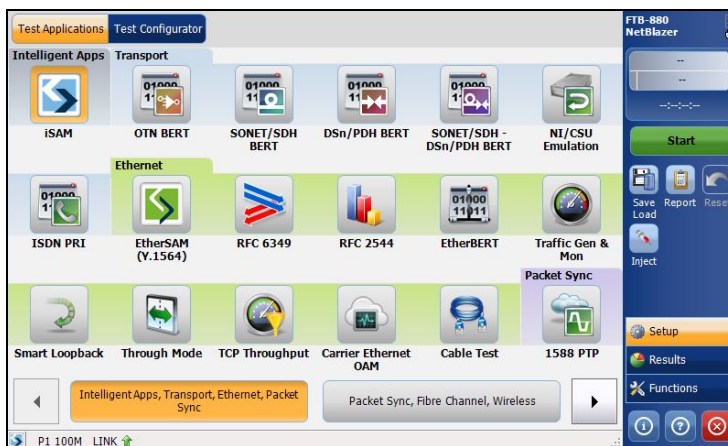


## ETHERNET AND MULTISERVICE TESTER

# NetBlazer for FTB-1

### FTB-700G/800 Series



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Units of measurement in this publication conform to SI standards and practices.

### ***Patents***

Dual Test Set/Bi-Directional testing is protected by patent appl. US 2012/0307666 A1 and equivalents in other countries.

September 21, 2018  
Document version: 8.0.0.1

## **Certification Information**

### **Canada and USA Regulatory Statement**

This unit was certified by an agency approved in both Canada and the United States of America. It has been evaluated according to applicable North American approved standards for product safety for use in Canada and the United States.

Electronic test and measurement equipment is exempt from FCC part 15, subpart B compliance in the United States of America and from ICES-003 compliance in Canada. However, EXFO Inc. makes reasonable efforts to ensure compliance to the applicable standards.

The limits set by these standards are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the user guide, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

### European Community Declaration of Conformity

Warning: This is a class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures. Your product is compliant with industrial electromagnetic environments.

The full text of the EU declaration of conformity is available at the following Internet address: *[www.exfo.com/en/resources/legal-documentation](http://www.exfo.com/en/resources/legal-documentation)*.

### Laser



Your instrument is a Class 1 laser product in compliance with standards IEC 60825-1: 2007 and 21 CFR 1040.10, except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.

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# 1 **Introducing the Ethernet and Multiservice Tester**

ALL-IN-ONE Ethernet/optical solution for field technicians installing, testing and troubleshooting FTTx, fronthaul, backhaul, small-cell, DAS, remote radio head and data center networks, in addition to OTN, SONET/SDH, Fibre Channel, GigE and 10 GigE, CPRI/OBSAI and SyncE/1588 PTP services, with the added support of OTDR and iOLM capabilities.

## Features

| Features            | Model |             |              |                |             |     |     |
|---------------------|-------|-------------|--------------|----------------|-------------|-----|-----|
|                     | 860GL | 860<br>860G | 720G<br>730G | 730G+<br>730G+ | 810<br>810G | 870 | 880 |
| Intelligent Apps.   | X     | X           | X            | X              |             | X   | X   |
| Ethernet            | X     | X           | X            | X              |             | X   | X   |
| Packet Sync         |       | X           | X            | X              |             | X   | X   |
| Fibre Channel       |       | X           | X            | X              |             | X   | X   |
| Wireless            |       | X           | X            | X              |             | X   | X   |
| OTN                 |       |             |              | X              |             | X   | X   |
| SONET/SDH           |       |             |              | X              | X           | X   | X   |
| DSn/PDH             |       |             |              |                | X           |     | X   |
| ISDN PRI and NI/CSU |       |             |              |                | X           |     | X   |
| OTDR and iOLM       |       |             | X            | X              |             |     |     |

## Technical Specifications

To obtain this product's technical specifications, visit the EXFO Web site at [www.exfo.com](http://www.exfo.com).

## Conventions

Before using the product described in this guide, you should understand the following conventions:



### **WARNING**

Indicates a potentially hazardous situation which, if not avoided, could result in *death or serious injury*. Do not proceed unless you understand and meet the required conditions.



### **CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in *minor or moderate injury*. Do not proceed unless you understand and meet the required conditions.



### **CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in *component damage*. Do not proceed unless you understand and meet the required conditions.



### **IMPORTANT**

Refers to information about this product you should not overlook.

## 2 ***Safety Information***



### **WARNING**

Do not install or terminate fibers while a light source is active. Never look directly into a live fiber and ensure that your eyes are protected at all times.



### **WARNING**

The use of controls, adjustments and procedures, namely for operation and maintenance, other than those specified herein may result in hazardous radiation exposure or impair the protection provided by this unit.



### **WARNING**

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.



### **WARNING**

Use only accessories designed for your unit and approved by EXFO. For a complete list of accessories available for your unit, refer to its technical specifications or contact EXFO.



### IMPORTANT

When you see the following symbol on your unit , make sure that you refer to the instructions provided in your user documentation. Ensure that you understand and meet the required conditions before using your product.



### IMPORTANT

When you see the following symbol on your unit , it indicates that the unit is equipped with a laser source, or that it can be used with instruments equipped with a laser source. These instruments include, but are not limited to, modules and external optical units.



### IMPORTANT

Other safety instructions relevant for your product are located throughout this documentation, depending on the action to perform. Make sure to read them carefully when they apply to your situation.

## **Additional Laser Safety Information**

This product employs Class 1 Laser transceivers.



### **WARNING**

When the LASER LED is on or flashing, the FTB-700G/800 Series is transmitting an optical signal on the SFP/SFP+ transceiver ports.

**Note:** *Refer to the OTDR, iOLM, and FTB-1 user guides for additional test equipment safety information and ratings.*

## Safety Information

### Installation Instruction Warnings

---



#### CAUTION

When you use the unit outdoors, ensure that it is protected from liquids, dust, direct sunlight, precipitation, and full wind pressure.



#### CAUTION

Except for the dual Bantam connector and the RJ-48C port, all telecom (electrical) interfaces are SELV (Safety Extra Low Voltage) circuitry intended for intra-building use only.



#### CAUTION

For the dual Bantam connector and the RJ-48C ports, use only No. 26 AWG or larger telecommunication line cord to reduce the risk of fire.



#### CAUTION

No user serviceable parts are contained inside. Contact the manufacturer regarding service of this equipment.



#### IMPORTANT

All wiring and installation must be in accordance with local building and electrical codes acceptable to the authorities in the countries where the equipment is installed and used.



#### WARNING

Use only accessories designed for your unit and approved by EXFO.



## CAUTION

### Electrostatic Discharge (ESD) Sensitive Equipment:

Plug-in modules can be damaged by static electrical discharge. To minimize the risk of damage, dissipate static electricity by touching a grounded unpainted metal object

- before removing, inserting, or handling the module.
- before connecting or disconnecting cables to/from the NetBlazer.
- before inserting or removing **SFP/SFP+** transceiver to/from the NetBlazer.



# 3 **Getting Started**

If the FTB-700G/800 Series has been purchased at the same time as the FTB-1, the FTB-700G/800 Series module is pre-installed with the appropriate software version. If the NetBlazer is not already installed, refer to the FTB-1 User Guide for more information on how to install the module.

## **Turning On the Unit**

Turn on the FTB-1. Refer to the FTB-1 user guide for more information.

## **Starting the FTB-700G/800 Series Application**

The module can be configured and controlled by starting the NetBlazer or OTDR application; only one application can run at once.

### ***To start the NetBlazer application:***

1. For FTB-800 Series, from **Mini ToolBox** tap the NetBlazer application button.
2. For FTB-700G Series, from **Mini ToolBox** select the **FTB-7xx Ethernet & Multi-Service** module then tap NetBlazer application button.

**Note:** *To start the OTDR application, refer to the OTDR or iOLM user guide for more information.*



## 4 *Physical Interfaces and LEDs*

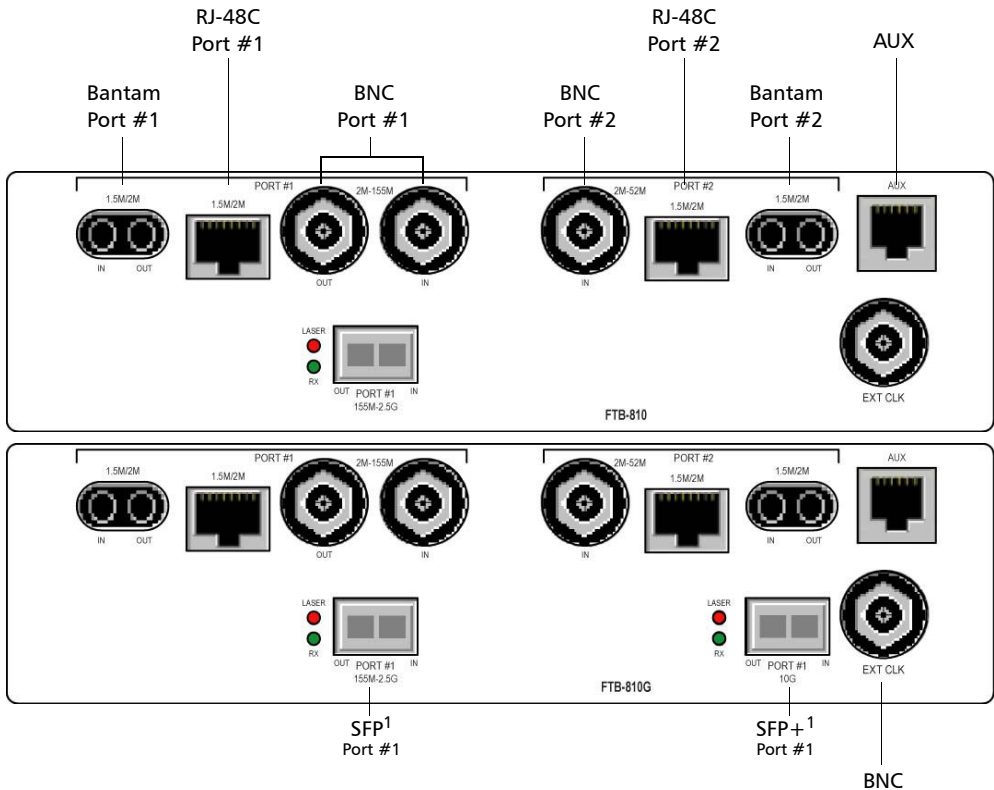
This section describes all connectors (ports) and LEDs available on the FTB-700G/800 Series.



### CAUTION

To prevent exceeding the maximum input/output power level, please refer to this product's technical specifications at [www.exfo.com](http://www.exfo.com).

### FTB-810 and FTB-810G Modules

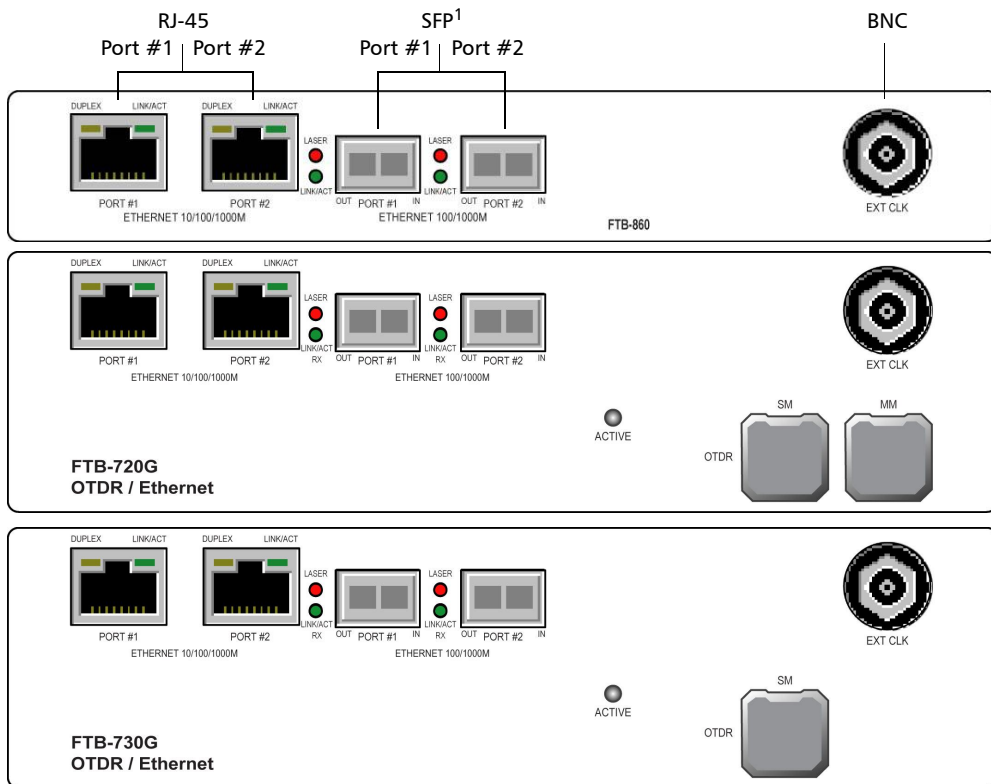


1. Laser radiation emitted from this port when LASER LED is on.

## Physical Interfaces and LEDs

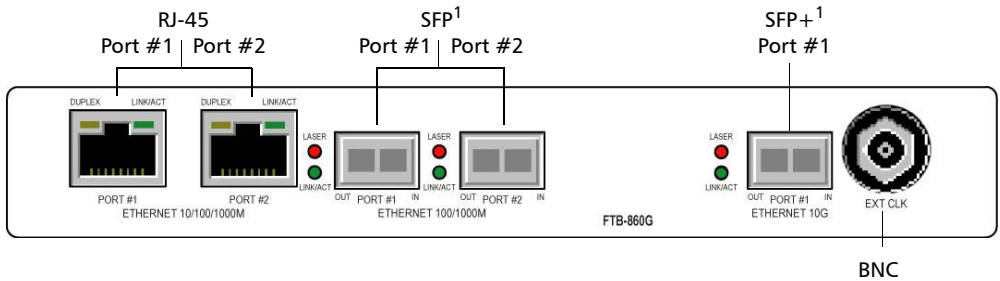
FTB-860, FTB-720G, and FTB-730G Modules

### FTB-860, FTB-720G, and FTB-730G Modules



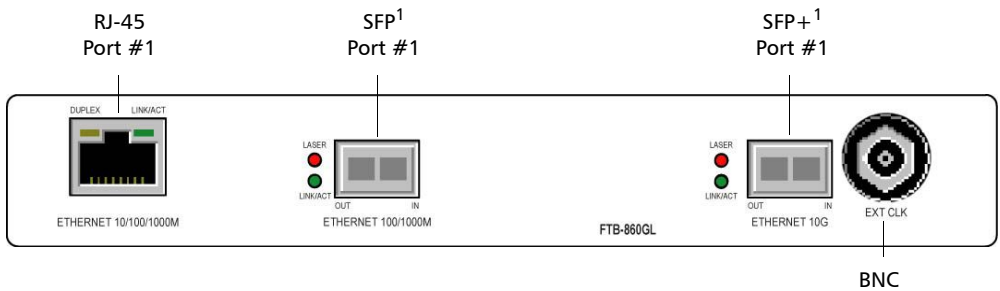
1. Laser radiation emitted from this port when LASER LED is on.

## FTB-860G Module



1. Laser radiation emitted from this port when LASER LED is on.

## FTB-860GL Module

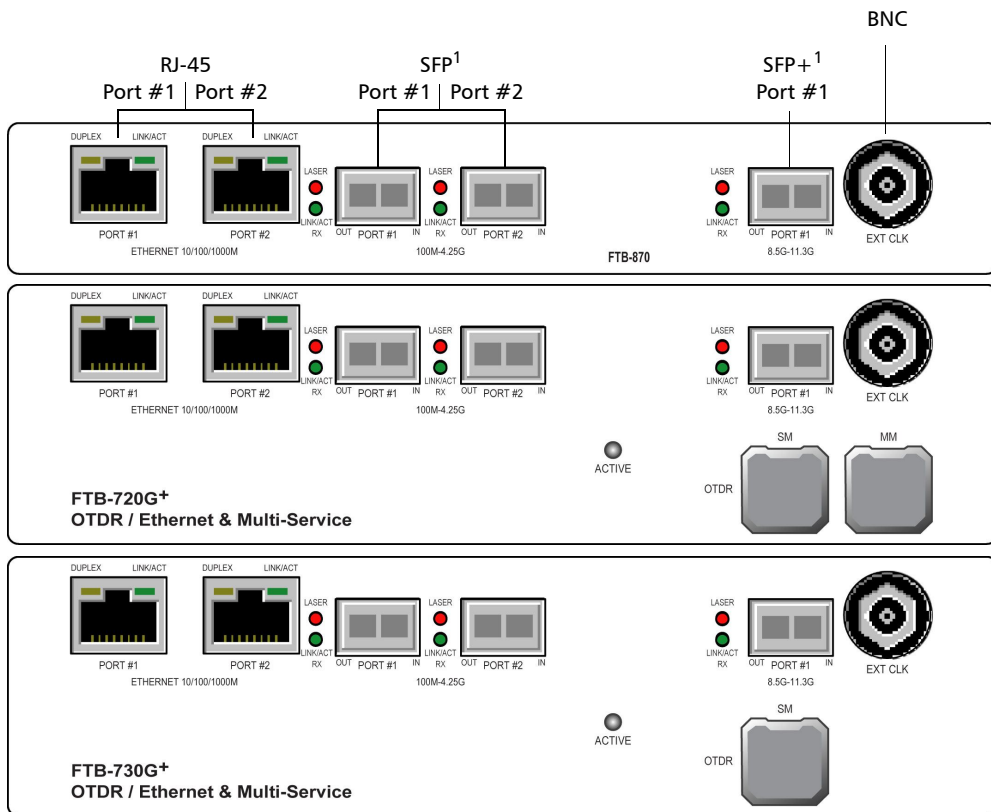


1. Laser radiation emitted from this port when LASER LED is on.

## Physical Interfaces and LEDs

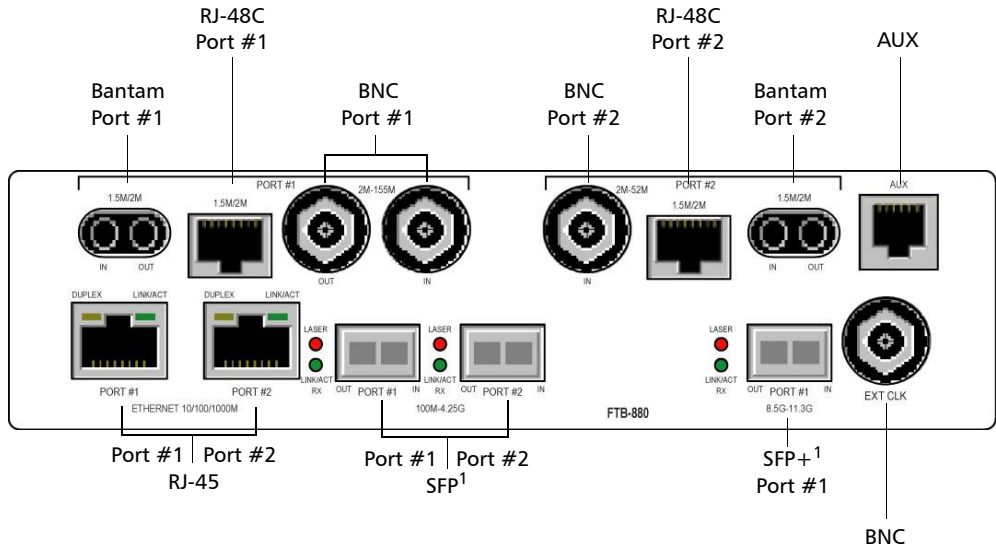
*FTB-870, FTB-720G<sup>+</sup>, and FTB-730G<sup>+</sup> Modules*

# FTB-870, FTB-720G<sup>+</sup>, and FTB-730G<sup>+</sup> Modules



1. Laser radiation emitted from this port when LASER LED is on.

## FTB-880 Module



## Physical Interfaces and LEDs

### Port Availability on the Visual Guardian Lite

## Port Availability on the Visual Guardian Lite

The following table shows the list of available ports as well as a description and signals supported for each module.

| Connector | Labelled                                           | Description and Supported signal(s)                                                                                                                                                         | Module                                                              |
|-----------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Bantam    | 1.5M/2M<br>PORT #1                                 | DS1/1.5M, E1/2M                                                                                                                                                                             | FTB-810/810G/880                                                    |
|           | 1.5M/2M<br>PORT #2                                 | DS1/1.5M (IN port)                                                                                                                                                                          | FTB-810/810G/880                                                    |
| BNC       | 2M-155M<br>PORT #1                                 | E1/2M, E3/34M, DS3/45M, STS-1e/STM-0e/52M, E4/140M, STS-3e/STM-1e/155M                                                                                                                      | FTB-810/810G/880                                                    |
|           | 2M/52M<br>PORT #2                                  | DS3/45M (IN port)                                                                                                                                                                           | FTB-810/810G/880                                                    |
|           | EXT CLK                                            | External clock synchronization: DS1/1.5M, E1/2M, 2MHz, 1PPS                                                                                                                                 | All                                                                 |
| AUX       | AUX                                                | Future use                                                                                                                                                                                  | FTB-810/<br>810G/880                                                |
| RJ-45     | ETHERNET<br>10/100/1000M<br>PORT #1 and<br>PORT #2 | Ethernet 10/100/1000 Mbit/s electrical                                                                                                                                                      | FTB-720G/<br>720G+/<br>730G/ 730G+/<br>860/ 860G/860GL <sup>a</sup> |
| RJ-48C    | 1.5M/2M<br>PORT #1                                 | DS1/1.5M, E1/2M                                                                                                                                                                             | FTB-810/810G/880                                                    |
|           | 1.5M/2M<br>PORT #2                                 | DS1/1.5M (IN port)                                                                                                                                                                          | FTB-810/810G/880                                                    |
| SFP       | ETHERNET<br>100/1000M<br>PORT #1 and<br>PORT #2    | Ethernet 100 Mbit/s, 1000 Mbit/s optical<br>CPRI 1.2288, 2.4576, 3.072, 4.9152, 6.1440 Gbit/s <sup>b</sup><br>OBSAI 3.072 Gbit/s <sup>b</sup><br>Fibre Channel 1X/2X/4X                     | FTB-720G/ 730G/<br>860/ 860G/860GL <sup>a</sup>                     |
|           | 100M-4.25<br>PORT #1 and<br>PORT #2 <sup>b</sup>   | Ethernet 100 Mbit/s, 1000 Mbit/s optical<br>CPRI 1.2, 2.4, 3.1, 4.9, 6.1 Gbit/s<br>OBSAI 3.1 Gbit/s<br>Fibre Channel 1X/2X/4X<br>OC-1/STM-0, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16,<br>OTU1 | FTB-720G <sup>+</sup> /730G <sup>+</sup> /<br>870/880               |
|           | 155M-2.5G<br>(PORT #1)                             | OC-1/STM-0, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16                                                                                                                                           | FTB-810/810G                                                        |

## Physical Interfaces and LEDs

*Port Availability on the Visual Guardian Lite*

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| Connector | Labelled                | Description and Supported signal(s)                                                                                 | Module                                                 |
|-----------|-------------------------|---------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| SFP+      | ETHERNET 10G<br>PORT #1 | Ethernet 10 Gbit/s<br>CPRI 9.8304 Gbit/s<br>Fibre Channel 8X/10X                                                    | FTB-860G/ 860GL <sup>a</sup>                           |
|           | 8.5G-11.3G<br>PORT #1   | Ethernet 10 Gbit/s<br>CPRI 9.8304 Gbit/s<br>Fibre Channel 8X/10X<br>OC-192/STM-64, OTU2, OTU1e, OTU2e, OTU1f, OTU2f | FTB-720G <sup>+</sup> /730G <sup>+</sup><br>+/ 870/880 |
|           | 10G<br>PORT #1          | OC-192/STM-64                                                                                                       | FTB-810G                                               |

- a. Only one port is available on the FTB-860GL module. The FTB-860GL module does not support Fibre Channel and CPRI/OBSAI test applications.
- b. OC-x/STM-x/OTU1 and CPRI/OBSAI are only available on PORT #1.

Physical Interfaces and LEDs

100M-4.25G (PORT #1/#2)

100M-4.25G (PORT #1/#2)

These ports can be used for the following test applications and rates:

| Application               | Rates                                                   | PORT |    |
|---------------------------|---------------------------------------------------------|------|----|
|                           |                                                         | #1   | #2 |
| Transport                 | OC-1/STM-0, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, OTU1 | X    |    |
| Intelligent Apps Ethernet | 100Mbit/s, 1000 Mbit/s                                  | X    | X  |
| Packet Sync               | 100Mbit/s, 1000 Mbit/s                                  | X    | X  |
| Fibre Channel             | 1X, 2X, 4X                                              | X    | X  |
| Wireless                  | CPRI 1.2, 2.4, 3.1, 4.9, 6.1 Gbit/s; OBSAI 3.1 Gbit/s.  | X    | X  |

Plug the SFP transceiver into the PORT #1 or PORT #2 slot.



WARNING

Use only EXFO supported transceivers. Refer to this product’s technical specifications at [www.exfo.com](http://www.exfo.com) for the list of supported transceivers. Using non-supported transceivers can affect the performance and accuracy of the test.

**Note:** Do not replace a SFP/SFP+ while the test is running to avoid distorting statistics. First stop the test case, replace the SFP/SFP+ and then restart the test.

## 8.5G-11.3G (PORT #1)

The 8.5G-11.3G PORT #1 can be used for the following test application and optical rates:

| Application   | Rates                                               |
|---------------|-----------------------------------------------------|
| Transport     | OC-192/STM-64, OTU2, OTU1e, OTU2e, OTU1f, and OTU2f |
| Ethernet      | 10Gbit/s LAN and 10Gbit/s WAN                       |
| Packet Sync   | 10Gbit/s LAN                                        |
| Fibre Channel | 8X and 10X                                          |
| Wireless      | CPRI: 9.8304 Gbit/s                                 |

Plug the SFP+ transceiver into the **8.5G-11.3G** PORT #1 slot.



### WARNING

Use only EXFO supported transceivers. Refer to this product's technical specifications at [www.exfo.com](http://www.exfo.com) for the list of supported transceivers. Using non-supported transceivers can affect the performance and accuracy of the test.

**Note:** *Do not replace a SFP+ while the test is running to avoid distorting statistics. First stop the test case, replace the SFP+ and then restart the test.*

## Physical Interfaces and LEDs

### 155M-2.5G (PORT #1)

---

## 155M-2.5G (PORT #1)

The 155M-2.5G PORT #1 can be used for optical Transport test applications.

Supported rates:

OC-1/STM-0, OC-3/STM-1, OC-12/STM-4, OC-48/STM-16.

Plug the SFP transceiver into the **155M-2.5M** PORT #1 slot.



## WARNING

Use only EXFO supported transceivers. Refer to this product's technical specifications at [www.exfo.com](http://www.exfo.com) for the list of supported transceivers. Using non-supported transceivers can affect the performance and accuracy of the test.

**Note:** *Do not replace a SFP while the test is running to avoid distorting statistics. First stop the test case, replace the SFP and then restart the test.*

## 10G (PORT #1)

The 10G PORT #1 can be used for optical Transport test applications.

Supported rates:

OC-192/STM-64.

Plug the SFP+ transceiver into the **10G** PORT #1 slot.



### WARNING

Use only EXFO supported transceivers. Refer to this product's technical specifications at [www.exfo.com](http://www.exfo.com) for the list of supported transceivers. Using non-supported transceivers can affect the performance and accuracy of the test.

**Note:** *Do not replace a SFP+ while the test is running to avoid distorting statistics. First stop the test case, replace the SFP+ and then restart the test.*

ETHERNET 10G (PORT #1)

The ETHERNET 10G PORT #1 can be used for the following test application and optical rates:

| Application   | Rates                         |
|---------------|-------------------------------|
| Ethernet      | 10Gbit/s LAN and 10Gbit/s WAN |
| Packet Sync   | 10Gbit/s LAN                  |
| Fibre Channel | 8X and 10X                    |
| Wireless      | CPRI: 9.8304 Gbit/s           |

Plug the SFP+ transceiver into the **ETHERNET 10G** PORT #1 slot.



WARNING

Use only EXFO supported transceivers. Refer to this product’s technical specifications at [www.exfo.com](http://www.exfo.com) for the list of supported transceivers. Using non-supported transceivers can affect the performance and accuracy of the test.

**Note:** *Do not replace a SFP+ while the test is running to avoid distorting statistics. First stop the test case, replace the SFP+ and then restart the test.*

## ETHERNET 100/1000M (PORT #1/#2)

The ETHERNET 100/1000M PORT #1 can be used for the following test application and optical rates:

| Application   | Rates                                                                     | PORT |    |
|---------------|---------------------------------------------------------------------------|------|----|
|               |                                                                           | #1   | #2 |
| Ethernet      | 100Mbit/s, 1000 Mbit/s                                                    | X    | X  |
| Packet Sync   | 100Mbit/s, 1000 Mbit/s                                                    | X    | X  |
| Fibre Channel | 1X, 2X, 4X                                                                | X    | X  |
| Wireless      | CPRI 1.2288, 2.4576, 3.072, 4.9152, 6.1440 Gbit/s;<br>OBSAI 3.072 Gbit/s. | X    | X  |

Plug the SFP transceiver into the **ETHERNET 100/1000M** PORT #1 or PORT #2 slot.



### WARNING

Use only EXFO supported transceivers. Refer to this product's technical specifications at [www.exfo.com](http://www.exfo.com) for the list of supported transceivers. Using non-supported transceivers can affect the performance and accuracy of the test.

**Note:** *Do not replace a SFP while the test is running to avoid distorting statistics. First stop the test case, replace the SFP and then restart the test.*

## ETHERNET 10/100/1000M

This port can be used for electrical Intelligent Apps, Ethernet, or Packet Sync test applications.

Supported electrical rates are 10Mbits/s, 100Mbit/s, and 1000Mbit/s. 10Mbits/s is not supported for SyncE. Plug the 10/100/1000 electrical interface or the cable to be tested to the ETHERNET 10/100/1000M (PORT #1 or PORT #2) connector. The electrical ports is RJ45 for category 5 unshielded twisted pair (UTP). Refer to *Ethernet Cables* on page 606 for cable specifications.

## 2M-155M (PORT #1)

This port can be used for electrical Transport test applications.

Supported electrical signal are E1/2M, E3/34M, DS3/45M, STS-1e/STM-0e/52M, E4/140M, and STS-3e/STM-1e/155M. Plug the signal to be tested to the BNC IN and OUT ports. Connector type is BNC for coaxial 75-ohm cable connection.

## 2M-52M (PORT #2)

This port can be used for electrical DS3 dual RX Transport test application.

Supported electrical signal are DS1 or DS3 for Dual RX testing capability. Plug the signal to be tested to the BNC IN port. Connector type is BNC for coaxial 75-ohm cable connection.

## 1.5M/2M (PORT #1/#2)

This port can be used for electrical Transport test applications.

Supported electrical signal are DS1/1.5M and E1/2M. Plug the signal to be tested to either Bantam or RJ48C port.

