SonetExpert™ Channelized Analyzer
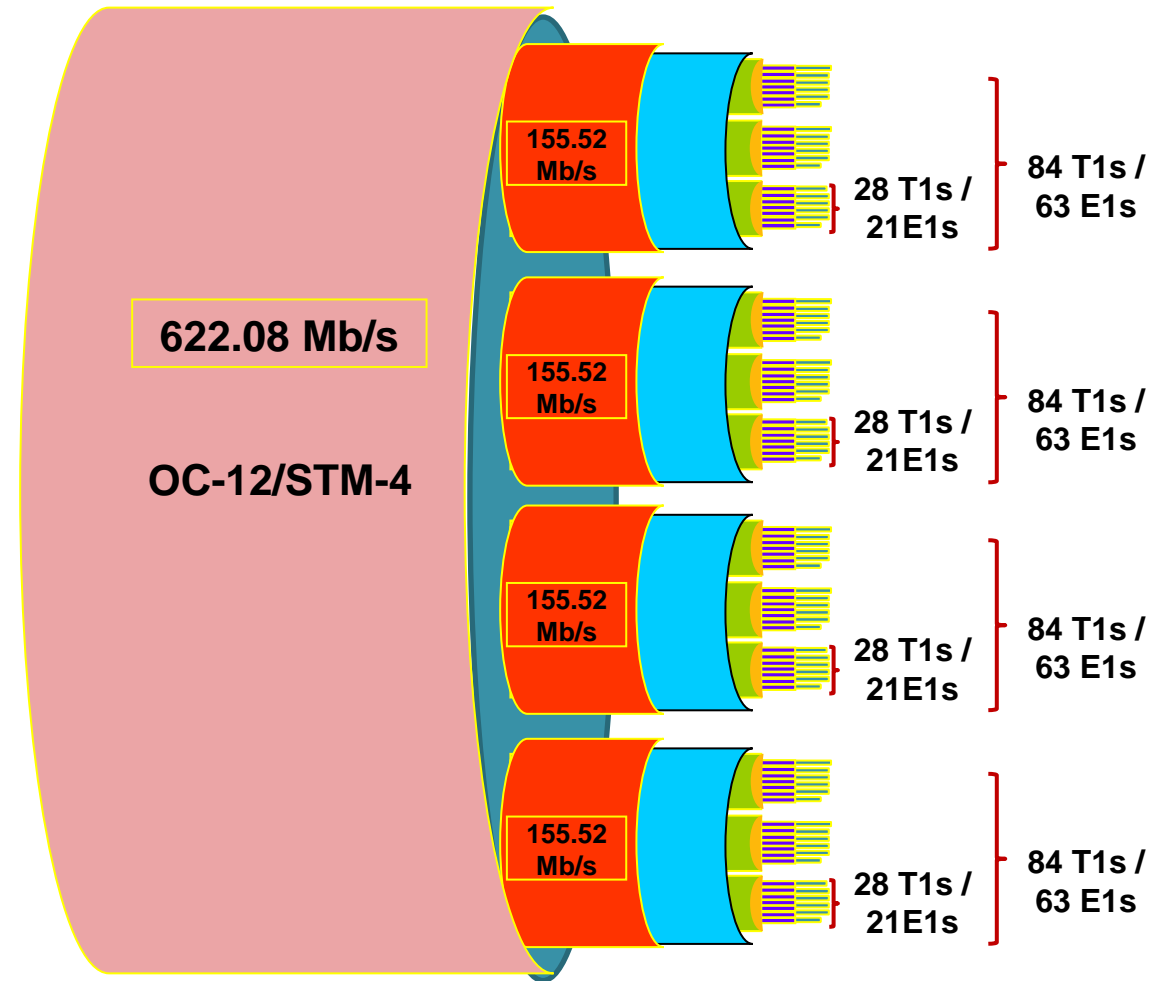
GL Communications Inc.

Introduction

- SONET = Synchronous optical networking. Used in North America

- SDH = Synchronous digital hierarchy. Used in the rest of the world

- SONET and SDH are optical transmission protocols for high-speed data, voice and video traffic

