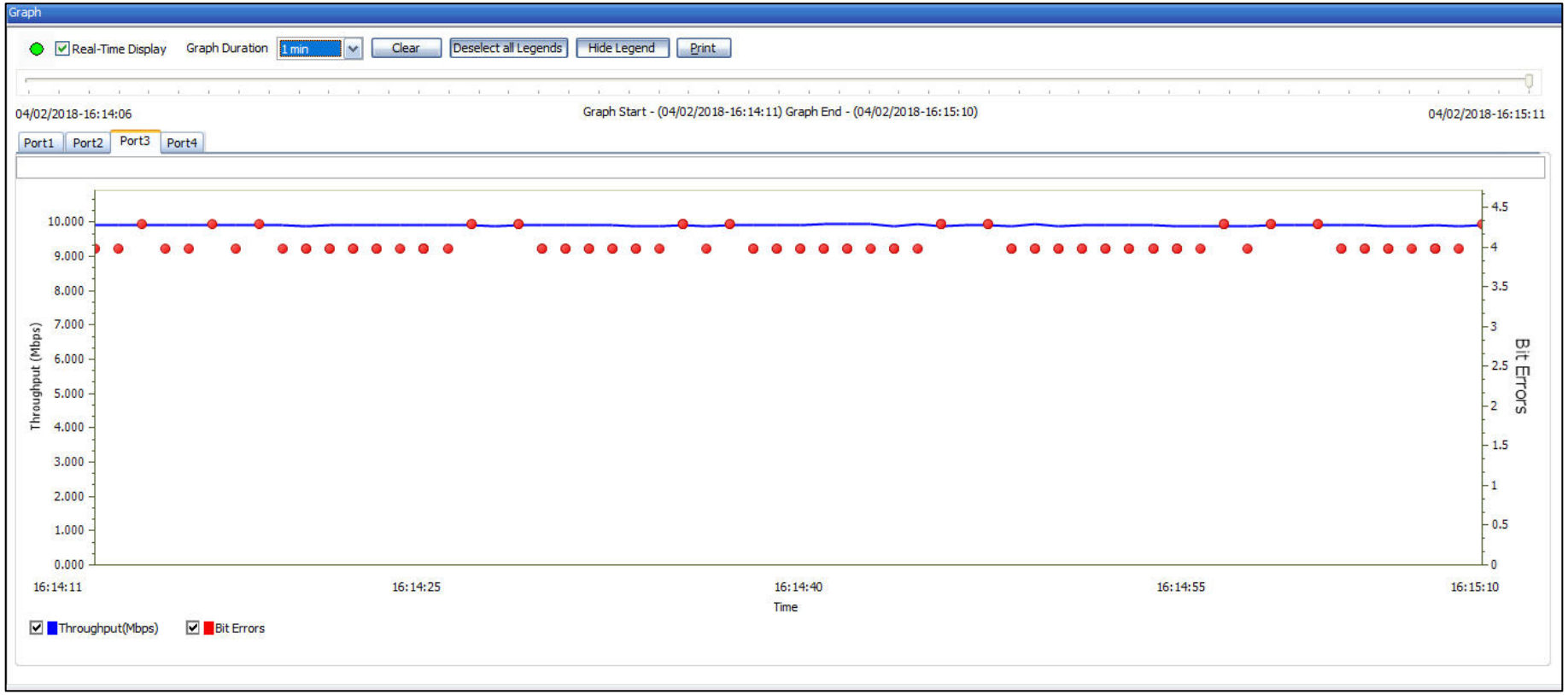


- In this case, Source and the Destination PacketExpert™ applications are located in different IP networks. These 2 networks are connected through a router. A simple example above shows 2 LANs connected through a router

PacketExpert™ 24 Ports - BERT



BERT Results (w/ LEDs) and Graph



- Optional Sequence number insertion allows detecting Out-of-sequence packets and packet loss
- Detailed BERT statistics like the Bit Error Count, Bit Error Rate, Bit Error Seconds etc. are provided
- Bit Error Count is displayed in both Tabular and Graphical formats

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All Ports Result

All Ports

Options

Tx	Port 1	Port 2	Port 3	Port 4
Total Frames	1562724	1562858	1562461	1615858
Valid Frames	1562740	1562869	1562473	1615870
Number Of Bytes	156275500	156288100	156248400	155124864
Link Utilisation	-	-	-	-
DataRate(Mbps)	8.538899	8.334709	8.337879	8.273890
Frame Rate(Fram...	10672.675522	10428.169014	10413.434248	10770.413064
Broadcast Frames	0	0	0	0

Rx	Port 1	Port 2	Port 3	Port 4
Total Frames	1613564	1561938	1562893	1562467
Valid Frames	1613564	1561938	1562893	1562467
Number Of Bytes	154903488	156194900	156290500	156247800
Link Utilisation	-	-	-	-
DataRate(Mbps)	8.281139	8.337795	8.335606	8.334615
Frame Rate(Fram...	10783.681214	10426.013195	10418.560606	10427.333975
Broadcast Frames	0	0	0	0

Bert Status	Port 1	Port 2	Port 3	Port 4
Rx Traffic				
Sync Status				
Bit Errors				
Out Of Sequence Pack...				

Bert Statistics	Port 1	Port 2	Port 3	Port 4
Bert Status	Sync	Sync	Sync	Sync
Test Time	00:01:51	00:01:51	00:01:51	00:01:51
Bits Received	465008480	465008480	465347048	465347048
Bit Error Count	0	0	0	0
Bit Error Rate	0.000E+000	0.000E+000	0.000E+000	0.000E+000
Bit Error Seconds	0	0	0	0
Sync Loss Count	0	0	0	0
Sync Loss Seconds	0	0	0	0
Out of Sequence ...	0	0	0	0
Out of Sequence S...	0	0	0	0
Error Free Seconds	149	149	149	149

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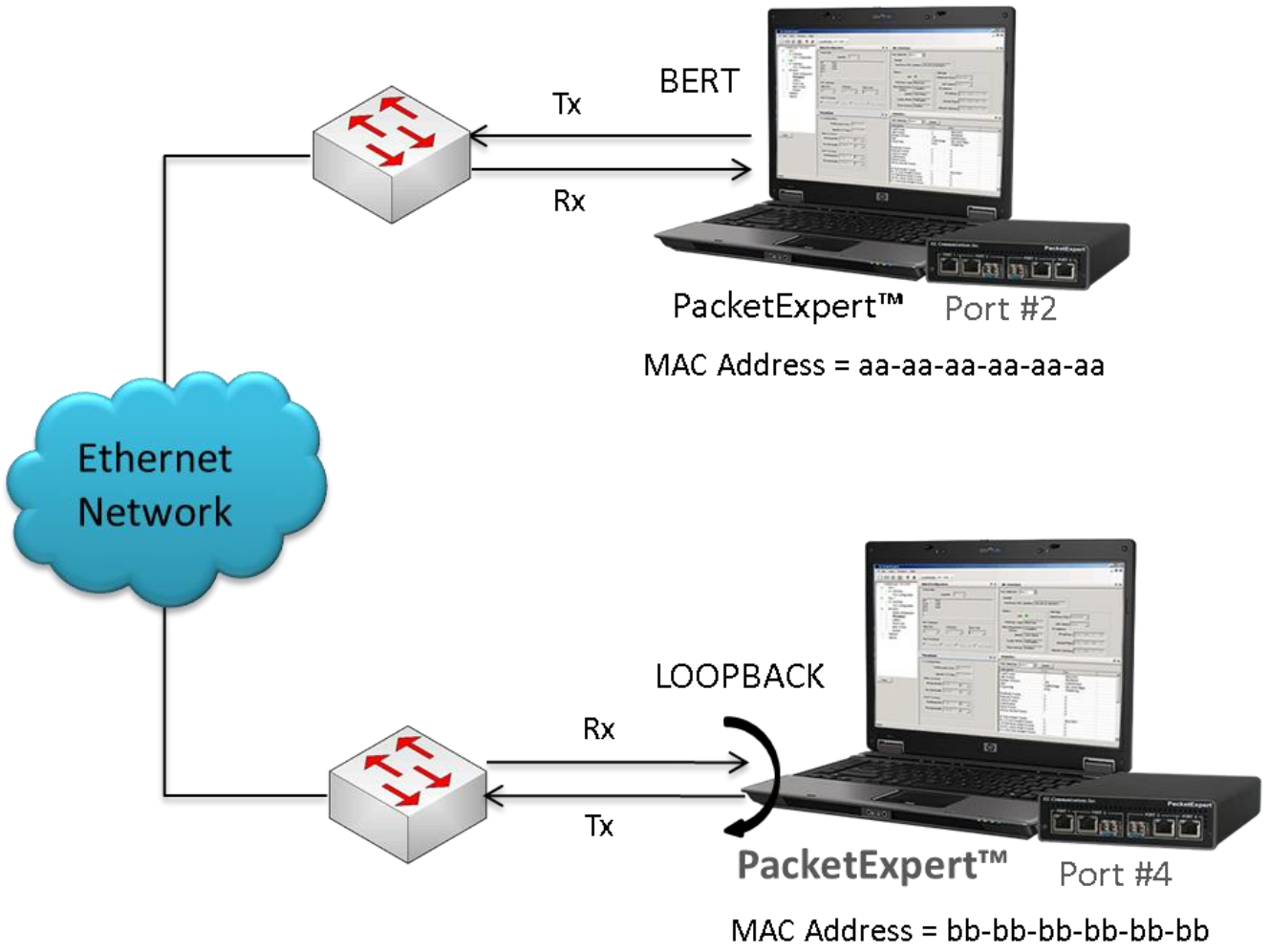
2 Ports BERT and Loopback

- Loopback helps in easy test setup, especially in end-to-end testing, when the other end is in a remote place
- In such cases, one PacketExpert™ can be put in constant Loopback at the remote end, and BERT tests can be started / stopped anytime at the local end



Layer 2 - Ethernet Loopback Types

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Loopback

Rx

Ethernet Dst MAC Address	Ethernet Src MAC Address	Ethernet Len/Type Field	Payload	FCS
Ex: bb-bb-bb-bb-bb-bb	Ex: aa-aa-aa-aa-aa-aa			