## EXT CLK

The FTB-700G/800 Series provides one connector, labeled **EXT CLK** that can be used either for input/output external clock DS1 (1.5M), E1 (2M), 2MHz, or 1PPS synchronization signal. 1PPS is available for **Dual Test Set** in **One-Way Latency** measurement mode. The connector type is BNC SMB for coaxial 75-ohm cable connection. An adapter cable (BNC to Bantam) is required for Bantam connection (not supplied).

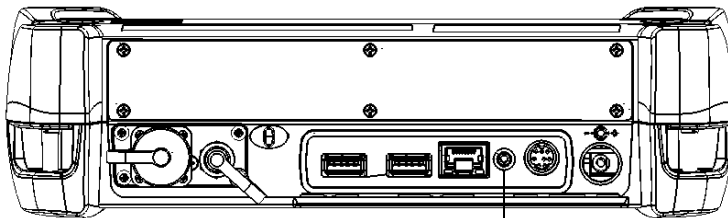
## Headset/Microphone Port (FTB-1)



### CAUTION

When using speech over ISDN (ISDN PRI test application), use only the headset supplied by EXFO to ensure adequate protection.

The headset port can be used with the ISDN PRI test application to connect a headset allowing to talk and listen when calls are made and received.



Headset/microphone port

**Note:** Refer to *FTB-1 User Guide* for instructions on configuring the *Headset/Microphone settings*.

## AUX Connection

The **AUX** port is reserved for future use to attach a buttset or telephone to talk and listen over an ISDN PRI line.

## Fibre Cables Connection

Carefully connect optical fibre cables to the SFP/SFP+'s IN and OUT ports. To ensure good signal quality, make sure that the optical fibre connector is fully inserted into the optical connector port.



### CAUTION

To prevent exceeding the maximum input power level please use an attenuator when a loopback configuration is used.

## LEDs

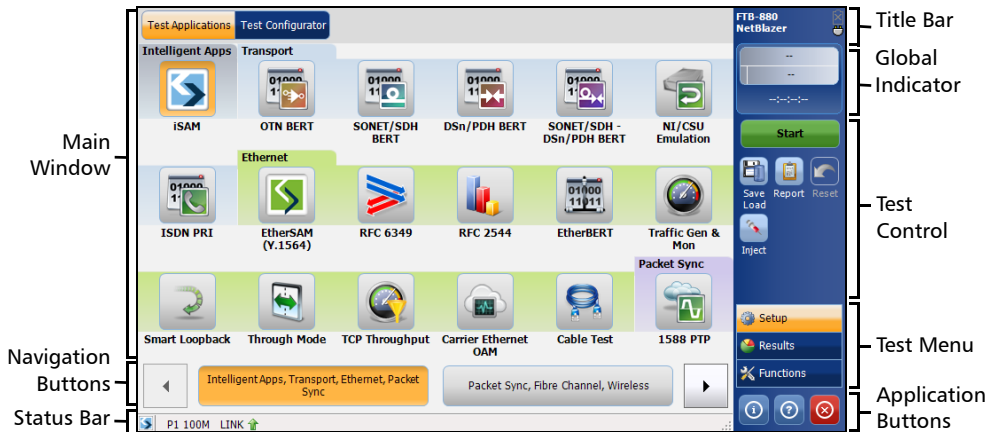
- **LASER** red LED is on when the FTB-700G/800 Series is emitting an optical laser signal.
- **LINK** green LED is on when the link is up, off when the link is down, and flashing when frames are transmitted and/or received.
- **DUPLEX** green LED is on for Full Duplex mode, off for Half Duplex mode, and flashing when collisions are detected.

# 5 Graphical User Interface Overview

This chapter describes the FTB-700G/800 Series graphical user interface.

## Main Application Window

The following main application window is displayed when the NetBlazer application is started.



## Main Window

The main window allows to setup a test and to view the test status and results.

## Navigation Buttons

Navigation buttons appear when there is not enough room on one page to display all available test applications. The left and right arrow buttons allow to respectively access the previous or next window. The buttons in between the left and right arrow buttons allow to directly select the window for the type of test application listed.

## Status Bar

The status bar displays the following information.

| Icon and/or text                                                                      | Description                                                                                                                                                                                                       | Test Application                                          |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Test icon                                                                             | Icon representing the active test application.                                                                                                                                                                    | All                                                       |
| P1, P2                                                                                | Port number (Port 1 or Port 2)                                                                                                                                                                                    | All                                                       |
| TX/RX, TX, RX                                                                         | Indicates the direction of the signal per port.                                                                                                                                                                   | Transport                                                 |
| Interface/<br>Signal                                                                  | The interface or signal rate per port: 1GE Optical, OTU1, OTU2, etc.                                                                                                                                              | All                                                       |
| (BTS) or<br>(RRH)                                                                     | <b>BTS:</b> Emulation mode is Base Station<br><b>RRH:</b> Emulation mode is Remote Radio Head                                                                                                                     | CPRI/OBSAI BERT                                           |
| LINK                                                                                  | Green arrow: Link up.<br>Red arrow: Link down.<br>Gray arrow: Awaiting incoming data to provide a status.                                                                                                         | Transport<br>Ethernet<br>Fibre Channel<br>CPRI/OBSAI BERT |
| PTP                                                                                   | Green arrow: Signaling requests granted.<br>Red arrow: Request denied, session canceled, or no reply.<br>Gray arrow: Pending or inactive.<br>Refer to <i>Negotiation Status</i> on page 398 for more information. | 1588 PTP                                                  |
| ESMC                                                                                  | Green arrow: ESMC valid information frame received.<br>Red arrow: No ESMC valid information frames received.<br>Gray arrow: Pending state.<br>Refer to <i>ESMC Monitoring</i> on page 274 for more information.   | SyncE                                                     |
| D-Channel                                                                             | The channel used as the D-channel to transmit signalling information.<br>Green arrow: Link up<br>Red arrow: Link down.                                                                                            | ISDN PRI                                                  |
|  7 | B-Channel #x is configured as a <b>Speech</b> or <b>3.1 kHz</b> channel                                                                                                                                           | ISDN PRI                                                  |

| Icon and/or text                                                                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Test Application                                    |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| Power level                                                                         | The received signal level per port in <b>dBdsx</b> for DSn signal or <b>dBm</b> for PDH and optical signals. For Transport electrical interface, LOS on red background indicates that there is no electrical signal power. For optical interface, the following background color are used as power level qualifier:<br>Green: Power level in range.<br>Yellow: Power level out-of-range.<br>Red with "LOS": Loss of signal.<br>Red with "Power": Power level is close to damage.<br>Gray: Invalid operational range value. | All except for Cable Test                           |
| Amplitude                                                                           | Amplitude indicates the received signal amplitude per port. Only available with electrical interfaces.                                                                                                                                                                                                                                                                                                                                                                                                                     | Transport                                           |
|    | Laser ON. The laser icon is not displayed when the laser is off. The laser icon is only displayed for optical interfaces. The laser is ON by default when the test is created. The laser control is not affected when turning off the laser by generating a LOS for example. Refer to <i>Laser Button</i> on page 535.                                                                                                                                                                                                     | All                                                 |
|    | The status of the received signal pattern per port:<br>Green: Pattern is synchronized.<br>Red: Loss of pattern.<br>Gray: Test is not running (EtherBERT test) or the <b>No Pattern Analysis (Live)</b> check box is selected.                                                                                                                                                                                                                                                                                              | Transport<br>EtherBERT<br>Fibre Channel<br>Wireless |
|    | A connection is established between two testing units either in <b>Dual Test Set (DTS)</b> or in <b>Loop Up</b> mode. Not available with <b>Intelligent Apps</b> .                                                                                                                                                                                                                                                                                                                                                         | Ethernet                                            |
|  | Loopback Tool enabled on the port unused by the main test application.                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Ethernet                                            |
|  | Clock synchronization signal clock. The clock icon is followed by the clock mode: <b>INT</b> for Internal, <b>EXT</b> for External, or <b>RCV</b> for Recovered.<br>Green: Clock Synchronized.<br>Red: Loss of clock.                                                                                                                                                                                                                                                                                                      | Transport<br>Ethernet<br>Fibre Channel<br>Wireless  |
|  | Indicates a manual change in the OH bytes transmitted. Not displayed when using the default OH values.                                                                                                                                                                                                                                                                                                                                                                                                                     | Transport                                           |
|  | The test is in loopback mode. Not displayed when not in loopback mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                     | NI-CSU Emulation                                    |

# Graphical User Interface Overview

## Title Bar

| Icon and/or text                                                                  | Description                                                                              | Test Application                                                            |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
|  | Alarm/error is currently injected. Not displayed when there is no alarm/error injection. | Transport<br>EtherBERT<br>Carrier Ethernet OAM<br>Fibre Channel<br>Wireless |

The following status are also displayed:

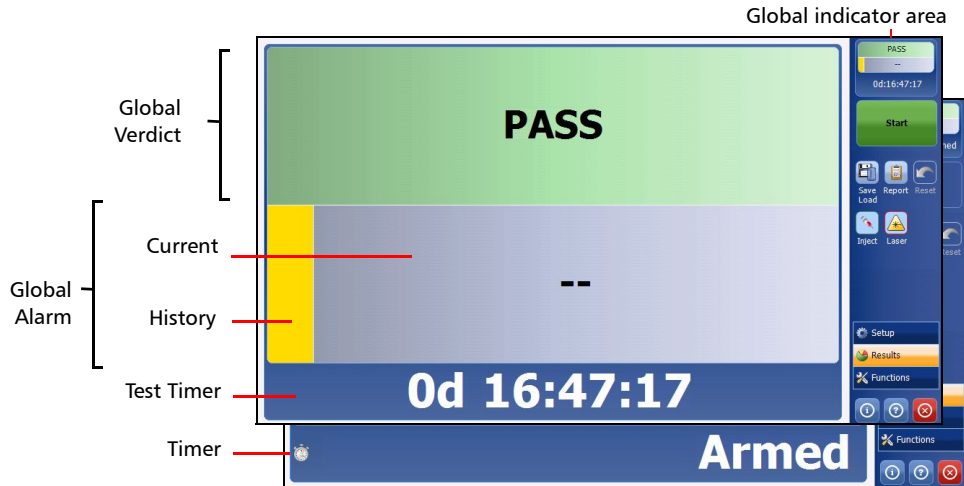
- Battery/AC icons indicate the battery level and if the FTB-1 is connected to an AC power source. Refer to the FTB-1 user guide for more information.
- Date and Time indicate the current date and time.

## Title Bar

The Title Bar displays the software application name and the battery level indicator.

### Global Indicator

The global indicator area displays the global pass/fail verdict, global alarm, and the test duration.



The global indicator area can be maximized for distant viewing. Tap anywhere within the global indicator area to display a maximized view. Tap again to exit the maximized view.

Global Verdict

Reports the global test verdict status when supported by the test application and enabled (when applicable).

| Verdict | Description                                                                                                                                                                                                                                                        |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PASS    | <b>PASS</b> is displayed with a green background when all result values meet the configured threshold criteria.                                                                                                                                                    |
| FAIL    | <b>FAIL</b> is displayed with a red background when any result value does not meet the configured threshold criteria or when a specific alarm is detected (refer to each test application for additional information).                                             |
| --      | <b>--</b> is displayed with a gray background when at least one of the following conditions is met: <ul style="list-style-type: none"><li>- Pass/Fail verdict is not enabled</li><li>- there is no defined criterion</li><li>- the test has not run yet.</li></ul> |

Global Alarm

Indicates the current and history alarm/error status of the test.

| Background color | Alarm/Error | Text displayed                   | Description                                                                       |
|------------------|-------------|----------------------------------|-----------------------------------------------------------------------------------|
| Gray             | Current     | --                               | No test result available.                                                         |
|                  | History     |                                  |                                                                                   |
| Green            | Current     | No Alarm                         | No alarm/error has occurred in the last second.                                   |
|                  | History     |                                  | No alarm/error has occurred during the test.                                      |
| Red              | Current     | Alarms or the name of the alarm. | An alarm/error occurred in the last second.                                       |
|                  | History     |                                  |                                                                                   |
| Amber            | History     |                                  | No current alarm/error but at least one alarm/error has occurred during the test. |

### Test Timer

The test timer without the timer icon indicates the time elapsed since the beginning of the test. No timer action is active. The test timer format is “day hour:minute:second”.

### Timer

The timer icon with **Armed** indicates that a start time is active.

The timer icon with the Test Timer indicates that a duration and/or a stop time is active.

## Test Control

**Note:** Refer to Test Control on page 529 for more information.

## Test Menu

The test menu displays the following buttons:

- **Setup** allows to configure the selected test. Refer to *Test Setup - Test Configurator, Timer, and System* on page 87 for more information.
- **Results** allows to view test results. Refer to *Test Results* on page 287 for more information.
- **Functions** allows to configure additional test functions (refer to *Test Functions* on page 455).

## Application Buttons

- **Help (?)** displays the help information related to the content of the active main window. It is also possible to navigate through the remainder of the help information.
- **Exit (x)** closes the application.
- **About (i)** mainly displays the product version details and technical support information.

**Module Details** button displays the NetBlazer details such as its ID, Serial Number, Software Product Version, etc.

**View Licence Agreement** button displays the details of the product licence agreement.

**Software Options** button displays the list of software options.

**Note:** *For information on how to install and activate software options, refer to the FTB-1 User Guide. The NetBlazer application must be restarted once a new software option is installed in order to activate it.*

| Software Option | Description                                                 |
|-----------------|-------------------------------------------------------------|
| DSn             | Digital Signal                                              |
| DS1-FDL         | DS1/1.5M Facility Data Link                                 |
| DS3-FEAC        | DS3/45M Far-End Alarm and Control                           |
| DUALRX          | Dual RX                                                     |
| DS3-G747        | ITU-T Recommendation G.747                                  |
| PDH             | Plesiochronous Digital Hierarchy                            |
| NI-CSU          | NI/CSU Emulation                                            |
| ISDN-PRI        | Primary Rate North American and/or European ISDN            |
| SONET           | Synchronous Optical Network                                 |
| SDH             | Synchronous Digital Hierarchy                               |
| TCM             | Tandem Connection Monitoring                                |
| OTU2-1f-2f      | Optical Transport Unit-2 Overclocked (11.270/11.317 Gbit/s) |
| OTU2-1e-2e      | Optical Transport Unit-2 Overclocked (11.049/11.096 Gbit/s) |

| Software Option  | Description                                   |
|------------------|-----------------------------------------------|
| OTU2             | Optical Transport Unit-2 (10.7 Gbit/s)        |
| OTU1             | Optical Transport Unit-1 (2.7 Gbit/s)         |
| 52M              | 52 Mbit/s                                     |
| 155M             | 155 Mbit/s                                    |
| 622M             | 622 Mbit/s                                    |
| 2488M            | 2.488 Gbit/s                                  |
| 9953M            | 9.953 Gbit/s                                  |
| 100optical       | 100 Mbit/s optical interfaces.                |
| GigE _Optical    | 1000Base-T and GigE optical interfaces.       |
| GigE _Electrical | 1000Base-T electrical Interfaces.             |
| 10G_LAN          | 10G LAN optical interface.                    |
| 10G_WAN          | 10G WAN optical interface.                    |
| FC-1X            | Fibre Channel 1X                              |
| FC-2X            | Fibre Channel 2X                              |
| FC-4X            | Fibre Channel 4X                              |
| FC-8X            | Fibre Channel 8X                              |
| FC-10X           | Fibre Channel 10X                             |
| IPV6             | IPV6 testing.                                 |
| MPLS             | MPLS Encapsulation                            |
| TRAFFIC _GEN     | Traffic Gen & Mon test application            |
| iSAM             | Intelligent Service Activation Methodology    |
| Cable_Test       | Cable Test application                        |
| TCP-THPUT        | TCP Throughput Test Application               |
| CPRI-1.2G        | CPRI 1.2288 Gbit/s                            |
| CPRI             | CPRI 2.4576 Gbit/s and 3.072 Gbit/s           |
| CPRI-4.9G        | CPRI 4.9152 Gbit/s                            |
| CPRI-6.1G        | CPRI 6.144 Gbit/s                             |
| CPRI-9.8G        | CPRI 9.8304 Gbit/s                            |
| OBSAI            | OBSAI 3.072 Gbit/s                            |
| 1588PTP          | 1588 Precision Time Protocol Test Application |
| SyncE            | Synchronous Ethernet Test Application         |
| ETH-THRU         | Through Mode test application.                |
| TRAFFIC-SCAN     | Traffic Scan                                  |
| ETH-OAM          | Carrier Ethernet OAM test application         |

# Graphical User Interface Overview

## Zoomed-In/Zoomed-Out Views

| Software Option | Description                               |
|-----------------|-------------------------------------------|
| LINK-OAM        | Link OAM                                  |
| TST-OAM         | Test Over Service OAM                     |
| RFC6349         | RFC 6349 test application (10GE and less) |
| ETH-CAPTURE     | Ethernet Frame Capture                    |
| ADV-FILTERS     | Advanced filtering                        |

## Zoomed-In/Zoomed-Out Views

Some configuration and result blocks give access to zoomed views allowing more detailed configurations/results.

The block title contains the magnifier (+) icon when a zoomed view is available.

To zoom-in, tap the magnifier (+) icon or anywhere on the block.

To zoom-out, tap on the magnifier (-) icon or anywhere on the block title.

## Arrow Buttons

|                                                                                     |                               |
|-------------------------------------------------------------------------------------|-------------------------------|
|    | Moves to the top of the list. |
|  | Moves one page up.            |
|  | Moves one line up.            |
|  | Moves one line down.          |
|  | Moves one page down.          |
|  | Moves to the end of the list. |

## Keyboard Usage

The GUI pops up different keyboards to modify data. Following are the usual keyboard keys:

- Left arrow moves the cursor one position to the left.
- Right arrow moves the cursor one position to the right.
- Up arrow increases the value by one.
- Down arrow decreases the value by one.
- **Del** deletes the value at the cursor position.
- **Back** deletes the value preceding the cursor position.
- **OK** completes data entry.
- **Cancel** closes the keyboard and discards the keyboard entry.
- **Previous...** allows the selection of previously configured values. This button is only available for certain fields like IP Address, MAC Address, etc.

**Note:** *For certain text fields, the GUI pops up or uses the unit's on-screen keyboard. Refer to the FTB-1 user guide for more information on how to use it.*

For full keyboard, the **Back**, **Del**, **Shift**, and **Space** bar keys have the same functionality as a regular PC keyboard.

## Graphical User Interface Overview

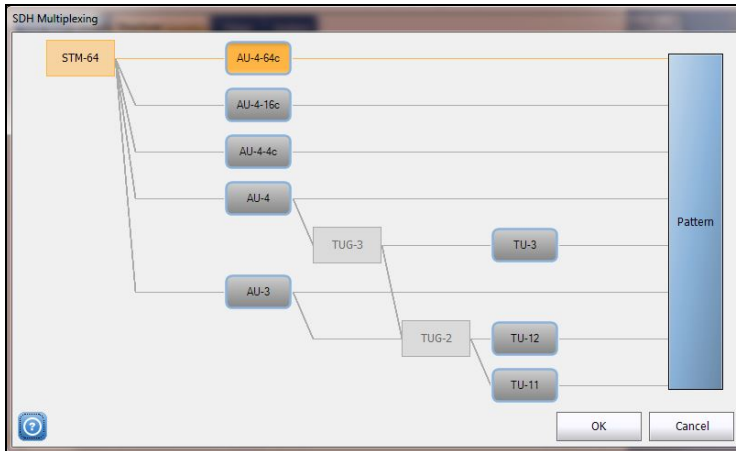
### Keyboard Usage

---

For multiplexing keyboard, tap on all mapped signals that have to be added/removed to/from the test path.

A mapped signal with an orange background color is part of the test path.

A mapped signal with a gray background color is not part of the test path.



The Trace message keyboard allows entering alphanumeric characters (ITU T.50) required for Trace fields. Tap the **Control Characters** button to access these characters.

| ITU T.50 Characters |           |                       |          |           |                           |
|---------------------|-----------|-----------------------|----------|-----------|---------------------------|
| b7 to b1            | Character | Description           | b7 to b1 | Character | Description               |
| 000 0000            | NUL       | Null                  | 001 0000 | DLE       | Data Link Escape          |
| 000 0001            | SOH       | Start Of Heading      | 001 0001 | DC1       | Device Control 1          |
| 000 0010            | STX       | Start of Text         | 001 0010 | DC2       | Device Control 2          |
| 000 0011            | ETX       | End of Text           | 001 0011 | DC3       | Device Control 3          |
| 000 0100            | EOT       | End Of Transmission   | 001 0100 | DC4       | Device Control 4          |
| 000 0101            | ENQ       | Enquiry               | 001 0101 | NAK       | Negative Acknowledge      |
| 000 0110            | ACK       | Acknowledge           | 001 0110 | SYN       | Synchronous idle          |
| 000 0111            | BEL       | Bell                  | 001 0111 | ETB       | End of Transmission Block |
| 000 1000            | BS        | Backspace             | 001 1000 | CAN       | Cancel                    |
| 000 1001            | HT        | Horizontal Tabulation | 001 1001 | EM        | End of Medium             |
| 000 1010            | LF        | Line Feed             | 001 1010 | SUB       | Substitute character      |
| 000 1011            | VT        | Vertical Tabulation   | 001 1011 | ESC       | Escape                    |
| 000 1100            | FF        | Form Feed             | 001 1100 | IS4       | Information Separator 4   |
| 000 1101            | CR        | Carriage Return       | 001 1101 | IS3       | Information Separator 3   |
| 000 1110            | SO        | Shift-Out             | 001 1110 | IS2       | Information Separator 2   |
| 000 1111            | SI        | Shift-In              | 001 1111 | IS1       | Information Separator 1   |



# 6 Test Setup - Test Applications

The NetBlazer offers the following test applications.

| Type             | Application              | Available on FTB-...     |              |       |                      |     | Page |
|------------------|--------------------------|--------------------------|--------------|-------|----------------------|-----|------|
|                  |                          | 720G, 730G,<br>860, 860G | 810,<br>810G | 860GL | 720G+,<br>730G+, 870 | 880 |      |
| Intelligent Apps | iSAM                     | X                        | -            | -     | X                    | X   | 42   |
| Transport        | OTN BERT                 | -                        | -            | -     | X                    | X   | 43   |
|                  | SONET/SDH BERT           | -                        | X            | -     | X                    | X   | 45   |
|                  | DSn/PDH BERT             | -                        | X            | -     | -                    | X   | 48   |
|                  | SONET/SDH - DSn/PDH BERT | -                        | X            | -     | -                    | X   | 50   |
|                  | NI/CSU Emulation         | -                        | X            | -     | -                    | X   | 53   |
|                  | ISDN PRI                 | -                        | X            | -     |                      | X   | 54   |
| Ethernet         | EtherSAM (Y.1564)        | X                        | -            | -     | X                    | X   | 55   |
|                  | RFC 6349                 | X                        | -            | -     | X                    | X   | 57   |
|                  | RFC 2544                 | X                        | -            | -     | X                    | X   | 56   |
|                  | EtherBERT                | X                        | -            | -     | X                    | X   | 58   |
|                  | Traffic Gen & Mon        | X                        | -            | -     | X                    | X   | 59   |
|                  | Smart Loopback           | X                        | -            | X     | X                    | X   | 60   |
|                  | Through Mode             | X                        | -            | -     | X                    | X   | 62   |
|                  | TCP Throughput           | X                        | -            | -     | X                    | X   | 63   |
|                  | Carrier Ethernet OAM     | X                        | -            | -     | X                    | X   | 64   |
|                  | Cable Test               | X                        | -            | X     | X                    | X   | 66   |
| Packet Sync      | 1588 PTP                 | X                        | -            | -     | X                    | X   | 67   |
|                  | SyncE                    | X                        | -            | -     | X                    | X   | 68   |
| Fibre Channel    | FC BERT                  | X                        | -            | -     | X                    | X   | 69   |
| Wireless         | CPRI/OBSAI BERT          | X                        | -            | -     | X                    | X   | 70   |

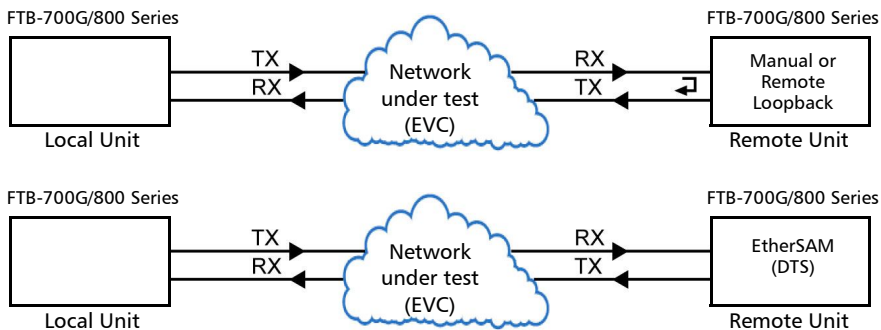
### iSAM

iSAM is a simplified version of EtherSAM that is centered around addressing turn-up of E-Line circuits (EVC). The objective of the test is to validate Carrier Ethernet-based services key performance indicators defined in MEF: Frame Delay (FD), Inter-Frame Delay Variation (IFDV), and Frame Loss Ratio (FLR). In addition the RFC 6349 subtest can be enabled to validate that the Ethernet service is able to properly carry TCP traffic.

The **iSAM** test has to be executed in conjunction with a remote module. The remote module can be either in loopback configuration for unidirectional testing or in EtherSAM **Dual Test Set** mode for bidirectional testing.

The **Dual Test Set** test allows bi-directional test between two compatible modules providing independent results for each test direction. The results from local-to-remote and remote-to-local are available on the local testing unit.

➤ Typical iSAM test applications:

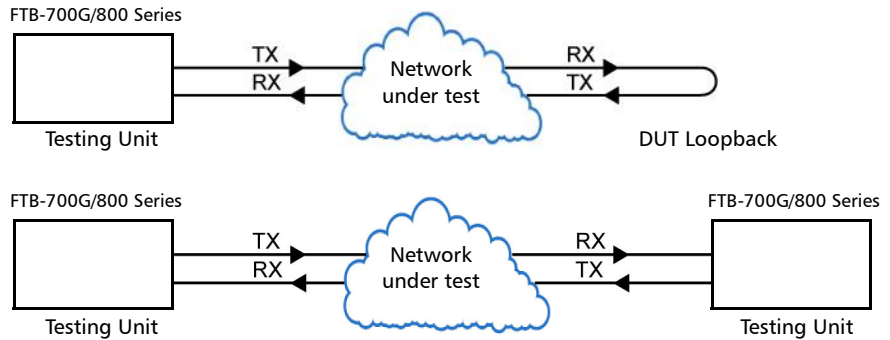


➤ Supported Interfaces/Rates: 10M to 10G LAN/WAN.

## OTN BERT

Allows OTN (framed and unframed) traffic generation with specific test pattern for Bit Error Rate analysis.

➤ Typical OTN BERT test applications:



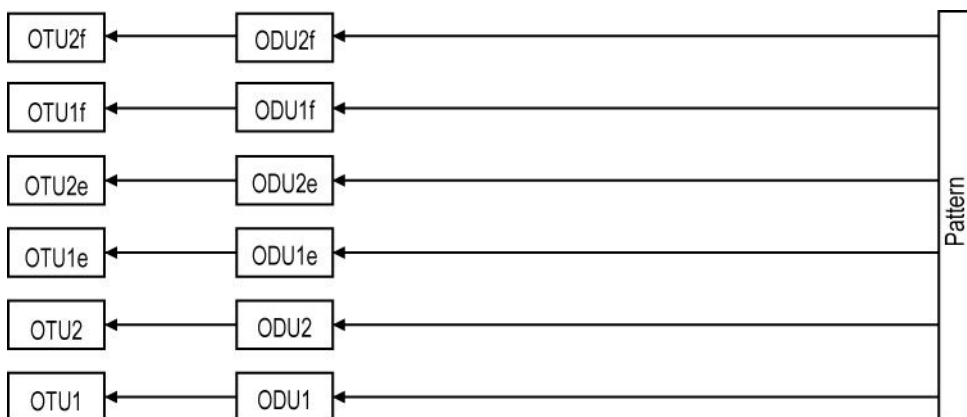
## Test Setup - Test Applications

### OTN BERT

---

#### ➤ Path/Mapping

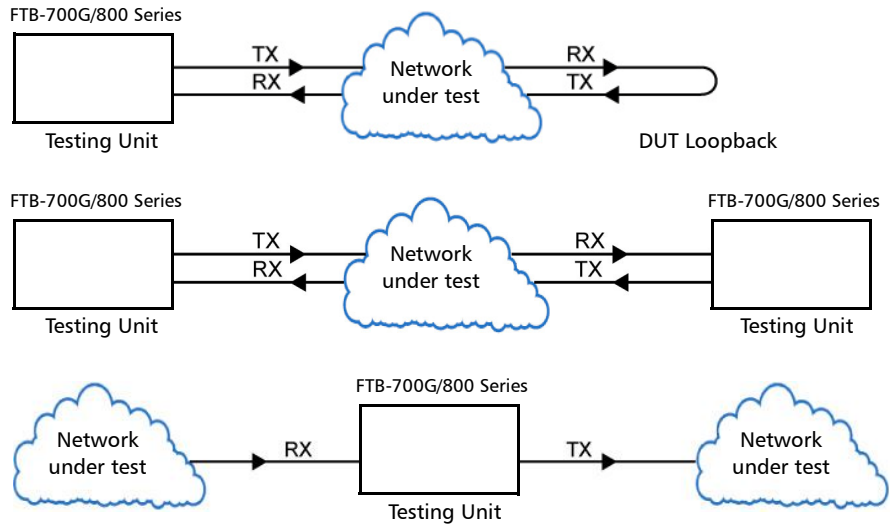
The **OTN BERT** test application offers the following path/mapping structures depending on the inserted SFP/SFP+ transceiver, and enabled options.



## SONET/SDH BERT

Allows the validation of the SONET or SDH transport protocol by performing a BERT test to check the traffic or payload stability over a network facility.