- Data rates

  ➢ SONET: Optical Carrier (OC) - N

  ➢ SDH: Synchronous Transport Module (STM) - N

- SONET/SDH can carry channelized and unchannelized data

  ➢ Channelized = T1 E1

    ▪ OC-3/STM-1 supports 84 T1s or 63 E1s

    ▪ OC-12/STM-4 supports 336 T1s or 252 E1s

  ➢ Unchannelized = Packet over SONET (PoS), Asynchronous Transfer Mode (ATM)
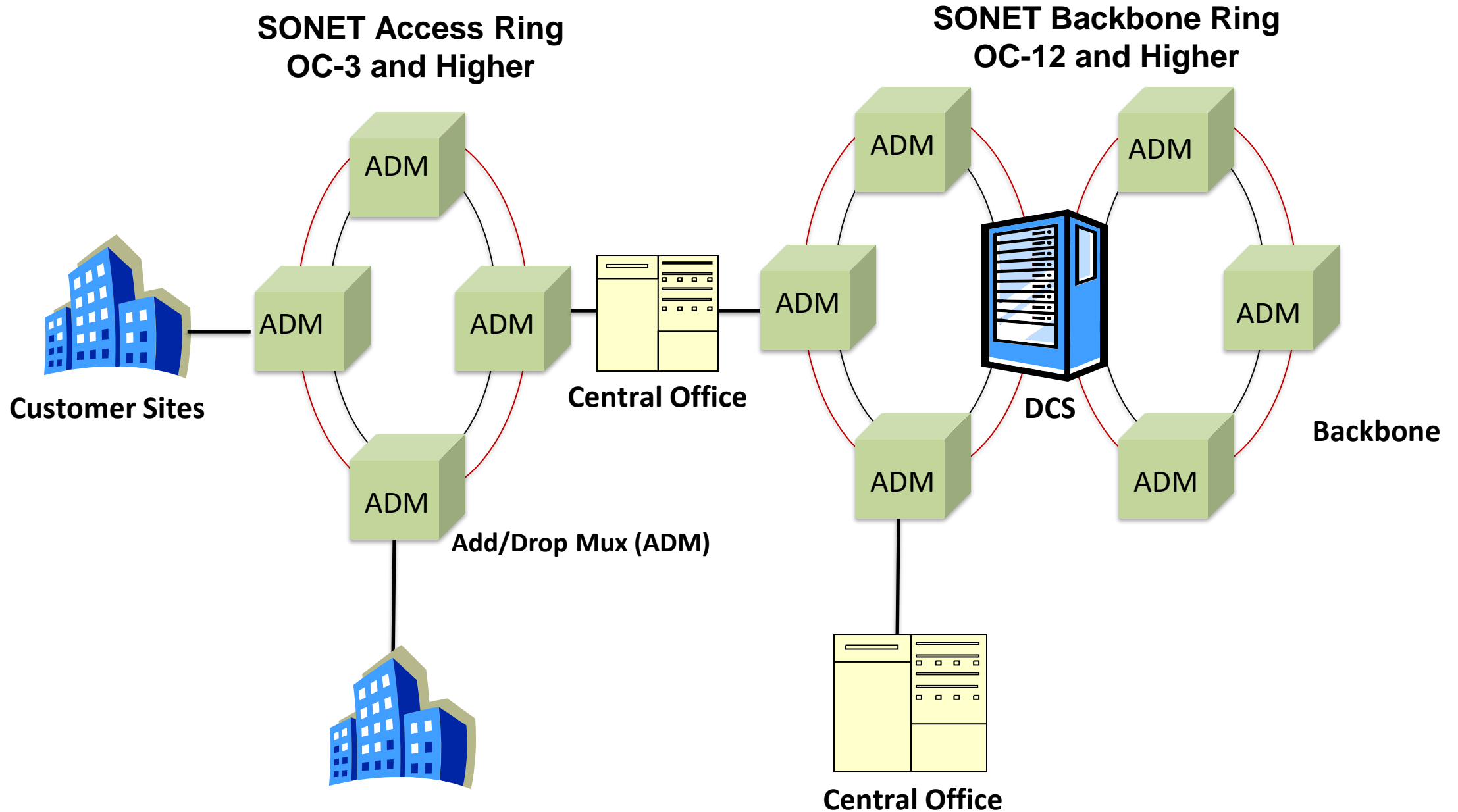
SONET/SDH Line Rates

Electrical	Optical (SONET)	Line Rates	SDH Equivalent
STS-1	OC-1	51.84 Mbps	____
STS-3	OC-3	155.52 Mbps	STM-1
STS-9	OC-9	466.56 Mbps	____
STS-12	OC-12	622.08 Mbps	STM-4
STS-18	OC-18	933.12 Mbps	____
STS-24	OC-24	1.2 Gbps	____
STS-36	OC-36	1.9 Gbps	____
STS-48	OC-48	2.5 Gbps	STM-16
STS-96	OC-96	5 Gbps	____
STS-192	OC-192	10 Gbps	STM-64
STS-768	OC-768	40 Gbps	____
STS-3072	OC-3072	160 Gbps	____

Channelized OC-3/12 STM-1/4

- DS0 = Digital Signal 0 (64 Kbps)

  ➤ Carries digital traffic (including voice)

- T1 = 24 DS0

- E1 = 32 DS0

- STM-1 = 84 T1 or 63 E1

- STM-4 = 4 STM-1

  ➤ STM-4 = 336 T1

  ➤ STM-4 = 252 E1

- STM-4/OC-12 can support ~ 8000 data streams (voice calls)

622.08 Mb/s

OC-12/STM-4

155.52 Mb/s — 28 T1s / 21E1s — 84 T1s / 63 E1s

155.52 Mb/s — 28 T1s / 21E1s — 84 T1s / 63 E1s

155.52 Mb/s — 28 T1s / 21E1s — 84 T1s / 63 E1s

155.52 Mb/s — 28 T1s / 21E1s — 84 T1s / 63 E1s

SONET Network Elements

SONET/SDH Testing Scenarios

- Monitor T1s, E1s, and DS0s directly without requiring physical access

  ➢ Accessing individual T1 / E1s on a SONET/SDH link

  ➢ Readily identify traffic types within the complex SONET/SDH structure

  ➢ Capturing and analyzing voice calls for call quality or surveillance

- Load testing SONET/SDH network by generating the maximum number of voice calls/data streams

- Real time alarm detection and management: Send SNMP traps at the individual T1 E1 level for network management

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SonetExpert™ SONET/SDH Channelized Testing Solution