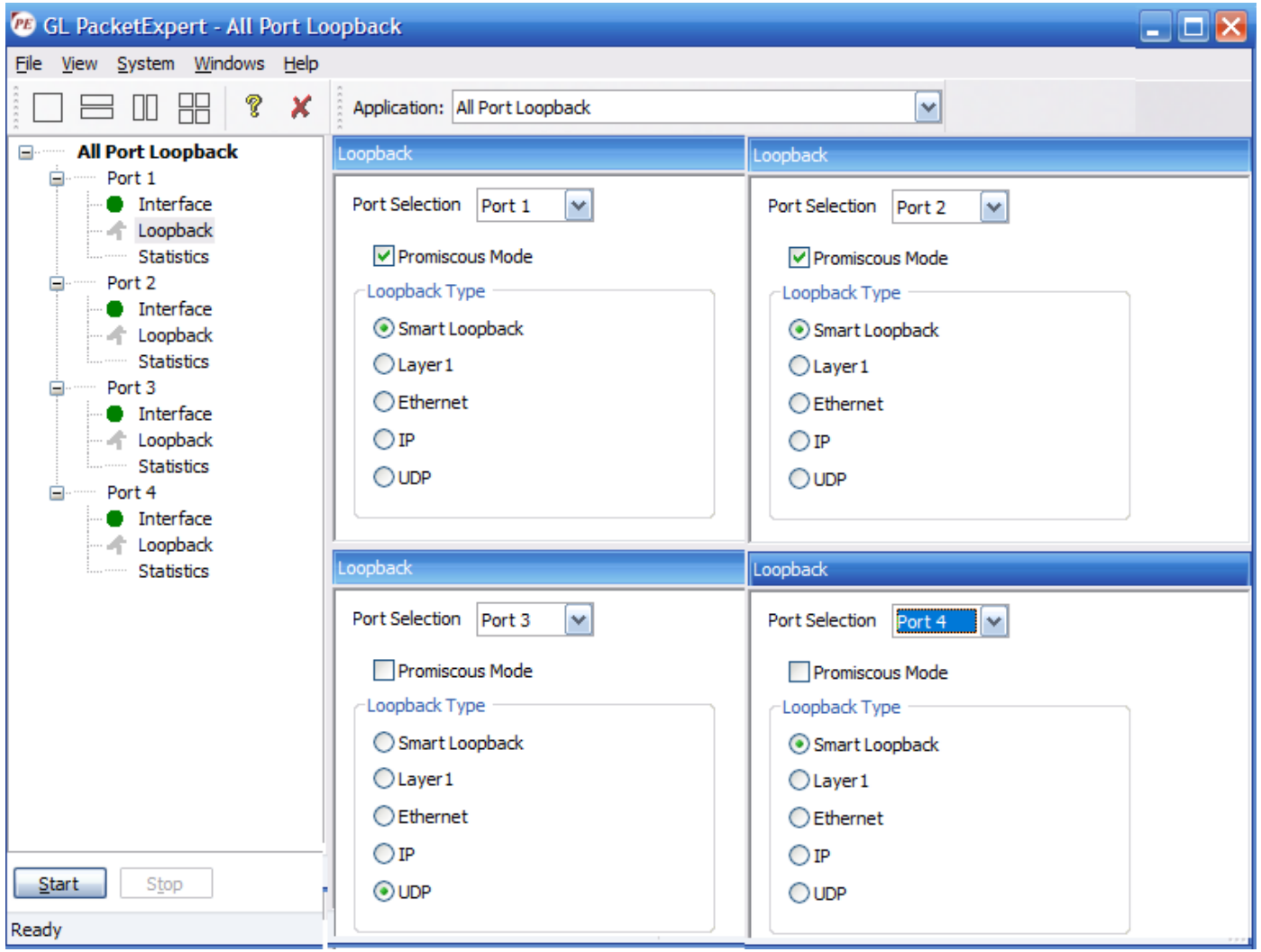
Tx

Ethernet Dst MAC Address	Ethernet Src MAC Address	Ethernet Len/Type Field	Payload	FCS
Ex: aa-aa-aa-aa-aa-aa	Ex: bb-bb-bb-bb-bb-bb			

- PacketExpert™ has all ports/2 ports Loopback capability. PacketExpert™ supports Layer-wise Loopback as well as Smart Loopback
- The above picture depicts the Ethernet Loopback type, swaps Source and Destination MAC addresses before sending back the packet

Loopback Testing (On all Ports/4 Ports)

- Supports Loopback on 10G / 1G ports
- Loopback Types – Smart Loopback, Layer 1, Ethernet, IP, UDP
- General statistics per port (similar to BERT port level statistics)



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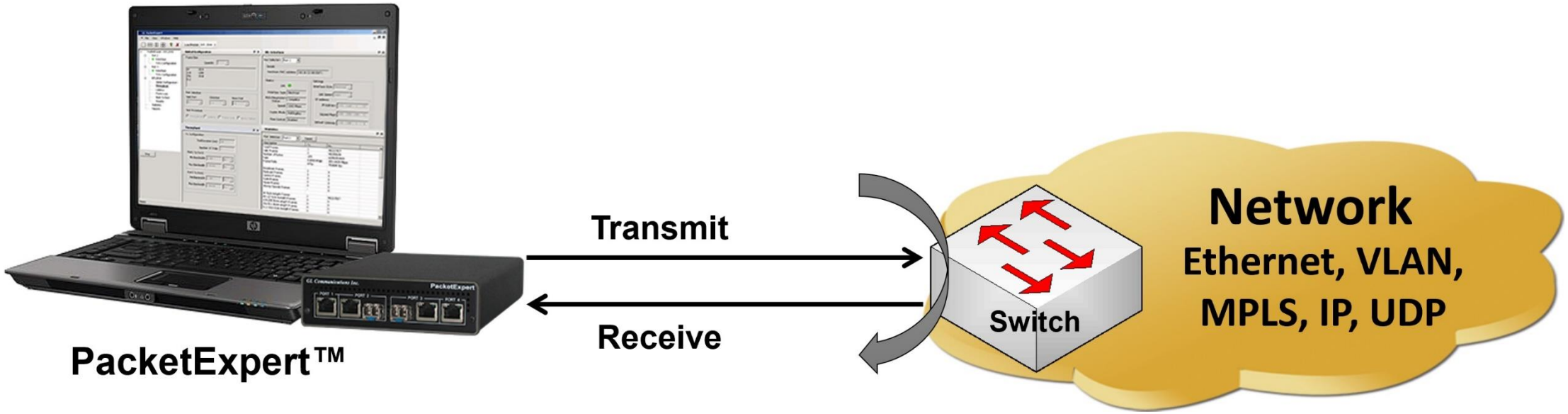
RFC 2544 Testing

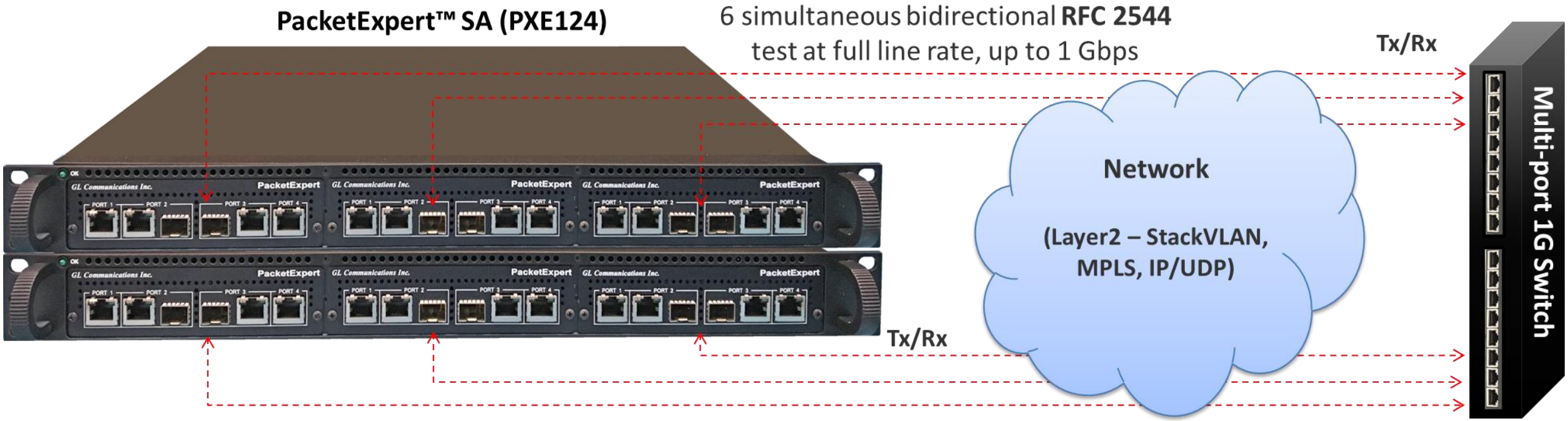
RFC 2544 Testing



RFC 2544 test application includes the following tests:

- **Throughput** - Maximum number of frames per second that can be transmitted without any error
- **Latency** - Measures the time required for a frame to travel from the originating device through the network to the destination device
- **Frame Loss** - Measures the network's response in overload conditions
- **Back-to-Back** - It measures the maximum number of frames received at full line rate before a frame is lost

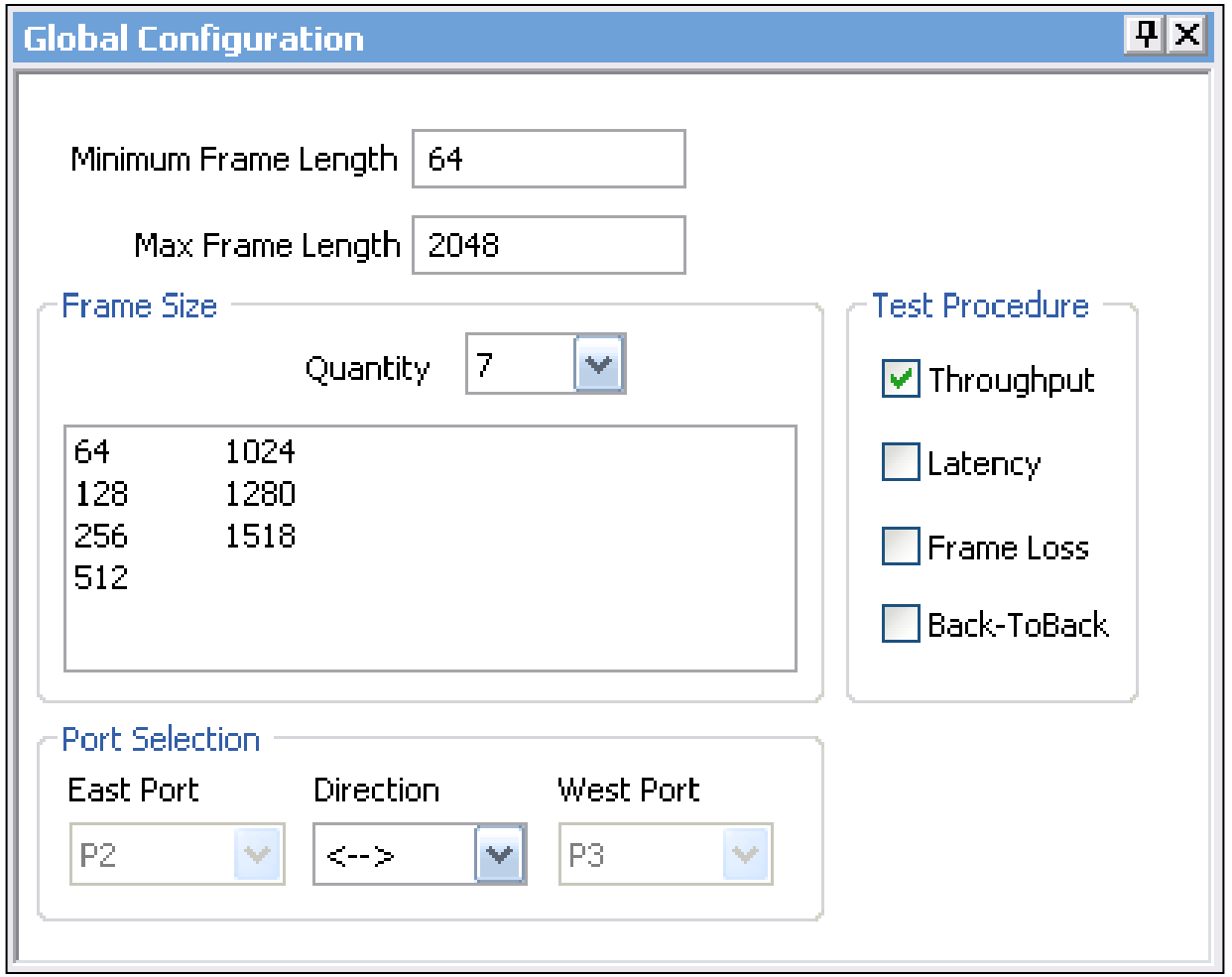
PacketExpert™ 24 Ports – RFC 2544



Highlights

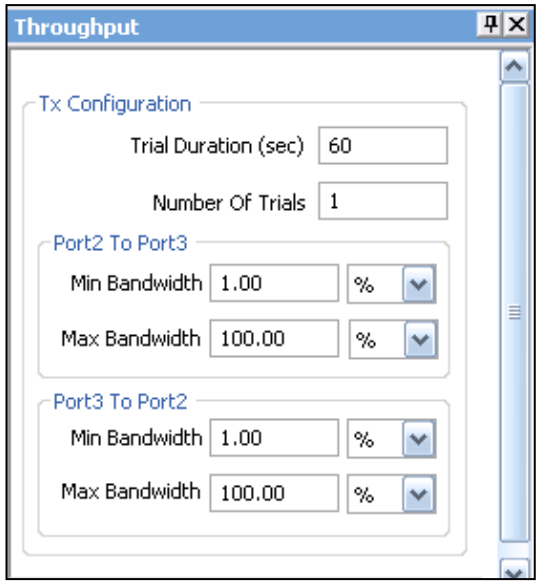
- Throughput, back-to-back, latency and frame loss testing supporting uni-directional and bi-directional traffic between ports
- Supports RFC 2544 on electrical / optical (1000Mbps) ports
- Includes various parameter configurations such as Test Selection, Frame Sizes selection, Unidirectional/Bidirectional, Number of trials, Trial Duration, and many more
- User-defined options to configure various packet header parameters, like MAC addresses, IP addresses, UDP ports, VLAN ID, MPLS Labels, and more
- Results are displayed in both tabular as well as graphical format