➤ Typical SONET/SDH BERT test applications:



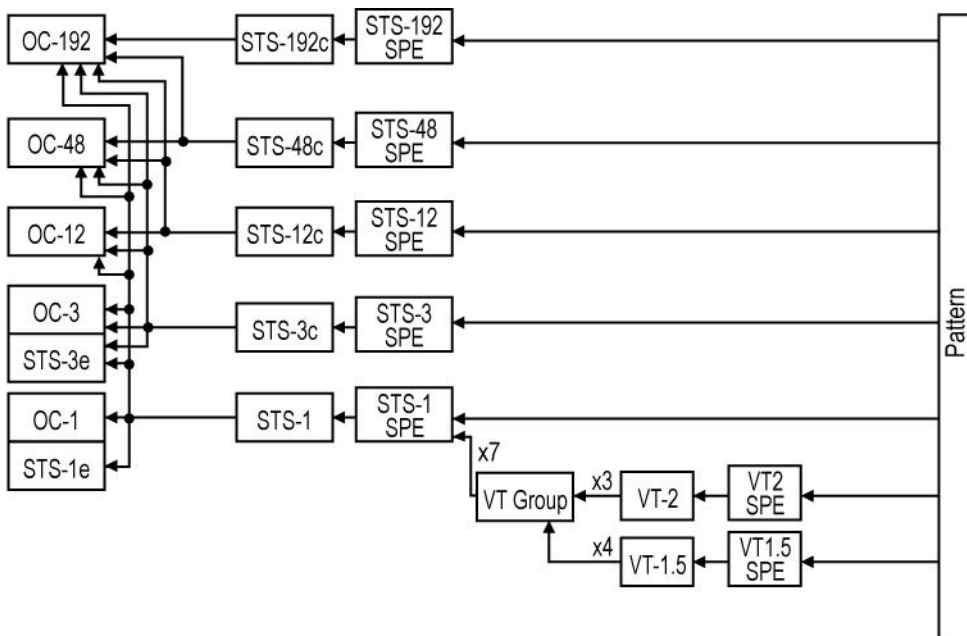
## Test Setup - Test Applications

### SONET/SDH BERT

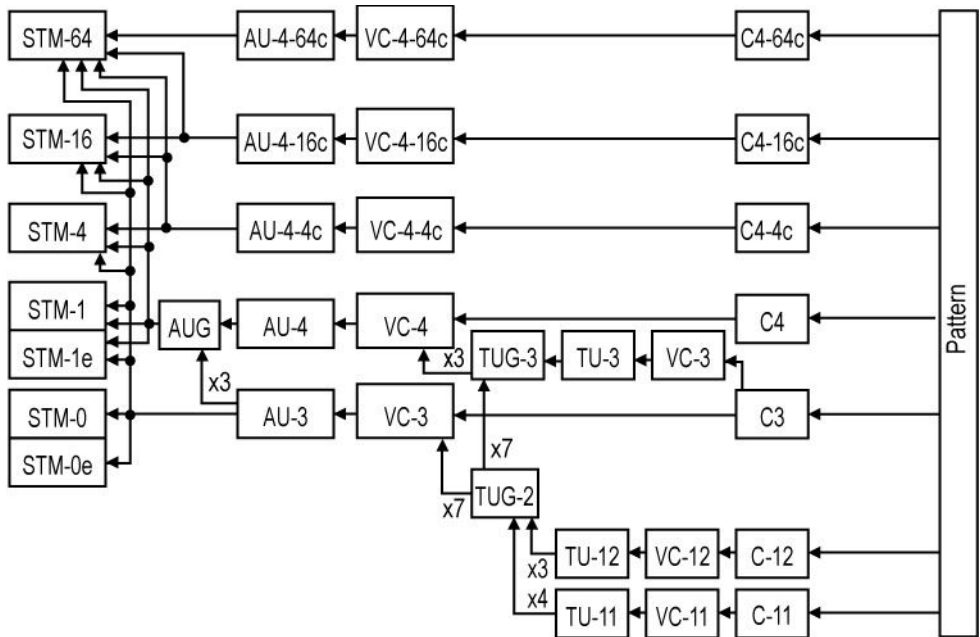
#### ➤ Path/Mapping

The **SONET/SDH BERT** test application offers the following path/mapping structures depending on the inserted SFP/SFP+ transceiver, and enabled options.

For SONET BERT



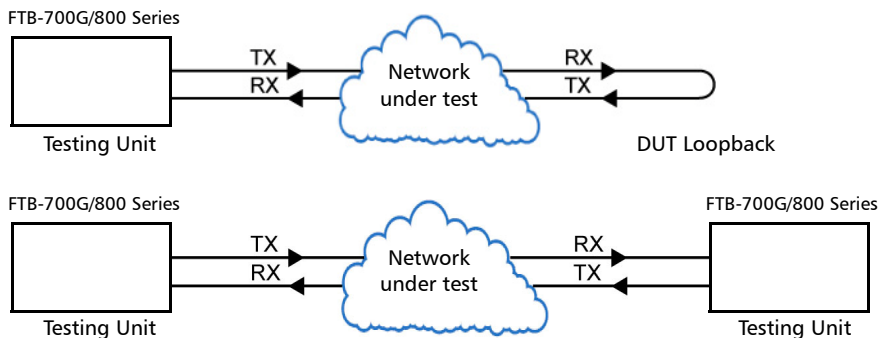
For SDH BERT



## DSn/PDH BERT

Allows validation of the DSn or PDH transport protocol by performing a BERT test to check the traffic or payload stability over a network facility.

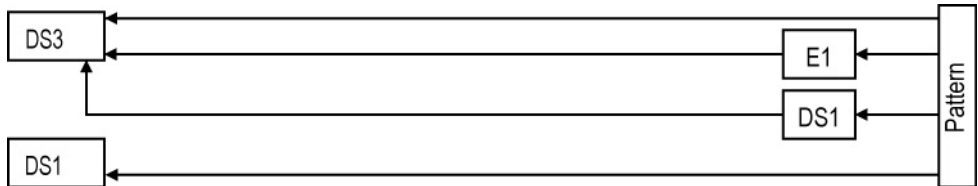
- Typical DSn/PDH BERT test applications:



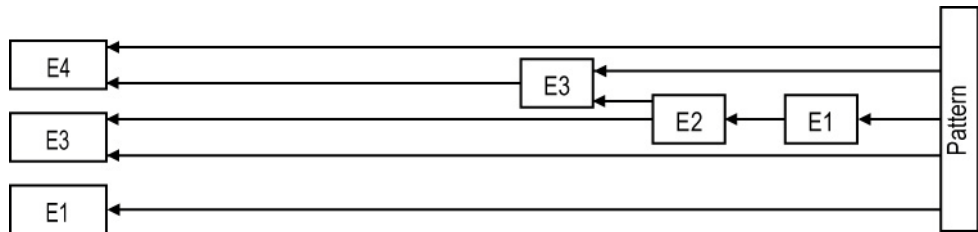
### ➤ Path/Mapping

The **DSn/PDH BERT** test application offers the following path/mapping structures depending on model and enabled options.

For DSn:



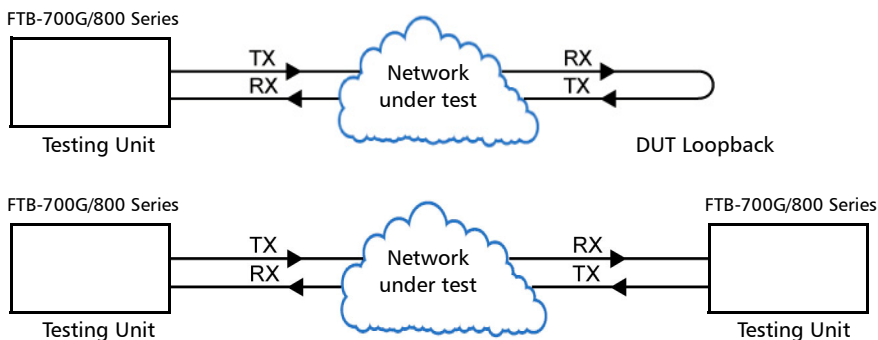
For PDH:



## SONET/SDH - DS<sub>n</sub>/PDH BERT

Allows validation of the DS<sub>n</sub> or PDH embedded in SONET or SDH transport protocol by performing a BERT test to check the traffic or payload stability over a network facility.

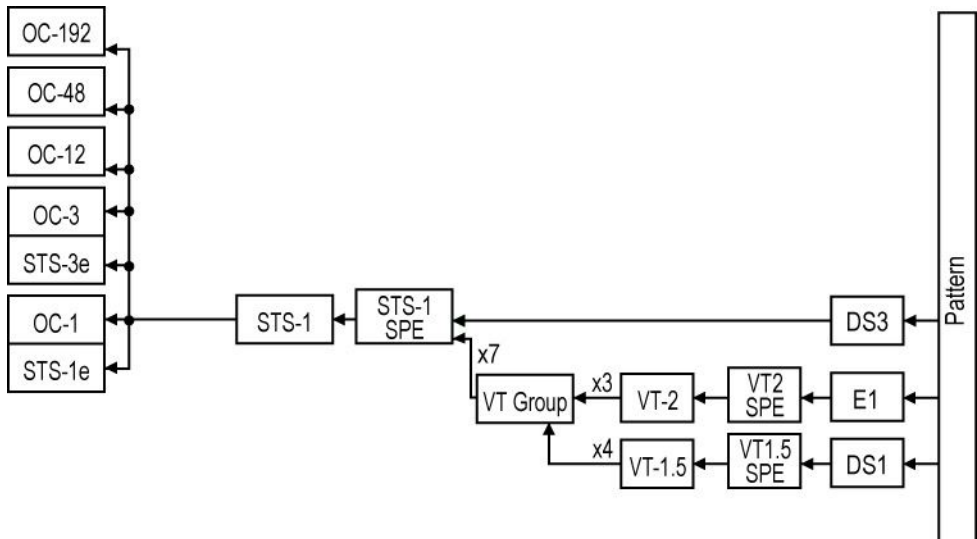
- Typical SONET/SDH - DS<sub>n</sub>/PDH BERT test applications:



### ➤ Path/Mapping

The **SONET/SDH - DSn/PDH BERT** test application offers the following path/mapping structures depending on the model and enabled options.

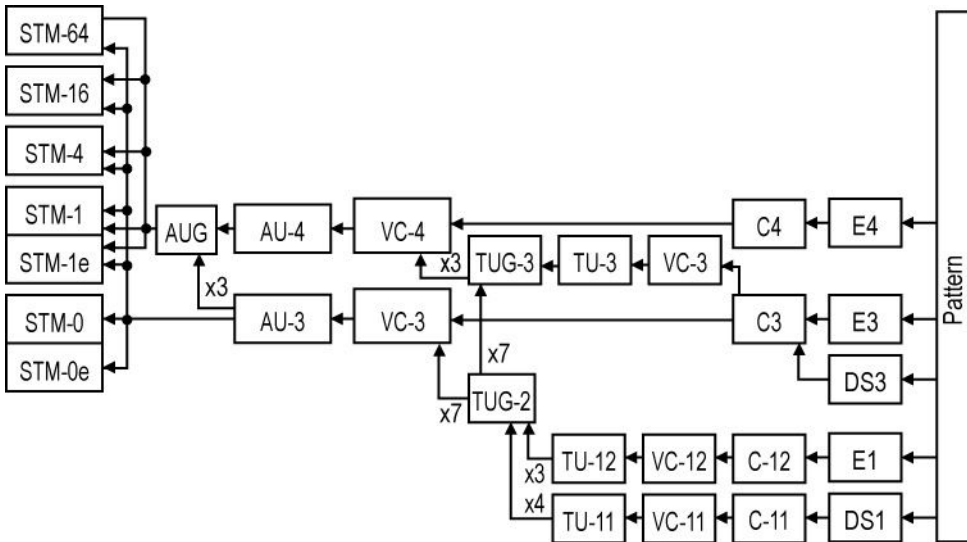
For SONET:



## Test Setup - Test Applications

SONET/SDH - DSn/PDH BERT

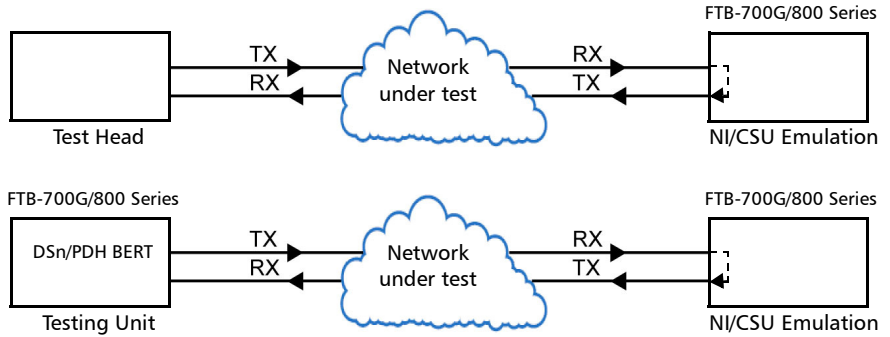
For SDH:



## NI/CSU Emulation

Allows DS1 testing in NI/CSU (Network Interface/Customer Service Unit) emulation mode.

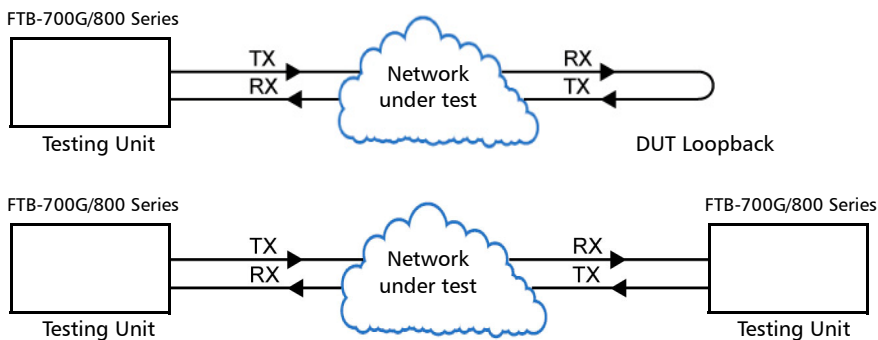
Typical NI/CSU Emulation test applications:



## ISDN PRI

Allows to test and troubleshoot North American or European ISDN PRI configurations by calling one or all 23 DS1 or 30 E1 PRI channels. Once connected, the user can perform a channel-by-channel BERT, or talk and listen via a headset.

Typical ISDN PRI test applications:



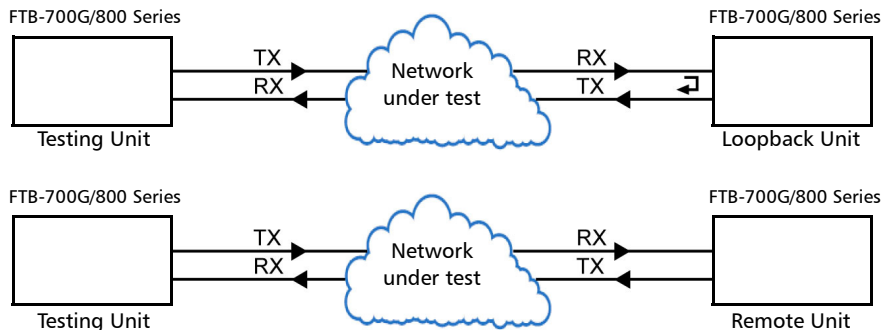
## EtherSAM (Y.1564)

EtherSAM can simulate all types of services that will run on the network and simultaneously qualify all key SLA parameters for each of these services. Moreover, it validates the QoS mechanisms provisioned in the network to prioritize the different service types, resulting in more accurate validation and much faster deployment and troubleshooting.

The **EtherSAM (Y.1564)** test has to be executed in conjunction with a remote module. The remote module can be either in loopback configuration for unidirectional testing or in EtherSAM **Dual Test Set** mode for bidirectional testing.

The **Dual Test Set** test allows bi-directional test between two compatible modules providing independent results for each test direction. The results from local-to-remote and remote-to-local are available on the local testing unit.

➤ Typical EtherSAM (Y.1564) test applications:



➤ Supported Interfaces/Rates: 10M to 10G LAN/WAN.

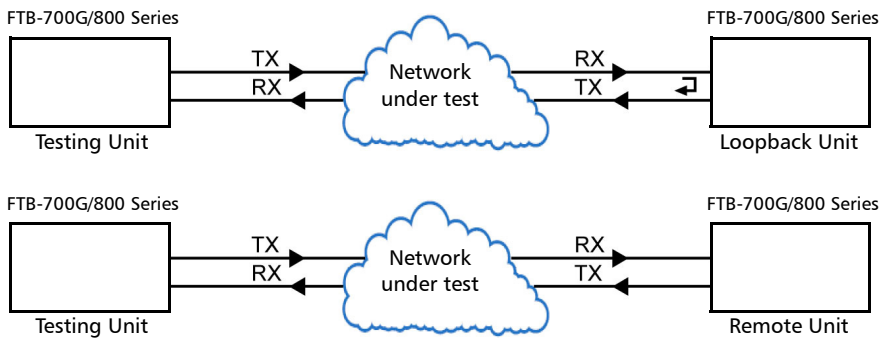
### RFC 2544

RFC 2544 allows Ethernet Throughput, Back-to-Back, Frame Loss, and Latency performance testing in accordance with RFC 2544 specifications.

The **RFC 2544** test has to be executed in conjunction with a remote module. The remote module can be either in loopback configuration for unidirectional testing or in RFC 2544 **Dual Test Set** mode for bidirectional testing.

The **Dual Test Set** test allows bi-directional test between two compatible modules providing independent results for each test direction. The results from local-to-remote and remote-to-local are available on the local testing unit.

➤ Typical RFC 2544 test applications:



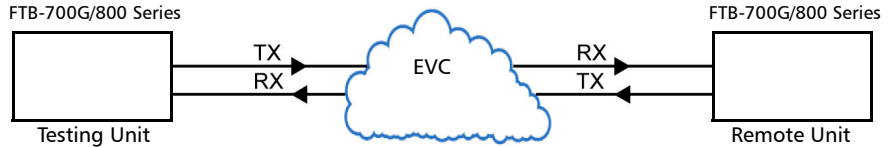
➤ Supported Interfaces/Rates: 10M to 10G LAN/WAN.

## RFC 6349

RFC 6349 is used to confirm that the Ethernet service is able to properly carry TCP traffic.

The **RFC 6349** test has to be executed in conjunction with a remote compatible module in RFC 6349 **Dual Test Set** mode allowing bidirectional testing. The **Dual Test Set** test provides independent results for each test direction. The results from local-to-remote and remote-to-local are available on the local testing unit.

- Typical RFC 6349 test application:

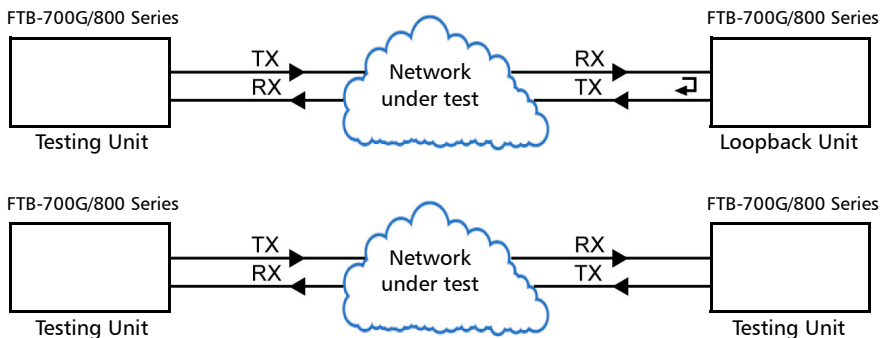


- Supported Interfaces/Rates: 10M to 10G LAN.

### EtherBERT

Allows Ethernet Layer 1 up to Layer 4 and Unframed Layer 1 traffic generation with specific test pattern for Bit Error Rate analysis.

- Typical EtherBERT test applications:

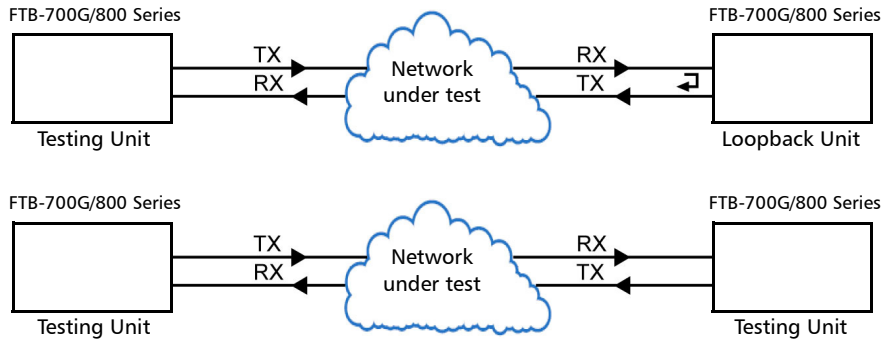


- Supported Interfaces/Rates: 10M to 10G LAN/WAN.

## Traffic Gen & Mon

Allows Ethernet traffic generation and analysis of up to 16 streams.

- Typical Traffic Gen & Mon test applications:



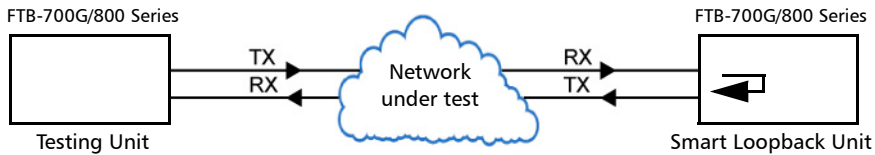
- Supported Interfaces/Rates: 10M to 10G LAN/WAN.

## Smart Loopback

Allows transmitting back the received Ethernet stream of data while interchanging the source and destination MAC addresses, IP addresses, and/or UDP/TCP ports. However in **Transparent (Pseudo-Physical)** mode the Smart Loopback operates as a physical loopback by transmitting all received frames unaltered and without discrimination.

The Smart Loopback test can be created locally (refer to *Ethernet Test Applications* on page 78) or remotely using an EXFO unit (refer to *Discover Remote Button* on page 530) or a Third-Party device (see *Third-Party Remote Loopback* on page 61).

- Typical Smart Loopback test application:



- Supported Interfaces/Rates: 10M to 10G LAN/WAN.

## **Third-Party Remote Loopback**

The Third-party Remote Loopback feature provides the capability to be discovered and react to loop-up and loop-down commands from a third party device. This feature is used for unidirectional testing, where the test stream is transmitted from the third party device to a remote EXFO device. The looped back test stream is received and analyzed by the third-party device.

The third-party loopback supports three level of messages:

- Layer 2: Only MAC addresses are swapped.
- Layer 3: MAC and IP addresses are swapped.
- Layer 4: MAC and IP addresses are swapped along with the UDP port.

To emulate a third-party remote device, the loopback mode is set in the function of the layer of loop messages received. The loop messages are:

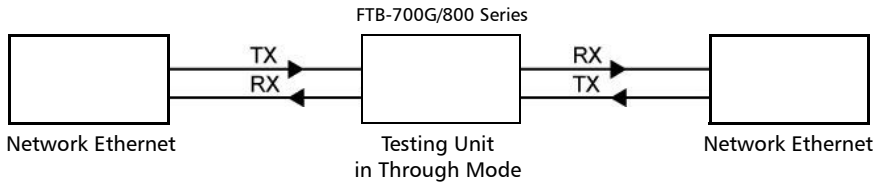
- Layer 2: Ethernet
- Layer 3: IP
- Layer 4: UDP/TCP

On receipt of the third-party loop-up command as per requested layer, the loopback mode is set and initiated on the module.

## Through Mode

The Through Mode test application allows traffic to pass through the FTB-700G/800 Series unit using two electrical or optical ports for in-service troubleshooting of live traffic between the carrier/service provider network and the customer's network.

- Typical Through Mode test application:



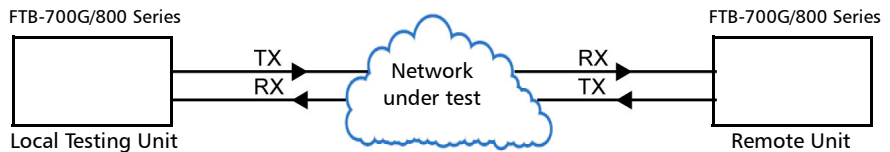
- Supported Interfaces/Rates: 10M to 1G optical.

## TCP Throughput

The objective of this test is to find the TCP throughput based on the successfully transported bytes over the test time. Two units running a TCP Throughput test are required. One unit will act as the source (Local) and the other one as the destination (Remote).

The local unit starts sending TCP segments using the Initial Window Size defined. The window size is adjusted following the TCP algorithm. The window size is incremented until the Maximum Window Size or congestion is reached. However, the window size will be reduced when congestion occurs, then incremented again as described above when the congestion is cleared. TCP Throughput and windows size statistics will be gathered throughout the test.

- Typical TCP Throughput test application:



- Supported Interfaces/Rates: 10M to 1G.

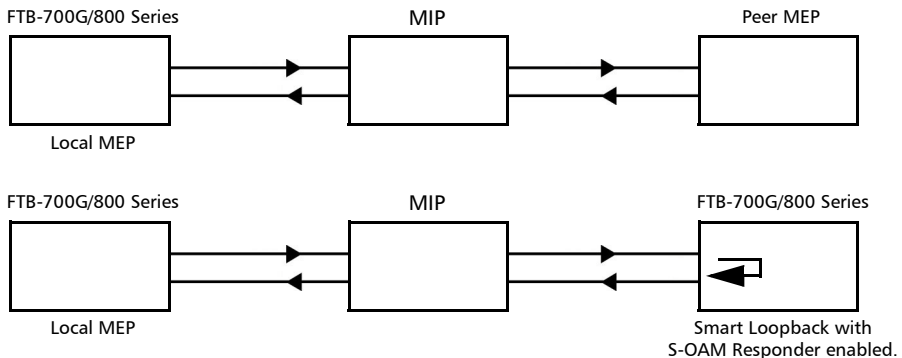
## Carrier Ethernet OAM

The Carrier Ethernet OAM test application supports the following tests:  
**Ethernet OAM (S-OAM)**, **MPLS-TP OAM**, and **Link OAM**.

### Ethernet OAM and MPLS TP OAM

The Ethernet Service OAM tests are divided in two main categories:

- Performance Monitoring measures parameters such as frame delay, frame loss, and synthetic loss (Y.1731/MEF).
  - Connectivity Fault Management provides the capability for detecting, verifying, and isolating connectivity failure (Y.1731/802.1ag/MEF).
- Typical Ethernet OAM and MPLS TP OAM test applications:

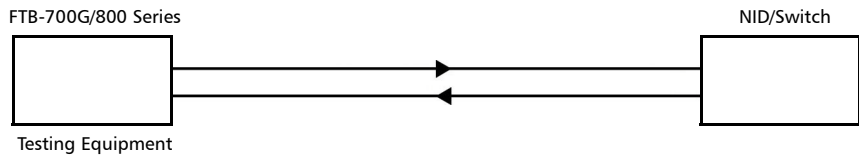


- Supported Interfaces/Rates: 10M to 10G LAN/WAN.

### Link OAM

The Link OAM test validates the Link OAM protocol capabilities and the Ethernet link connection of a remote equipment.

- Typical Link OAM test application:



- Supported Interfaces/Rates: 10M to 10G LAN/WAN.

## Cable Test

The cable test application is used to diagnose un-shielded twisted pairs (UTP) cables (up to Category 6e/Class E).

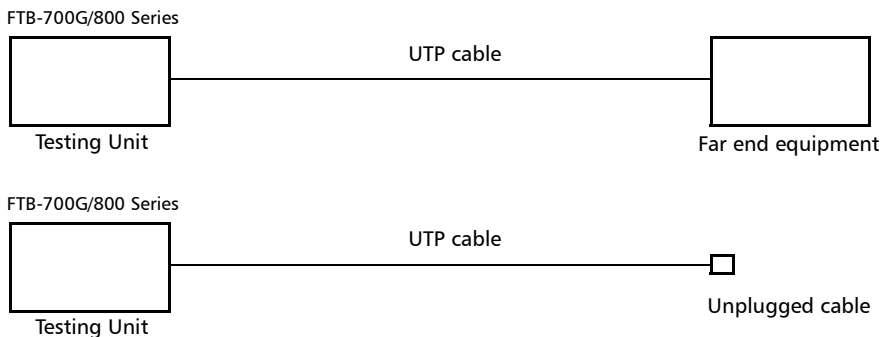
Cable test can be performed everywhere in the network where an electrical 10/100/1000 Mbit/s Ethernet interface is available for testing. Only the pairs used by the Ethernet signal will be tested. For 10 Base-T, and 100 Base-TX, pair 2 and 3 will be tested; for 1000 Base-T, all pairs will be tested. However, if the Ethernet signal is unknown, all four pairs will be tested.

Even if a link up is not required when testing with a far end equipment, it is preferable to have the far end equipment powered up to maximize the cable test results.

Supported Ethernet cable categories are: Category 3/Class C, Category 4, Category 5, Category 5e/Class D, and Category 6e/Class E.

**Note:** *Cable test result is reliable for cable length of 10 meters to 120 meters (32.81 feet to 393.7 feet).*

### ➤ Typical Cable Test applications:

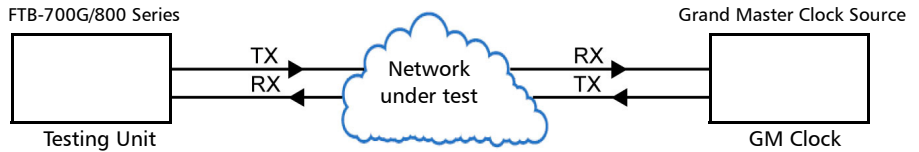


### ➤ Supported Interfaces/Rates: 10M to 1000M Electrical.

## 1588 PTP

The 1588 PTP (Precision Time Protocol) test application handles the 1588 PTP communication with the Grand Master (GM) clock, collects statistics related to packets, and monitors the clock Quality Level.

- Typical 1588 PTP test application:

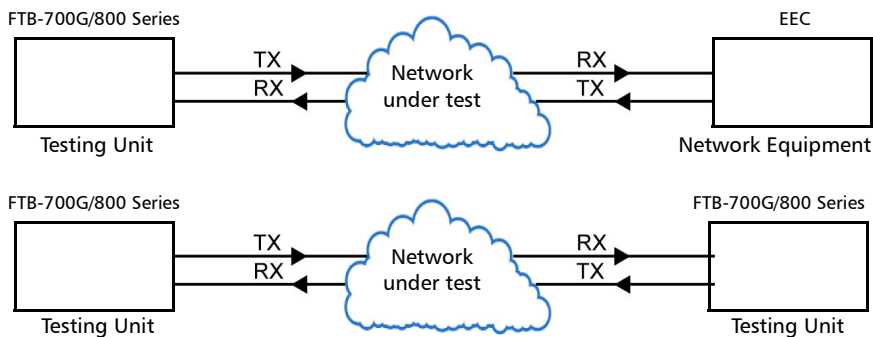


- Supported Interfaces/Rates: 10M to 10G LAN.

### SyncE

The Synchronous Ethernet (SyncE) test application provides elementary test primitives to interactively validate the clock management functions of a SyncE capable network equipment.

- Typical SyncE test applications:

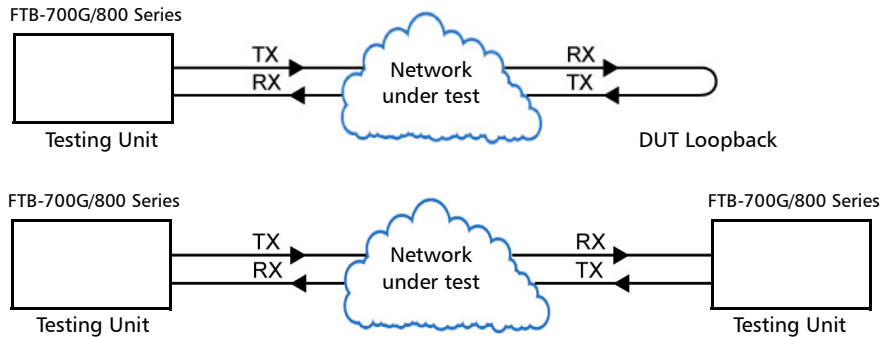


- Supported Interfaces/Rates: 100M to 10G LAN.