SonetExpert™

USB 3.0

SonetExpert™

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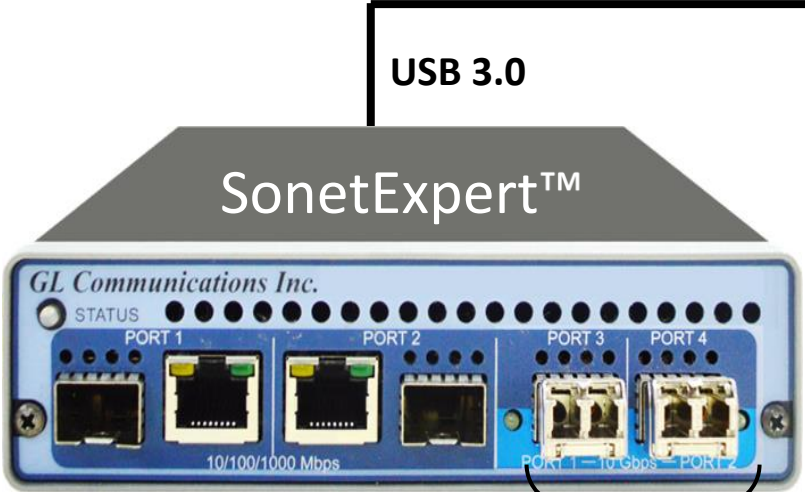
**Channelized Ports
OC-3/STM-1 and OC-12/STM-4**
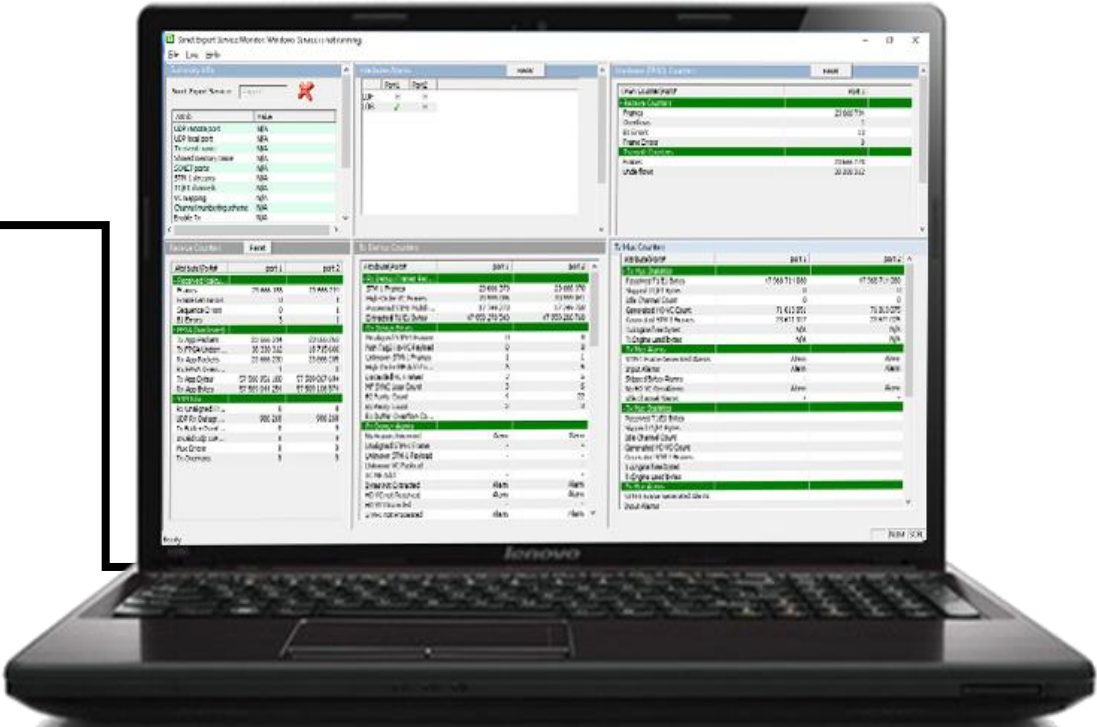
SonetExpert™ is configured from a Windows® 10 PC via USB 3.0 port

SonetExpert™ Portable Hardware Unit
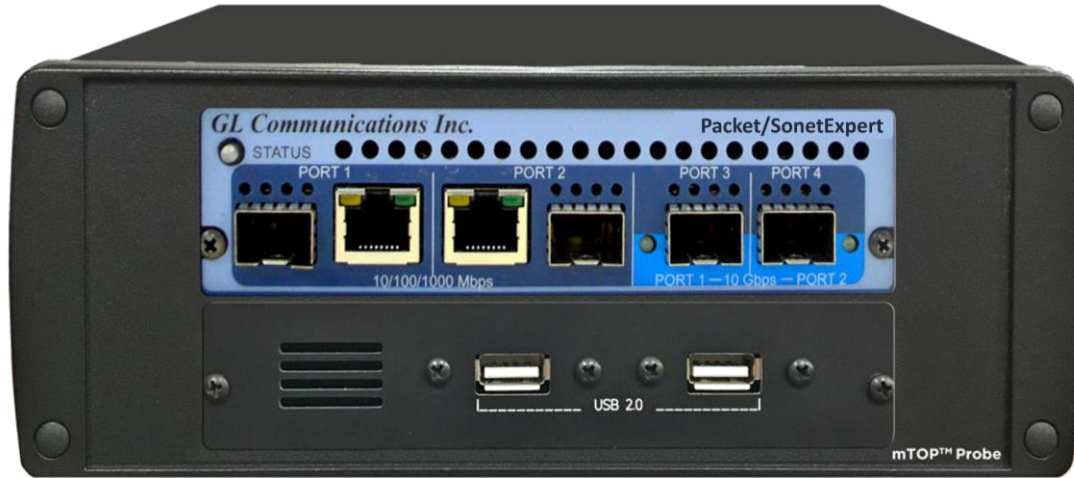
Ethernet Testing