Global Configurations

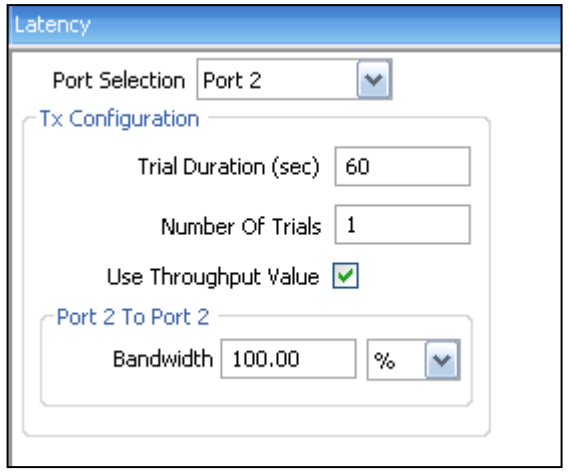


Individual Test Configuration Details

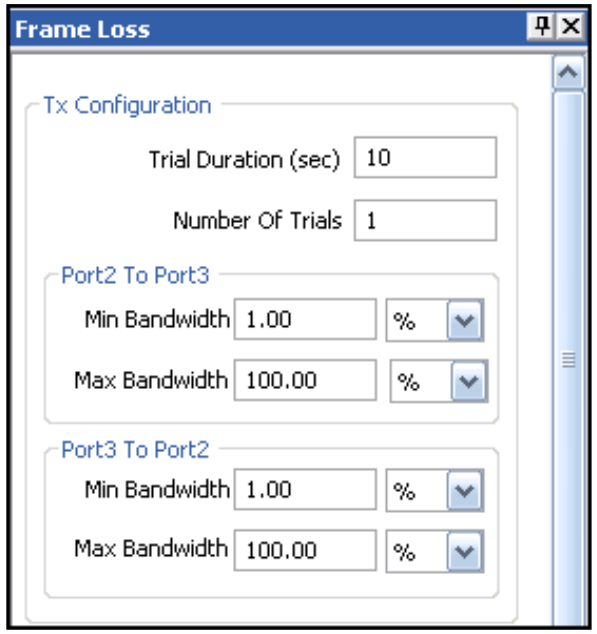
Throughput



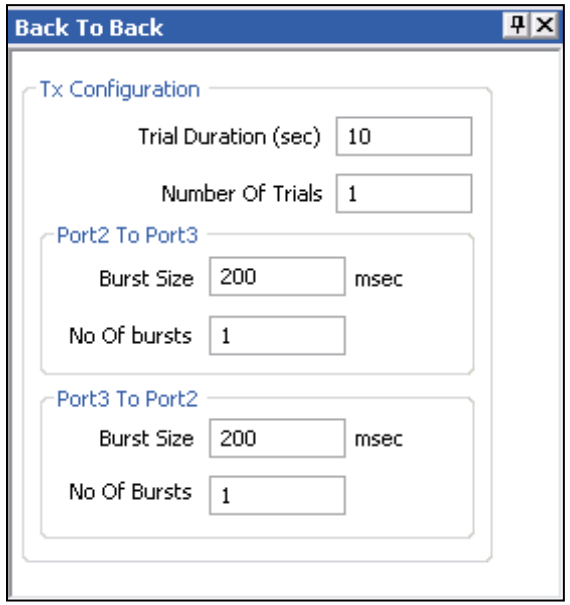
Latency



Frame Loss



Back-to-Back



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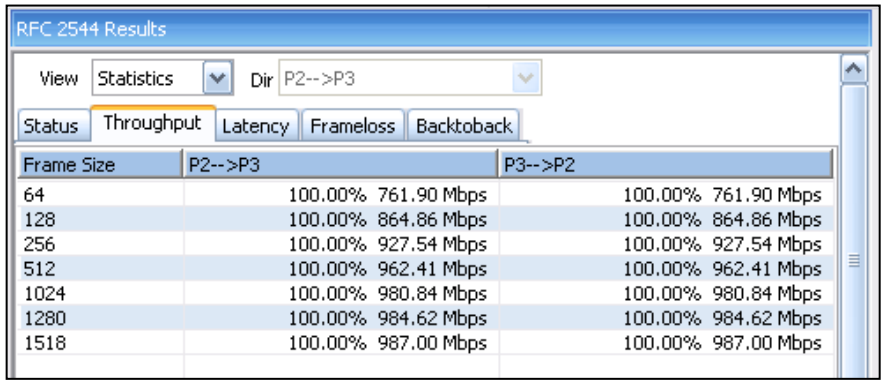
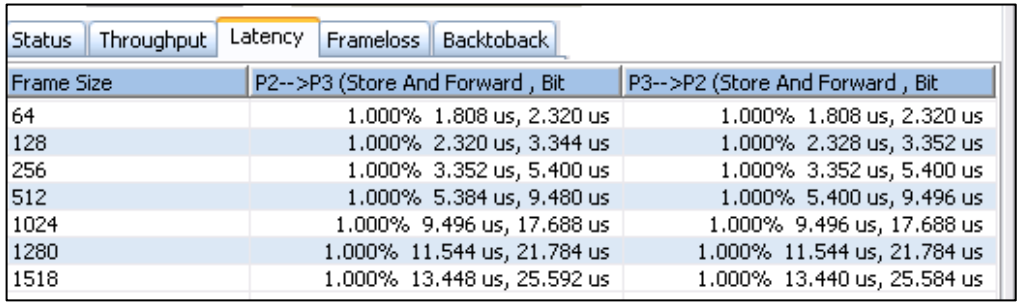
Results

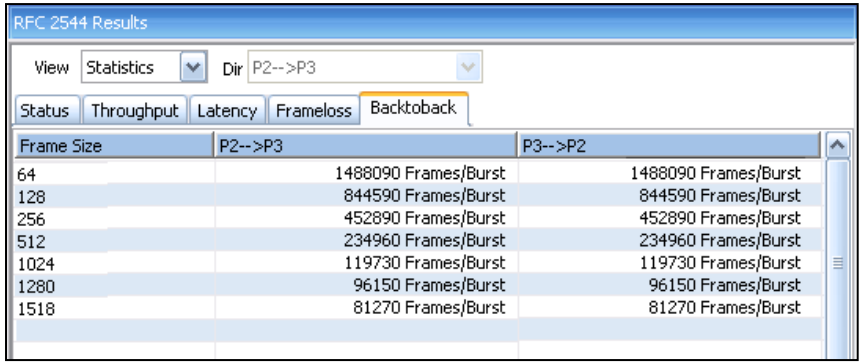
- **Throughput** – Both relative (% of link speed) and absolute (in Mbps) throughput values are displayed
- **Latency** – displayed in Microseconds
- **Back-to-Back** – Displayed in Frames/Burst
- **Frame Loss** – Displays the Frame Loss Rate (in %) against attempted Frame Rate (in % of link speed)



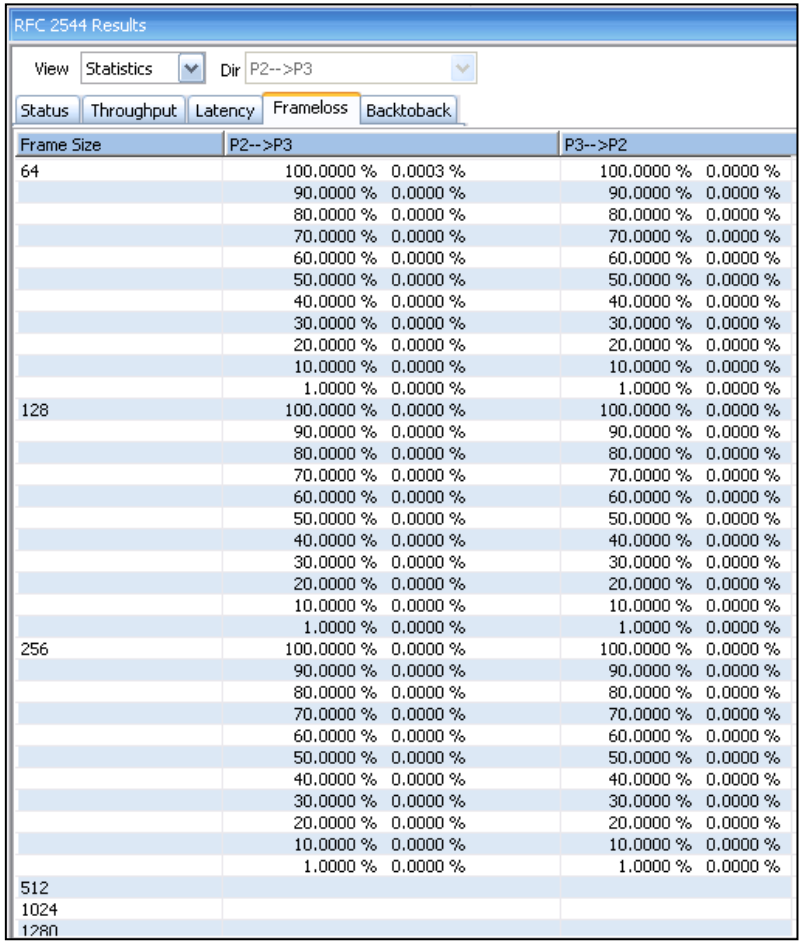
Frame Size	P2-->P3	P3-->P2
64	100.00% 761.90 Mbps	100.00% 761.90 Mbps
128	100.00% 864.86 Mbps	100.00% 864.86 Mbps
256	100.00% 927.54 Mbps	100.00% 927.54 Mbps
512	100.00% 962.41 Mbps	100.00% 962.41 Mbps
1024	100.00% 980.84 Mbps	100.00% 980.84 Mbps
1280	100.00% 984.62 Mbps	100.00% 984.62 Mbps
1518	100.00% 987.00 Mbps	100.00% 987.00 Mbps



Frame Size	P2-->P3 (Store And Forward , Bit	P3-->P2 (Store And Forward , Bit
64	1.000% 1.808 us, 2.320 us	1.000% 1.808 us, 2.320 us
128	1.000% 2.320 us, 3.344 us	1.000% 2.328 us, 3.352 us
256	1.000% 3.352 us, 5.400 us	1.000% 3.352 us, 5.400 us
512	1.000% 5.384 us, 9.480 us	1.000% 5.400 us, 9.496 us
1024	1.000% 9.496 us, 17.688 us	1.000% 9.496 us, 17.688 us
1280	1.000% 11.544 us, 21.784 us	1.000% 11.544 us, 21.784 us
1518	1.000% 13.448 us, 25.592 us	1.000% 13.440 us, 25.584 us



Frame Size	P2-->P3	P3-->P2
64	1488090 Frames/Burst	1488090 Frames/Burst
128	844590 Frames/Burst	844590 Frames/Burst
256	452890 Frames/Burst	452890 Frames/Burst
512	234960 Frames/Burst	234960 Frames/Burst
1024	119730 Frames/Burst	119730 Frames/Burst
1280	96150 Frames/Burst	96150 Frames/Burst
1518	81270 Frames/Burst	81270 Frames/Burst