## FC BERT

The FC BERT (Fibre Channel BERT) application provides full wire-speed traffic generation at the FC-2 layer allowing BER testing for link integrity measurements, latency, buffer-to-buffer credit measurements for optimization as well as login capabilities.

- Typical Fibre Channel BERT test applications:



- Supported Interfaces/Rates: 1X, 2X, 4X, 8X, 10X.

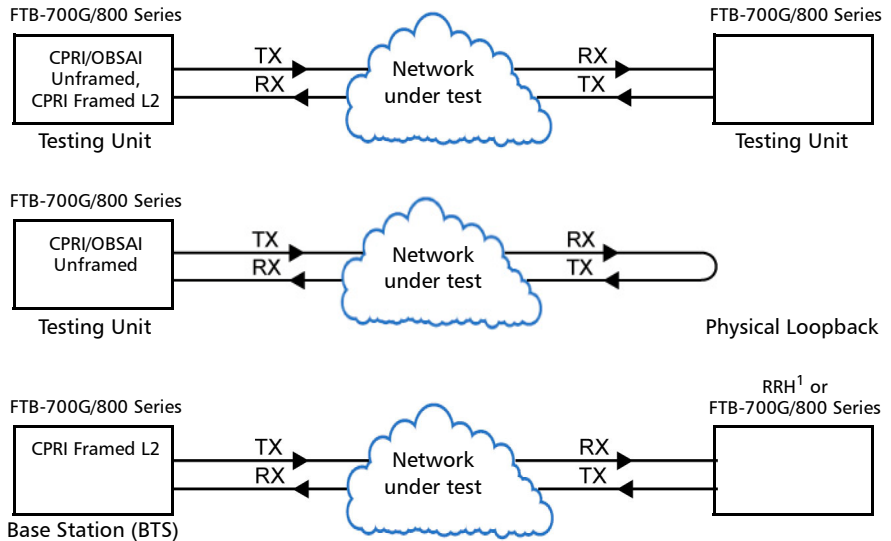
## **CPRI/OBSAI BERT**

The CPRI/OBSAI BERT test application offers the capability to test the fronthaul and dark fiber for CPRI/OBSAI and in addition supports detailed CPRI L2 protocol testing, round trip delay, and Service Disruption Time measurements.

The Common Public Radio Interface (CPRI) is an industry cooperation aimed at defining a publicly available specification for the key internal interface of radio base stations between the Radio Equipment Control (REC) and the Radio Equipment (RE). In the industry the CPRI REC and RE are mainly known as Base Station (BTS) and Remote Radio Head (RRH) respectively.

The Open Base Station Architecture Initiative (OBSAI) is a standard that defines the internal modular structure and interface for base stations.

### ➤ Typical CPRI/OBSAI BERT test applications:



<sup>1</sup> Note that a RRH is typically not capable to perform a loopback of the traffic so BERT test monitoring is not applicable. The BERT test is more common when testing between two test units.

### ➤ Supported Interfaces/Rates:

CPRI: 1.2, 2.4, 3.1, 4.9, 6.1, and 9.8 Gbit/s

OBSAI: 3.1 Gbit/s.



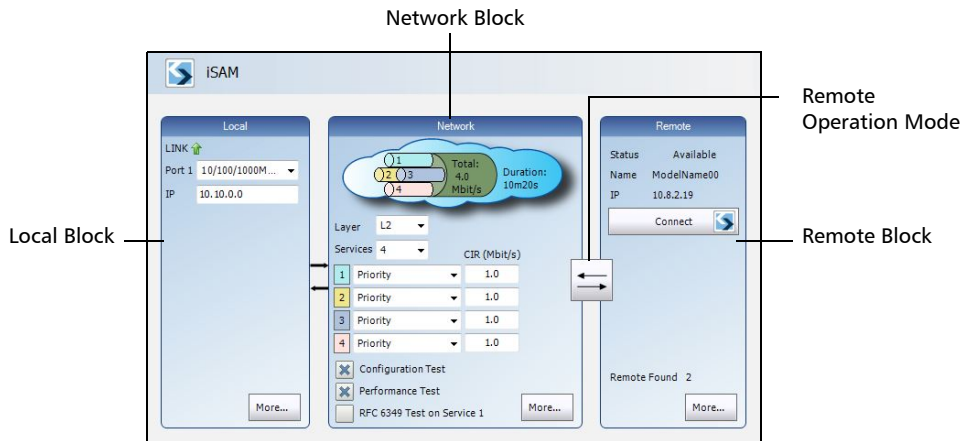
## 7 *Selecting and Starting a Test*

A test can be created either by selecting the test from the Test Applications tab or by loading a previously saved configuration (refer to *Save/Load Button* on page 552 for more information).

### Intelligent Apps

**To select, configure, and start an Intelligent Application:**

1. From the test menu, tap **Setup**.
2. From the **Test Applications** tab, under **Intelligent Apps**, tap a test icon.
3. From the **Test Configurator** tab configure the interface structure and its parameters.



- 3a.** From the **Local** block, either select the basic port parameters or click on **More** for all settings (refer to *Interface (iSAM)* on page 158). Ensure that the link is up and the power level for optical interface (when supported) is adequate in the status bar before proceeding to the next step (refer to *Status Bar* on page 28).

## Selecting and Starting a Test

### Intelligent Apps

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- 3b.** From the **Network** block, either select the basic test parameters or click on **More** for all settings (refer to *Network Details (iSAM)* on page 191). The total bandwidth and the estimated test duration are displayed.
- 3c.** Select the remote operation mode; DTS is automatically selected when the **RFC 6349 Test** is enabled:

|                                                                                   |                                                                                                                                              |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
|  | <b>DTS (Dual Test Set)</b><br>The remote device is automatically set in EtherSAM when the connection/overtake is successfully established.   |
|  | <b>Remote Loopback</b><br>The remote device is automatically set in Smart Loopback when the connection/overtake is successfully established. |
|  | <b>Manual Loopback</b><br>The remote device is a physical loopback or has to be manually set in loopback.                                    |

- 3d.** From the **Remote** block, either select the basic remote parameters or click on **More** for all settings (refer to *Remote Details (iSAM)* on page 202).

**Note:** The *iSAM* test application uses **Internal** timing for clock synchronization.

4. Tap the **Start** button from the right navigation bar to start the test (refer to *Start/Stop | TX Button* on page 558). If the connection with the remote module is not established with either **DTS** or **Remote Loopback** mode, the automatic remote connection process is performed before starting the test. The **Summary** result page will be automatically displayed when the test is started from any **Setup** configuration page. For additional results refer to *Test Results* on page 287.
5. When the test ends automatically or is manually stopped, the generate report pop-up is displayed by default. If required, tap **Yes** to generate a report of the test results and statistics (refer to *Report Button* on page 547 for more information).

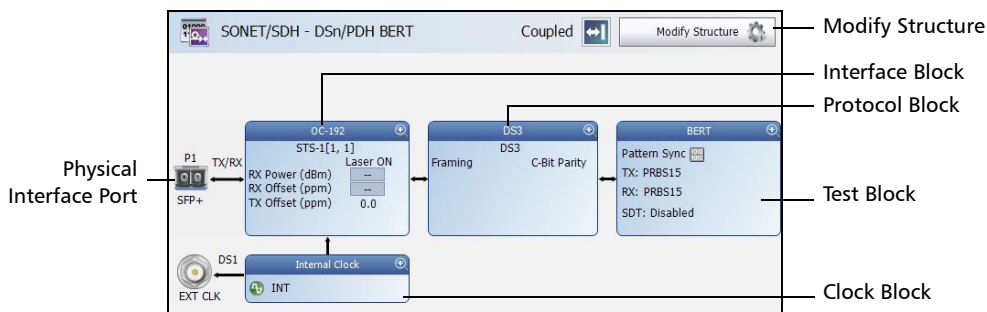
## Selecting and Starting a Test

### Transport Test Applications

## Transport Test Applications

**To select, configure, and start a Transport test:**

1. From the test menu, tap **Setup**.
2. From the **Test Applications** tab, under **Transport**, tap a test icon.
3. From the **Test Configurator** tab configure the signal structure and its parameters.



- 3a. Tap the **Modify Structure** button to set the basic structure of the test such as the interface/rate, connector, etc. (refer to *Modify Structure Button* on page 97).
- 3b. Tap the interface block to configure the signal parameters (refer to page 87).
- 3c. For an embedded signal, tap the protocol block to configure the signal (refer to page 87).

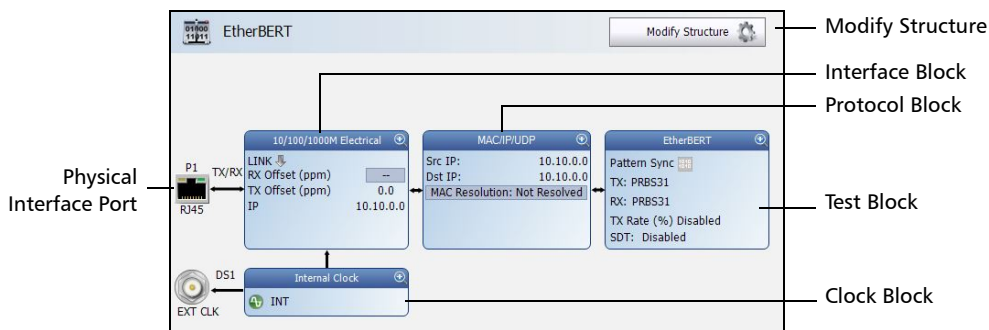
- 3d.** Tap the test block to configure the specific test settings (refer to page 87). Not available with **NI/CSU Emulation** test application.
- 3e.** Tap the clock block to configure the clock synchronization (refer to *Clock* on page 125).
- 4.** Tap the **Timer** tab to automatically start and/or stop the test at a given time or for a specific duration (refer to *Timer* on page 279).
- 5.** For additional test configurations refer to *Test Functions* on page 455.
- 6.** Tap the **Start** button from the right navigation bar to start the test. (refer to *Start/Stop | TX Button* on page 558). The **Summary** result page will be automatically displayed when the test is started from any **Setup** configuration page. For additional results, refer to *Test Results* on page 287.
- 7.** Tap the **Stop** button to stop the test. By default the generate report pop-up is displayed. If required, tap **Yes** to generate a report of the test results and statistics (refer to *Report Button* on page 547).

## Selecting and Starting a Test

### Ethernet Test Applications

**To select, configure, and start an Ethernet test:**

1. From the test menu, tap **Setup**.
2. From the **Test Applications** tab, under **Ethernet**, tap a test icon.
3. From the **Test Configurator** tab configure the interface structure and its parameters.



- 3a. Tap the **Modify Structure** button to set the basic structure of the test such as the interface/rate, connector, etc. (refer to *Modify Structure Button* on page 97).
- 3b. Tap the interface block to configure the interface parameters (refer to page 87). Ensure that the link is up and the power level (when supported) is present in the status bar before proceeding to the next step (refer to *Status Bar* on page 28).

- 3c.** Tap the protocol block<sup>1</sup> to configure the frame structure and its parameters (refer to page 89).
- 3d.** Tap the test block<sup>2</sup> to configure the specific test settings (refer to page 89).
- 3e.** Tap the clock block to configure the clock synchronization (refer to *Clock* on page 125).
- 4.** Tap the **Timer** tab to automatically start and/or stop the test at a given time or for a specific duration (refer to *Timer* on page 279).
- 5.** For additional test configurations refer to *Test Functions* on page 455.
- 6.** Tap the **Start** button from the right navigation bar to start the test (refer to *Start/Stop | TX Button* on page 558). The **Summary** result page will be automatically displayed when the test is started from any **Setup** configuration page. For additional results refer to *Test Results* on page 287.
- 7.** Depending on the test, when the test ends automatically or is manually stopped, the generate report pop-up is displayed by default. If required, tap **Yes** to generate a report of the test results and statistics (refer to *Report Button* on page 547 for more information).

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1. Not available with Smart Loopback, Through Mode, TCP Throughput, Carrier Ethernet OAM, and Cable Test.

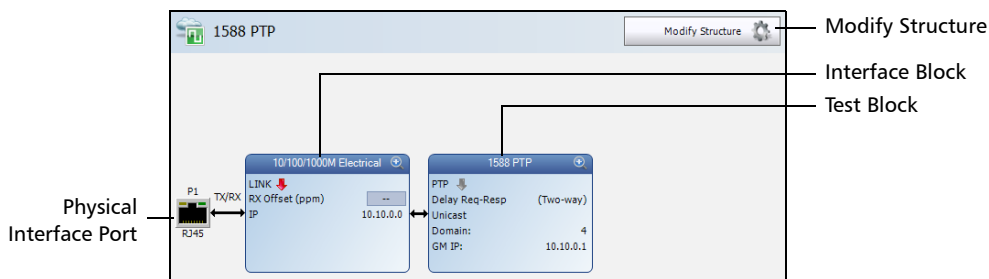
2. Not available with Traffic Gen & Mon and Through Mode.

## Selecting and Starting a Test

### Packet Sync Test Applications

**To select, configure, and start a Packet Sync test:**

1. From the test menu, tap **Setup**.
2. From the **Test Applications** tab, under **Packet Sync**, tap a test icon.
3. From the **Test Configurator** tab configure the interface structure and its parameters.



- 3a. Tap the **Modify Structure** button to set the basic structure of the test such as the interface/rate, connector, etc. (refer to *Modify Structure Button* on page 97).
- 3b. Tap the interface block to configure the interface parameters (refer to page 87). Ensure that the link is up and the power level (when supported) is present in the status bar before proceeding to the next step (refer to *Status Bar* on page 28).
- 3c. Tap the test block to configure the specific test settings (refer to page 90).

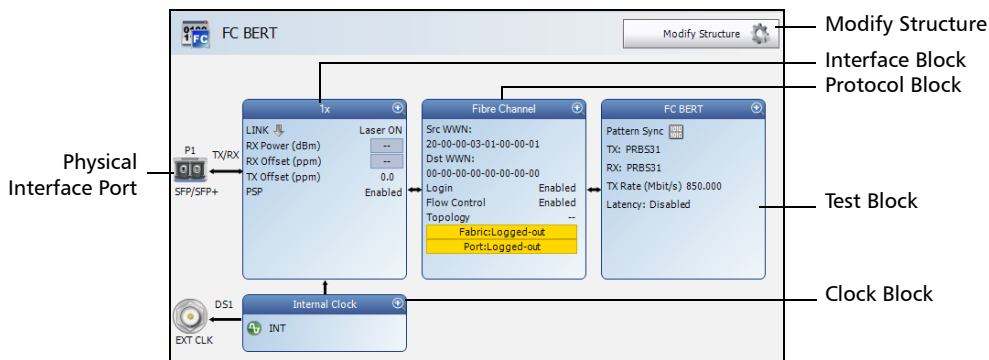
4. Tap the **Timer** tab to automatically start and/or stop the test at a given time or for a specific duration (refer to *Timer* on page 279).
5. For additional test configurations refer to *Test Functions* on page 455.
6. Tap the **Start** button from the right navigation bar to start the test (refer to *Start/Stop | TX Button* on page 558). The **Summary** result page will be automatically displayed when the test is started from any **Setup** configuration page. For additional results refer to *Test Results* on page 287.
7. Depending on the test, when the test ends automatically or manually stopped, the generate report pop-up is displayed by default. If required, tap **Yes** to generate a report of the test results and statistics (refer to *Report Button* on page 547 for more information).

## Selecting and Starting a Test

### Fibre Channel Test Application

**To select, configure, and start a Fibre Channel test:**

1. From the test menu, tap **Setup**.
2. From the **Test Applications** tab, under **Fibre Channel**, tap the **FC BERT** test icon.
3. From the **Test Configurator** tab configure the interface structure and its parameters.



- 3a. Tap the **Modify Structure** button to set the basic structure of the test such as the interface/rate and connector. (refer to *Modify Structure Button* on page 97).
- 3b. Tap the interface block to configure the interface parameters (refer to page 149). Ensure that the link is up and the power level (when supported) is present in the status bar before proceeding to the next step (refer to *Status Bar* on page 28).
- 3c. Tap the protocol block to configure the frame structure and its parameters (refer to page 143).

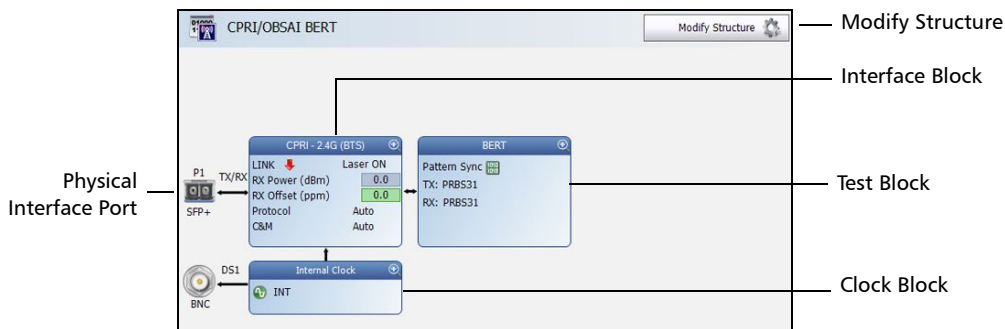
- 3d.** Tap the test block to configure the specific test settings (refer to page 129).
- 3e.** Tap the clock block to configure the clock synchronization (refer to *Clock* on page 125).
- 4.** Tap the **Timer** tab to automatically start and/or stop the test at a given time or for a specific duration (refer to *Timer* on page 279).
- 5.** Tap the **Start** button from the right navigation bar to start the test (refer to *Start/Stop | TX Button* on page 558). The **Summary** result page will be automatically displayed when the test is started from any **Setup** configuration page. For additional results refer to *Test Results* on page 287.
- 6.** When the test ends automatically or is manually stopped, the generate report pop-up is displayed by default. If required, tap **Yes** to generate a report of the test results and statistics (refer to *Report Button* on page 547 for more information).

## Selecting and Starting a Test

### Wireless Test Application

**To select, configure, and start a Wireless test:**

1. From the test menu, tap **Setup**.
2. From the **Test Applications** tab, under **Wireless**, tap the **CPRI/OBSAI BERT** test icon.
3. From the **Test Configurator** tab configure the interface structure and its parameters.



- 3a. Tap the **Modify Structure** button to set the basic structure of the test such as the interface/rate, connector, etc. (refer to *Modify Structure Button* on page 97).
- 3b. Tap the interface block to configure the interface parameters (refer to page 149). Ensure that the power level is present in the status bar before proceeding to the next step (refer to *Status Bar* on page 28).

- 3c.** Tap the test block to configure the specific test settings (refer to page 129).
- 3d.** For **Framed L2** in **Base Station** emulation mode, tap the clock block to configure the clock synchronization (refer to *Clock* on page 125). The clock is automatically set to **Recovered** for **Remote Radio Head** emulation mode.

**Note:** For *Unframed*, the clock is set to **Internal**.

- 4.** Refer to *Test Functions* on page 455 for additional test configurations.
- 5.** Tap the **Timer** tab to automatically start and/or stop the test at a given time or for a specific duration (refer to *Timer* on page 279).
- 6.** Tap the **Start** button from the right navigation bar to start the test (refer to *Start/Stop | TX Button* on page 558). The **Summary** result page will be automatically displayed when the test is started from any **Setup** configuration page. For additional results refer to *Test Results* on page 287.
- 7.** When the test ends automatically or is manually stopped, the generate report pop-up is displayed by default. If required, tap **Yes** to generate a report of the test results and statistics (refer to *Report Button* on page 547 for more information).



## 8 ***Test Setup - Test Configurator, Timer, and System***

The **Setup** menu offers the following structure:

➤ **Test Configurator** for **Intelligent Apps** test application.

| Block   | Subtab or Pop Up | Test Application<br>iSAM | Page |
|---------|------------------|--------------------------|------|
| Local   | Interface        | X                        | 158  |
|         | SFP/SFP+         | X                        | 240  |
| Network | Network Details  | X                        | 191  |
| Remote  | Remote Details   | X                        | 202  |

## Test Setup - Test Configurator, Timer, and System

➤ **Test Configurator** for **Transport** test applications.

| Block     | Subtab or Pop Up           | Test Application |     |   |     |   |   | Page |
|-----------|----------------------------|------------------|-----|---|-----|---|---|------|
|           |                            | a                | b   | c | d   | e | f |      |
| Button    | Modify Structure           | X                | X   | X | X   | X | X | 97   |
|           | Signal Auto-Detect         | -                | -   | X | -   | X | X | 111  |
| Interface | FTFL/PT                    | X                | -   | - | -   | - | - | 146  |
|           | Labels                     | -                | X   | - | X   | - | - | 169  |
|           | SFP/SFP+                   | X                | X   | - | X   | - | - | 240  |
|           | Signal                     | X                | X   | X | X   | X | X | 241  |
|           | Traces                     | 281              | 284 | - | 284 | - | - | <--- |
| Protocol  | Signal                     | -                | -   | - | X   | - | - | 247  |
| Test      | BERT                       | X                | X   | X | X   | - | - | 117  |
|           | ISDN PRI - Call Management | -                | -   | - | -   | - | X | 162  |
|           | ISDN PRI - ISDN Settings   | -                | -   | - | -   | - | X | 167  |
| Clock     | Clock                      | X                | X   | X | X   | X | X | 125  |

- a. OTN BERT
- b. SONET/SDH BERT
- c. DS<sub>n</sub>/PDH BERT
- d. SONET/SDH - DS<sub>n</sub>/PDH BERT
- e. NI/CSU Emulation
- f. ISDN PRI

➤ **Test Configurator** for **Ethernet** test applications.

| Block     | Subtab or Pop Up            | Test Application |   |   |   |   |   |   |   |   |   | Page |
|-----------|-----------------------------|------------------|---|---|---|---|---|---|---|---|---|------|
|           |                             | a                | b | c | d | e | f | g | h | i | j |      |
| Button    | Modify Structure            | X                | X | X | X | X | X | X | X | X | X | 97   |
| Interface | Interface                   | X                | X | X | X | X | X | X | X | X | X | 149  |
|           | Network                     | X                | X | X | X | X | X | X | X | X | X | 185  |
|           | SFP+                        | X                | X | X | X | X | X | X | X | X | - | 240  |
| Protocol  | MAC/IP/UDP                  | X                | - | X | X | X | - | - | - | - | - | 172  |
|           | Services - Global           | X                | - | - | - | - | - | - | - | - | - | 230  |
|           | Services - Profile          | X                | - | - | - | - | - | - | - | - | - | 233  |
|           | Streams - Global            | -                | - | - | - | X | - | - | - | - | - | 264  |
|           | Streams - Profile           | -                | - | - | - | X | - | - | - | - | - | 266  |
| Test      | Cable Test                  | -                | - | - | - | - | - | - | - | - | X | 123  |
|           | EtherBERT and Unframed BERT | -                | - | - | X | - | - | - | - | - | - | 129  |
|           | EtherSAM - Burst            | X                | - | - | - | - | - | - | - | - | - | 135  |
|           | EtherSAM - Global           | X                | - | - | - | - | - | - | - | - | - | 137  |
|           | EtherSAM - Ramp             | X                | - | - | - | - | - | - | - | - | - | 141  |
|           | Link OAM                    | -                | - | - | - | - | - | - | - | X | - | 170  |
|           | RFC 2544 - Global           | -                | - | X | - | - | - | - | - | - | - | 206  |
|           | RFC 2544 - Subtests         | -                | - | X | - | - | - | - | - | - | - | 209  |
|           | RFC 6349                    | -                | X | - | - | - | - | - | - | - | - | 217  |
|           | S-OAM / MPLS-TP OAM         | -                | - | - | - | - | - | - | - | X | - | 220  |
|           | Smart Loopback              | -                | - | - | - | - | X | - | - | - | - | 262  |
|           | TCP Throughput              | -                | - | - | - | - | - | - | X | - | - | 277  |
| Clock     | Clock                       | X                | - | X | X | X | X | - | X | X | - | 125  |

- a. EtherSAM
- b. RFC 6349
- c. RFC 2544
- d. EtherBERT
- e. Traffic Gen & Mon
- f. Smart Loopback
- g. Through Mode
- h. TCP Throughput
- i. Carrier Ethernet OAM
- j. Cable Test

## Test Setup - Test Configurator, Timer, and System

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### ➤ Test Configurator for Packet Sync test applications.

| Block     | Subtab or Pop Up | Test Application |       | Page |
|-----------|------------------|------------------|-------|------|
|           |                  | 1588 PTP         | SyncE |      |
| Button    | Modify Structure | X                | X     | 97   |
| Interface | Interface        | X                | X     | 149  |
|           | Network          | X                | X     | 185  |
|           | SFP/SFP+         | X                | X     | 240  |
| Test      | 1588 PTP         | X                | -     | 112  |
|           | SyncE            | -                | X     | 274  |

### ➤ Test Configurator for Fibre Channel test application.

| Block     | Subtab or Pop Up | Test Application<br>FC BERT | Page |
|-----------|------------------|-----------------------------|------|
| Button    | Modify Structure | X                           | 97   |
| Interface | Interface        | X                           | 149  |
|           | SFP/SFP+         | X                           | 240  |
| Protocol  | Fibre Channel    | X                           | 143  |
| Test      | FC BERT          | X                           | 129  |

- **Test Configurator** for **Wireless** test application.

| Block     | Subtab or Pop Up          | Test Application<br>CPRI/OBSAI BERT | Page |
|-----------|---------------------------|-------------------------------------|------|
| Button    | Modify Structure          | X                                   | 97   |
| Interface | Interface                 | X                                   | 149  |
|           | SFP/SFP+                  | X                                   | 240  |
| Test      | BERT and<br>Unframed BERT | X                                   | 129  |

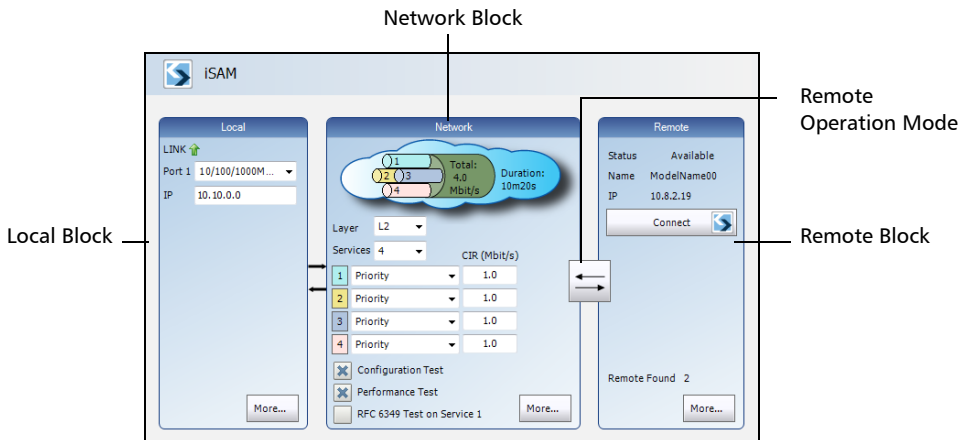
- **Timer**, see page 279.
- **System**, see page 276.

## Test Configurator Overview

The **Test Configurator** tab displays the interconnected blocks composing the test structure. Each block of the test structure gives an overview of its configuration/status. Availability of each block depends on the selected test application and its structure. Arrows are used to indicate the interconnection between blocks as well as the direction of the clock and data flow. Tap on a block to change the configuration parameters of this block.

From the **Test** menu, tap **Setup**, and the **Test Configurator** tab.

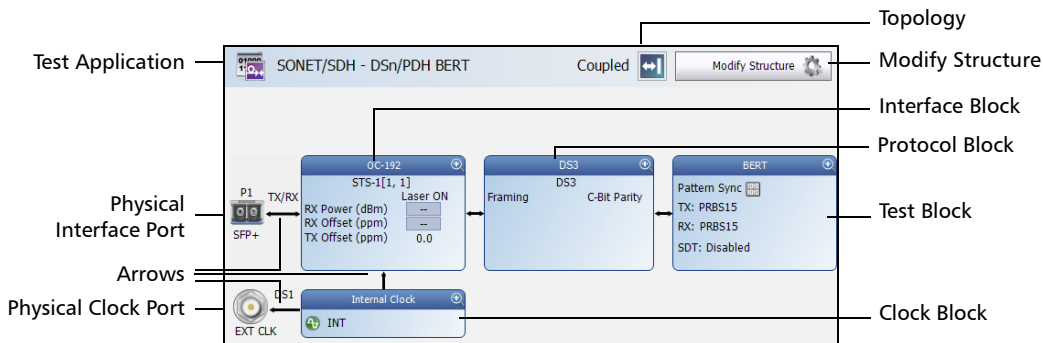
- Intelligent Apps:



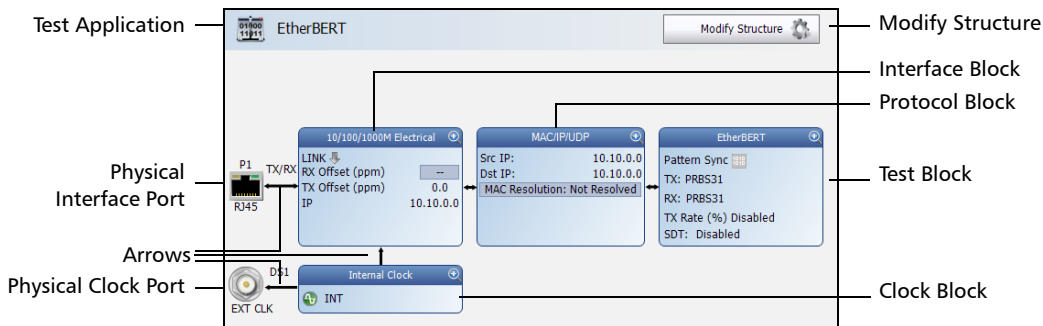
The block arrangement represents the network under test. From any block, either select the basic parameters or click on **More** for all settings.

- **Local** block displays and allows to change basic interface settings. Tap on the **More** button to access all settings.
- **Network** block displays and allows to change basic test settings. Tap on the **More** button to access all settings.