Port# 1 and Port# 2 Optical Interface for OC-3/12 STM-1/4 Channelized

Front Panel

Back Panel

12V, 3A Power Supply

Power LED

USB 3.0
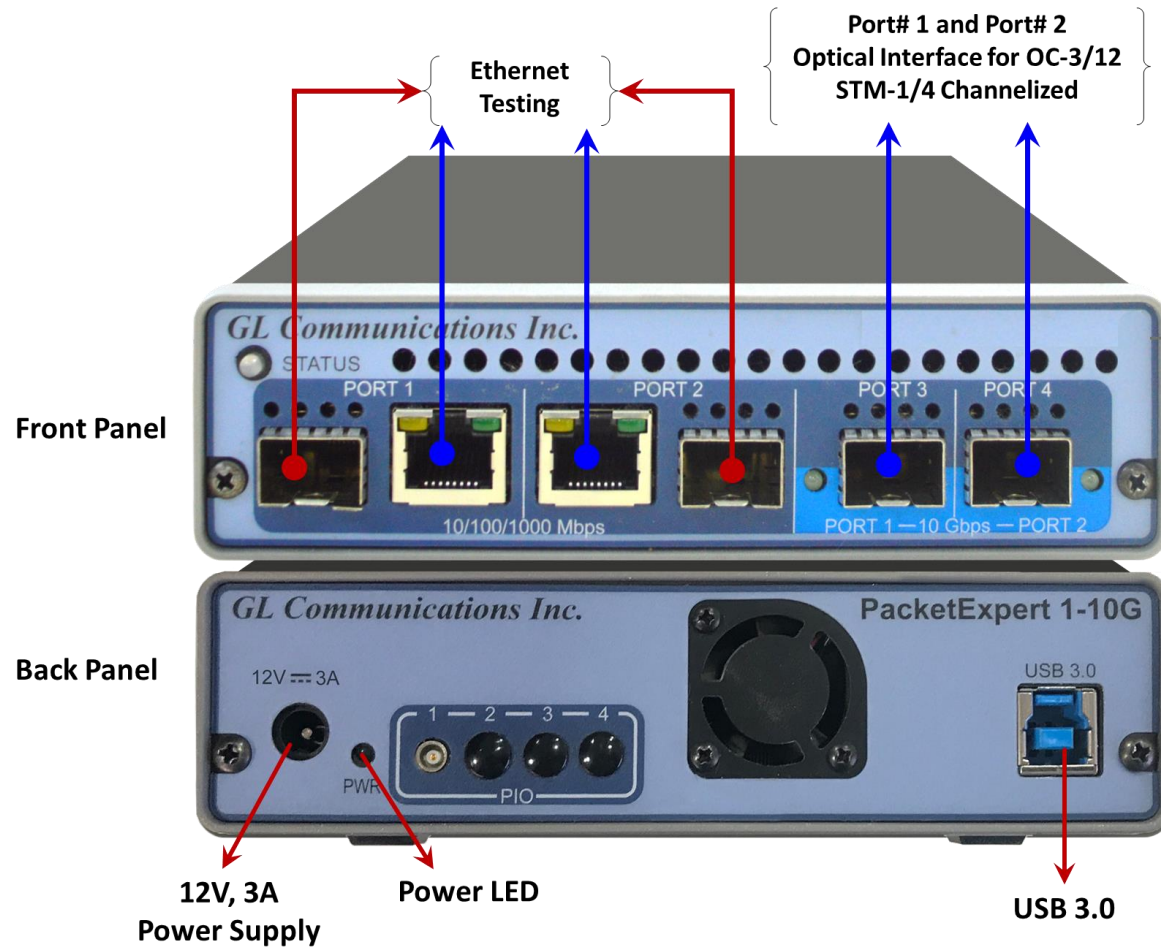
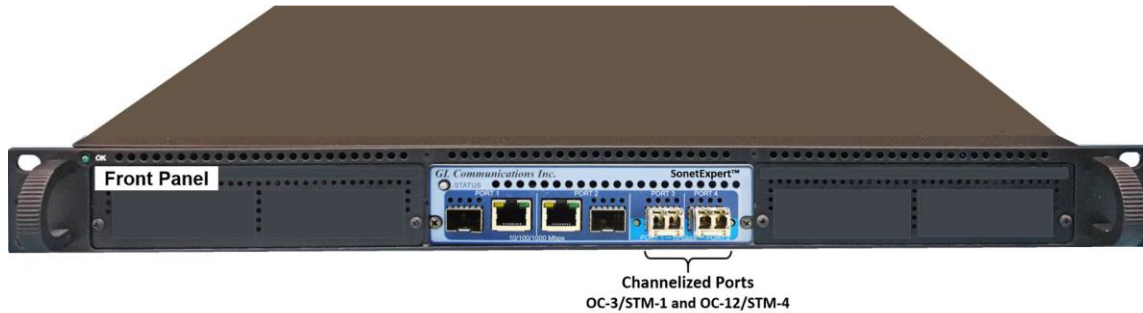| Interfaces	• 2 x Channelized Ports (STM-1/STM-4) • Single Mode or Multi Mode Fiber SFP support with LC connector • USB 3.0 Port • External Clock: Input Port 1, Port 2 and Output Port 1, Port 2
T1 E1	• Sync Loss, HDB3 Violation, Carrier Loss, Frame Error, Remote, Distant MF, AIS, BPV Errors, CRC Errors, Frame Errors, Transmit Under Run, Receive Over Run
Dimensions	• Length: 8.45 in. (214.63 mm) • Width: 5.55 in. (140.97 mm) • Height: 1.60 in (40.64 mm)
External Power Supply	• +12 Volts (Medical Grade), 3 Amps

SonetExpert™ mTOP™ Probe unit

- PacketExpert™ hardware is used for both Packet/SonetExpert™)

Physical Specifications	• Height: 3.0 Inches (76.2 mm) • Length: 10.4 Inches (264.16 mm) • Width: 8.4 Inches (213.36 mm) • Optional 4-Port SMA Jack Trigger Board (TTL Input/Output) • External USB based Wi-Fi adaptor
SonetExpert™ interfaces (1 unit)	• 4x 1G Base-X Optical OR 10/100/1000 Base-T Electrical • 2x 10G Base-SR, -LR -ER Optical option • 2 x 100 Mbps Base-FX optical interface • Single Mode or Multi Mode Fiber SFP support with LC connector
External Power Supply	• +12 Volts (Medical Grade), 3 Amps
SBC Specifications	• Intel Core i3 or optional i7 NUC Equivalent • Windows® 10 64-bit Pro Operating System • USB 2.0 or 3.0 Ports, ATX Power Supply • 256 GB Hard drive, 8G Memory (Min) • Two HDMI ports (Optional VGA to HDMI interface)