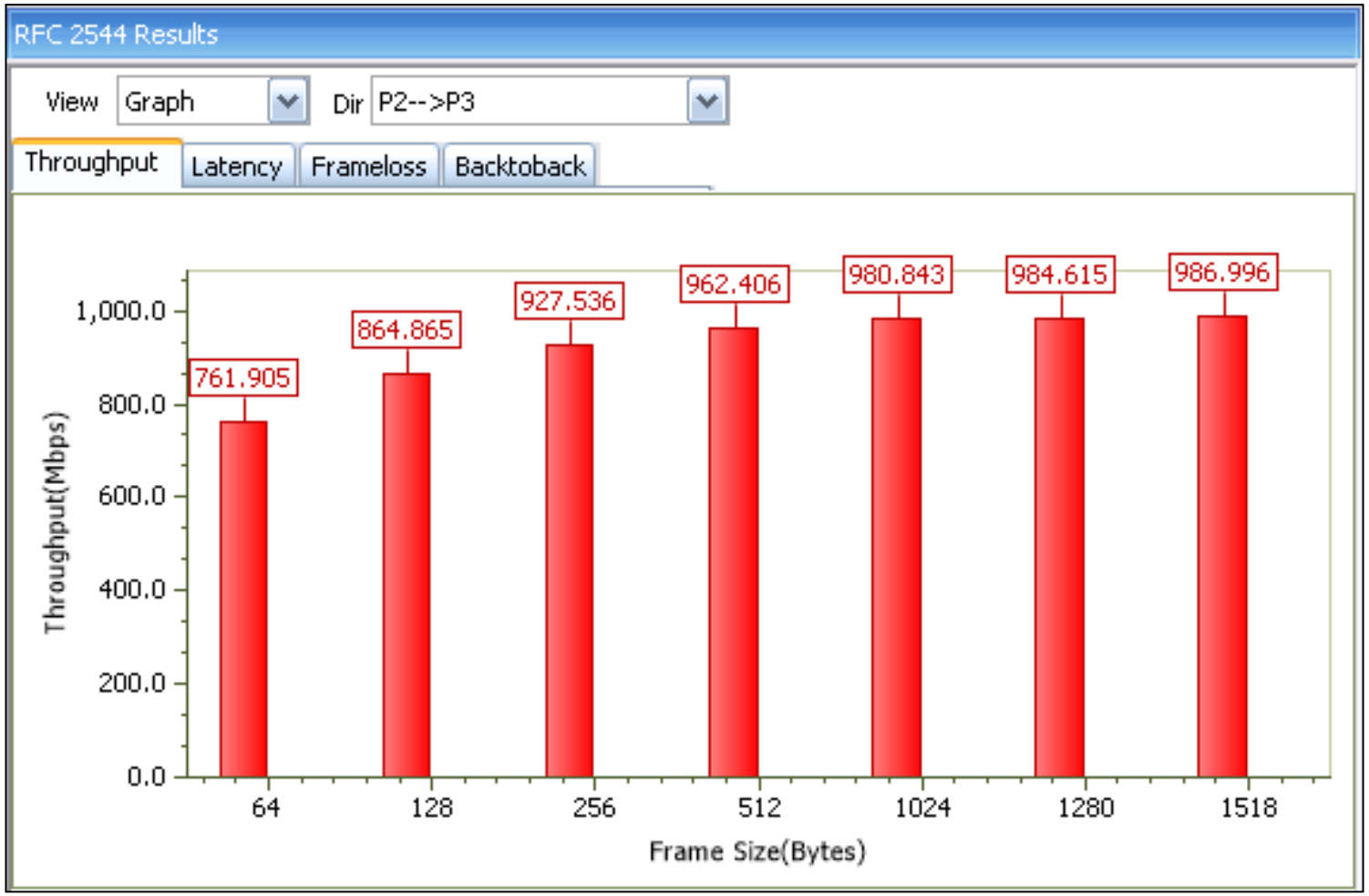


Frame Size	P2-->P3		P3-->P2	
64	100.0000 %	0.0003 %	100.0000 %	0.0000 %
	90.0000 %	0.0000 %	90.0000 %	0.0000 %
	80.0000 %	0.0000 %	80.0000 %	0.0000 %
	70.0000 %	0.0000 %	70.0000 %	0.0000 %
	60.0000 %	0.0000 %	60.0000 %	0.0000 %
	50.0000 %	0.0000 %	50.0000 %	0.0000 %
	40.0000 %	0.0000 %	40.0000 %	0.0000 %
	30.0000 %	0.0000 %	30.0000 %	0.0000 %
	20.0000 %	0.0000 %	20.0000 %	0.0000 %
	10.0000 %	0.0000 %	10.0000 %	0.0000 %
	1.0000 %	0.0000 %	1.0000 %	0.0000 %
128	100.0000 %	0.0000 %	100.0000 %	0.0000 %
	90.0000 %	0.0000 %	90.0000 %	0.0000 %
	80.0000 %	0.0000 %	80.0000 %	0.0000 %
	70.0000 %	0.0000 %	70.0000 %	0.0000 %
	60.0000 %	0.0000 %	60.0000 %	0.0000 %
	50.0000 %	0.0000 %	50.0000 %	0.0000 %
	40.0000 %	0.0000 %	40.0000 %	0.0000 %
	30.0000 %	0.0000 %	30.0000 %	0.0000 %
	20.0000 %	0.0000 %	20.0000 %	0.0000 %
	10.0000 %	0.0000 %	10.0000 %	0.0000 %
	1.0000 %	0.0000 %	1.0000 %	0.0000 %
256	100.0000 %	0.0000 %	100.0000 %	0.0000 %
	90.0000 %	0.0000 %	90.0000 %	0.0000 %
	80.0000 %	0.0000 %	80.0000 %	0.0000 %
	70.0000 %	0.0000 %	70.0000 %	0.0000 %
	60.0000 %	0.0000 %	60.0000 %	0.0000 %
	50.0000 %	0.0000 %	50.0000 %	0.0000 %
	40.0000 %	0.0000 %	40.0000 %	0.0000 %
	30.0000 %	0.0000 %	30.0000 %	0.0000 %
	20.0000 %	0.0000 %	20.0000 %	0.0000 %
	10.0000 %	0.0000 %	10.0000 %	0.0000 %
	1.0000 %	0.0000 %	1.0000 %	0.0000 %
512				
1024				
1280				

GL Communications

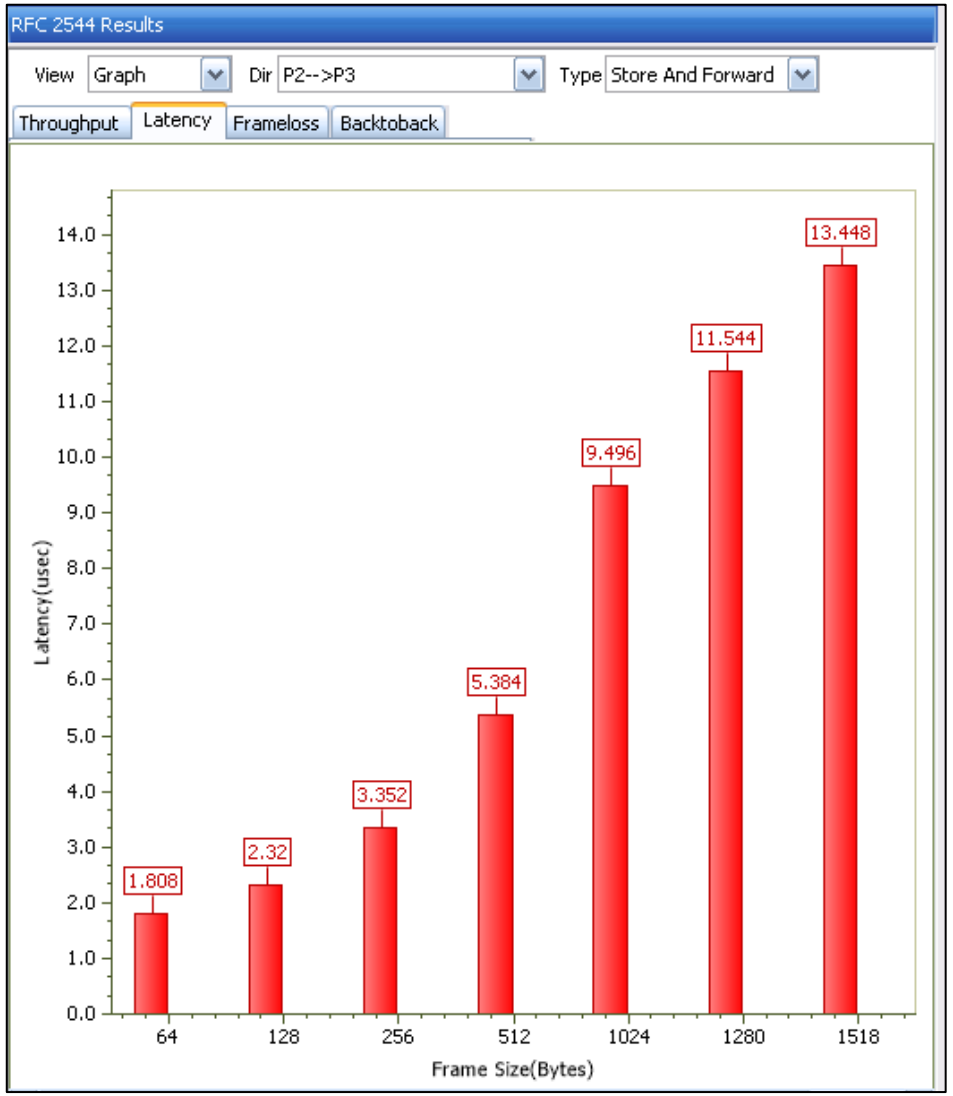
Graphs

Throughput

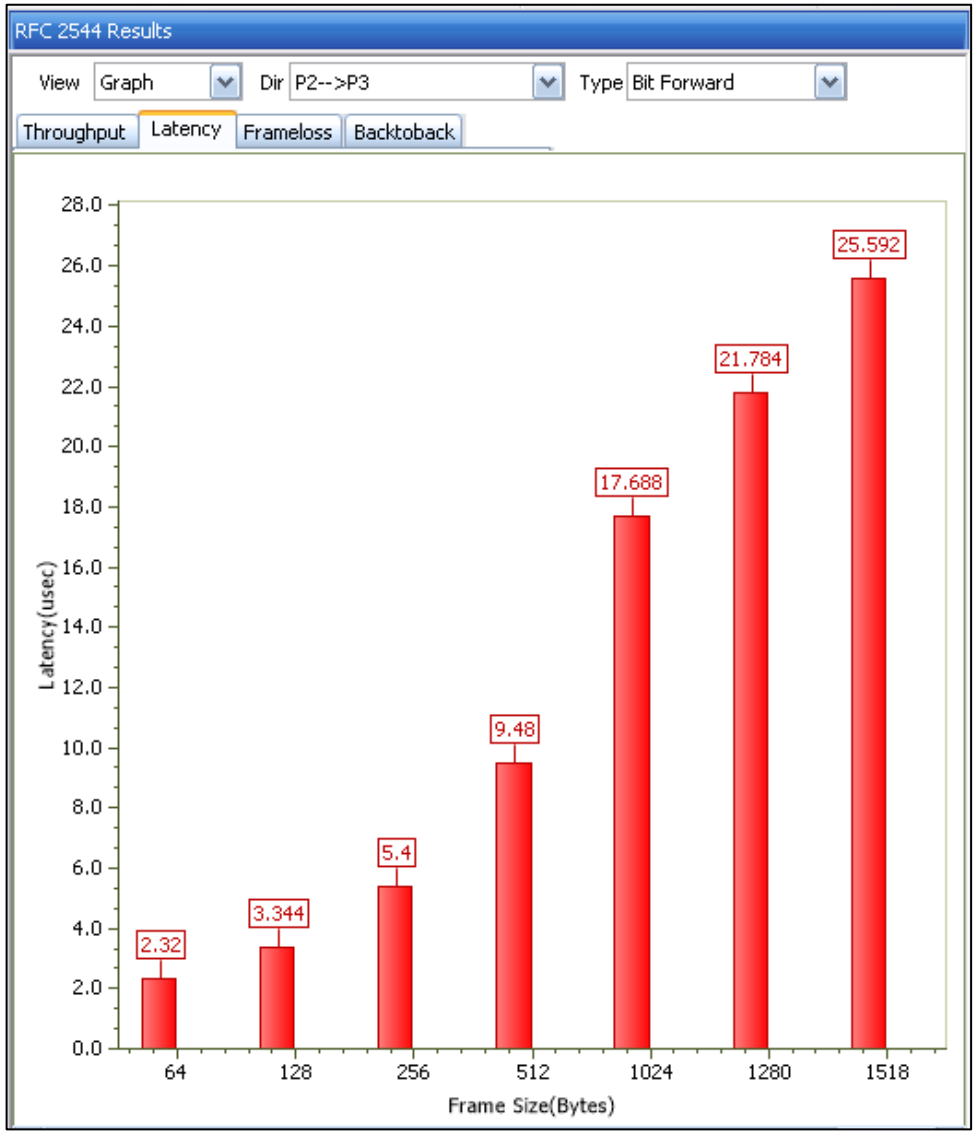


Graphs (Contd.)