- Remote operation mode allows to select the remote operation mode. Tap on the button to change the remote operation mode.
- **Remote** block displays and allows to change basic remote settings. Tap on the **More** button to access all settings.
- Transport Test Applications:



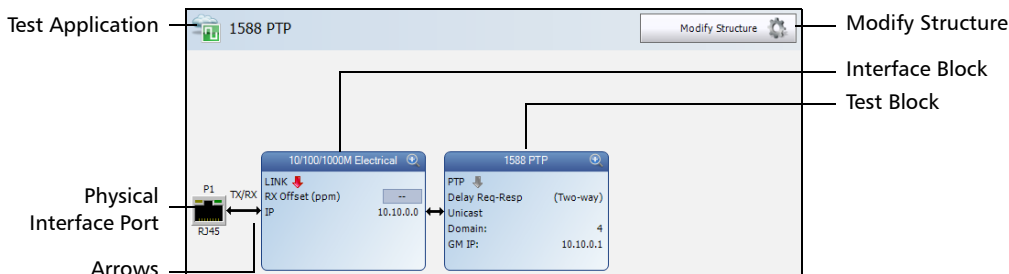
- Ethernet Test Applications:



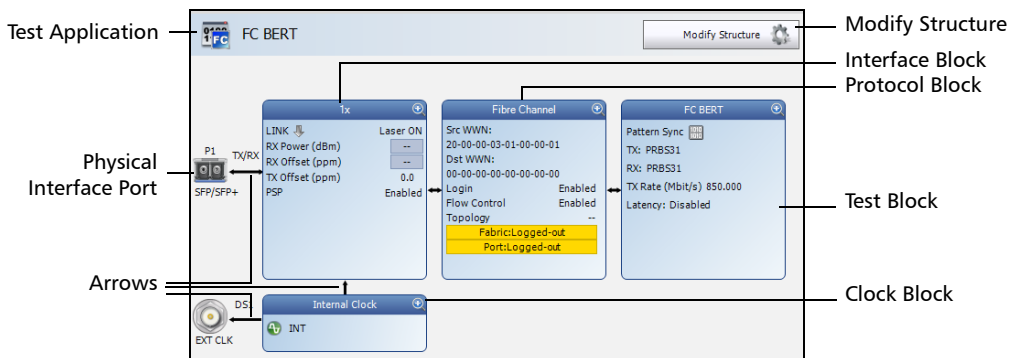
## Test Setup - Test Configurator, Timer, and System

### Test Configurator Overview

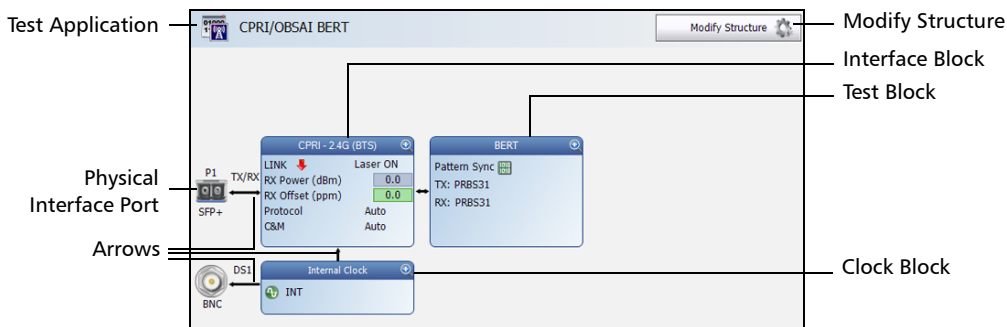
#### ➤ Packet Sync Test Applications:



#### ➤ Fibre Channel Test Application:



#### ➤ Wireless Test Application:



- Test Application indicates the selected test application.
  - Topology, for Transport Test Applications, indicates the selected test topology.
  - Modify Structure button, allows the configuration of the physical port and the signal interface structure.
  - Physical Interface Port indicates the physical interface port.
  - Arrows are used to indicate the interconnection between blocks as well as the direction of the clock and data flow.

A line with an arrow on both ends indicates a bidirectional communication (TX/RX).

A line with a single arrow indicates a unidirectional communication, either **TX** when going out of a block or **RX** when going into a block.

A line going out of a block returning back to the same block, indicates a loopback communication.

- Physical Clock Port indicates the direction, TX or RX, of the selected clock. The arrow next to the physical clock image indicates if a clock is generated (TX, arrow pointing to the left) or received (RX, arrow pointing to the right) at/from the physical EXT CLK port.
- Interface Block displays an overview of the interface settings and status. Tap on the interface block to change the settings and to see detailed status.
- Protocol Block displays an overview of either the frame structure and its parameters for Ethernet test applications or the embedded signal for Transport test applications. This block is not present for all tests. Tap on the protocol block to change the settings and to see detailed status.

## Test Setup - Test Configurator, Timer, and System

### *Test Configurator Overview*

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- Test Block displays an overview of the test settings and status. Tap on the test block to change the settings and to see detailed status.
- Clock Block displays an overview of the clock settings and status. Tap on the clock area to change the settings and to see detailed status.

## Modify Structure Button

From the **Test** menu, tap **Setup**, **Test Configurator**, and the **Modify Structure** button.

### For Transport Test Applications

**TX/RX** allows the configuration of the following parameters for either TX/RX, TX1/RX1 and RX2, TX, or RX depending on the selected topology.

- **Interface/Rate:** Select the desired interface rate. Choices depend on the selected test and the rates available on the NetBlazer.

| Test  | Interface/Rate                                                                                                                                                                   |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OTN   | OTU2 [10.709 Gbit/s]<br>OTU1e [11.049 Gbit/s]<br>OTU2e [11.096 Gbit/s]<br>OTU1f [11.270 Gbit/s]<br>OTU2f [11.318 Gbit/s]<br>OTU1 [2.666 Gbit/s]                                  |
| SONET | OC-192 [9.953 Gbit/s]<br>OC-48 [2.488 Gbit/s]<br>OC-12 [622.08 Mbit/s]<br>OC-3 [155.520 Mbit/s]<br>OC-1 [51.840 Mbit/s]<br>STS-3e [155.520 Mbit/s]<br>STS-1e [51.840 Mbit/s]     |
| SDH   | STM-64 [9.953 Gbit/s]<br>STM-16 [2.488 Gbit/s]<br>STM-4 [622.080 Mbit/s]<br>STM-1 [155.520 Mbit/s]<br>STM-0 [51.840 Mbit/s]<br>STM-1e [155.520 Mbit/s]<br>STM-0e [51.840 Mbit/s] |
| DSn   | DS1 [1.544 Mbit/s]<br>DS3 [44.736 Mbit/s]                                                                                                                                        |
| PDH   | E1 [2.048 Mbit/s]<br>E3 [34.368 Mbit/s]<br>E4 [139.264 Mbit/s]                                                                                                                   |

## Test Setup - Test Configurator, Timer, and System

*Modify Structure Button*

| Test             | Interface/Rate                          |
|------------------|-----------------------------------------|
| NI/CSU Emulation | DS1                                     |
| ISDN PRI         | DS1 [1.544 Mbit/s]<br>E1 [2.048 Mbit/s] |

- **Connector** allows the selection of the NetBlazer's port.

| Interface/Rate                                                                                                                                                                                                              | Connector                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| OTU2 [10.709 Gbit/s]<br>OTU1e [11.049 Gbit/s]<br>OTU2e [11.096 Gbit/s]<br>OTU1f [11.270 Gbit/s]<br>OTU2f [11.318 Gbit/s]<br>OC-192 [9.953 Gbit/s]<br>STM-64 [9.953 Gbit/s]                                                  | Port 1 - SFP+                                     |
| OTU1 [2.666 Gbit/s]<br>OC-48 [2.488 Gbit/s]<br>OC-12 [622.08 Mbit/s]<br>OC-3 [155.520 Mbit/s]<br>OC-1 [51.840 Mbit/s]<br>STM-16 [2.488 Gbit/s]<br>STM-4 [622.080 Mbit/s]<br>STM-1 [155.520 Mbit/s]<br>STM-0 [51.840 Mbit/s] | Port 1 - SFP                                      |
| STS-3e [155.520 Mbit/s]<br>STS-1e [51.840 Mbit/s]<br>STM-1e [155.520 Mbit/s]<br>STM-0e [51.840 Mbit/s]                                                                                                                      | Port 1 - BNC                                      |
| DS1 [1.544 Mbit/s]                                                                                                                                                                                                          | Port 1 - Bantam<br>Port 1 - RJ48C                 |
| E1 [2.048 Mbit/s]                                                                                                                                                                                                           | Port 1 - Bantam<br>Port 1 - BNC<br>Port 1 - RJ48C |
| DS3 [44.736 Mbit/s]<br>E3 [34.368 Mbit/s]<br>E4 [139.264 Mbit/s]                                                                                                                                                            | Port 1 - BNC                                      |

- **Framing:** For OTN BERT, and SONET/SDH BERT test applications, the framing is set to **Framed**.
- **OTN Multiplexing**, only available with OTN BERT, indicates the OTN test mapping.

| Interface/Rate        | OTN Multiplexing |
|-----------------------|------------------|
| OTU1 [2.666 Gbit/s]   | ODU1             |
| OTU2 [10.709 Gbit/s]  | ODU2             |
| OTU1e [11.049 Gbit/s] | ODU1e            |
| OTU2e [11.096 Gbit/s] | ODU2e            |
| OTU1f [11.270 Gbit/s] | ODU1f            |
| OTU2f [11.318 Gbit/s] | ODU2f            |

## Test Setup - Test Configurator, Timer, and System

*Modify Structure Button*

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- **SONET/SDH Multiplexing** allows the selection of SONET/SDH multiplexing. Only available with SONET/SDH BERT test application.

| Embedded SONET/SDH | SONET/SDH Multiplexing                                                                             |
|--------------------|----------------------------------------------------------------------------------------------------|
| OC-192             | STS-192c, STS-48c, STS-12c, STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5                                  |
| STM-64             | AU-4-64c, AU-4-16c, AU-4-4c, AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11 |
| OC-48              | STS-48c, STS-12c, STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5                                            |
| STM-16             | AU-4-16c, AU-4-4c, AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11           |
| OC-12              | STS-12c, STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5                                                     |
| STM-4              | AU-4-4c, AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11                     |
| OC-3               | STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5                                                              |
| STM-1              | AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11                              |
| OC-1               | STS-1, STS-1/VT2, STS-1/VT1.5                                                                      |
| STS-3e             | STS-3c, STS-1, STS-1/VT2, STS-1/VT1.5                                                              |
| STS-1e             | STS-1, STS-1/VT2, STS-1/VT1.5                                                                      |
| STM-0              | AU-3, AU-3/TU-12, AU-3/TU-11                                                                       |
| STM-1e             | AU-4, AU-4/TU-3, AU-4/TU-12, AU-4/TU-11, AU-3, AU-3/TU-12, AU-3/TU-11                              |
| STM-0e             | AU-3, AU-3/TU-12, AU-3/TU-11                                                                       |

- **DSn/PDH Multiplexing**, available with **SONET/SDH - DSn/PDH BERT** and **DSn/PDH** test application applications, allows the selection of the DSn/PDH multiplexing.

| Interface/Rate | DSn/PDH Multiplexing         |
|----------------|------------------------------|
| DS3            | None (default), DS1, E1      |
| DS1            | None                         |
| E4             | None (default), E3, E3/E2/E1 |
| E3             | None (default), E2/E1        |
| E1             | None                         |

- **Client** is set to **Pattern**.
- **Switch Type**<sup>1</sup> allows the selection of the **Switch Type** for ISDN DS1 and E1 rates. The switch type in brackets indicates the switch type in abbreviated format.
  - **DS1: National ISDN (NI-4)** - (default), **National ISDN (NI-3)**, **National ISDN (NI-2)**, **National ISDN (NI-1)**, **AT&T 4ESS**, **AT&T 5ESS**, and **Nortel DMS-100/250**.
  - **E1: Euro ISDN** (default), **Euro Q.SIG**, and **Euro VN6**.
- **Emulation Mode**<sup>1</sup>: **TE** (Terminal Equipment) - (default), and **NT** (Network Termination).

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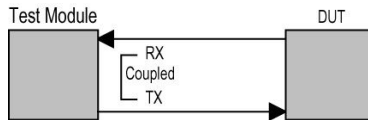
1. Only available with ISDN PRI test application.

## Test Setup - Test Configurator, Timer, and System

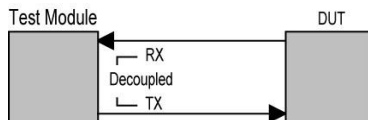
### Modify Structure Button

---

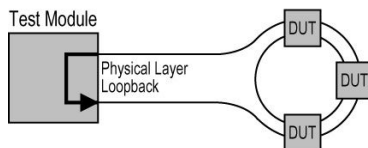
- **Topology** allows the selection of the network test topology.
- **Coupled (TX=RX)** uses the same settings for both the TX and RX signals.



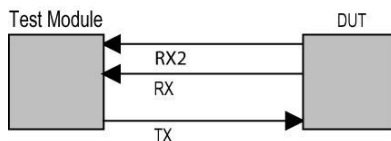
- **Decoupled (TX≠RX)** uses independent settings for TX and RX signals. However, the pattern and some other parameters are always coupled. **Decoupled** is not supported with **OTN BERT** test application.



- **Through** loops the RX signal to the TX port without TX overwrite capabilities.



- **Dual RX** uses two DS1 or DS3 signals at the same time. Both RX ports are coupled at the exception of the termination mode. Only available with DS1 and DS3 signal rates.



## For Ethernet Test Applications

- **Interface/Rate** choices depend on the selected test and the rates available on the NetBlazer.

| Test                                                                                                         | Interface/Rate                                                                              |
|--------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| EtherSAM<br>RFC 2544<br>RFC 6349<br>EtherBERT<br>Traffic Gen & Mon<br>Smart Loopback<br>Carrier Ethernet OAM | 10GE WAN <sup>a</sup><br>10GE LAN<br>1GE Optical<br>100M Optical<br>10/100/1000M Electrical |
| Through Mode                                                                                                 | 1GE Optical<br>100M Optical                                                                 |
| TCP Throughput                                                                                               | 1GE Optical<br>100M Optical<br>10/100/1000M Electrical                                      |
| Cable Test                                                                                                   | 10/100/1000M Electrical                                                                     |

- a. Not available with RFC 6349 test application.

# Test Setup - Test Configurator, Timer, and System

Modify Structure Button

- **Primary Port / Secondary Port**, available with Through Mode test application, allows to select the NetBlazer’s ports that are respectively used as primary (Port 1) and secondary (Port 2) port. The configuration of the network configuration parameters will be available on the Primary Port only.
- **Connector** allows the selection of the NetBlazer’s port.

| Interface/Rate              | Connector                      |
|-----------------------------|--------------------------------|
| 10GE WAN<br>10GE LAN        | Port 1 - SFP+                  |
| 1GE Optical<br>100M Optical | Port 1 - SFP<br>Port 2 - SFP   |
| 10/100/1000M Electrical     | Port 1 - RJ45<br>Port 2 - RJ45 |

- **Framing**, available for EtherBERT test application, allows the selection of the test framing type; otherwise the framing is set to Framed Layer 2. See *Network* on page 185 for more information on frame format.
- **Framed Layer 1**: Frame of x bytes that allows connection to any interface that complies with 802.3 Ethernet PHY or DWDM fibre. Available with rate up to 10G WAN.

|                        |                       |                 |                                              |
|------------------------|-----------------------|-----------------|----------------------------------------------|
| IFG<br>(Min. 12 bytes) | Preamble<br>(7 bytes) | SFD<br>(1 byte) | Test Pattern<br>(Length: 48 to 10/16 Kbytes) |
|------------------------|-----------------------|-----------------|----------------------------------------------|

- **Framed Layer 2**: Frames of x<sup>1</sup> bytes without network layer (**None**) that complies with IEEE 802a Ethernet II standard.

|     |                        |                   |      |                                       |     |     |
|-----|------------------------|-------------------|------|---------------------------------------|-----|-----|
| SOF | Destination<br>Address | Source<br>Address | Type | Test Pattern<br>(Configurable length) | FCS | IFG |
|-----|------------------------|-------------------|------|---------------------------------------|-----|-----|

- **Framed Layer 3/4** (default): Frames of x<sup>1</sup> bytes with UDP (default) or TCP network layer that complies with IEEE 802a Ethernet II standard.

|     |                     |                |      |           |            |          |                                    |                        |     |     |
|-----|---------------------|----------------|------|-----------|------------|----------|------------------------------------|------------------------|-----|-----|
| SOF | Destination Address | Source Address | Type | IP Header | UDP Header | BERT Tag | Test Pattern (Configurable length) | FCS                    | IFG |     |
| SOF | Destination Address | Source Address | Type | IP Header | TCP Header | BERT Tag | Test Pattern (Configurable length) | TCP Checksum Canceller | FCS | IFG |

1. To set the frame length, see Frame Size on page 134 for EtherBERT, and page 207 for RFC 2544.

Test Setup - Test Configurator, Timer, and System

Modify Structure Button

- **Unframed (Interop)** is only available with optical interface up to 10G LAN:

For **Seed A** and **Seed B**, only available for 10G LAN, the pattern is generated by the PCS scrambler from a specific seed. The pattern is not encoded.

For **PRBS31 Unscrambled**, only available for 10G LAN, the pattern is generated at the PCS layer. The pattern is not encoded and not scrambled.

For **PRBS** and **User Pattern**: Pattern generated by the PCS scrambler. The pattern is encoded.

|                        |                       |                 |                                    |
|------------------------|-----------------------|-----------------|------------------------------------|
| IFG<br>(Min. 12 bytes) | Preamble<br>(7 bytes) | SFD<br>(1 byte) | Test Pattern<br>(Length: infinite) |
|------------------------|-----------------------|-----------------|------------------------------------|

- **Unframed** is only available with optical interface up to 10G LAN:  
Encoded pattern generated by the PCS scrambler.

|                        |                       |                 |                                    |
|------------------------|-----------------------|-----------------|------------------------------------|
| IFG<br>(Min. 12 bytes) | Preamble<br>(7 bytes) | SFD<br>(1 byte) | Test Pattern<br>(Length: infinite) |
|------------------------|-----------------------|-----------------|------------------------------------|

- **Unframed with Sync** is only available with optical interface up to 10G LAN: Pattern of a length corresponding to the number of bytes transmitted in 1 second.

|                        |                       |                 |                                          |
|------------------------|-----------------------|-----------------|------------------------------------------|
| IFG<br>(Min. 12 bytes) | Preamble<br>(7 bytes) | SFD<br>(1 byte) | Test Pattern<br>(Length: about 1 second) |
|------------------------|-----------------------|-----------------|------------------------------------------|

### ➤ Loopback Mode

**Note:** Only available for Smart Loopback Ethernet test application.

**Transparent (Pseudo-Physical)** check box when selected (cleared by default), determines that the Smart Loopback operates as a physical loopback by transmitting all received frames unaltered and without discrimination. When the check box is cleared, the Loopback mode is selectable from *Loopback* on page 262.

In transparent mode, the **Network** tab and the **Ping & Trace Route** functions are not available.

**Note:** The **Transparent** mode is intended to be used for point-to-point topology; not for switched or routed networks. Use the **Transparent** mode with caution because all received frames are looped back without discrimination.

### ➤ OAM Type

**Note:** Only available for Carrier Ethernet OAM test application.

Selects the type of Carrier OAM network: **Ethernet OAM** (S-OAM; default), **MPLS-TP OAM**, or **Link OAM**.

➤ **S-OAM** check box when selected, enables S-OAM on all services.

### For Packet Sync Test Applications

- **Interface/Rate:** Select the desired interface rate. Choices depend on the selected test and the rates available on the NetBlazer.

| Test              | Interface/Rate                                                                  |
|-------------------|---------------------------------------------------------------------------------|
| 1588 PTP<br>SyncE | 10GE LAN<br>1GE Optical<br>100M Optical<br>10/100/1000M Electrical <sup>a</sup> |

- a. The 10M rate is not available for SyncE test application.

- **Connector:** Allows the selection of the NetBlazer's port available for the selected interface/rate.

| Interface/Rate              | Connector                      |
|-----------------------------|--------------------------------|
| 10GE LAN                    | Port 1 - SFP+                  |
| 1GE Optical<br>100M Optical | Port 1 - SFP<br>Port 2 - SFP   |
| 10/100/1000M Electrical     | Port 1 - RJ45<br>Port 2 - RJ45 |

## For Fibre Channel Test Application

- **Interface/Rate:** Select the desired interface rate. Choices depend on the rates available on the NetBlazer.

| Interface/Rate | Model                                                                                  |
|----------------|----------------------------------------------------------------------------------------|
| 1X<br>2X<br>4X | FTB-860, FTB-860G,<br>FTB-720G, FTB-720G+,<br>FTB-730G, FTB-730G+,<br>FTB-870, FTB-880 |
| 8X<br>10X      | FTB-860G,<br>FTB-720G+, FTB-730G+,<br>FTB-870, FTB-880                                 |

- **Connector:** Allows the selection of the NetBlazer's port available for the selected interface/rate.

| Interface/Rate | Connector                    |
|----------------|------------------------------|
| 1X<br>2X<br>4X | Port 1 - SFP<br>Port 2 - SFP |
| 8X<br>10X      | Port 1 - SFP+                |

### For Wireless Test Application

- **Interface/Rate** allows the selection of the interface rate.

| Interface Rate                                                                          | Connector                    |
|-----------------------------------------------------------------------------------------|------------------------------|
| CPRI - 1.2G<br>CPRI - 2.4G<br>CPRI - 3.1G<br>OBSAI - 3.1G<br>CPRI - 4.9G<br>CPRI - 6.1G | Port 1 - SFP<br>Port 2 - SFP |
| CPRI - 9.8G                                                                             | Port 1 - SFP+                |

- **Connector** is the NetBlazer's port available for the selected interface/rate (see table above).
- **Framing**
  - **Framed L2** (default) is mainly used to validate connectivity with the base station (REC) or remote radio head (RE) over the fiber interface.
  - **Unframed** is mainly used to validate the continuity of the dark fiber at CPRI or OBSAI rate.
- **Emulation Mode**, available with **Framed L2**, determine the CPRI Start-Up Sequence operation and synchronization operation.
  - **Base Station** (default) is used to validate the connectivity with the RRH. It initiates the start-up sequence and provides synchronization to the RRH.
  - **Remote Radio Head** is used to validate the communication with a base station. It begins its start-up sequence when it detects a valid signal from the base station.

## Signal Auto-Detect

The Signal Auto-Detect allows the detection of the DS1/DS3 interface **Line Coding** (DS1), **Framing**, and **Test Pattern**.

**Signal Auto-Detect** is only available:

- with DS1 and DS3 interfaces.
- when the test is stopped.
- when Loopback is not activated for NI/CSU Emulation test.

**Note:** *Test Pattern is not detected with NI/CSU Emulation and ISDN PRI test applications.*

During the detection process, the following messages may be displayed: **Detecting**, **Successful**, and/or **Failed**.

When the auto-detection is successful, the detected parameters are automatically applied as the test interface configuration.

Upon detection of specific alarms, the detection may not be possible, tap **Retry** to invoke the detection again.

### 1588 PTP

From the **Test** menu, tap **Setup, Test Configurator**, and the 1588 PTP test block.

#### PTP

- **Profile** is not configurable and is set to **ITU G.8265.1**, also called Telecom Profile, which is for frequency synchronization.
- **Mode** is not configurable and is set to **Unicast** which implies a dedicated communication link between the master and the slave clock.
- **Framing** is not selectable and is set to **UDP/IPv4**.
- **Domain** is the PTP domain parameter used by the 1588 PTP function to communicate with the Grand Master clock: **4** (default) to **23**.
- **GM IP Address** is the IP address of the Grand Master Clock used by the 1588 PTP function to communicate with it.
- **Quick Ping** button allows to test if the Grand Master IP address can be reached. A message is returned indicating if the ping attempt was **Successful** or **Failed**.
- **IP TOS/DS** allows to enter the Type of Service: **0x00** (default) to **0xFF**.
- **Mechanism** is not selectable and is set to **Delay Req-Resp** (Delay Request-Response) which specifies the mechanism used by the 1588 PTP function to communicate with the Grand Master clock. Refer to *Delay Request-Response* on page 596 for more information.
- **Delay Mode** is not selectable and is set to **Two-way** which uses Sync/Follow Up, Delay Request, and Delay Response messages.
- **Connect** button is used to initiate the Grand Master Connection process. This process is also automatically initiated when starting the test if not already initiated. The process automatically ends when stopping the test.

- **Negotiation Status** is displayed during the Unicast negotiation process which is initiated when either the test is started or the **Connect** button is activated. See *Negotiation Status* on page 398 for more information.
- **Message Rate**
  - **Announce** determines the transmission interval of the Announce messages: **1 message/2s** (default), **1 message/s**, or **8 message/s**.
  - **Sync** determines the transmission interval of the Sync messages: **32** (default), **64**, or **128 message/s**.
  - **Delay-Request** determines the transmission interval of the Delay Request messages: **1, 2, 4, 8, 16, 32** (default), **64**, or **128 message/s**. The **Delay-Request** message rate is limited by the Sync rate selection; the Delay-Request message rate is automatically updated to be smaller than or equal to the **Sync** message rate.
- **Service Duration**
  - **Lease Duration** is not configurable and is set to **300** seconds which determines the Lease Duration used between the 1588 PTP function and the Grand Master clock.
  - **Renewal Interval** is not configurable and is set to **150** seconds which determines the interval used by the 1588 PTP function to initiate the renewal of its lease with the Grand Master clock.

### ➤ GM Info

**Note:** Only available when Grand Master clock information is available.

The Grand Master Information window displays the decoded clock information.

- **Identity** report the 8-byte identification code of the Grand Master Clock.
- **Clock Class** reports the description and code of the Grand Master Clock Class.

| Code                                                                                 | Description                            |
|--------------------------------------------------------------------------------------|----------------------------------------|
| 0-5, 8-12, 15-51, 53-57, 59-67, 123-132, 171-186, 188-192, 194-215, 233-247, 249-254 | Reserved                               |
| 6                                                                                    | Sync to primary reference              |
| 7, 14                                                                                | Holdover                               |
| 13                                                                                   | Sync to application-specific reference |
| 52, 58, 187, 193                                                                     | Degraded                               |
| 68 to 79, 81-109 (odd values), 11-122, 133-170, 216-232                              | Alternate PTP profiles                 |
| 80-110 (even values) <sup>a</sup>                                                    | Quality Level (QL-xxx <sup>a</sup> )   |
| 248                                                                                  | Default                                |
| 255                                                                                  | Slave only                             |

a. Refer to QL table on page 374 for the list of Quality Level values that will be used as the description.

- **Clock Mode** reports the description of the Grand Master Clock Mode: **Two-step** or **One-step**.

## PTSF Alarm Timeout/Threshold

**Note:** *The following parameters are also used to declared the Pass/Fail verdict.*

- **Receipt Timeout** defines the threshold used to declare a **Loss Announce** or **Loss Sync** message alarm: **2** to **255** messages (default is **3** messages). A message is considered lost if not received within its expected arrival time and a loss alarm is declared when the number of consecutive lost messages is greater than or equal to the defined **Receipt Timeout**.
- **IPDV Threshold** defines the inter packet delay variation threshold used to raise the **Unusable** message alarm. The alarm is raised when IPDV is not within the configured **IPDV Threshold: 0.001** to **1000ms** (default is **2ms**). The minimum value of 0.001 is adjusted when the **Sync** or **Delay Req** is set to 4 messages/s or less.

## Quality Level

The quality level characterizes the clock quality in terms of network synchronization.

- **QL Mismatch Monitoring** when selected (default) enables the Quality Level mismatch monitoring.
- **Expected QL** allows, when **QL Mismatch Monitoring** check box is selected, the selection of the Expected Quality Level value: **QL-PRS** by default. Refer to page 374 for more information.

### Pass/Fail Verdict

**Pass/Fail Verdict** check box when selected (default) enables the use of the pass/fail verdict. The global pass/fail verdict is based on the following criteria: alarms (**Link Down**, **Loss Sync**, **Loss Announce**, **Unusable**, and/or **QL Mismatch** (when **QL Mismatch Monitoring** is enabled)), or the test is automatically aborted (service request denied, session canceled, or no reply).

### Restore 1588 PTP Defaults

Reverts the 1588 PTP test application to its default factory settings.

## BERT

From the **Test** menu, tap **Setup**, **Test Configurator**, and tap on the **BERT** block.

### Pattern

The icon next to the **Pattern** label indicates the status of the received pattern signal. Refer to *Status Bar* on page 28 for more information.

- **Coupled RX to TX** check box, when selected (default), allows coupling both the TX and RX signal with the same test pattern.

For a framed test, the **Coupled RX to TX** check box is selected and cannot be cleared.

- **No Pattern Analysis (Live)** check box when cleared (default), monitors the received traffic pattern. For live traffic, the **No Pattern Analysis (Live)** check box should be selected as the traffic is a live pattern thus there is no analysis of pattern loss, bit error, and no traffic indications. Only available with a framed test.

## Test Setup - Test Configurator, Timer, and System

BERT

- **TX Pattern/RX Pattern** sets respectively the TX and RX test pattern.

| Pattern                                               | DS0, E0        | DS1            | DS3, E1        | E3, E4         | SONET/SDH      | OTN            |
|-------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 0000<br>1010<br>1100<br>1111<br>1in8<br>1in16<br>2in8 | X              | X              | X              | X              | X              | -              |
| 3in24                                                 | X              | X              | X              | X (E3 only)    | -              | -              |
| T1 DALY<br>55 OCTET<br>Multi-Pattern                  | -              | X              | -              | -              | -              | -              |
| PRBS9                                                 | X              | X              | X              | X              | X              | X              |
| PRBS11                                                | X <sup>a</sup> | X              | X              | X              | X              |                |
| PRBS15                                                | -              | X              | X <sup>a</sup> | X              | X <sup>b</sup> | X              |
| PRBS20<br>User Pattern                                | X              | X              | X              | X              | X              | X              |
| PRBS23                                                | -              | X              | X              | X <sup>a</sup> | X <sup>c</sup> | X              |
| PRBS31                                                | -              | X              | X              | X              | X <sup>d</sup> | X <sup>a</sup> |
| QRSS                                                  | -              | X <sup>a</sup> | -              | -              | -              | -              |
| Null Client                                           | -              | -              | -              | -              | -              | X              |

- a. Default value.  
b. Default value for VT1.5/TU-11/TU-12.  
c. Default value for HOP and all other SONET/SDH concatenations from STS-1/AU-3/AU-4/TU-3 up to STS-48c/AU-4-16c.  
d. Default value for STS-192c/AU-4-64c.

For Multi-Pattern, see *Multi-Pattern Configuration* on page 122.

When **User Pattern** is selected, enter the payload pattern hexadecimal value.

- **Invert** check box, when selected (cleared by default), inverts the test pattern meaning that every 0 will be changed for 1 and every 1 for 0. For example, the pattern 1100 will be sent as 0011. Not available when pattern is Multi-Pattern.

### Bit Error

- **Pass/Fail Verdict** allows to enable bit-error-rate pass/fail verdict by selecting either **Bit Error Count** or **Bit Error Rate**. The default value is **Disabled**.
- **BER Threshold** allows to enter the threshold **Count** or **Rate** value that will be used to declare the pass/fail verdict. The **BER Threshold** applies to individual pattern for **Multi-Pattern**.

For **Count**, enter the maximum bit error count allowed before declaring a fail verdict: **0** (default) to **999999**.

For **Rate**, enter the maximum bit error rate allowed before declaring a fail verdict: **1.0E-14** to **1.9E-01**. The default value is **1.0E-12**.

### Service Disruption

The Service Disruption Time (SDT) corresponds to the duration associated to a defect that occurred in the network. For example a disruption that occurs during a network switching from the active channels to the backup channels or vice versa.