SonetExpert™ mTOP™ 1U Rack Solution

SonetExpert™ mTOP™ 1U rack solution (Front Panel View)

Channelized Ports
OC-3/STM-1 and OC-12/STM-4
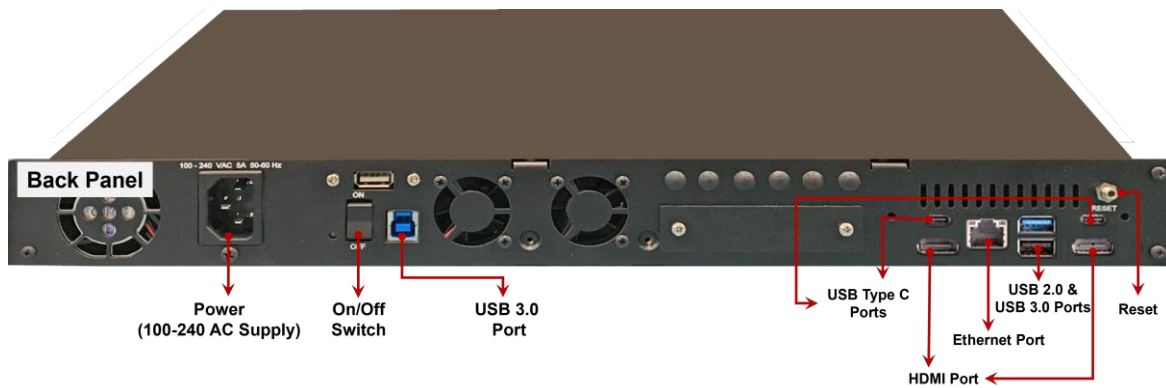
SonetExpert™ mTOP™ 1U rack solution (Back Panel View)

Physical Specifications	• Height: 1U Rack
	• Length: 16 Inches
	• Width: 19 Inches
	• mTOP™ System (embedded SBC, 1x SonetExpert™)
SonetExpert™ interfaces (1 unit)	• Two channelized Ports (STM-1/STM-4)
	• Single Mode or Multi Mode Fiber SFP support with LC connector
SBC Specifications	• Intel Core i7, Windows® 10 64-bit Pro Operating System
	• USB 2.0 or 3.0 Ports, ATX Power Supply
	• USB Type C ports, Ethernet 2.5GigE port
	• 256GB Hard drive, 8G Memory (Min)

SonetExpert™ Features

- 2 Channelized Ports:

  ➢ OC-3/STM-1 or OC-12/STM-4 interfaces

  ➢ Simulate and monitor in both directions

- Configure the number of T1 E1 channels to be Multiplexed or Demultiplexed

- Analyze / emulate voice, data, fax, protocols, analog and digital signals, including echo and voice quality

- Comprehensive protocol analysis and emulation - HDLC, SS7, ISDN, CAS, PPP, Frame Relay, ATM and more

- Capture, transmit and process at wirespeed

- Broadcasts the selected T1 E1 channel data on all the 252 E1's or 336 T1's

- Direct access to any or all T1s and E1s

  ➢ 2 x 336 T1's x 24 = 16,128 DS0s

  ➢ 2 x 252 E1's x 31 = 15,624 DS0s

SonetExpert™ Features (Contd.)

- Pluggable SFPs allow Single Mode (SM), and Multi-mode (MM) fiber optic non-intrusive tap

- Supports any combination of DS0/64/56/16/8 kbps fractional T1 E1, and N x T1 E1 interface definitions (a total of 252 E1s or 336 T1s – in each port)

- Provides Loss of Signal (LOS) and Loss of Frames (LOF) Hardware Alarms indication, Service logging, External Clock, Line and Diagnostic Loopback options, Through mode and Port Swap Cross-port options

- Supports multiplexing multiple T1 or E1 channels to a single channelized OC-3/12 STM-1/4 line

- User configurable OC-3/12, STM-1/4 mapping

- Provides an option to restart the SEC service automatically

Channelized T1 E1 Monitoring

Central Office

Optical Network

Fiber Optic Lines

Customer Sites

Fiber Tap

STM-1 MUX

84 T1s / 63 E1s

8 Octal T1E1 Cards

Fiber Tap

Channelized SonetExpert™ Analyzer

Monitoring
2 x 336 T1s (16,128 DS0s)/
2 x 252 E1s (15,624 DS0s)

New Solution

- Simple to configure
- Cost effective Solution
- Portable

- Multiple Hardware Interfaces
- Complex to Configure & Maintain
- Space Consuming & Expensive