Store And Forward Latency



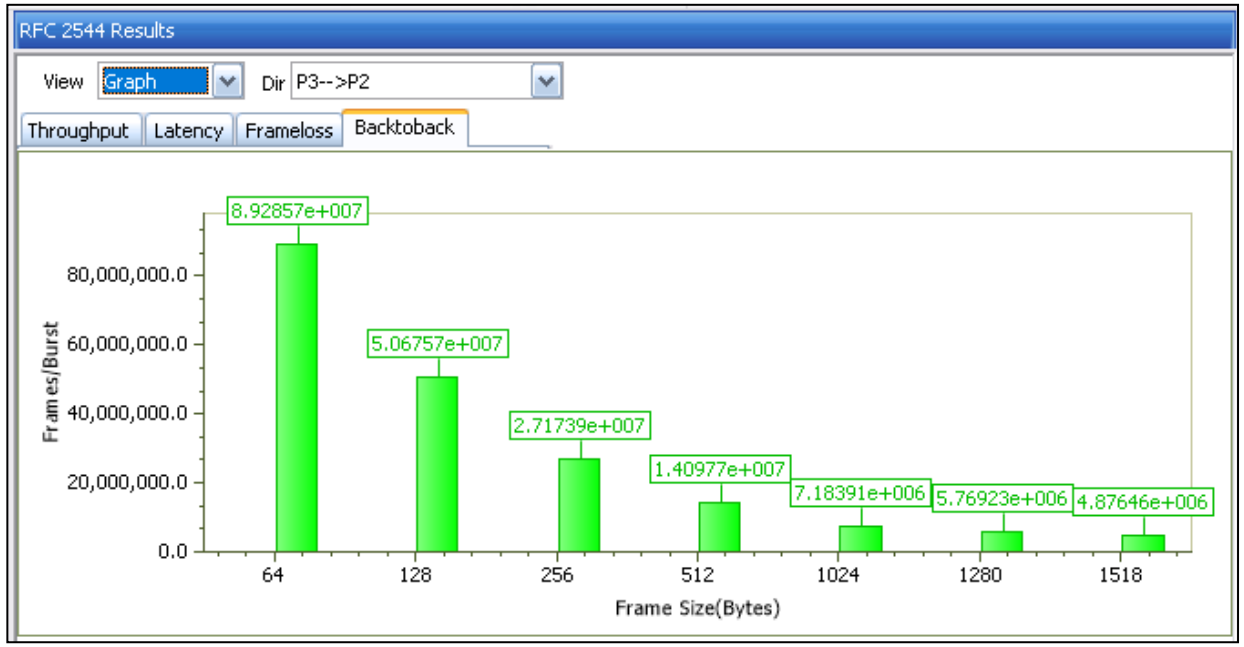
Bit Forward Latency



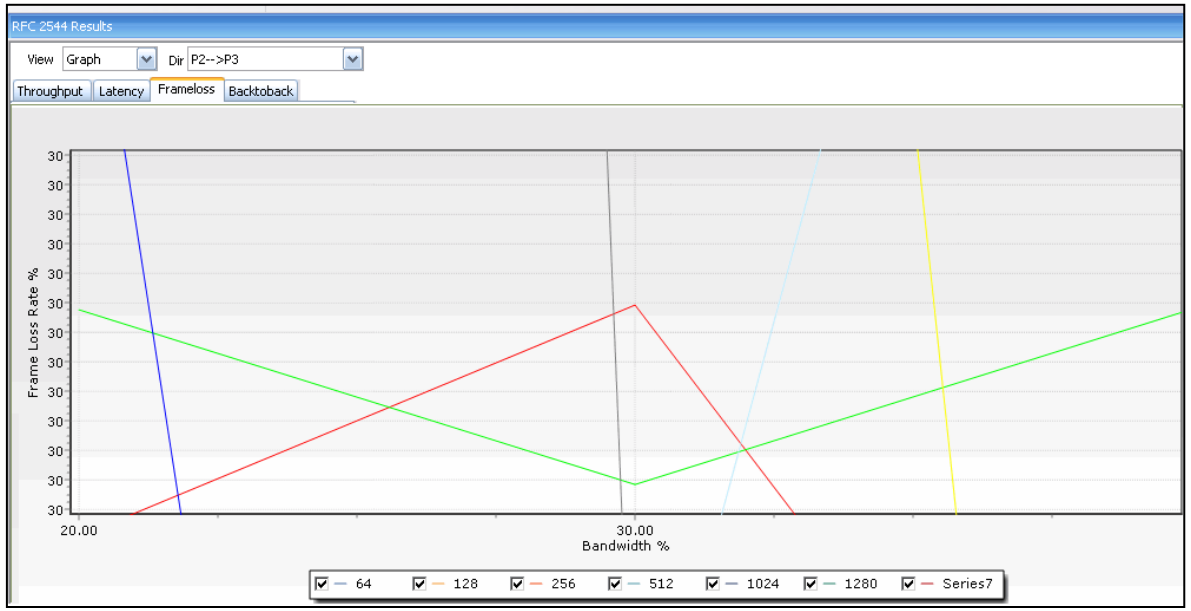
GL Communications

Graphs (Contd.)

Back-to-Back

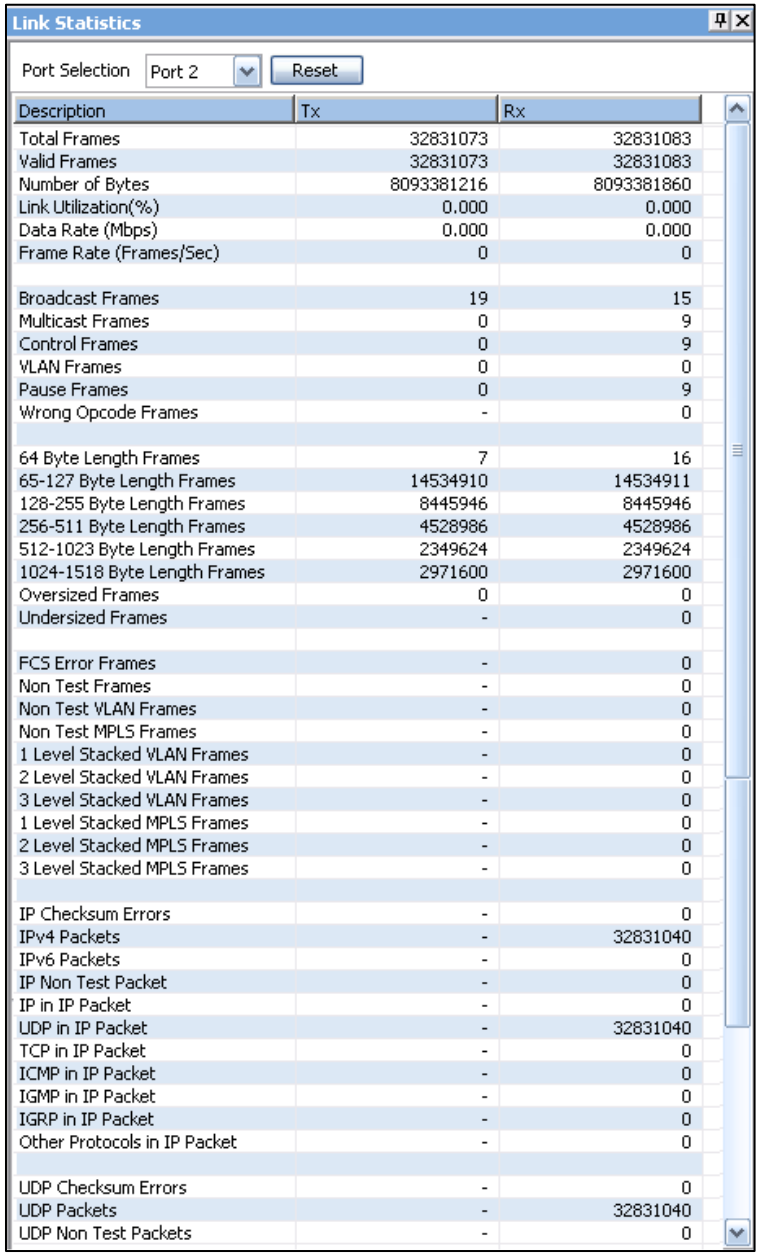


Frame Loss



Port Statistics

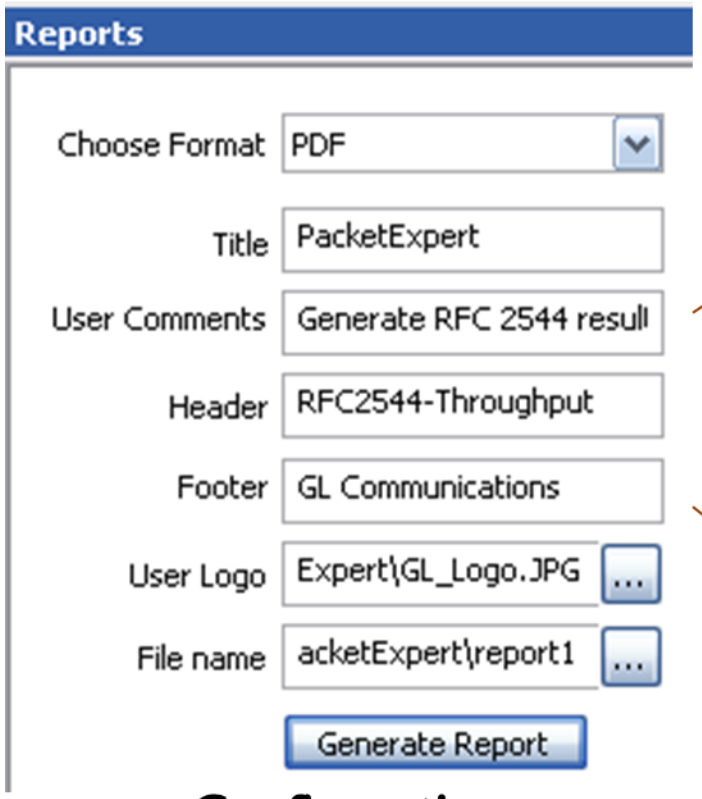
- Per port detailed statistics are provided –
  - Tx / Rx Frame count
  - Number of Bytes transmitted & received
  - Tx & Rx Frame Rate
  - Broadcast, Multicast, Control, VLAN, Pause Frame count
  - Frame count for byte lengths 64/65-127
  - MPLS and VLAN Frame count for various stack level
  - IPv4/ UDP packet count
  - Oversized / Undersized Error frame count
  - FCS error count
  - IP/UDP checksum error count and others



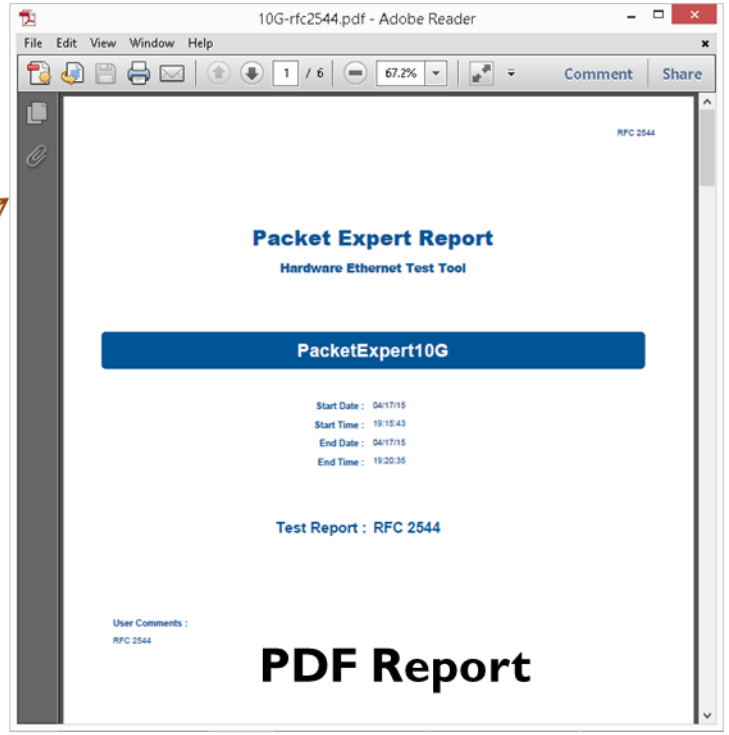
Description	Tx	Rx
Total Frames	32831073	32831083
Valid Frames	32831073	32831083
Number of Bytes	8093381216	8093381860
Link Utilization(%)	0.000	0.000
Data Rate (Mbps)	0.000	0.000
Frame Rate (Frames/Sec)	0	0
Broadcast Frames	19	15
Multicast Frames	0	9
Control Frames	0	9
VLAN Frames	0	0
Pause Frames	0	9
Wrong Opcode Frames	-	0
64 Byte Length Frames	7	16
65-127 Byte Length Frames	14534910	14534911
128-255 Byte Length Frames	8445946	8445946
256-511 Byte Length Frames	4528986	4528986
512-1023 Byte Length Frames	2349624	2349624
1024-1518 Byte Length Frames	2971600	2971600
Oversized Frames	0	0
Undersized Frames	-	0
FCS Error Frames	-	0
Non Test Frames	-	0
Non Test VLAN Frames	-	0
Non Test MPLS Frames	-	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
IP Checksum Errors	-	0
IPv4 Packets	-	32831040
IPv6 Packets	-	0
IP Non Test Packet	-	0
IP in IP Packet	-	0
UDP in IP Packet	-	32831040
TCP in IP Packet	-	0
ICMP in IP Packet	-	0
IGMP in IP Packet	-	0
IGRP in IP Packet	-	0
Other Protocols in IP Packet	-	0
UDP Checksum Errors	-	0
UDP Packets	-	32831040
UDP Non Test Packets	-	0