**Note:** *The service disruption measurements are cleared when changing the criteria. Service Disruption is not available for **Multi-Pattern**.*

- **Defect** allows to choose on which layer and defect the service disruption time test will be performed. Choices depend on the selected test path.

| Layer       | Signal                  | Defect                                                                        |
|-------------|-------------------------|-------------------------------------------------------------------------------|
| Interface   | OTN/SONET/SDH           | LOS                                                                           |
|             | DSn                     | LOS, BPV, EXZ                                                                 |
|             | PDH                     | LOS, CV                                                                       |
| OTUk        | OTN                     | AIS, BDI, BEI, BIAE, BIP-8, IAE, LOF, LOM                                     |
| ODUk        | OTN                     | AIS, OCI, LCK, BDI, BIP-8, BEI                                                |
| OPUk        | OTN                     | AIS, CSF                                                                      |
| Section/RS  | SONET/SDH               | LOF-S/ RS-LOF, B1                                                             |
| Line/MS     | SONET/SDH               | AIS-L/MS-AIS, RDI-L/MS-RDI, REI-L/MS-REI, B2                                  |
| STS/AU Path | SONET/SDH               | AIS-P/AU-AIS, LOP-P/AU-LOP, RDI-P/HP-RDI, REI-P/HP-REI, B3, UNEQ-P/HP-UNEQ    |
| VT/TU Path  | SONET/SDH               | AIS-V/TU-AIS, LOP-V/TU-LOP, RDI-V/TU-RDI, REI-V/LP-REI, BIP-2, UNEQ-V/LP-UNEQ |
| DS1         | DSn                     | AIS, OOF, RAI, Framing Bit, CRC-6                                             |
| DS3         | DSn                     | AIS, OOF, Idle, RDI, F-Bit, C-Bit, P-Bit, FEBE                                |
| E1          | PDH                     | AIS, CRC-4, E-Bit, LOMF, TS16 AIS, LOF, FAS, RAI, RAI MF                      |
| E4, E3, E2  | PDH                     | AIS, LOF, FAS, RAI                                                            |
| BER         | OTN, SONET/SDH, DSn/PDH | Pattern Loss, Bit Error                                                       |

**Note:** *The Service Disruption Time measurement supports a parent defect approach where the SDT measurement is triggered when the selected defect or a higher defect in the signal structure hierarchy is detected. For example, if Bit Error is selected, an OPU AIS error will trigger a SDT event.*

- **No Defect Time (ms)** represents the period without any defects before stopping SDT measurement: **0.005 ms** to **2000 ms** (default is **300 ms**).
- **Disruption Monitoring** check box when selected (disabled by default) enables the disruption time measurements. However, the measurement will only start if the test is already started, or when the test will be started.

**Note:** *Clearing the **Disruption Monitoring** check box will stop the measurement without clearing the results. The disruption monitoring is automatically stopped without clearing results when the test is stopped. However, starting the test again while the **Disruption Monitoring** check box is selected will reset the results before restarting.*

- **Pass/Fail Verdict** check box when selected (cleared by default) enables service disruption pass/fail verdict and allows to set the threshold value.
- **SDT Threshold (ms)** allows to enter the SDT threshold value that will be used to declare the pass/fail verdict: **0.001** to **299999.999 ms** (default is **50 ms**). For EtherBERT, the minimum value is adjusted with respect to the **No Traffic Time**.

## Multi-Pattern Configuration

**Note:** *Multi-Pattern Configuration is only available for **DSN/PDH BERT** test application with DS1 signal (DS0 disabled) and when the pattern is **Multi-Pattern**.*

This feature allows sending each pattern for a specific duration, sequentially and continuously.

- **Pattern** represents a sequence of patterns that will be generated: **1111**, **1in8**, **2in8**, **3in24**, and **QRSS**.
- **Enable** allows enabling the generation of each pattern individually in the pattern sequence. All patterns are enabled by default. All 1's (1111) is disabled for **Unframed** test.
- **Individual Pattern Duration** specifies the transmission duration of each pattern: **15 s**, **30 s**, **45 s**, **1 min**, **2 min**, **3 min** (default),... up to **15 min**.

## Restore < Test Application > Defaults

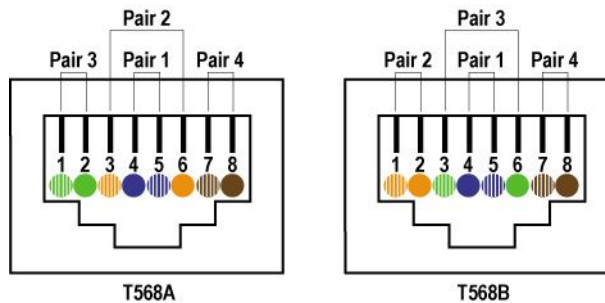
Reverts the current test application to its default factory settings.

## Cable Test

From the **Test** menu, tap **Setup**, **Test Configurator**, and the test block.

### Global Options

- **Wiring Standard** is the pin-to-pair assignment corresponding to the UTP cable used: **T568A** (default) or **T568B**.



- **Length Unit** is the unit used for cable length and distance to fault results: **Meter** (default) or **Feet**.

### Pass/Fail Verdict

- **Pass/Fail Verdict** check box when selected (default) enables the cable test pass/fail verdict and allows to set the threshold values.
  - **Prop. Delay Threshold (ns)** is the maximum time for a pulse to reach the far end: **0** to **1000** ns (default is **1000** ns for 10 Mbit/s, **556** ns for 100 Mbit/s, and **570** ns for 1 Gbit/s).

## Test Setup - Test Configurator, Timer, and System

### *Cable Test*

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- **Delay Skew Threshold (ns)** is the maximum time between the fastest and slowest pairs of a 1000 Base-T signal: **0** to **120** ns (default is **50** ns).
- **Length Threshold (m)** is the maximum acceptable cable length: **0** to **120** m (0 to 394 feet) (default is **100** m (328 ft)).

## Restore Cable Test Defaults

Reverts the configured parameters to their default values.

## Clock

Allows the configuration of the clock synchronization.

From the **Test** menu, tap **Setup**, **Test Configurator**, and tap on the clock block.

### Clock Synchronization

**Clock Mode** allows to select the source clock that will be used for transmission (TX). The clock mode is forced to **Recovered** for 1GE electrical interface using **Slave** local clock (see **Local Clock** on page 150). For CPRI, the clock is configurable to **Internal** or **External**.

- **Internal:** Internal clock of the unit (STRATUM 3).
- **Recovered:** Line clock from the input port signal involved in the test. Available with Transport test applications and Ethernet applications using 10G WAN.
- **External:** Clock signal from the EXT CLK port.

## Ext Clock In

**Note:** Available when the **Clock Mode** is set to **External**.

Allows to set the external clock for test synchronization.

- **Interface Type** allows the selection of the clock interface: **DS1** (default), **E1**, **2MHz**, or **1PPS**. **1PPS** is automatically selected for **Dual Test Set in One-Way Latency** measurement mode.

**Ext Clock In** on a green background indicates that a valid clock is received on the **EXT CLK** port.

**LOS** on a red background indicates that the clock is not valid on the **EXT CLK** port.

- **Termination** mode specifies how the NetBlazer is connected to the synchronization signal. The **Termination** mode is set to **TERM** for 2MHz and configurable for DS1 and E1.

For DS1:

- **TERM** provides an input that terminates the DS1 signal.
- **DSX-MON** provides high-input impedance and compensation for resistive loss. This setting is useful for monitoring DS1 signals at DSX monitor points, which are resistor-isolated.
- **BRIDGE** provides high-input impedance for bridging lines that are already terminated. This setting is useful for bridging directly across copper cable pairs.

For E1:

- **TERM** provides an input that terminates the E1 signal.
- **MON** provides high-input impedance and compensation for resistive loss. This setting is useful for monitoring E1 signals at monitor points, which are resistor-isolated.
- **BRIDGE** provides high-input impedance for bridging lines that are already terminated. This setting is useful for bridging directly across copper cable pairs.
- **Line Coding** allows the selection of the interface line coding.

For DS1: **AMI** and **B8ZS** (default).

For E1: **AMI** and **HDB3** (default).

- **Framing:** Allows the selection of the interface framing.

For DS1: **SF**, **SLC-96**, and **ESF** (default).

For E1: **PCM30** (default), **PCM30 CRC-4**, **PCM31**, and **PCM31 CRC-4**.

- **Frequency (MHz)** displays the frequency of the received signal rate.
- **Offset (ppm)** displays the positive or negative frequency offset between the standard rate specification and the rate from the received signal. The background color is used to indicate if the received clock meets (green) or not (red) the standard rate specification.

| Signal | Standard Rate specification    |
|--------|--------------------------------|
| DS1    | 1544000 ± 8 bit/s (± 4.6 ppm)  |
| E1     | 2048000 ± 10 bit/s (± 4.6 ppm) |
| 2MHz   | 2048000 ± 10 bit/s (± 4.6 ppm) |

## Ext Clock Out

**Note:** Available when the **Clock Mode** is set to **Internal**, or **Recovered**.

Allows to set the clock that will be generated.

- **Interface Type** allows the selection of the clock interface:  
**DS1** (default), **E1**, and **2MHz**.

**Ext Clock Out** on a green background indicates that a valid clock is generated on the **EXT CLK** port.

**LOC** on a red background indicates that no clock is generated on the **EXT CLK** port.

- **LBO** (Line Build Out), available with DS1 only, allows the selection of the interface Line Build Out that meets the interface requirements over the full range of cable lengths: **DSX-1 (0-133 ft)** (default), **DSX-1 (133-266 ft)**, **DSX-1 (266-399 ft)**, **DSX-1 (399-533 ft)**, and **DSX-1 (533-655 ft)**.
- **Line Coding**, available with DS1 and E1, allows the selection of the interface line coding.  
For DS1: **AMI** and **B8ZS** (default).  
For E1: **AMI** and **HDB3** (default).
- **Framing**, available with DS1 and E1, allows the selection of the interface framing.  
For DS1: **SF**, **SLC-96**, and **ESF** (default).  
For E1: **PCM30** (default), **PCM30 CRC-4**, **PCM31**, and **PCM31 CRC-4**.

# EtherBERT, FC BERT, BERT (CPRI), and Unframed BERT

From the **Test** menu, tap **Setup**, **Test Configurator**, and tap on the **EtherBERT**, **FC BERT**, **BERT**, or **Unframed BERT** block.

## Pattern

- **Coupled RX to TX** check box, when selected (default), couples both the TX and RX signal with the same test pattern. The **Coupled RX to TX** check box is selected and not configurable for **Seed A**, **Seed B**, and **PRBS31 Unscrambled** patterns as well as for Wireless CPRI/OBSAI BERT test.
- **No Pattern Analysis (Live)** check box when cleared (default; selected by default for framed CPRI), monitors the incoming traffic pattern and Round-Trip Latency. For live traffic, the **No Pattern Analysis (Live)** check box should be selected as the traffic is a live pattern and in this case no monitoring is required. Even if this check box is not available for FC BERT, the received traffic pattern and Round-Trip Latency are monitored. See *BER* on page 296 for more information.
- **TX Pattern/RX Pattern**: Select the test pattern from the list for each direction (TX and RX) if required. Choices are **PRBS9**, **PRBS11**, **PRBS15**, **PRBS20**, **PRBS23**, **PRBS31** (default), **Seed A**<sup>1</sup>, **Seed B**<sup>1</sup>, **PRBS31 Unscrambled**<sup>1</sup>, **CSPAT**<sup>2</sup>, **CJTPAT**<sup>2</sup>, **CRPAT**<sup>2</sup>, **Short CRTPAT**<sup>2</sup>, **Long CRTPAT**<sup>2</sup>, and **User Pattern**.

When **User Pattern** is selected, enter the payload pattern hexadecimal value.

- **Invert** check box, when selected (cleared by default), inverts the generated/expected test pattern meaning that every 0 will be changed for 1 and every 1 for 0. For example, the pattern 1100 will be sent as 0011.

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1. Only available for 10G LAN with **Unframed (Interop)** (see Framing on page 105).

2. Only available for 1G optical with **Framed Layer 1** (see Framing on page 105).

## Test Setup - Test Configurator, Timer, and System

*EtherBERT, FC BERT, BERT (CPRI), and Unframed BERT*

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### Bit/Pattern Error

The configuration of **Bit Error** is available with all patterns at the exception of **Seed A** and **Seed B** for which **Pattern Error** is available.

- **Pass/Fail Verdict** allows to enable and configure bit/pattern error rate/count threshold prior to run the test. This allows for a simple pass/fail verdict, leaving no room for misinterpretation of the test results. To enable the pass/fail verdict, select either **Bit/Pattern Error Count** or **Bit/Pattern Error Rate** (default is **Disabled**).
- **BER Threshold** allows to enter the threshold **Count** or **Rate** value that will be used to declare the pass/fail verdict.

For **Count**, enter the maximum bit/pattern error count allowed before declaring a fail verdict: **0** (default) to **999999**.

For **Rate**, enter the maximum bit/pattern error rate allowed before declaring a fail verdict: **1.0E-14** to **1.9E-01**. The default value is **1.0E-12**.

### CPRI

**Note:** *Available with CPRI/OBSAI BERT test application with CPRI Framed L2.*

**Pass/Fail Verdict** check box when selected (default) enables the pass/fail verdict. A pass verdict is given when the link status is up and no CPRI alarm and/or error are recorded for the duration of the test.

### Restore CPRI/OBSAI Defaults

**Note:** *Available with CPRI/OBSAI BERT test application.*

Reverts the current test application to its default factory settings.

### Service Disruption

**Note:** *Not available for FC BERT.*

- **No Traffic Time** (ms) represents the time between two Ethernet Frames that is acceptable without raising an alarm including a Service Disruption event: **0.005 ms** to **1000 ms** in step of 0.005 ms (default is **50 ms**). Only available with EtherBERT.
- **No Defect Time (ms)** represents the period without any defects before stopping SDT measurement: **0.005 ms** to **2000 ms** (default is **300 ms**). Only available with CPRI/OBSAI.
- **Disruption Monitoring** check box when selected (disabled by default) enables the disruption time measurements. However, the measurement will only start if the test is already started, or when the test will be started.

**Note:** *Clearing the **Disruption Monitoring** check box will stop the measurement without clearing the results. The disruption monitoring is automatically stopped without clearing results when the test is stopped. However, starting the test again while the **Disruption Monitoring** check box is selected will reset the results before restarting.*

- **Pass/Fail Verdict** allows to enable and configure the SDT Threshold.
- **SDT Threshold** allows to configure the amount of time with no traffic that is accepted before failing the test: **0.005** to **299999.995** ms in step of 0.005 ms (default is **50** ms). The threshold value cannot be less than the **No Traffic Time** value.

## Test Setup - Test Configurator, Timer, and System

*EtherBERT, FC BERT, BERT (CPRI), and Unframed BERT*

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### FC Frame

**Note:** *Only available with FC BERT.*

**Frame Size (Bytes)** allows to enter the frame size (in step of 4 bytes) for FC BERT test application: **40** to **2148** bytes (default). However the minimum frame size is 64 bytes when the **Latency Tag** check box is selected.

### Latency Tag Insertion

**Note:** *Only available with FC BERT.*

Round trip latency measures the average round trip latency (delay) between the time the data was transmitted and received.

- **Latency Tag** check box when selected, enables latency measurements.
- **Pass/Fail Verdict** check box when selected, enables the pass/fail verdict and allows to set the **Round-Trip Latency Threshold**.
- **Round-Trip Latency Threshold (ms)** allows the selection of the round trip latency: **0.015** (default) to **8000 ms**.

### Shaping

- **TX Rate** allows the selection of the transmission rate in percentage of utilization (100 percent by default), Mbit/s, Gbit/s, Frame/s, or IFG for Ethernet; Mbit/s, Gbit/s, MB/s, or % for Fibre Channel. For Ethernet, the maximum percentage is 105 percent depending on the frame size selected.
- **Enable TX** check box is automatically selected when starting the test allowing stream generation; automatically cleared when the test stops. The **Enable TX** check box may also be selected or cleared while the test is running. Not available for FC BERT.

## Test Setup - Test Configurator, Timer, and System

*EtherBERT, FC BERT, BERT (CPRI), and Unframed BERT*

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### Ethernet Frame

**Frame Size (Bytes)** allows to enter the frame size for Ethernet test applications. The range is from **64**<sup>1</sup> to **16000**<sup>2</sup>.

The following table lists each component that may affect the minimum frame size values.

| Component            | Description                     |
|----------------------|---------------------------------|
| VLAN                 | 4 bytes per VLAN (up to 3 VLAN) |
| UDP                  | 8 bytes                         |
| TCP                  | 20 bytes                        |
| Ethernet Header      | 14 bytes                        |
| LLC and SNAP Headers | 8 bytes                         |
| IPv4                 | 20 bytes                        |
| IPv6                 | 40 bytes                        |

**Note:** *Sending traffic with frame size >1518 in switched network may result in losing all frames.*

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1. The minimum frame size will be adjusted according to the frame structure and components selected.

2. The maximum frame size is limited to 10000 for 10/100/1000Mbps electrical interface.

## EtherSAM - Burst

**Note:** The **Burst** settings are only available for configuration when the **Burst Test** check box is selected (see page 137).

From the **Test** menu, tap **Setup**, **Test Configurator**, tap on the test block, and on the **Burst** tab.

**Note:** The burst configuration parameters are defined globally for all services but **CBS**, **EBS**, and **Burst Max Rate** parameters are as per each service configuration.

### Burst Sequence

The graphic illustrates the configured burst sequence that contains in order, from left to right:

- **Refill Delay** represents the pre-burst recuperation time in percentage that is equal to the remaining percentage not used by the post-burst time (**Refill Delay Ratio**).
- **Burst Frames** represents the burst frame ratio in percentage that is equal to the subtraction of **100% - Burst/IR Frame Ratio**.
- **Refill Delay** represents the post-burst recuperation time in percentage that is equal to the configured **Refill Delay Ratio**.
- **CIR or CIR+EIR Frames** represents the percentage of transmission at CIR or CIR+EIR rate. The **CIR or CIR+EIR Frames** percentage is equal to the configured **Burst/IR Frame Ratio**.
- The “. . .” next to the burst sequence indicates that the burst sequence is repeated the number of times specified in the **Number of Burst Sequence** field.

### Parameters

- **Number of Burst Sequence** is the number of times, **1** to **100** (default is **2**), the burst sequence will be repeated for the CBS and EBS tests.
- **Refill Delay Ratio (%)** is the percentage of time required to refill the CBS/EBS token buckets. The refill delay ratio is used for post-burst delay and the remaining percentage is applied to the pre-burst delay. The **Refill Delay Ratio** is configurable from **0** to **100** percent (**50** percent is the default as well as the standard's minimum recommended value).
- **Burst/IR Frame Ratio (%)** is the percentage of frames transmitted at CIR rate for the CBS test and the percentage of frames transmitted at CIR+EIR rate for the EBS test. The **Burst/IR Frame Ratio** is configurable from **10** to **90** percent (**90** percent is the default as well as the standard's recommended percentage value).

### Table

**Note:** *Test time values are only displayed for enabled services.*

- **Service No** indicates the service number.
- **Service Name** indicates the name of the service.
- **Direction**, available with **Dual Test Set**, indicates results from local to remote (L->R) and remote to local (R->L).
- **CBS Test Time (s)** indicates the total time required to perform all burst sequence iterations of the CBS test for this service.
- **EBS Test Time (s)** indicates the total time required to perform all burst sequence iterations of the EBS test for this service.
- **Total Burst Test Time (s)** indicates the total time required to perform all burst sequence iterations of both **CBS** and **EBS** tests for this service.

## EtherSAM - Global

From the **Test** menu, tap **Setup, Test Configurator**, tap on the test block, and on the **Global** tab.

### Dual Test Set

- **Dual Test Set (DTS)** check box when selected (cleared by default) enables EtherSAM **Dual Test Set**. Once **Dual Test Set** is enabled, use the **Discover Remote** button to select a remote unit.

**Note:** *Alternatively it is possible to use the Discover Remote button to connect to a remote module and automatically enable the Dual Test Set. For more details, refer to Discover Remote Button on page 530.*

**Disconnected** indicates that there is no connection established with a remote module.

**Connected** indicates that the connection is established with a remote module.

- **Discover Remote** button allows to discover remote modules supporting **Remote Loopback** and/or **Dual Test Set**. For more details, see *Discover Remote Button* on page 530.

### Subtests

- **Service Configuration Test** verifies if the network configuration is correct for each service before starting a long term test (Service Configuration Test). To test the network configuration, a ramp test and/or a burst tests is/are generated for each configured service.
- **Seconds per Service** indicates the **Service Configuration Test** duration in seconds based on the configured Services, Ramp, and Burst settings.
- **Ramp Test** check box when selected (default):

In the first stage of the test, when **CIR** check box is selected (see *SLA Parameters* on page 238), the throughput is increased incrementally in steps until the CIR level is reached. During the first stage, the maximum Jitter, Latency, Frame Loss, and throughput are measured and are compared to the SLA thresholds to declare a pass/fail verdict.

In the second stage of the test, when the **CIR+EIR** check box is selected (see *SLA Parameters* on page 238), the throughput is increased to the **CIR+EIR** level to compare against expected maximum throughput threshold to declare a pass/fail verdict.

In the third stage of the test, when the **Traffic Policing** check box is selected (see *Test Parameters* on page 237), the throughput is increased one step over the **CIR+EIR** if selected otherwise over the **CIR** to compare against expected maximum throughput threshold to declare a pass/fail verdict.

The ramp test procedure is generated for each enabled service.

- **Burst Test** check box when selected (cleared by default) verifies that the expected burst size can be transmitted at maximum burst rate with minimal loss.

**CBS** (Committed Burst Size) check box when selected (see *SLA Parameters* on page 238), verifies the performance of a committed burst size at **CIR**'s average **TX** rate.

**EBS** (Excess Burst Size) check box when selected (see *SLA Parameters* on page 238), verifies the performance of an excess burst size at **CIR+EIR**'s average **TX** rate.

The maximum Jitter, Latency, Frame Loss, and throughput are measured. For **CBS**, the Jitter, Latency, and Frame Loss are compared to the SLA thresholds to declare a pass/fail verdict. For **EBS**, the throughput is compared to the SLA thresholds to declare a pass/fail verdict.

The burst test procedure is generated for each enabled service.

- **Service Performance Test** check box when selected (default) verifies that the **SLA** parameters (see *SLA Parameters* on page 238) are met over time by running multiple services simultaneously. The maximum Jitter, Latency, Frame Loss, and average throughput are measured and compared to the configured thresholds to declare pass/fail verdicts. The **Service Performance Test** is only performed for services that have their **CIR** check box selected.

**Subtest Duration** allows to set the duration time, in HH:MM:SS format, for the **Service Performance Test** (default is 10 minutes).

- **Global Test Duration Estimate** indicates the total estimate duration of the test.

### Global Options

- **Per Direction Configuration** check box when selected (default) specifies that the values can be configured independently for each direction (local to remote and remote to local) for **Dual Test Set**. When the **Per Direction Configuration** check box is cleared the configuration will be coupled and the values apply to both directions.

**Note:** *For Dual Test Set the Per Direction Configuration is only available when the communication with the remote module is established.*

- **Pass/Fail Verdict** check box when selected (default) enables the pass/fail verdict. A global pass/fail verdict is given for the EtherSAM test, **Service Configuration**, and **Service performance** (for each service). The pass/fail verdict is based on the following criteria: **Frame Loss**, **Max Jitter**, **Round-Trip Latency**, and **Average RX Rate**.
- **Latency Measurement Mode**, available with **Dual Test Set** for rates from 10M to 10GE, allows the selection of the latency measurement mode: **Round-Trip** (default) or **One-Way**.

Synchronization with an external 1PPS clock is required to perform One-Way Latency measurement. One-Way Latency is only possible when both local and remote 1PPS signal clocks are valid. The following alarms are available with One-Way Latency measurement.

**LOPPS-L** and **LOPPS-R** (Loss Of Pulse Per Second - Local/Remote) are declared when either no pulse is received or when no pulse is received within 1 second  $\pm 6.6 \mu s$  after the previous pulse. LOPPS-R is only monitored once the DTS connection is established.

### Restore EtherSAM Defaults

Reverts the current test application to its default factory settings.

# EtherSAM - Ramp

**Note:** The **Ramp** tab is only available for configuration when the **Ramp Test** check box is selected (see page 137).

From the **Test** menu, tap **Setup**, **Test Configurator**, tap on the test block, and on the **Ramp** tab.

**Note:** The ramp configuration parameters are defined globally for all services but the presence of CIR+EIR, and Traffic Policing steps are as per each service configuration. CIR, CIR+EIR, and Traffic Policing steps are part of the step list as soon as they are enabled for at least one service even if that service is not enabled.

## Dynamic Ramp

The graphic displays the percentage of each CIR level step in time.

## Step Time

The step time is the test duration for each ramp step: **5** (default) to **60** seconds.

## Ramp Duration

The ramp duration indicates the total time required to perform all the ramp steps for each service.

## Add Step

Allows to add a new ramp step. Enter the CIR percentage from **1** to **99**. A maximum of 7 pre CIR steps can be added in the ramp configuration.

### **Delete Step**

Allows to delete a step from the ramp. Select the step from the list and tap on **Delete**.

### **Defaults**

Reverts the ramp configuration to its default factory settings.

## Fibre Channel

From the **Test** menu, tap **Setup, Test Configurator**, and the **Fibre Channel** block.

### World Wide Name (WWN)

The following WWN settings are only available when the **Login - Enable** check box is selected (see page 144).

- **Source** allows to set the 64-bit WWN address of the local fibre channel port: **00-00-00-00-00-00-00-00** to **FF-FF-FF-FF-FF-FF-FF-FF** (default is **20-00-00-03-01** [IEEE-MAC lsb (bits 23..0)]).
- **Destination** allows to set the 64-bit WWN address of the remote fibre channel port: **00-00-00-00-00-00-00-00** (default) to **FF-FF-FF-FF-FF-FF-FF-FF**. The destination WWN address is displayed and grayed-out for Point-to-Point topology after a successful login.

### Buffer to Buffer Flow Control

Buffer to Buffer (BB) Flow Control, also called Flow Control Management, manages the control of data traffic between the local and remote fibre channel ports based on the network, distance, and traffic congestion.

Each remote port advertises the buffer size (**BB\_Credit**) during the login.

- **Enable** check box when selected allows to set or use buffers to receive frames. The **Enable** check box is force selected when the **Login - Enable** check box is selected (see page 144).
- **Available BB\_Credit** is the number of frame buffers that the remote port has available to receive frames from the local port: **1 to 65535** (default is **10**). The **Available BB\_Credit** is not editable when the **Login - Enable** check box is selected but its value received from the remote interface through the login process is displayed. If the login fails, the **Available BB\_Credit** displays “-”.

## Login

After a link is established, it is possible to login to the Fibre Channel Network to send and receive data between a local and remote fibre channel port.

- **Enable** check box when selected (default) allows to press the **Login** button to start the login process.
- **Advertised BB\_Credit** is the number of frame buffers the local port has available to receive frames from the remote port: **1** to **65535** (default is **10**). **Advertised BB\_Credit** is advertised to the remote port through the **Login** process. Changing the **Advertised BB\_Credit** requires to manually re-send a login using the **Login** button.
- **Login/Re-Login** button allows the initiation of the Login process with the selected **Advertised BB\_Credit**. Available when the **Login - Enable** check box is selected. The **Login** button initiates a log-in when not logged-in while the **Re-Login** re-initiates a log-in after changing the **BB\_Credit** and/or **WWN** when already logged-in. The capability to login is available only with Framed Layer 2 (FC-2) when a successful link has been established. There are two Login processes supported by Fibre Channel: **Port Login** (PLOGI) and **Fabric Login** (FLOGI).

It is possible to skip the **Login** procedure and use the **BB\_Credit** value. This is called **Implicit Login** and is only applicable for **Point-to-Point** topology. For **Point-to-Point** topology using implicit login, you must manually configure the **Available BB\_Credit** value for the remote port.

- **Discovered Topology** indicates the discovered topology.

**Fabric:** Ports are interconnected to a fabric switching network.

A **Fabric** and **Port** login are required, and the **BB\_Credit** value is set based on the buffer capacity of the fabric switch.

**Point To Point:** Direct link between two ports.

- **Fabric Status** indicates the status of the Fabric switching network. The status is not available when the discovered topology is Point-to-Point.
  - **Logged-in** indicates that the login process has completed successfully.
  - **Failed** indicates that the login process is not completed successfully or an error has been detected.
  - **In Progress** indicates that the login process is running (not completed yet).
  - **Logged-out** (default) indicates that the system has not logged in yet or has received a valid Logout command from the remote port.
- **Port Status** indicates the state of the port login process.
  - **Logged-in** indicates that the login process has completed successfully.
  - **Failed** indicates that the login process is not completed successfully or an error has been detected.
  - **In Progress** indicates that the login process is running (not completed yet).
  - **Logged-out** (default) indicates that the system has not logged in yet, has received a valid Logout command from the remote port, or the Fabric status is either Failed, In Progress, or Logged-out.

## FTFL/PT

From the **Test** menu, tap **Setup, Test Configurator**, tap on the signal block, and on the **FTFL/PT** tab.

### FTFL

Allows the configuration of the Forward and Backward ODU Fault Type Fault Location (FTFL) to be generated.

- **Fault Indication** and **Fault Indication Code** allow the selection of the FTFL fault indicator message/code (byte 0 for forward, byte 128 for backward) to be generated.

| Fault Indication | Fault Indication Code (Hex) |
|------------------|-----------------------------|
| No fault         | 00 (default)                |
| Signal fail      | 01                          |
| Signal Degrade   | 02                          |
| Reserved         | 03 <sup>a</sup>             |

- a. Selecting **Reserved** will use the hexadecimal code **03** but, all codes from **03** to **FF** are reserved for future international standardization.

**Note:** *The **Fault Indication Code** field is automatically updated when the **Fault Indication** is changed and vice versa.*

- **Operator Identifier** allows editing the Operator Identifier to be generated (bytes 1 to 9 for forward, bytes 129 to 137 for backward; 9 characters allowed). By default no Operator Identifier is defined.
- **Operator Specific** allows editing the Operator Specific to be generated (bytes 10 to 127 for forward, bytes 138 to 255 for backward; 118 characters allowed). By default no Operator Specific is defined.

## PT

**Note:** Changing the payload type (PT) does not alter the signal structure; it only modifies the OH value that is generated.

### ► Payload Type and Code

**Generated:** Allows to select the payload signal type to be generated either by selecting the payload type from the list or by entering its code in hexadecimal (00 to FF.).