Traditional Solution

GL Communications

SonetExpert™ Analyzer GUI

Monitor all T1s / E1s

Protocol Analyzers

ISDN Call Capture and Analysis

SonetExpert™ Channelized T1 E1 Emulation

Emulation

SonetExpert™ Channelized Analyzer

n x T1 E1 — PRI ISDN, SS7, MLPPP, IMA

T1 E1 — CAS, SS7

n x 64 Kbps — Frame Relay

64 Kbps

n x 8 Kbps — GSM, TRAU · BTS

Access Network

OC-3/STM-1 or
OC-12/STM-4 or
OC-48/STM-16 or
OC-192/STM-64

**SonetExpert™ Portable Channelized Analyzer
(Monitoring STM Line)**
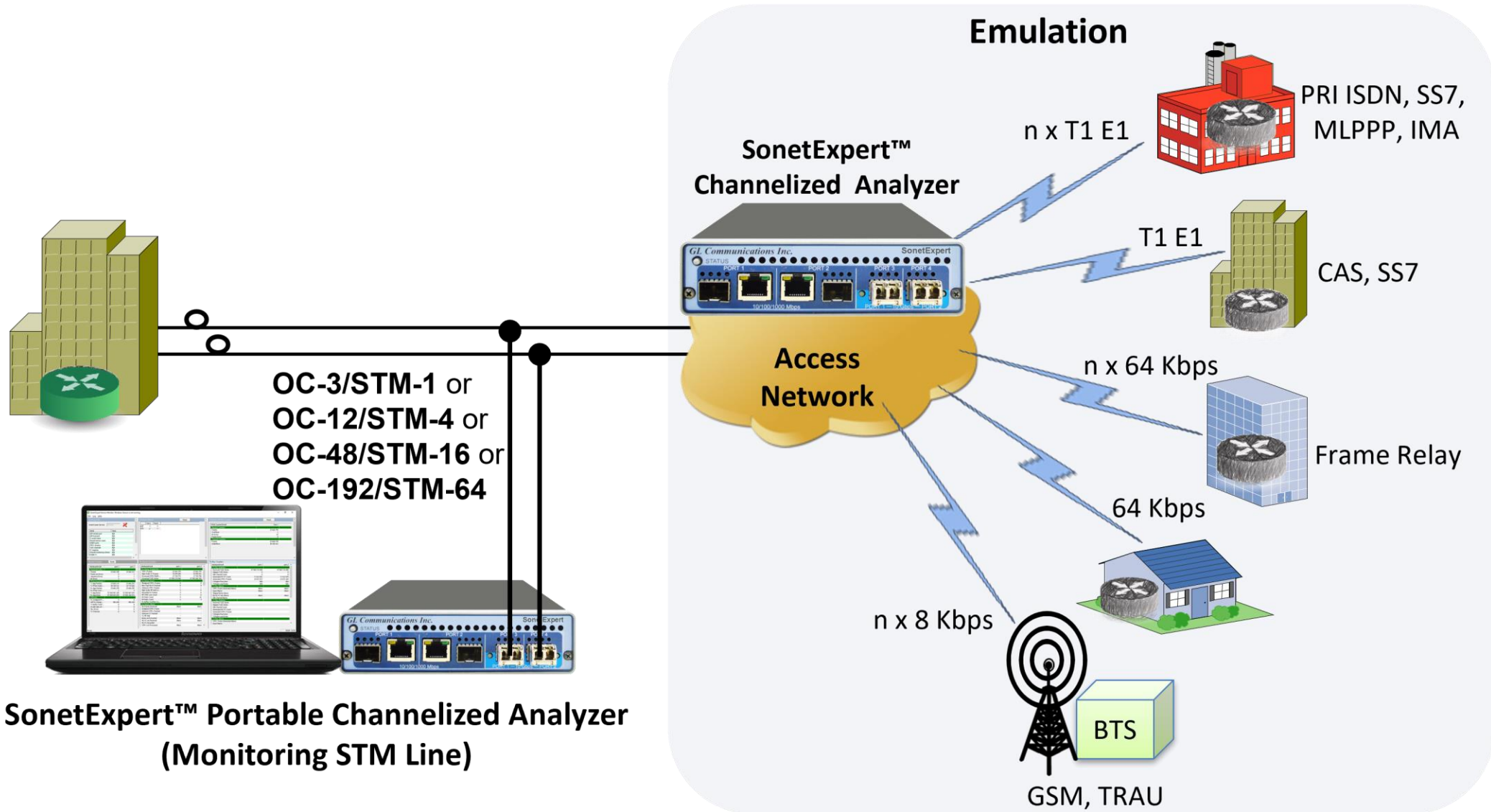
MAPS™ Call Generation, Reception, and Statistics

- Generating 1890 calls continuously

Working Principle

OC-3/12 STM-1/4 Lines

Port 4

Channelized

Port 3

SonetExpert™
Hardware

USB 3.0

PC

SonetExpert™
Channelized Service

84 T1s
63 E1s

UDP

84 T1s
63 E1s

SonetExpert™
Channelized T1 E1
Analyzer

Emulation & Analysis of all
Signaling, Data on T1s/E1s
(Ex: HDLC, SS7, ISDN, CAS)

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SonetExpert™ Monitor and Control Application

Hardware Alarms

Summary Information Panel

Hardware (FPGA) Counters

Rx Demux Counters

Receive Counters

Tx Mux Counters

OC3 Sonet Expert Service Monitor

File   Log   Help

Summary Info

Sonet Expert Service: RUNNING

Attrib	Value
UDP remote port	20012
UDP local port	20011
Tx event name	SECH_TX_EVENT
Shared memory name	SECH_SMEM
SONET ports	1-2
STM-1 streams	1
T1/E1 channels	1-63
VC mapping	E1_VC3
Channel numbering scheme	Lucent
Enable Tx	YES
Enable broadcast	no
Broadcast src channel	1
Broadcast source STM-1	1
Clock Port 1	Internal
Clock Port 2	Internal
Crossport 1	None
Crossport 2	None
Loopback 1	None
Loopback 2	None

Hardware Alarms   Reset

	Port1	Port2	
LOF	✓	✓	
LOS	✓	✓	

Hardware (FPGA) Counters   Reset

FPGA Counter\Port#	Port 1	Port 2
- Receive Counters		
Frames	5 088 097	5 088 097
Overflows	0	0
B1 Errors	0	0
Frame Errors	0	0
- Transmit Counters		
Frames	5 088 098	5 088 097
Underflows	0	0

Receive Counters   Reset

Attribute\Port#	port 1	port 2
- Received (calcul...		
Frames	5 072 184	5 072 158
Frame Len Errors	0	0
Sequence Errors	0	0
B1 Errors	0	0
- FPGA (hardware)		
Tx App Packets	5 072 173	5 072 173
Tx FPGA Underr...	0	0
Rx App Packets	5 072 173	5 072 174
Rx FPGA Overruns	0	0
Tx App Bytes	12 325 380 390	12 325 382 820
Rx App Bytes	12 325 382 820	12 325 382 820
- STM Info		
Rx Unaligned Fr...	0	0
UDP Rx Datagrams	317 014	317 014
Tx Buffer Overfl...	0	0