GL Communications

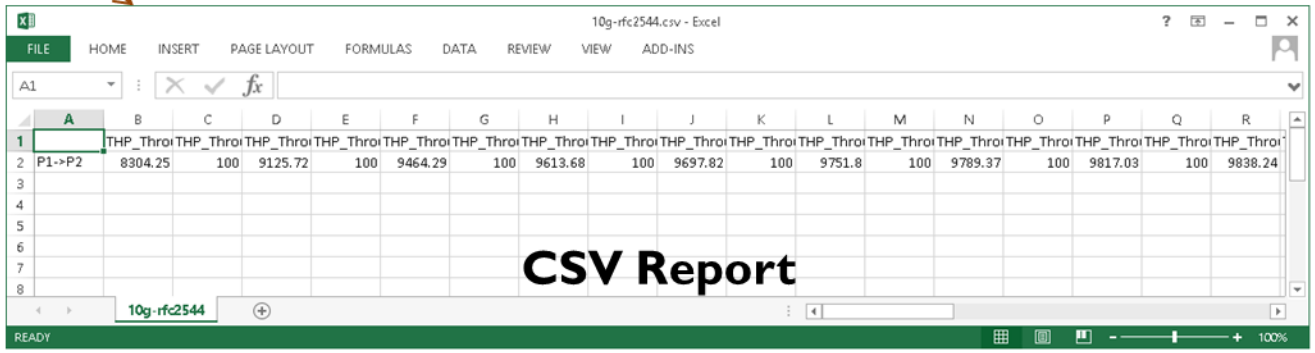
Generate Reports



Configuration



PDF Report

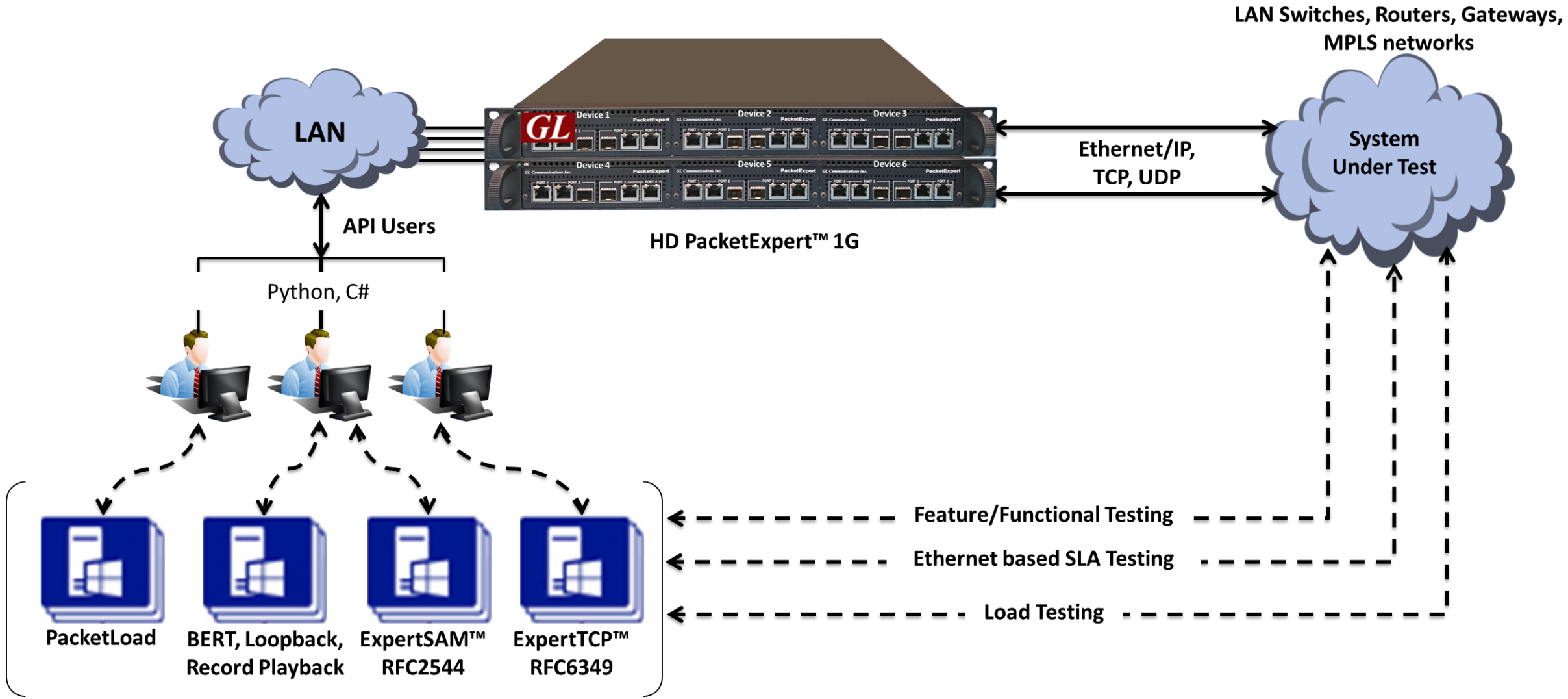


CSV Report

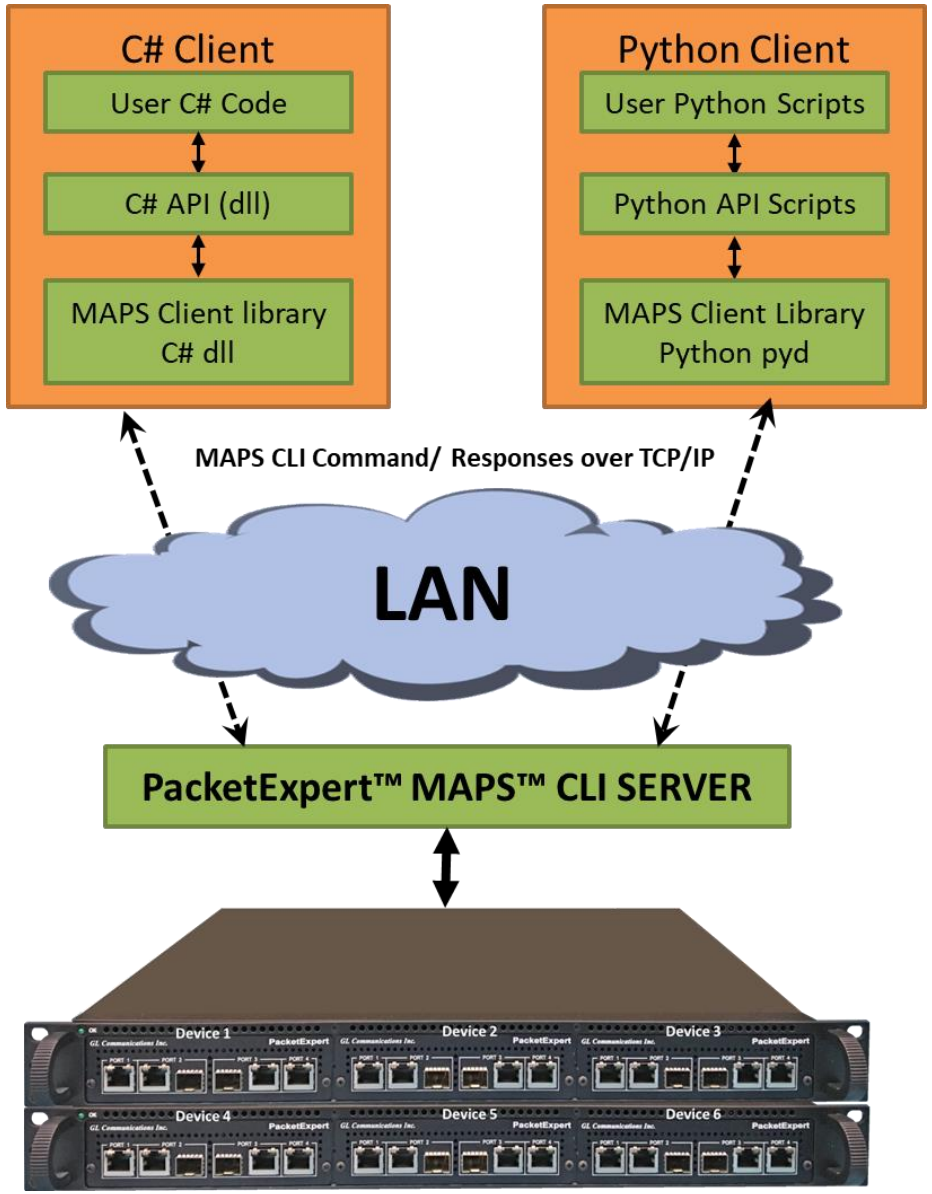
GL Communications

Command Line Interface (CLI)

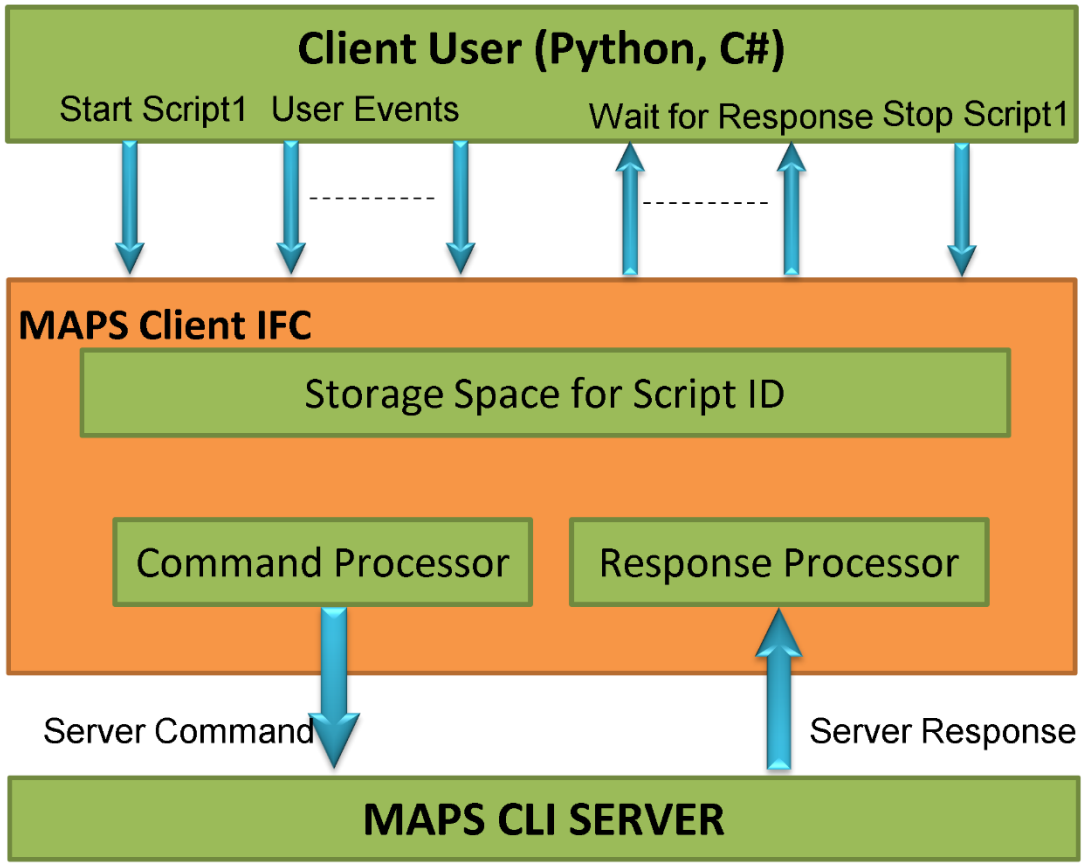
APIs for Test Automation and Remote Access