**Expected:** Allows to select the expected payload signal type.

**Note:** Codes not listed in the table are reserved for future standardization (Reserved For International Standardization).

| Payload type                                            | Hex Code | MSB<br>1234 | LSB<br>5678 |
|---------------------------------------------------------|----------|-------------|-------------|
| Reserved for International Standardization <sup>a</sup> | 00       | 0000        | 0000        |
| Experimental mapping                                    | 01       | 0000        | 0001        |
| Asynchronous CBR mapping                                | 02       | 0000        | 0010        |
| Bit Synchronous CBR mapping                             | 03       | 0000        | 0011        |
| ATM mapping                                             | 04       | 0000        | 0100        |
| GFP mapping                                             | 05       | 0000        | 0101        |
| Virtual Concatenation Signal                            | 06       | 0000        | 0110        |
| PCS Codeword Transparent Ethernet                       | 07       | 0000        | 0111        |
| FC-1200 into ODU2e                                      | 08       | 0000        | 1000        |
| GFP mapping into extended OPU2                          | 09       | 0000        | 1001        |
| OC-3/STM-1 into ODU0                                    | 0A       | 0000        | 1010        |
| OC-12/STM-4 into ODU0                                   | 0B       | 0000        | 1011        |
| FC-100 into ODU0                                        | 0C       | 0000        | 1100        |
| FC-200 into ODU1                                        | 0D       | 0000        | 1101        |
| FC-400 into ODUflex                                     | 0E       | 0000        | 1110        |
| FC-800 into ODUflex                                     | 0F       | 0000        | 1111        |
| Bit Stream with Octet Timing mapping                    | 10       | 0001        | 0000        |
| Bit Stream Without Octet Timing mapping                 | 11       | 0001        | 0001        |

## Test Setup - Test Configurator, Timer, and System

FTFL/PT

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| Payload type                                    | Hex Code | MSB<br>1234 | LSB<br>5678 |
|-------------------------------------------------|----------|-------------|-------------|
| IB SDR mapping into ODUflex                     | 12       | 0001        | 0010        |
| IB DDR mapping into ODUflex                     | 13       | 0001        | 0011        |
| IB QDR mapping into ODUflex                     | 14       | 0001        | 0100        |
| ODU Multiplex with ODTUjk                       | 20       | 0010        | 0000        |
| ODU Multiplex with ODTUk.ts/ODTUjk              | 21       | 0010        | 0001        |
| Not Available <sup>b</sup>                      | 55       | 0101        | 0101        |
| Reserved Codes for Proprietary Use <sup>c</sup> | 80       | 1000        | 0000        |
| NULL Test Signal mapping                        | FD       | 1111        | 1101        |
| PRBS Test Signal mapping                        | FE       | 1111        | 1110        |

- a. Selecting **Reserved for International Standardization** will use the hexadecimal code 00 but, all codes not listed in the previous table at the exception of those covered in notes b and c are reserved for future standardization.
- b. Selecting **Not Available** will use the hexadecimal code 55 but, 66 and FF are also Not Available payload types.
- c. Selecting **Reserved Proprietary** will use the hexadecimal code 80 but, all codes from 80 to 8F are reserved proprietary payload types.

**Note:** *The **Code** field is automatically updated when the **Payload Type** is changed and vice versa.*

➤ **OPU-PLM**, when selected, enables the OPU-PLM alarm analysis.

## Interface (Ethernet, Packet Sync, Fibre Channel, and Wireless)

From the **Test** menu, tap **Setup**, **Test Configurator**, the interface block, and the **Interface** tab.

### LINK

An arrow is used to indicate the status of the test link.

- A green arrow indicates that the link is up.
- A red arrow indicates alarms, the link is down.
- A gray arrow indicates awaiting incoming data to provide a status.

For Ethernet and Packet Sync test applications:

- **Auto-Negotiation** check box is available with **10/100/1000M Electrical** and **1GE Optical** interfaces. When the **Auto-Negotiation** check box is selected the test application indicates to the remote port which parameters to use. The **Auto-Negotiation** check box is automatically selected for 1GE Electrical interface and is not configurable.

**Note:** *When the **Auto-Negotiation** check box is selected, the port **Speed**, **Duplex**, **Flow Control**, and **Local Clock** parameters can be set. Those settings are not applied immediately to the port, they are used only when the negotiation process is started and take effect only when the auto-negotiation succeeds. However current settings are applied immediately to the port when the **Auto-Negotiation** check box is cleared.*

## Test Setup - Test Configurator, Timer, and System

*Interface (Ethernet, Packet Sync, Fibre Channel, and Wireless)*

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- **Speed**, available with **10/100/1000M Electrical** interface, allows the selection of the interface rate: **10M**, **100M**, **1GE**, or **Auto**<sup>1</sup>. The negotiated speed will be displayed next to the **Speed** field selection. The **10M** speed is not available with SyncE test application.
- **Duplex** choices for **10M** and **100M** electrical interfaces are **Full Duplex** (default), **Half Duplex**, and **Auto**<sup>1</sup>. For other rates the Duplex is set to **Full Duplex**. Availability of choices depend on the test applications. The negotiated duplex will be displayed next to the **Duplex** field selection.
- **Flow Control** choices are **TX**, **RX**, **RX and TX**, **None** (default), and **Auto**<sup>1</sup>. When the **Flow Control** is set to **None**, pause frames received are ignored. Availability of choices depend on test applications.
- **Cable Mode** is available with **10/100/1000M Electrical** interface. Availability of choices depend on the test application.

**Manual** mode is selected when the **Auto-Negotiation** check box is cleared and allows to select the type of cable: **MDI** (default) for straight through cable or **MDIX** for crossover cable.

**Automatic** mode is selected when the **Auto-Negotiation** check box is selected and allows the FTB-700G/800 Series to automatically detect the MDI or MDIX cable type.

- **Local Clock** is only available with 1GE interface and allows to set the provenance of the clock: **Master** (default), or **Slave**, or **Auto**<sup>1, 2</sup>.

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1. **Auto** is only available when the **Auto-Negotiation** check box is selected.

2. Not available with SyncE test application.

## Test Setup - Test Configurator, Timer, and System

*Interface (Ethernet, Packet Sync, Fibre Channel, and Wireless)*

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For Fibre Channel test application:

- **PSP (Link Protocol)** (Primitive Sequence Protocol) check box when selected (default) allows link management by activating the port.

For CPRI **Unframed** test application:

- **Scrambling** check box when selected (default) enables the scrambler. Only available with **Unframed** CPRI rates 4.9152 Gbit/s and higher.

For CPRI **Framed L2** test application:

- **Sequence** indicates the last Startup Sequence State: **Standby (A)**, **L1 Sync (B)**, **Protocol (C)**, **L2 C&M (D)**, **Vendor (E)**, **Operation (F)**, or **Passive (G)**.
- **Protocol** defines how the CPRI Startup Sequence negotiates the protocol version.
  - **Auto** can use protocol **Version 1** and **Version 2** during the negotiation.
  - **Version 1** negotiates the protocol with Scrambling disabled. Available with all supported CPRI rates.
  - **Version 2** negotiates the protocol with Scrambling enabled. Available with CPRI rates: 9.8, 6.1, and 4.9 Gbit/s.

**Protocol** table indicates either the last received (**Version 1** or **Version 2**) or negotiated (**Auto**) protocol version. A light-red background indicates a Protocol version mismatch between the received value and the expected generated value.

## Test Setup - Test Configurator, Timer, and System

*Interface (Ethernet, Packet Sync, Fibre Channel, and Wireless)*

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- **C&M Channel** defines the kind of channel that will be used by the startup sequence for negotiation.
  - **Auto** (default): Overhead byte #Z.66.0 can use any of the HDLC rates and Overhead byte #Z.194.0 can use any of the Ethernet Subchannel in the negotiation process.
  - **HDLC**: Only overhead byte #Z.66.0 is used with the configured HDLC Rate during the negotiation process. Ethernet #Z.194.0 byte is set to rr00 0000 as it is disabled.
  - **Ethernet**: Only overhead byte #Z.194.0 is used with the configured Ethernet Subchannel during the negotiation process. HDLC #Z.66.0 byte is set to rrrr r000 as it is disabled.
  - **Disabled**: Both HDLC Rates and Ethernet Subchannel are disabled to simulate a Passive Link. Ethernet #Z.194.0 byte is set to rr00 0000 and HDLC #Z.66.0 byte is set to rrrr r000. Only available with **Base Station** emulation mode.

**C&M** table indicates either the received (HDLC or Ethernet) or negotiated (Auto) C&M for Ethernet subchannel and HDLC rates in Mbit/s. A red background indicates either a C&M type mismatch or HDLC Rate/Ethernet subchannel mismatch compared to the generated C&M channel. An arrow is displayed indicating which C&M Channel should normally be selected as per the standard rules.

- **Subchannel** selects the Ethernet Subchannel number: **20** to **63** where 63 is the lowest bit rate and 20 the highest.

## Test Setup - Test Configurator, Timer, and System

*Interface (Ethernet, Packet Sync, Fibre Channel, and Wireless)*

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➤ **Rate (Mbit/s)** is available with **HDLC** and **Ethernet C&M Channel**.

For **HDLC**: Allows the selection of the HDLC bit rate. Choices depend on the selected CPRI interface rate. HDLC **Proprietary** is used to exercise a case where the Base Station is aware in advance of the HDLC rate to use. The proprietary rate are not described in the standard. If an HDLC Proprietary is received during the negotiation process while the **C&M Channel** is set to **Auto**, the negotiation completes but no actual bit rate is reported as it is unknown. Similarly, if an equipment vendor uses an invalid rate (as per the CPRI Standard) during the negotiation process, this rate is reported as **Unspecified (Code)** where **Code** is a decimal value representing an invalid rate based on the configured interface rate.

| CPRI Rate (Gbit/s) | HDLC Rate (Mbit/s)                                              |
|--------------------|-----------------------------------------------------------------|
| 1.2                | 0.240, 0.480, 0.960 (default), Proprietary                      |
| 2.4                | 0.240, 0.480, 0.960, 1.920 (default), Proprietary               |
| 3.1                | 0.240, 0.480, 0.960, 1.920, 2.400 (default), Proprietary        |
| 4.9                | 0.240, 0.480, 0.960, 1.920, 2.400, 3.840 (default), Proprietary |
| 6.1                | 0.240, 0.480, 0.960, 1.920, 2.400, 4.800 (default), Proprietary |
| 9.8                | 0.240, 0.480, 0.960, 1.920, 2.400, 7.680 (default), Proprietary |

For **Ethernet**: Indicates the bit rate corresponding to the selected **Subchannel**.

## Test Setup - Test Configurator, Timer, and System

Interface (Ethernet, Packet Sync, Fibre Channel, and Wireless)

### WIS Button

**Note:** *WIS is only available for 10GE WAN interface.*

- **J0 Trace** allows to set the **J0 Trace** value in 16 bytes format (default is **EXFO 10GigE**).
- **J1 Trace** allows to set the **J1 Trace** value in 16 bytes format allowing up to 15 bytes (a CRC-7 byte will be added in front for a total of 16 bytes). Default is **EXFO 10GigE**.

**Note:** *J0 and J1 values should be 7-bit T.50 suitable characters. The **Padding** drop list from the message keyboard allows to select **Null** or **Space** to fill up the **J0 Trace** and **J1 Trace** up to 15 byte value. The **Control Characters** button in the **J0 Trace** and **J1 Trace** message keyboard, allows to select the required character. For more details on **Control Characters**, see page 39.*

- **Path Signal Label (C2)** byte is allocated to indicate the content of the STS SPE, including the status of the mapped payload.

| C2 (Hex.)       | Description                     |
|-----------------|---------------------------------|
| 00              | Unequipped                      |
| 01              | Equipped - Non-Specific         |
| 1A <sup>a</sup> | 10 Gbit/s Ethernet (IEEE 802.3) |
| FE              | Test Signal, ITU-T 0.181        |

a. Default value.

### Physical Interface

- **Laser** indicates the status of the laser: **ON** with the laser pictogram (emitting an optical laser signal) or **OFF**.
- **TX Power (dBm)** indicates, when supported, the transmit power level of the optical laser in dBm.
- **Wavelength (nm)** indicates the detected wavelength when supported by the transceiver.
- **RX Power (dBm)** indicates, when supported, the current received power level of the optical laser in dBm.

Green: Power level in range.

Yellow: Power level out-of-range.

Red: Loss of signal or power level is close to damage.

Gray: Invalid operational range value.

- **Min RX Power (dBm)** indicates, when supported, the minimum received power level of the optical laser in dBm.
- **Max RX Power (dBm)** indicates, when supported, the maximum received power level of the optical laser in dBm.
- **Lasers OFF at Start-Up** check box when selected automatically turns OFF the laser when starting the NetBlazer or when switching from one test application to another. However the laser remains ON, on a remote module receiving a request for a DTS connection or a loopback command. This check box is cleared by default.
- **Power Range (dBm)** indicates the SFP/SFP+ operational RX power range.

## Test Setup - Test Configurator, Timer, and System

Interface (Ethernet, Packet Sync, Fibre Channel, and Wireless)

---

### TX Frequency

- **TX Frequency (GHz)** indicates the frequency (actual frequency + Frequency offset) used for transmission.

**Note:** *Frequency offset is not available with Wireless or RFC 6349 test application.*

- **Offset (ppm)** check box, when selected (cleared by default), allows to set the frequency offset that will be generated:  $\pm 120$  ppm. Use the “+” or “-” button to respectively increment or decrement the frequency offset value based on the defined **Increment/Decrement Size**, or directly type the frequency offset value in the field.
- **Step Size (ppm)** allows to set the increment/decrement value (from 0.1 to the maximum offset) that will be used when changing the frequency offset with the “+” or “-” button.

## RX Frequency

- **Frequency (GHz)** indicates the frequency of the input signal.
- **Offset (ppm)** indicates the frequency offset between the standard rate specification and the rate at the input signal.

**Note:** For both **Frequency** and **Offset** the following background colors are used.

| Background color | Description                                                  |
|------------------|--------------------------------------------------------------|
| Green            | The frequency is in range.                                   |
| Red              | The frequency is out-of-range. <b>LOC</b> is also displayed. |
| Gray             | Pending state.                                               |

- **Max Offset (ppm)**

**Negative** indicates the maximum negative frequency offset between the standard rate specification and the rate from the received signal.

**Positive** indicates the maximum positive frequency offset between the standard rate specification and the rate from the received signal.

## Interface (iSAM)

From the **Test** menu, tap **Setup**, **Test Configurator**, and the **More** button from the **Local** block.

### LINK

An arrow is used to indicate the status of the test link.

- A green arrow indicates that the link is up.
- A red arrow indicates that the link is down.
- A gray arrow indicates awaiting incoming data to provide a status.
- **Interface/Rate** or **Port** choices depend on the rates available on the module.

| Interface/Rate          |
|-------------------------|
| 10GE WAN                |
| 10GE LAN                |
| 1GE Optical             |
| 100M Optical            |
| 10/100/1000M Electrical |

For 10GE WAN, the test uses the WIS default values for J0, J1, and C2 as defined in *WIS Button* on page 154.

- **Connector** allows the selection of the module's port.

| Interface/Rate              | Connector                      |
|-----------------------------|--------------------------------|
| 10GE WAN<br>10GE LAN        | Port 1 - SFP+                  |
| 1GE Optical<br>100M Optical | Port 1 - SFP<br>Port 2 - SFP   |
| 10/100/1000M Electrical     | Port 1 - RJ45<br>Port 2 - RJ45 |

- **Auto-Negotiation** check box when selected (default), indicates to the remote port which parameters to use. Only available with **10/100/1000M Electrical** and **1GE Optical** interfaces. For 1GE Electrical interface, the **Auto-Negotiation** check box is automatically selected and is not configurable.

**Note:** When the **Auto-Negotiation** check box is selected, the port **Speed** can be set. This settings is not applied immediately to the port, it is used only when the negotiation process is started and take effect only when the auto-negotiation succeeds. However current setting is applied immediately to the port when the Auto-Negotiation check box is cleared.

- **Speed**, available with **10/100/1000M Electrical** interface, allows the selection of the interface rate: **10M**, **100M**, **1GE**, or **Auto**; **Auto** is only available when the Auto-Negotiation check box is selected. The negotiated speed will be displayed next to the Speed field selection.

**Note:** **Full Duplex** is used and there is no **Flow Control** (pause frames received are ignored).

- **Lasers OFF at Start-Up** allows to automatically turn off all lasers when starting the module or when switching from one test application of the same group (Ethernet or Transport) to another. This check box is cleared by default.

## MAC

- **Address** indicates the default and unique Media Access Control (MAC) address given to the Ethernet port.
- **VLAN ID/Priority** check box when selected, cleared by default, enables C-VLAN with VLAN Ethernet type of 8100 and allows to set both VLAN ID and priority.

**VLAN ID** choices are **0** through **4095**; default is **2**; refer to *VLAN ID and Priority* on page 639 for more information.

**Priority** choices are **0** (default) to **7**. Refer to *VLAN ID and Priority* on page 639 for more information.

### IP

- **IP Version** is set to **IPv4**.
- **Automatic IP (DHCP)** check box, when selected (cleared by default), allows to dynamically obtain an IP address from a DHCP (Dynamic Host Configuration Protocol) server.

**Note:** *IP Address, Subnet Mask, and Default Gateway are not available when the Automatic IP (DHCP) check box is selected.*

- **IP Address** allows to enter the source IP address for the stream. The default setting is 10.10.x.y, where x and y are respectively the two least significant bytes of the port default MAC address.
- **Subnet Mask** allows to enter the Subnet Mask for the stream. The default setting is **255.255.0.0**.
- **Default Gateway** check box, when selected (cleared by default), allows to enter a default Gateway IP address. When the **Default Gateway** check box is selected, its default address is **0.0.0.0**.

### Remote Discovery ID

**Remote Discovery ID** is used to easily identify this module in case another module is performing a discovery scan. Up to 16 alpha-numeric characters are allowed.

## ISDN PRI - Call Management

From the **Test** menu, tap **Setup, Test Configurator**, the test block, and the **Call Management** tab.

### Call Origination Settings

#### ➤ Channel Identification

- The channel buttons allow the selection of a channel for call origination configuration. The selected channel has its button highlighted with a blue border. **D-Ch** indicates the channel configured as D-Channel and is not selectable.

A warning icon is displayed on each channel button for which either the originator and/or destination number is not defined.

- **Call All at Start** check box when selected, initiates calls for all configured channels when the test is started.
- **Calling Party** and **Called Party** defines respectively the originator and destination call information.
  - **Numbering Plan** choices are **Unknown**, **ISDN/Telephony** (default), or **Private**.
  - **Numbering Type** choices depend on the **Numbering Plan** and **DS1/E1 Switch Type** selected.

| Interface/<br>Rate | Switch Type                                 | Numbering Types for ... Numbering Plan |                                                       |                                                                                          |
|--------------------|---------------------------------------------|----------------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------|
|                    |                                             | Unknown                                | ISDN<br>Telephony                                     | Private                                                                                  |
| DS1                | National ISDN                               | Unknown                                | International,<br>National, Local                     | Subscriber                                                                               |
|                    | Nortel DMS-100/250<br>and<br>AT&T 4ESS/5ESS | Unknown                                | International,<br>National,<br>Subscriber             | Subscriber                                                                               |
| E1                 | Euro VN6<br>and<br>Euro ISDN                | Unknown                                | Unknown,<br>International,<br>National,<br>Subscriber | Unknown,<br>Network Specific,<br>Subscriber                                              |
|                    | Euro Q.SIG                                  | Unknown                                | Unknown,<br>International,<br>National,<br>Subscriber | Unknown,<br>Level 2 Regional,<br>Level 1 Regional,<br>PISN Specific,<br>Level 0 Regional |

- **Number** allows to enter respectively the originator and destination numbers. A maximum of 30 digits is permitted.

If the originator and/or destination number field is empty for any channel, a warning icon with the following message is displayed at the bottom of the pop-up:

**Call origination settings incomplete. Missing Calling or Called Party Number.**

- **Call at Start** check box when selected, initiates calls for the selected channel when the test is started. Alternatively the **Call All at Start** check box can be used to initiates calls for all configured channels when the test is started.

- **Call**
  - **Type** selects the service type: **3.1 kHz**, **Speech**, or **Data** (default).
  - **Rate** is only configurable for **Data** type: **56K** or **64K** (default). The rate is set **64K** for **3.1 kHz** and **Speech** types as well as for **Euro Q.SIG** switch type.
- **Network**
  - **Transit Net Code** (Transit Network Code) selects a specific network on which the call is placed and is only applicable in **TE - Emulation Mode**. The range is from **0** to **9999**. By default this field is blank meaning that no Transit Network Selection code is transmitted. Not supported with **Euro Q.SIG** switch type.
  - **Operator Sys Access** (Operator System Access) determines whether or not an operator is used: **Disabled** (default), **Principal**, and **Alternate**. Only applies to **National ISDN** switch type, **Speech** and **3.1 kHz** call type, and in **TE - Emulation Mode**.

## Answer Mode

Allows the selection of the call answering mode.

- **Auto-Answer** (default) answers all incoming calls automatically.
- **Auto-Reject** rejects all incoming calls automatically.
- **Prompt**: asks to answer or reject a call. A call answered or rejected is removed from the table in the **Answer Prompt** window. All incoming calls are listed in the received order.

Calls can be answered or rejected individually (**Answer/Reject**) or collectively (**Answer All/Reject All**).

The **Close** button is available once all calls are answered or rejected.

### Call Establishment/Termination Pass/Fail Verdict

- **Call Establishment/Termination Pass/Fail Verdict** check box when selected (cleared by default) enables call establishment and termination pass/fail verdict for each channel and globally for the test. No verdict is provided on the D-Channel.

A pass verdict indicates that there was no call processing error during call establishment or call termination.

A fail verdict indicates that one of the following events occurs.

- **Call Establishment:** An incoming or outgoing call is unexpectedly cleared before it reaches the connected state at the exception of rejected incoming calls.
- **Call Termination:** A connected call is unexpectedly cleared.

The global pass/fail verdict is reported as fail when any channel has a fail verdict or when a LOS, LOF, or AIS error occurs.

### Call Control

The channel buttons allow the selection of a channel to see its information or to initiate/terminate calls. The selected channel has its button highlighted with a blue border. Each channel button presents the following information.

| Information<br>(location on the button)      | Description                                                                                                                                 |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Channel number<br>(Top-left corner)          | Indicates the channel's number. There are 24 channels for DS1 and 31 for E1.                                                                |
| Pattern sync.<br>(Top-right corner)          | Available with data call. The pattern sync icon indicates if the data call pattern is properly synchronized (green icon) or not (red icon). |
| Call State or D-Channel<br>(Bottom-centered) | Indicates either the call state or <b>D-Ch</b> for the channel configured as D-Channel.                                                     |

## Test Setup - Test Configurator, Timer, and System

### ISDN PRI - Call Management

---

**Call/Hang-Up** and **Hang-Up All** buttons are available depending on the status of the call.

- **Call** initiates a call on the selected channel.
- **Hang-Up** terminates a call on the selected channel.
- **Hang-Up All** terminates all calls.

The information for the selected channel is displayed at the right of the channel's buttons. See *Call Origination Settings* on page 162 for more information.

**Phone Book Name** indicates the name associated to the call number when present in the phone book (refer to *Phone Book Button* on page 543).

The following message is displayed when either the originator and/or destination number field is empty for the selected channel:

**Call origination settings incomplete. Missing Calling or Called Party Number.**

## ISDN PRI - ISDN Settings

From the **Test** menu, tap **Setup, Test Configurator**, the test block, and the **ISDN Settings** tab.

### D-Channel

- **Channel** indicates the channel selected to establish the ISDN signalling path. The default D-Channel for DS1 is **24** and for E1 is **16**.
- **Rate** represents the rate at which data is exchanged. Depending on the network, the options available are **56K** and **64K** (default).
- **HDLC Mode** represents the bit inversion of the signal: **Normal** (default) or **Inverted**.
- **D-Channel** indicates the status of the D-Channel. A green arrow pointing up indicates that the link is up (**L2 - Multiple frame established**) and a red arrow pointing down indicates that the link is down.

### B-Channel

**Note:** *The following B-Channel settings apply to all data calls.*

- **Data Call Pattern** allows to select the pattern: **PRBS9**, **PRBS11** (default), **PRBS20**, **1111**, **1100**, **1010**, **0000**, **1in8**, **1in16**, **2in8**, and **3in24**.
- **Invert** check box when selected (cleared by default) inverts the test pattern meaning that every 0 will be changed for 1 and every 1 for 0. For example, the pattern 1100 will be sent as 0011.
- **RX Pattern Analysis** check box when selected enables the monitoring of the test pattern for all data calls.
- **BER Pass/Fail Verdict** allows to enable bit error pass/fail verdict by selecting either **Bit Error Count** or **Bit Error Rate** (default) or **Disabled**.

## Test Setup - Test Configurator, Timer, and System

### ISDN PRI - ISDN Settings

---

- **Threshold** allows to enter the threshold value that will be used to declare the pass/fail verdict.

For **Count**, enter the maximum bit error count allowed before declaring a fail verdict: **0** (default) to **999999**.

For **Rate**, enter the maximum bit error rate allowed before declaring a fail verdict: **1.0E-14** to **1.9E-01** (default is **1.0E-12**).

- **Idle Code** allows the generation of idle code when a B-Channel is in idle state or active with a Speech or 3.1 kHz call without the headset connected. Choices are **00** to **FF** (default is **7F**). Idle code is not present on a channel connected to the headset.
- **Binary** check box when selected allows to enter Idle Code in Binary format else it is in Hex format.

## Restore ISDN PRI Defaults

Reverts the current test application to its default factory settings.

## Labels

From the **Test** menu, tap **Setup, Test Configurator**, the interface block, and on the **Labels** tab.

**Note:** *Selecting a Label byte to be generated will automatically update the corresponding OH byte. Refer to OH - SONET/SDH on page 487 for more information.*

### Labels

- **STS/AU Path (C2):** The C2 byte is allocated to indicate the content of the STS SPE / VC, including the status of the mapped payloads.  
**Generated:** Select the C2 byte from the list. Selecting a C2 byte value will automatically update the OH C2 selection and vice versa. Refer to C2 on page 495 for more information.
- **PLM-P/UNEQ-P / HP-PLM/HP-UNEQ:** Enables the Payload Mismatch and STS/AU UNEQ monitoring. This setting is coupled with the configuration of *Traces - SONET/SDH* on page 445.  
**Expected:** Select the expected C2 byte from the list. Refer to C2 on page 495 for more information.
- **VT/TU Path (V5):** The V5 byte is allocated to indicate the content of the VT/TU path, including the status of the mapped payloads.
- **Generated:** Select the V5 byte from the list. Selecting a V5 byte value will automatically update the OH V5 selection and vice versa. Refer to V5 on page 498 for more information.
- **PLM-V/UNEQ-V / LP-PLM/LP-UNEQ:** Enables the Payload Mismatch and VT/TU UNEQ monitoring. This setting is coupled with the configuration on the *Labels* on page 357.
- **Expected:** Select the expected V5 byte from the list. Refer to V5 on page 498 for more information.

## Link OAM

From the test menu, tap **Setup, Test Configurator**, and the **Link-OAM (802.3)** test block.

### OAM Mode

Allows the selection of the OAM mode:

- **Active** (default) initiates the OAM discovery and send OAMPDU loopback control; doesn't respond to variable request nor generate Link Event Notification.
- **Passive** doesn't initiate OAM discovery nor send OAMPDU loopback control.

### OAMPDU Destination MAC Address

Indicates and allows to change the default multicast OAM PDU destination MAC address: **01:80:C2:00:00:02**.

**Default** check box when cleared (default is selected), allows the configuration of the OAM PDU destination MAC address:

**00:00:00:00:00:00** to **FF:FF:FF:FF:FF:FF**.

### Pass/Fail Verdict

**Pass/Fail Verdict** check box when selected (default) enables the use of the pass/fail verdict. A global fail verdict is declared when any of the following condition is met: **Link Down**, any Link OAM alarm, **Remote Alarms** (if enabled), or **Remote Loopback** (if enabled).

- **Remote Alarms** check box when selected (default) considers the following alarms to declare the pass/fail verdict: **Critical Event**, **Dying Gasp**, and **Link Fault**.
- **Remote Loopback** check box when selected (default) considers successful/unsuccessful remote loopback request to declare the pass/fail verdict.

## OAM Discovery Status

- **Local** reports the local OAM discovery status as follows:

| Status      | Description                                                                                                     |
|-------------|-----------------------------------------------------------------------------------------------------------------|
| Evaluating  | OAM discovery is started.                                                                                       |
| Stable      | OAM discovery is completed. Local OAM is satisfied with the remote OAM settings.                                |
| Unsatisfied | OAM discovery cannot complete successfully.<br>Local OAM equipment is unsatisfied with the remote OAM settings. |

- **Remote** reports the remote OAM discovery status as follows:

| Status      | Description                                                                                                     |
|-------------|-----------------------------------------------------------------------------------------------------------------|
| Evaluating  | OAM discovery is started.                                                                                       |
| Stable      | OAM discovery is completed. Remote OAM is satisfied with the local OAM settings.                                |
| Unsatisfied | OAM discovery cannot complete successfully.<br>Remote OAM equipment is unsatisfied with the local OAM settings. |

## Loopback

- **Local and Remote**
- **Status** indicates the status of the local and remote loopback: **Enabled** represents a Looped-Up condition and **Disabled** a Looped-Down condition.
  - **Enable/Disable** button allows to respectively Loop-Up (**Enable**) or Loop-Down (**Disable**).

## MAC/IP/UDP

**Note:** Only available with Framed Layer 2 (see **Framing** from the Modify Frame Structure). For Traffic Gen & Mon all parameters are configurable per stream. For EtherSAM all parameters are configured per service.

From the **Test** menu, tap **Setup, Test Configurator**, and...

- For **RFC 2544** and **EtherBERT**, tap on the protocol block.
- For **EtherSAM**, and **Traffic Gen & Mon**, tap on the protocol block, and on the **MAC/IP/UDP** tab.

### Stream Selection (Traffic Gen & Mon)

The Traffic Gen & Mon test application supports the configuration of up to 16 different streams. Select the stream to be configured by either using the left/right arrow or by tapping over the stream numbers area then tapping on a specific stream number.

### Service Selection (EtherSAM)

The EtherSAM test application supports the configuration of up to 10 different services. Select the service to be configured by either using the left/right arrow or by tapping over the service numbers area then tapping on a specific service number.

### Couple with Interface

The **Frame Format**, **Network Layer**, and all **IP** and **VLAN** settings are coupled with the interface (see *Network* on page 185) when the **Couple with Interface** check box is selected (default). The **Source MAC Address** is always coupled.

## Modify Frame Structure

Allows to modify the structure of the frame.

- **Global Option** is only available with EtherSAM and Traffic Gen & Mon test applications.
  - **S-OAM** check box when selected, enables EtherSAM over service OAM at Layer 2 on all services. The EtherSAM uses LBM and LBR messages of the S-OAM protocol to perform the test. A device having the capability to loopback LBM messages (via LBR) is required at the remote. Only available with EtherSAM. Not available in Dual Test Set.
  - **Layer Mode** sets the frame layer mode for all services (available with EtherSAM when the S-OAM check box is cleared):
    - Mixed** (default) allows configuring the frame layer per service: L2, L3, or L4.
    - L2 Only** configures all services to Layer 2 only (no IP, no MPLS).
  - **IP Version** allows to select **IPv4** (default) or **IPv6** that will be used for both the interface and streams/services.
- **Framing**
  - **Frame Format** (layer 2) allows to select **Ethernet II** (default) or **802.3 SNAP** as the frame format.
  - **Network Layer**<sup>1, 2</sup> (layer 3) sets the network traffic type: **IPv4** (default)/**IPv6**, or **None**.

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1. Not available with EtherSAM when the **S-OAM** check box selected.