Rx Demux Counters

Attribute\Port#	port 1	port 2
- Rx Demux Frames ...		
STM-1 Frames	8 337 680	8 337 654
High-Order VC Frames	25 012 983	25 012 959
Processed STM1 Mul...	6 253 245	6 253 239
Extracted T1/E1 Bytes	16 804 118 016	16 804 279 296
- Rx Demux Errors		
Misaligned STM-1 Fr...	0	0
Non Tug2 Ho-VC Pa...	0	0
Unknown STM-1 Fra...	1	1
High-Order MF Add ...	3	0
Discarded VC Frames	3	0
MF SYNC Loss Count	3	0
B2 Parity Count	18	0
B3 Parity Count	3	0
Rx Buffer Overflow ...		
- Rx Demux Alarms		

Tx Mux Counters

Attribute\Port#	port 1	port 2
- Tx Mux Statistics		
Received T1/E1 B...	16 814 859 264	16 814 859 264
Skipped T1/E1 Bytes	0	0
Idle Channel Count	0	0
Generated HO VC ...	25 028 763	25 028 979
Generated STM-1 ...	8 342 921	8 342 993
TxEngine free bytes	N/A	N/A
TxEngine used bytes	N/A	N/A
- Tx Mux Alarms		
STM-1 Frame Gen...	Alarm	Alarm
Input Alarms	Alarm	Alarm
Skipped Bytes Alar...	-	-
No HO VC Gen Ala...	Alarm	Alarm
Idle Channel Alarms	-	-

Ready   NUM

SonetExpert™ Channelized Configuration Utility

- SONET/SDH parameters

- OC-3, T1 E1 ports, Channels and Mapping

- Clock setting of SONET/SDH ports

- Cross port and loopback settings

Sonet Expert Configuration OC3 (C:\GlCommunications\...)

UDP Ports and Tx Event

UDP remote port	20012
UDP local port	20011
Tx Event Name	SECH_TX_EVENT
Shared Memory Name	SECH_SMEM

OC3, T1/E1 Ports, Channels and Mapping

OC-3 Ports	1-2
STM-1 Streams	1
T1/E1 Channels	1-63
VC Mapping	E1_VC3
Channel Numbering Scheme	Lucent
Enable Tx	☑