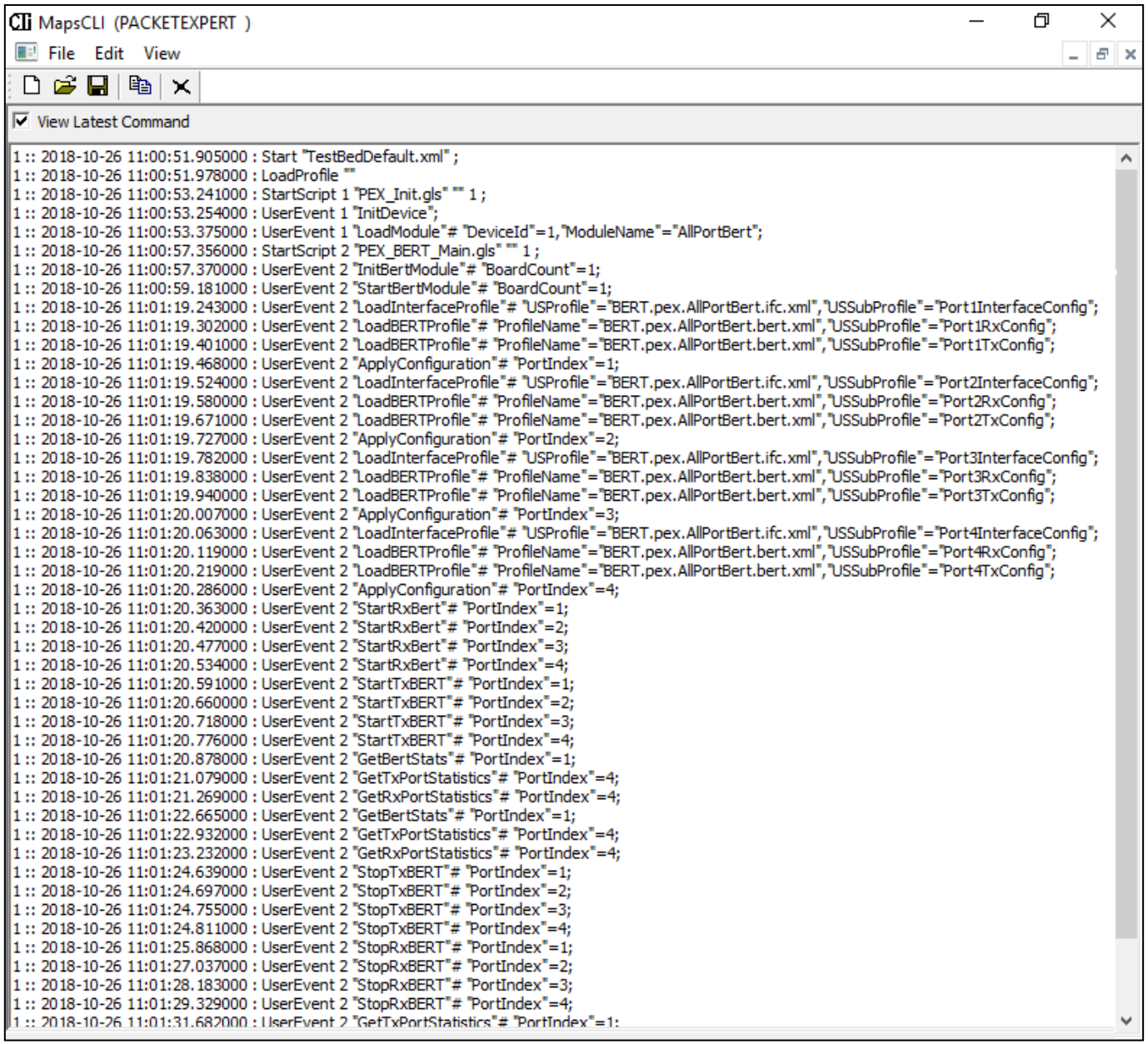
MAPS™ CLI Client/Server Architecture



Working Principle of MAPS™ CLI

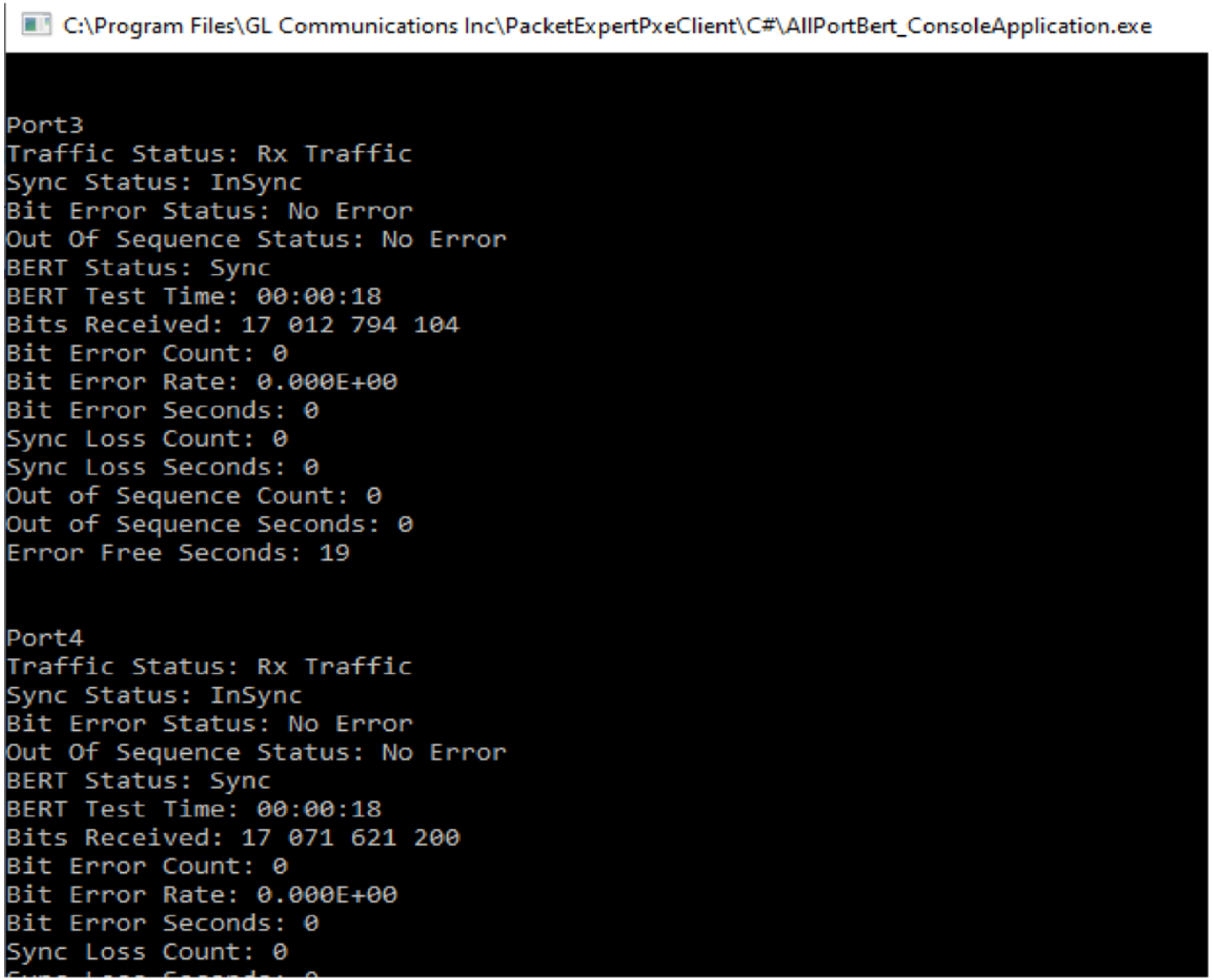


MAPS™ CLI Server



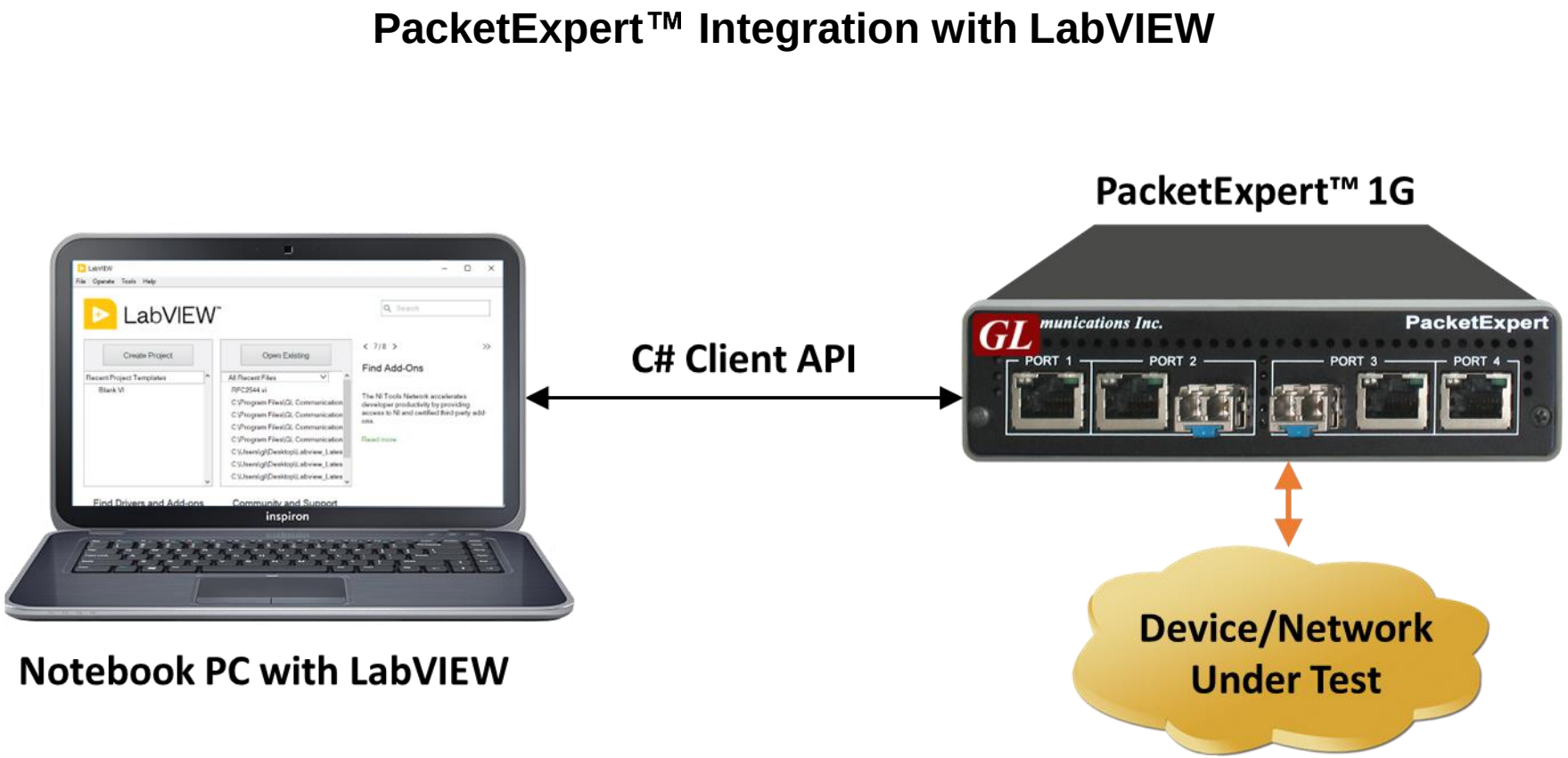
GL Communications

Executing Sample C# Client



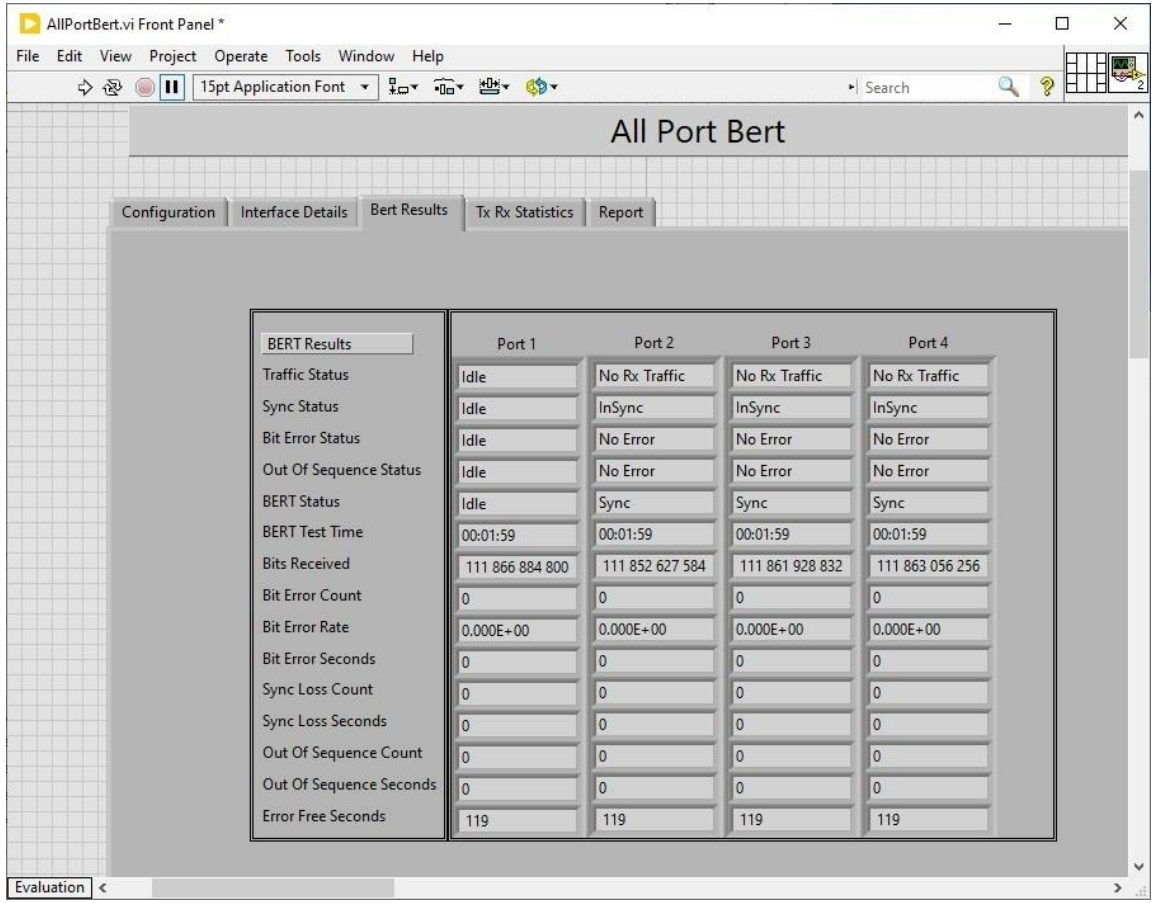
GL Communications

PacketExpert™ Integration with LabVIEW using C# Client



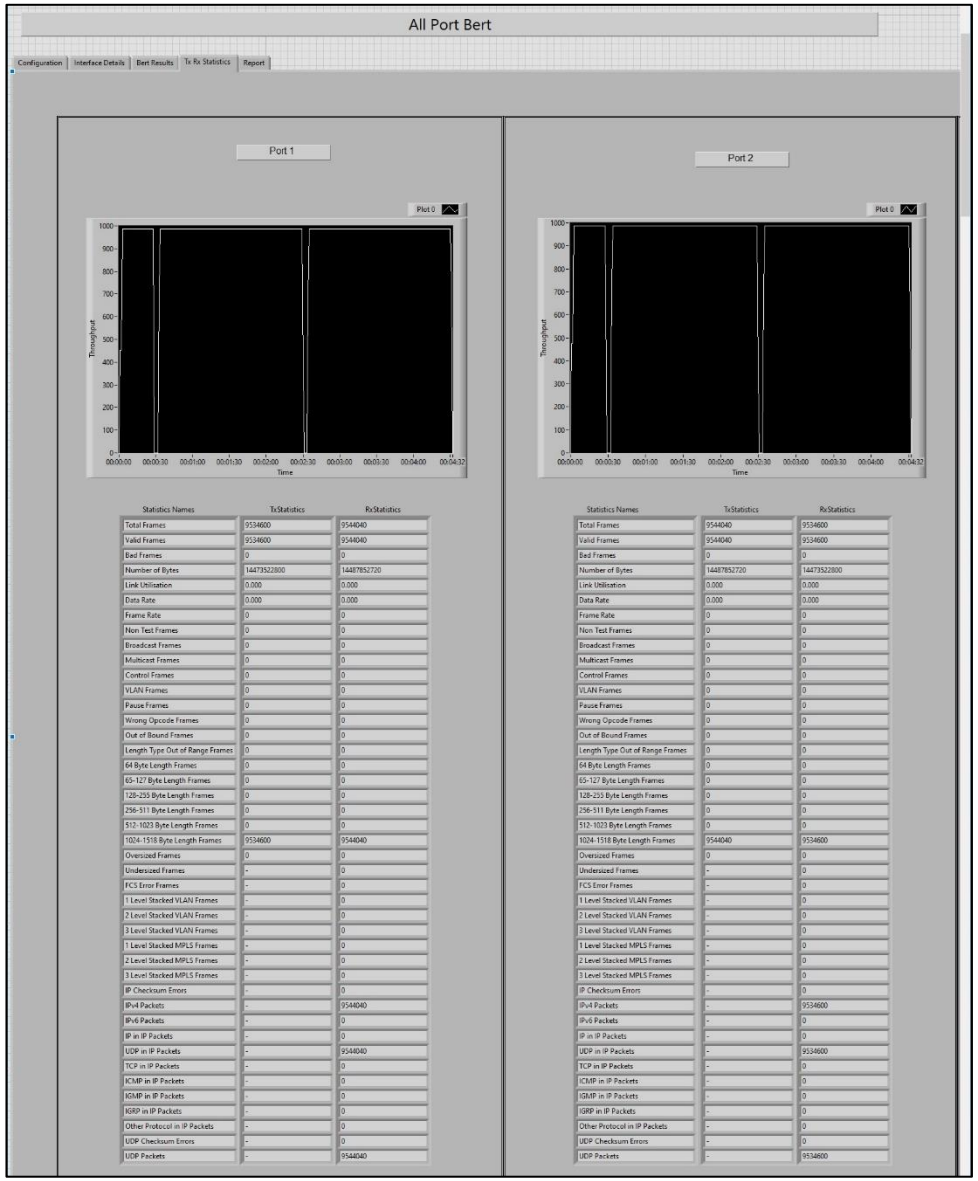
PacketExpert™ Integration with LabVIEW using C# Client

BERT Results



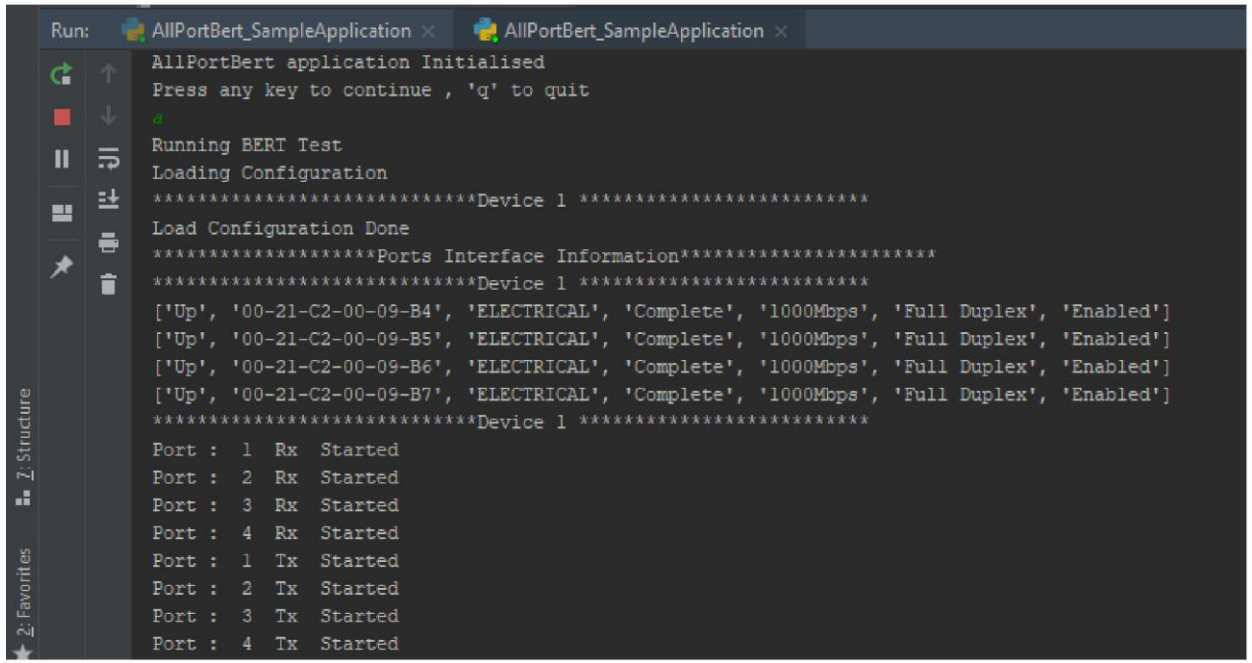
BERT Results	Port 1	Port 2	Port 3	Port 4
Traffic Status	Idle	No Rx Traffic	No Rx Traffic	No Rx Traffic
Sync Status	Idle	InSync	InSync	InSync
Bit Error Status	Idle	No Error	No Error	No Error
Out Of Sequence Status	Idle	No Error	No Error	No Error
BERT Status	Idle	Sync	Sync	Sync
BERT Test Time	00:01:59	00:01:59	00:01:59	00:01:59
Bits Received	111 866 884 800	111 852 627 584	111 861 928 832	111 863 056 256
Bit Error Count	0	0	0	0
Bit Error Rate	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Bit Error Seconds	0	0	0	0
Sync Loss Count	0	0	0	0
Sync Loss Seconds	0	0	0	0
Out Of Sequence Count	0	0	0	0
Out Of Sequence Seconds	0	0	0	0
Error Free Seconds	119	119	119	119

BERT Statistics



GL Communications

Executing Sample Python Script




```
Port :  4  Tx  Started
**********Device 1 **********

Bert Results of Port 1
[{'Traffic Status': 'Rx Traffic'},
 {'Sync Status': 'InSync'},
 {'Bit Error Status': 'No Error'},
 {'Out Of Sequence Status': 'No Error'},
 {'BERT Status': 'Sync'},
 {'BERT Test Time': '00:00:07'},
 {'Bits Received': '5 226 410 336'},
 {'Bit Error Count': '0'},
 {'Bit Error Rate': '0.000E+00'},
 {'Bit Error Seconds': '0'},
 {'Sync Loss Count': '0'},
 {'Sync Loss Seconds': '0'},
 {'Out of Sequence Count': '0'},
 {'Out of Sequence Seconds': '0'},
 {'Error Free Seconds': '7'}]

Bert Results of Port 2
[{'Traffic Status': 'Rx Traffic'},
 {'Sync Status': 'InSync'},
 {'Bit Error Status': 'No Error'},
 {'Out Of Sequence Status': 'No Error'},
 {'BERT Status': 'Sync'},
 {'BERT Test Time': '00:00:07'},
```

GL Communications

Thank you