Broadcast Settings

Enable Broadcast	☐
Broadcast Source Channel	1
Broadcast Source STM-1	1

Clock Settings

Clock Port1	Internal
Clock Port2	Internal

Crossport Settings

Crossport Port1	None
Crossport Port2	None

Loopback Settings

Loopback Port1	None
Loopback Port2	None

Loopback Port2
Loopback Settings Port 2

OK | Expand All | Collapse All | Set Default | Cancel

Optical Connectors and SFP Modules

LC Connectors
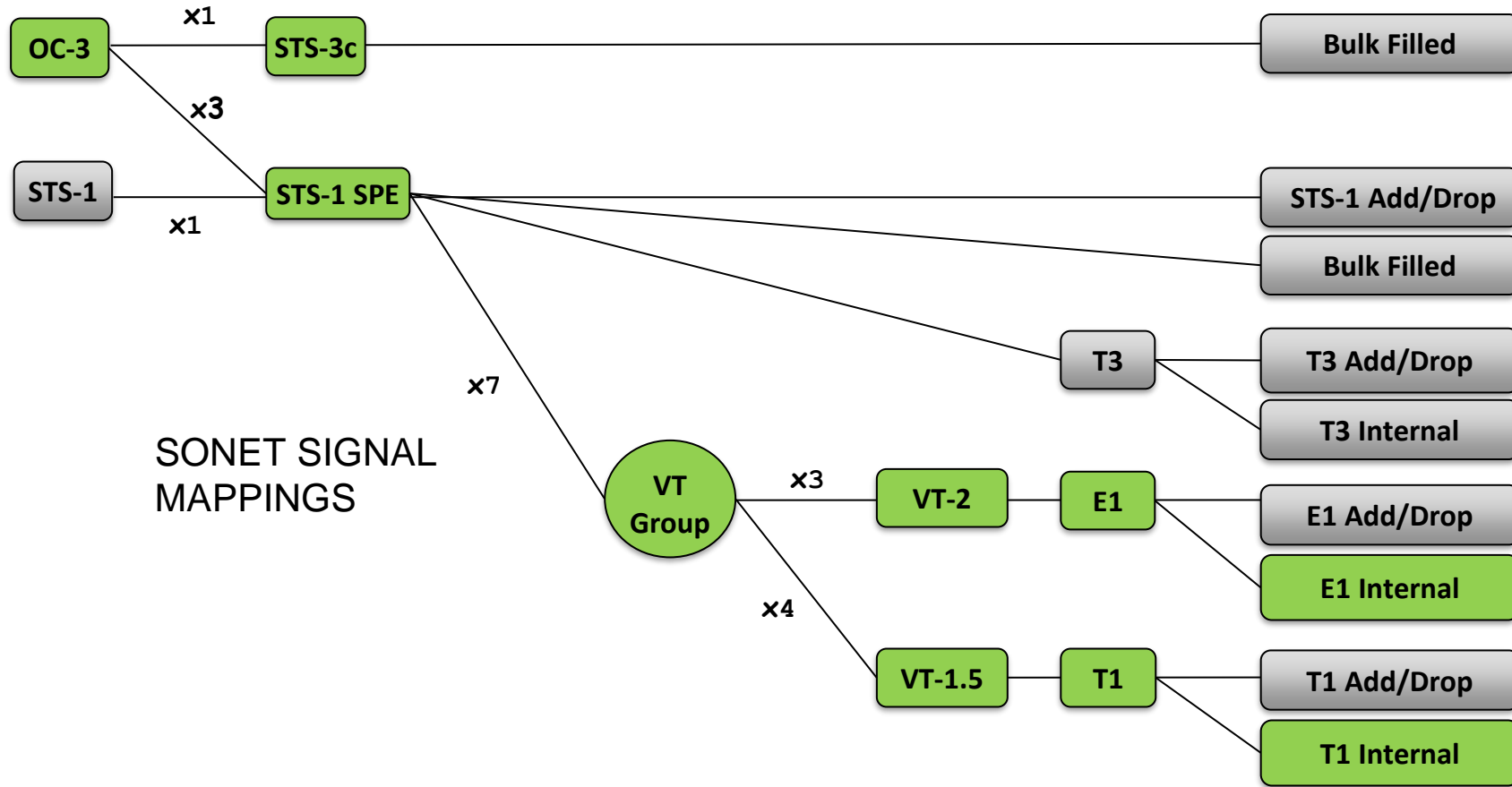

850 1310 1550 nm SFP Module

VC Mapping and Channel Numbering Scheme

- The paths colored in green are currently supported on the GL's SonetExpert™ hardware
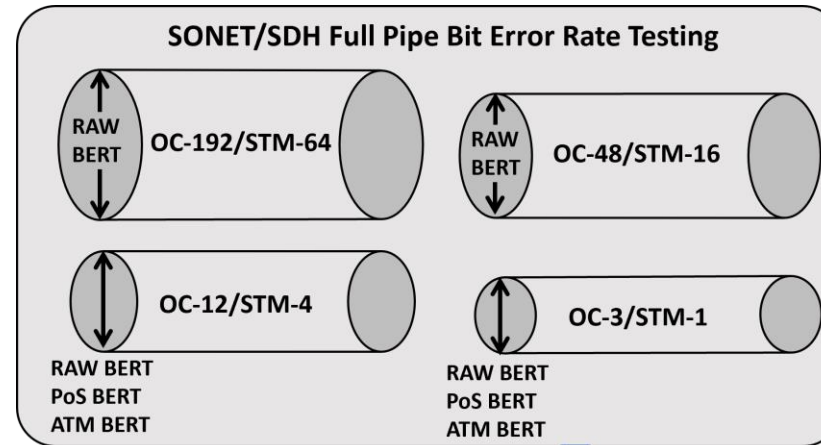

SONET SIGNAL MAPPINGS

VT – Virtual Tributary
VTG – Virtual Container Group
STS – Synchronous Transport Signal
SPE – Synchronous Payload Envelope
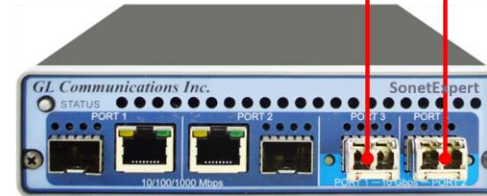**STS-3c** – Synchronous Transport Signal 3, concatenated

Unchannelized Analyzer

- Wirespeed processing of ATM, PoS or RAW data for Tx and Rx for both ports

- Supports BERT testing at rates from OC-3 to OC-192

- Ability to capture/playback to/from disk at full rate in both directions for all ports for detailed offline analysis

- Comprehensive transmit/receive testing capabilities; transmitting and verifying data with incrementing sequence numbers with each packet/cell

- Easy to use and flexible Bit Error Rate Test (BERT) application for ATM and POS

- ATM (AAL2, AAL5) Protocol Analyzer, UMTS Protocol Analyzer, PPP (IP and higher layer protocols) Protocol Analyzer

- ATM

  ➢ ATM Forum User Network Interface Specification

  ➢ ATM physical layer for Broadband ISDN according to CCITT Recommendation I.432

- PPP over SONET (PoS)

  ➢ Point-to-Point Protocol (PPP) over SONET/SDH specification according to RFC 2615 (1619) / 1662 of the PPP Working Group of the Internet Engineering Task Force (IETF)

- OC-3/OC-12/STM-1/STM-4 Transparent Payload

  ➢ Analyzer processes SONET/SDH payload in transparent (RAW) mode without any transport protocols
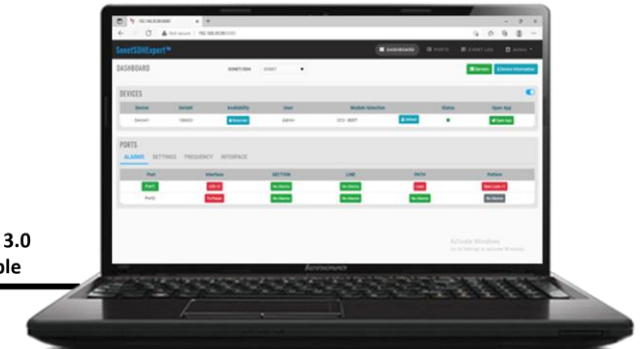

SONET/SDH Full Pipe Bit Error Rate Testing

RAW BERT — OC-192/STM-64

RAW BERT — OC-48/STM-16

OC-12/STM-4

OC-3/STM-1

RAW BERT
PoS BERT
ATM BERT

RAW BERT
PoS BERT
ATM BERT

Port 1 and Port 2 Unchannelized Ports
OC-3/STM-1 to OC-192/STM-64

USB 3.0 Cable

SonetExpert™ Unchannelized Analyzer (Portable)

SonetExpert™ Monitor and Control GUI Functionalities

- Starting and stopping the SEC service

- Configuring SEC service

- Launching Soft T1 E1 Analyzer

- Viewing and clearing the SEC service log

- Displaying alarms, error counters and operational statistics

Thank you