2. Not configurable and set to **None** when **Layer Mode** is set to **L2 Only**.

## Test Setup - Test Configurator, Timer, and System

MAC/IP/UDP

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- **Transport Layer**<sup>1</sup> is disabled when the **Network Layer** is **None**.

| Test Application  | Transport Layer          |
|-------------------|--------------------------|
| EtherSAM          | None, UDP (default), TCP |
| RFC 2544          | UDP                      |
| EtherBERT         | UDP (default), TCP       |
| Traffic Gen & Mon | None, UDP (default), TCP |

- **MPLS** - The **MPLS Label** check box, when selected (cleared by default), enables 1 or 2 MPLS labels allowing management and test frames to be transmitted and received. Only available with EtherSAM and Traffic Gen & Mon test applications. Not available with EtherSAM when the S-OAM check box selected or when **Layer Mode** is set to **L2 Only**.
- **VLAN** - The **VLAN Tag** check box when selected (cleared by default), enables up to 3 stacked VLAN.

See *VLAN* on page 176 for additional VLAN settings.

### Preamble/SFD

Indicates that the frame structure contains the Preamble and SFD.

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1. Not available with EtherSAM when the **S-OAM** check box selected.

## MAC

- **Source MAC Address** indicates the default and unique Media Access Control (MAC) address given to the Ethernet port.
- **Destination MAC Address:** Enter the destination MAC address for the stream. The default setting is the source MAC address. The destination MAC Address field is not accessible when the **Resolve MAC Address** check box is selected.
- **Resolve MAC Address** check box, when selected (default), sends a request to the network to retrieve the MAC address corresponding to the selected destination IP address. This setting is coupled with the **Resolve MAC Address** check box from *IP* on page 178. This check box is not available when the **Network Layer** is set to **None** (refer to *Modify Frame Structure* on page 173).
- **OAM Quick Ping** button automatically starts the quick Ping utility for the stream destination MAC address and provides either a successful or failed result. The quick Ping uses 3 attempts, a delay of 1 second, and a Timeout of 5 seconds.
- **EtherType** is set to the following values by default and is configurable from **0x0000** to **0xFFFF** when the **Network Layer** is set to **None**:
  - 0x0000** when **Network Layer** is set to **None**
  - 0x0800** for IPv4
  - 0x86DD** for IPv6
  - 0x8847** for MPLS
  - 0x88B7** when **Network Layer** is set to **None** with EtherBERT test.
  - 0x8902** for S-OAM (available with EtherSAM)

**Note:** Depending on the **Layer Mode** (available with EtherSAM), some **EtherType** require to set the configuration parameters through the **Modify Frame Structure** pop-up instead of configuring its value from this field; in this case a pop-up message is displayed indicating the reason. The following **EtherType** are not supported for **Mixed** layer mode: 0x0001 to 0x05FF and 0x8870.

## Test Setup - Test Configurator, Timer, and System

MAC/IP/UDP

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- **OUI**, available when the frame format **802.3 SNAP** is selected, allows the selection of the Organizationally Unique Identifier (OUI):  
**RFC1042** (0x000000) - (default)  
**User Defined**, available when **Network Layer** is set to **None**, allows to enter the **OUI** value: **0x000000** (default) to **0xFFFFFFFF**.

**Note:** *Source/Destination Flooding and Flood Range are only available with Traffic Gen & Mon when the Network Layer is set to None (see page 173).*

- **Source Flooding** and **Destination Flooding** check boxes when selected (cleared by default) allows generation of frames using source/destination MAC addresses flooding as follows: The first frame is transmitted starting with the least significant bits of the source/destination MAC address covered by the range set to 0; each subsequent frame is transmitted by incrementing the least significant bits by 1; when the upper limit of the range is reached, the source/destination MAC address restarts over with the least significant bits covered by the range set to 0.
- **Flood Range** is the range of the least significant bits used for the Source Flooding and/or Destination Flooding: **2 (1 bit)**, **4 (2 bits)**, **8 (3 bits)**, **16 (4 bits)**... up to **16777216 (24 bits)** (default).

## VLAN

**Note:** *VLAN is only available when the VLAN Tag is enabled; refer to Modify Frame Structure on page 173.*

For each VLAN tag enabled, C-VLAN / S-VLAN / E-VLAN, the following parameters are configurable.

- **VLAN ID** choices are **0** through **4095**; refer to *VLAN ID and Priority* on page 639 for more information.
- **Priority**, VLAN user priority, choices are **0** (default) to **7**. Refer to *VLAN ID and Priority* on page 639 for more information.

- **Type**, VLAN Ethernet Type, choices are **8100** (default for C-VLAN), **88A8** (default for S-VLAN), **9100** (default for E-VLAN), **9200**, and **9300**.
- **Drop Eligible**:, when set to **Yes** (DEI = 1), the transmitted frames will be dropped first on receipt when congestion occurs under test. Drop Eligible is not available when VLAN type is 8100. This parameter is set to **No** by default.

## MPLS

**Note:** *MPLS is only available when the MPLS Label is enabled; refer to Modify Frame Structure on page 173.*

- **Label** allows the selection of the MPLS TX labels: **0** to **1048575** (default is **16**). Refer to for the list of MPLS labels.
- **COS** allows the selection of the Class Of Service.
  - 0 (000 - Low)** (default)
  - 1 (001 - Low)**
  - 2 (010 - Low)**
  - 3 (011 - Low)**
  - 4 (100 - High)**
  - 5 (101 - High)**
  - 6 (110 - High)**
  - 7 (111 - High)**
- **TTL** allows the selection of the **Time to Live** value: **0** to **255** (default is **128**).

## S-OAM

**Note:** *S-OAM is only available with EtherSAM when the **S-OAM** check box is selected; refer to Modify Frame Structure on page 173.*

**MEG/MD Level** allows the selection of the Maintenance Entity Group Level / Maintenance Domain Level: **0** to **7** (default).

## IP

For **IPv4** the following configuration parameters are available.

- **Automatic IP (DHCP)** check box, when selected (cleared by default), allows to dynamically obtain an IP address from a DHCP (Dynamic Host Configuration Protocol) server.
- **Source IP Address** allows to enter the source IP address for the stream. The default setting is 10.10.x.y, where x and y are respectively the two least significant bytes of the port default MAC address. Not available when the **Automatic IP (DHCP)** check box is selected.
- **Destination IP Address** allows to enter the destination IP address for the stream. The default setting is the source IP address.

For **IPv6** the following configuration parameters are displayed: **Source Link-Local IPv6 Address**, and **Source Global IPv6 Address**. Tap on the **IPv6 Config** button to access all settings.

- **Link-Local IPv6 Address** (LLA) is used for local communication between on-link neighbors and for Neighbor Discovery process.
  - **Mode**
    - Stateless Auto** (default) allows automatic generation of the IPv6 address based on the MAC address.
    - Static** allows to enter the IP Address.
  - **Address**, available with **Static** mode, allows to select the Link-Local IPv6 Address. The accepted range is from **FE80:0000:0000:0000:0000:0000:0000** to **FE80:0000:0000:0000:FFFF:FFFF:FFFF:FFFF**. The default address is **FE80::[Interface ID]**, where **[Interface ID]** is generated from the source MAC address. When the **Address** field is selected for editing using virtual keyboard, the **Previous IPs** button appears allowing to select a previously configured IP address.

- **Global IPv6 Address** (GUA) is used to communicate with on-link neighbors and for global communication with hosts outside the subnet.
- **Mode**
  - None** disables the **Global IPv6 Address** and the **Default Gateway Address**.
  - Stateless Auto** (default) allows automatic generation of the IPv6 address based on the Link-Local address interface ID and the prefix obtained from the router advertisements. If no Interface ID has been obtained for the **Link Local Address**, the global address will not be generated.
  - Static** allows to enter the IP address.
- **Address**, available with **Static** mode, allows to select the **Global IPv6 Address**. The accepted range is from **0000:0000:0000:0000::[Interface ID]** to **FFFF:FFFF:FFFF:FFFF::[Interface ID]**. The default address is **2001:0000:0000:0000::[Interface ID]**, where **[Interface ID]** is generated from the source MAC address. When the **Address** field is selected for editing using virtual keyboard, the **Previous IPs** button appears allowing to select a previously configured IP address.
- **Interface ID Coupled**, available when the **Source Global IPv6 Address** mode is **Static**, allows to couple the interface ID of the Global address to the Link-Local source address.
  - Enabled** (default): Only the 64 bit (MSB) prefix ID in the IPv6 address is configurable, and the 64 bit (LSB) Interface ID is not configurable (read-only).
  - Disabled**: The 64 bit (MSB) Prefix ID and 64 bit (LSB) Interface ID in the IPv6 address are configurable.

- **Prefix Mask**, available with **Static** mode, allows to specify a prefix that defines the subnet. The accepted range is **0000:0000:0000:0000:0000:0000:0000** to **FFFF:FFFF:FFFF:FFFF:0000:0000:0000:0000**. For example:  
  
Global Address: 2001:0DB8:0001:0002:02AA:00FF:FE11:1111  
Prefix Mask: FFFF:FFFF:FFFF:0000:0000:0000:0000:0000  
Corresponding Prefix: 2001:0DB8:0001.
- **Default Gateway** allows the configuration of the default gateway address to forward packets outside the subnet.
- **Mode**  
  
**Automatic** (default) allows automatic selection of the default gateway.  
  
**Static** allows entering the default gateway IP address.
- **Address**, available with **Static** mode, allows to enter the IP address of the Default Gateway. The accepted range is from **0000:0000:0000:0000:0000:0000:0000** to **FE80:0000:0000:0000:FFFF:FFFF:FFFF:FFFF**. The default address is **FE80:0000:0000:0000:0000:0000:0000**.
- **IPv6 Destination Address** allows to select the destination IP address for the stream that must start with **FE80**. The accepted range is from **0000:0000:0000:0000:0000:0000:0000:0001** to **FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF**. The default address is **2001::**. When the **Address** field is selected for editing using virtual keyboard, the **Previous IPs** button appears allowing to select a previously configured IP address.

The following configuration parameters are available for both **IPv4** and **IPv6** unless otherwise specified.

- **Quick Ping** button automatically starts the quick Ping utility for the stream destination IP address and provides either a successful or failed result. The quick Ping uses 3 attempts, a Delay of 1 second, a Timeout of 2 seconds, and a Data Size of 32 Bytes. Refer to *Ping & Trace Route* on page 501 for more options.
- **Resolve MAC Address** check box, when selected (default), sends a request to the network to retrieve the MAC address corresponding to the selected destination IP address. This setting is coupled with the Resolve MAC Address check box from *MAC* on page 175. The Resolve MAC address status is displayed. Possible status are:

| Status           | Description                                    |
|------------------|------------------------------------------------|
| --               | The <b>Resolve MAC address</b> is not enabled. |
| <b>Resolving</b> | The MAC address is being resolved.             |
| <b>Resolved</b>  | The MAC address is resolved.                   |
| <b>Failed</b>    | The MAC address cannot be resolved.            |

- **Source IP Multiplier** check box, when selected (cleared by default), allows changing the 7 LSB (Least Significant bit) of the source IP address as specified in the range: **1-128** (default) or **0-127**.
- **Subnet Mask** (IPv4) allows to enter the Subnet Mask for the stream. The default setting is **255.255.0.0**. Not available when the **Automatic IP (DHCP)** check box is selected.
- **Default Gateway** (IPv4) check box, when selected (cleared by default), allows to enter a default Gateway IP address. When the **Default Gateway** check box is selected, its default address is **0.0.0.0**. The **Default Gateway** address is not configurable when the **Automatic IP (DHCP)** check box is selected.

- **TTL (IPv4) or HOP Limit TTL (IPv6)** sets the Time To Live value: **1** to **255** (default is **128**).
- **Flow Label (IPv6)** is a number used to identify a series of related packets from a source to a destination: **0** (default) to **1048575**.
- **IP TOS/DS (IPv4) or Traffic Class (TOS/DS) - (IPv6)** allows to enter either an hexadecimal value, **00** (default) to **FF**, or tap on the **TOS/DS Config** button to set each TOS or DS parameter individually. Changing the **IP TOS/DS** value will affect the **TOS/DS Config** settings and vice versa.
- **TOS/DS Config** button allows to set the Type of Service or the Differentiated Service parameters.

#### TOS/DS

- **TOS/DS** allows to select either Type Of Service (TOS) or Differentiated Services (DS).
- **Binary/Hex** allows to display, once this pop-up is closed, the IP TOS/DOS value either in binary or hexadecimal.

**Type Of Service** (available when **TOS** is selected).

- **Precedence** value:
  - 000 (Routine)** (Default)
  - 001 (Priority)**
  - 010 (Immediate)**
  - 011 (Flash)**
  - 100 (Flash Override)**
  - 101 (CRITIC/ECP)**
  - 110 (Internet Control)**
  - 111 (Network Control)**
- **Delay** allows the selection of the delay level: **Normal** (default) or **Low**.
- **Throughput** allows the selection of the throughput level: **Normal** (default) or **High**.

- **Reliability** allows the selection of the reliability level: **Normal** (default) or **High**.
- **Monetary Cost** allows the selection of the monetary cost level: **Normal** (default) or **Low**.
- **Reserved Bit** allows the selection of the reserved bit value: **0** (default) or **1**.

**Differentiated Services** (available when **DS** is selected).

- **DSCP Codepoints:**  
**000000 (CS0)** (default), **001000 (CS1)**, **010000 (CS2)**,  
**011000 (CS3)**, **100000 (CS4)**, **101000 (CS5)**, **110000 (CS6)**,  
**111000 (CS7)**, **001010 (AF11)**, **001100 (AF12)**, **001110 (AF13)**,  
**010010 (AF21)**, **010100 (AF22)**, **010110 (AF23)**, **011010 (AF31)**,  
**011100 (AF32)**, **011110 (AF33)**, **100010 (AF41)**, **100100 (AF42)**,  
**100110 (AF43)**, **101110 (EF)**, **110011 (51)**, **110110 (54)**, or  
**User Defined**.
- **User Defined Codes**, available when **User Defined** has been selected from the **DSCP codepoints**, allows to enter a user defined code from hexadecimal **00** (default) to **3F** once the **TOS/DS Config** pop-up is closed.
- **ECN** allows the selection of the Explicit Congestion Notification code: **00 (Not-ECT)** (default), **01 (ECT-1)**, **10 (ECT 0)**, or **11 (CE)**.

#### UDP

Allows the selection of the source and destination UDP port number.

- **Source Port** is configurable from **0** to **65535**; the default is **49184**.
- **Destination Port** is configurable from **0** to **65535**; the default is **7 (echo)**.

#### TCP

Allows the selection of the source and destination TCP port number.

- **Source Port** is configurable from **0** to **65535**; the default is **49184**.
- **Destination Port** is configurable from **0** to **65535**; the default is **7 (echo)**.

#### Payload

For RFC 2544 and EtherBERT, indicates that the frame structure contains a Payload.

For Traffic Gen & Mon, allows the selection of both user defined header and pattern. Payload is not configurable when the **QoS Metrics Tags Insertion** check box is selected (see the **Global** tab).

- **User Defined Header** check box when selected (cleared by default) allows to define a 16-byte header.
- **Pattern** allows the selection of a pattern: **00** to **FF** (default is **CC**).

#### FCS

Indicates that the frame structure contains an Ethernet FCS.

### Network

From the test menu tap **Setup**, **Test Configurator**, the interface block, and the **Network** tab.

**Note:** *For Through Mode test application, the Network tab is only available for the Primary Port but the configured parameters apply to both ports.*

#### MAC

- **MAC Address** indicates and allows to change, when the **Factory Default** check box is cleared, the default and unique Media Access Control (MAC) address given to the Ethernet port.
- **Factory Default** check box, when selected (default), indicates that the factory source MAC address is used.
- **Frame Format** (layer 2) allows to select **Ethernet II** (default) or **802.3 SNAP** as the frame format.

## IP

**IP Version** allows the selection of either **IPv4** (default) or **IPv6**. Only IPv4 is supported for TCP Throughput test application.

For **IPv4** the following configuration parameters are available.

- **Automatic IP (DHCP)** check box, when selected (cleared by default), allows to dynamically obtain an IP address from a DHCP (Dynamic Host Configuration Protocol) server.
- **IP Address**<sup>1</sup>: Enter the IP address of the port. The default setting is 10.10.x.y, where x and y are respectively the two least significant bytes of the port default MAC address.
- **Subnet Mask**<sup>1</sup>: Enter the Subnet Mask. The default setting is **255.255.000.000**.
- **Default Gateway**<sup>1</sup> check box, when selected (cleared by default), allows to enter a default Gateway IP address. When the **Default Gateway** check box is selected, its default address is **0.0.0.0**.

---

1. Not configurable when the **Automatic IP (DHCP)** check box is selected.

For **IPv6** the following configuration parameters are displayed: **Link-Local IPv6 Address**, **Global IPv6 Address**, and **Default Gateway**. Tap on the **Config** button to access all settings.

- **Link-Local IPv6 Address** (LLA) is used for local communication between on-link neighbors and for Neighbor Discovery process.
  - **Mode**

**Stateless Auto** (default) allows automatic generation of the IPv6 address based on the MAC address.

**Static** allows to enter the IP Address.
  - **Address**, available with **Static** mode, allows to select the Link-Local IPv6 Address. The accepted range is from **FE80:0000:0000:0000:0000:0000:0000:0000** to **FE80:0000:0000:0000:FFFF:FFFF:FFFF:FFFF**. The default address is **FE80::[Interface ID]**, where **[Interface ID]** is generated from the source MAC address. When the **Address** field is selected for editing using virtual keyboard, the **Previous IPs** button appears allowing to select a previously configured IP address.

- **Global IPv6 Address** (GUA) is used to communicate with on-link neighbors and for global communication with hosts outside the subnet.
- **Mode**
  - None** disables the **Global IPv6 Address** and the **Default Gateway Address**.
  - Stateless Auto** (default) allows automatic generation of the IPv6 address based on the Link-Local address interface ID and the prefix obtained from the router advertisements. If no Interface ID has been obtained for the **Link Local Address**, the global address will not be generated.
  - Static** allows to enter the IP address.
- **Address**, available with **Static** mode, allows to select the **Global IPv6 Address**. The accepted range is from **0000:0000:0000:0000::[Interface ID]** to **FFFF:FFFF:FFFF:FFFF::[Interface ID]**. The default address is **2001:0000:0000:0000::[Interface ID]**, where **[Interface ID]** is generated from the source MAC address. When the **Address** field is selected for editing using virtual keyboard, the **Previous IPs** button appears allowing to select a previously configured IP address.
- **Interface ID Coupled**, available when the **Source Global IPv6 Address** mode is **Static**, allows to couple the interface ID of the Global address to the Link-Local source address.
  - Enabled** (default): Only the 64 bit (MSB) prefix ID in the IPv6 address is configurable, and the 64 bit (LSB) Interface ID is not configurable (read-only).
  - Disabled**: The 64 bit (MSB) Prefix ID and 64 bit (LSB) Interface ID in the IPv6 address are configurable.

- **Prefix Mask**, available with **Static** mode, allows to specify a prefix that defines the subnet. The accepted range is **0000:0000:0000:0000:0000:0000:0000** to **FFFF:FFFF:FFFF:FFFF:0000:0000:0000:0000**. For example:  
  
Global Address: 2001:0DB8:0001:0002:02AA:00FF:FE11:1111  
Prefix Mask: FFFF:FFFF:FFFF:0000:0000:0000:0000:0000  
Corresponding Prefix: 2001:0DB8:0001.
- **Default Gateway** allows the configuration of the default gateway address to forward packets outside the subnet.
- **Mode**  
  
**Automatic** (default) allows automatic selection of the default gateway.  
  
**Static** allows entering the default gateway IP address.
- **Address**, available with **Static** mode, allows to enter the IP address of the Default Gateway. The accepted range is from **0000:0000:0000:0000:0000:0000:0000** to **FE80:0000:0000:0000:FFFF:FFFF:FFFF:FFFF**. The default address is **FE80:0000:0000:0000:0000:0000:0000**.

## VLAN

**VLAN Tag** check box, when selected (cleared by default), enables and allows to set up to 3 stacked VLANs.

For each VLAN tag enabled, C-VLAN / S-VLAN / E-VLAN, the following parameters are configurable.

- **VLAN ID** choices are **0** through **4095**; refer to *VLAN ID and Priority* on page 639 for more information.
- **Priority**, VLAN user priority, choices are **0** (default) to **7**. Refer to *VLAN ID and Priority* on page 639 for more information.
- **Type**, VLAN Ethernet Type, choices are **0x8100** (default for C-VLAN), **0x88A8** (default for S-VLAN), **0x9100** (default for E-VLAN), **0x9200**, and **0x9300**.
- **Drop Eligible**, when set to **Yes** (DEI = 1), the transmitted frames will be dropped first on receipt when congestion occurs under test. Drop Eligible is not available when VLAN type is 8100. This setting is set to **No** by default.

## Network Details (iSAM)

Either select the Layer parameter, the number of services, for each service the profile and CIR settings, or click on **More** for all settings. The total bandwidth (when the **Performance Test** is enabled) and the estimated test duration are also displayed.

From the **Test** menu, tap **Setup**, **Test Configurator**, and the **More** button from the **Network** block.

### iSAM

- **Layer** is the layer used for all services. The layer is fixed to **L3/L4** when the **RFC 6349 Test** is enabled.
  - **L2** (default) for Ethernet II.
  - **L3/L4** for Ethernet II, IP (IPv4), and respectively UDP for the Configuration and Performance subtests, and TCP for RFC-6349 subtest.
- **Classification** defines the traffic classification used in the provider network: **VLAN ID**, **VLAN Priority**, or **DSCP** (available with layer L3/L4).

**Note:** *At least one check box (**Configuration Test**, or **Performance Test**, or **RFC 6349 Test**) has to be selected.*

- **Configuration Test** check box when selected (default) verifies if the network configuration is correct for each service before starting a long term test (Performance Test).

Set the **Configuration Test** duration in seconds per step enabled (CIR and CIR+EIR): 5 seconds (default) to 60 seconds.

## Test Setup - Test Configurator, Timer, and System

### Network Details (iSAM)

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- **Performance Test** check box when selected (default) verifies that the SLA parameters (FD, IFDV, and FLR) are met over time by running multiple services simultaneously. Results are measured and compared to the configured thresholds to declare the pass/fail verdicts. The **Performance Test** is only performed for services that have their **CIR** check box selected.

Set the **Performance Test** duration in hh:mm format: 1 minute to 24 hours (default is 10 minutes).

- **RFC 6349 Test on Service 1** check box when selected (cleared by default) verifies that the Ethernet service is able to properly carry TCP traffic; **Service 1** is used to performed the RFC 6349 test. Enabling the **RFC 6349 Test on Service 1** automatically set the operation mode to DTS and the layer to **L3/L4**; direction is bidirectional, max MTU is 1500 bytes, multiple connections as well as Path MTU Discovery are enabled.

Duration: The field next to the **RFC 6349 Test on Service 1** check box is used to set the duration of the TCP Throughput phase per direction in hh:mm format: 1 minute (default) to 24 hours.

**Threshold (% of ideal)** allows to enter the TCP Throughput as a percentage of the Ideal L4 Throughput that will be used to declare the pass/fail verdict for both directions: **0** to **100%**; default is 95%.

## Services

Allows the selection of the number of services: **1** (default) to **4**.

The following parameters are configurable individually for each service:

### ► Profile

Two profiles are defined by default as well as **User Profile**. Profiles are user definable and up to 25 profiles can be predefined (see *Customizable Profiles* on page 198).

| Profile     | Parameter  |                                           |               |                  |                      |
|-------------|------------|-------------------------------------------|---------------|------------------|----------------------|
|             | Frame Type | Frame Sizes                               | VLAN Priority | DSCP             | Performance Criteria |
| Priority    | EMIX       | 64, 128, 512, 1024, and 1518 <sup>a</sup> | 7             | CS7 <sup>b</sup> | MEF Metro High       |
| Best Effort |            |                                           | 0             | CS0 <sup>b</sup> | MEF Metro Low        |

- a. The minimum frame size value is adjusted according to the frame structure and components selected as shown in the table of *Frame Size* on page 195.
- b. ECN is not present and not configurable but is set to 00 (Not-ECT).

## Test Setup - Test Configurator, Timer, and System

### Network Details (iSAM)

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**Note:** *At least one check box (**CIR** or **CIR+EIR**) has to be selected. Thus, clearing the CIR check box while CIR+EIR check box is cleared, will automatically select the CIR+EIR check box and vice versa.*

**Note:** *For Dual Test Set, the CIR and CIR+EIR values are the same (Symmetric) for both **L->R** and **R->L** directions.*

- **CIR** (Mbit/s) (Committed Information Rate) check box when selected (default) sets the service rate guaranteed by the SLA (default is **1 Mbit/s**).
- **CIR+EIR** (Mbit/s) check box when selected (cleared by default) sets the best effort allowed traffic for the service. The EIR (Excess Information Rate) value is equal to the CIR+EIR value minus CIR (default is 1.5 Mbit/s). The threshold value is configurable from the defined CIR value for this service to the line rate minus the total CIR from all services.
- **Frame Type** allows the selection of the frame type and frame size(s).
  - **Frame types** choices are: **Fixed** and **EMIX**.

**Fixed** allows to set a single frame size.

**EMIX** allows to set up to 8 EMIX frame sizes. The EMIX frame sequence is repeated until the test ends. Default are **64**, **128**, **512**, **1024**, and **1518**.

**Quantity**, available with **EMIX**, allows to select the number of EMIX frame sizes: 2 to 8 frames (default is **5**).

## ➤ Frame Size

| Type            | Frame Size (bytes)                              |
|-----------------|-------------------------------------------------|
| Fixed (default) | 64 <sup>a</sup> (default) to 16000 <sup>b</sup> |
| EMIX            | 64 <sup>a</sup> to 16000 <sup>b</sup>           |

- The minimum value is adjusted according to the frame structure and components selected as shown in the following table.
- The maximum frame size is limited to 10000 for 10/100/1000Mbps electrical interface.

The following table lists each component that may affect the minimum frame size value.

| Component       | Description |
|-----------------|-------------|
| C-VLAN          | 4 bytes     |
| UDP             | 8 bytes     |
| Ethernet Header | 14 bytes    |
| IPv4            | 20 bytes    |
| Using DTS       | 4 bytes     |

**Note:** *Sending traffic with frame size > 1518 in switched network may results in losing theses frames.*

## Test Setup - Test Configurator, Timer, and System

### Network Details (iSAM)

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#### ► Classification

Allows the selection of the value for the selected classification:

| Classification | Value                                                                                                                                                                                                                                                                                                                                                |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| VLAN ID        | 0 through 4095 (default is 2).<br>Refer to <i>VLAN ID and Priority</i> on page 639.                                                                                                                                                                                                                                                                  |
| VLAN Priority  | 0 (default) to 7.<br>Refer to <i>VLAN ID and Priority</i> on page 639.                                                                                                                                                                                                                                                                               |
| DSCP           | 000000 (CS0) (default), 001000 (CS1), 010000 (CS2), 011000 (CS3), 100000 (CS4), 101000 (CS5), 110000 (CS6), 111000 (CS7), 001010 (AF11), 001100 (AF12), 001110 (AF13), 010010 (AF21), 010100 (AF22), 010110 (AF23), 011010 (AF31), 011100 (AF32), 011110 (AF33), 100010 (AF41), 100100 (AF42), 100110 (AF43), 101110 (EF), 110011 (S1), 110110 (S4). |

### ► Performance Criteria

The following performance criteria are available by default:

| Name                 | ≤ FD (ms) | ≤ IFDV (ms) | ≤ FLR (%) |
|----------------------|-----------|-------------|-----------|
| MEF Metro High       | 10        | 3           | 0.01      |
| MEF Metro Med        | 20        | 8           | 0.01      |
| MEF Metro Low        | 37        | Disabled    | 0.1       |
| MEF Regional High    | 25        | 8           | 0.01      |
| MEF Regional Med     | 75        | 40          | 0.01      |
| MEF Regional Low     | 125       | Disabled    | 0.1       |
| MEF Continental High | 77        | 10          | 0.025     |
| MEF Continental Med  | 115       | 40          | 0.025     |
| MEF Continental Low  | 230       | Disabled    | 0.1       |
| MEF Global High      | 230       | 32          | 0.05      |
| MEF Global Med       | 250       | 40          | 0.05      |
| MEF Global Low       | 390       | Disabled    | 0.1       |

**User Performance** allows the configuration of the following values per service:

- **FD (Latency): 0.015 to 8000 ms** (default is **15 ms**).
- **IFDV (Jitter): 0.015 to 8000 ms** (default is **2 ms**).
- **FLR (Frame Loss): 0 to 5%** (default is **0.1%**).

**Note:** The **Performance Criteria** list is user definable and up to 25 Performance criteria can be created (see Customizable Performance Criteria on page 200).

## Customizable Profiles

As mentioned above, 2 profiles are available by default and up to 25 profiles can be predefined by editing the profile's text file (iSAMProfilesTemplate.ini) using a word processor like **Notepad**. The file is located under

Documents and Settings\All Users\Application Data\EXFO\ProtocolProducts\.

Example of profile's text file:

```
[Priority]
Frame Type = EMIX
Frame Size = 64, 128, 512, 1024, 1518
VLAN Priority = 7
DSCP = CS7
Performance Criteria = MEF Metro High

[Best Effort]
Frame Type = EMIX
Frame Size = 64, 128, 512, 1024, 1518
VLAN Priority = 0
DSCP = CS0
Performance Criteria = MEF Metro Low
```

Each profile entry has the following parameters.

- **Profile Name:** 1 to 16 characters. All ASCII characters from 32 to 126 decimal are supported.
- **Frame Type:** Enter **Fixed** or **EMIX**. When the frame type is missing from a profile, **EMIX** is used.
- **Frame Size** (see *Frame Size* on page 195 for possible values); when the frame size is missing from a profile, default value(s) is used:  
For **Fixed**: Enter a unique frame size.  
For **EMIX**: Enter 2 to 8 frame sizes with a comma between each entry.
- **VLAN Priority**<sup>1</sup> (optional): Enter the priority number.
- **DSCP**<sup>1</sup> (optional): Enter either the DSCP name or its binary value.
- **Performance Criteria**<sup>1</sup>: Enter the name of the performance criteria. When the **Performance Criteria** is missing from a profile or is not available from the user profile file, the **User Performance** criteria is used.

When a parameter is missing from a profile, the default value of the missing parameter is used.

The value of a parameter is validated to ensure it is within the supported range; otherwise the profile entry is unsupported.

If the profile file contain more than 25 profiles, only the first 25 valid profiles are retained.

---

1. See *Classification* on page 196 for possible values.

## Customizable Performance Criteria

As mentioned above, factory performance criteria are available and up to 25 performance criteria can be defined by editing the performance criteria text file (iSAMPerformanceCriteriaTemplate.ini) using a word processor application like **Notepad**. The file is located under

Documents and Settings\All Users\Application Data\EXFO\ProtocolProducts\.

Example of performance criteria's text file:

```
[MEF Metro High]
FD = 10
IFDV = 3
FLR = 0.01

[MEF Metro Med]
FD = 20
IFDV = 8
FLR = 0.01

[MEF Metro Low]
FD = 37
IFDV =
FLR = 0.1
```

Each profile entry has the following parameters:

- Performance Criteria Name: 1 to 16 characters. All ASCII characters from 32 to 126 decimal are supported.
- Frame Delay (FD) Threshold: 0.015 ms to 8000 ms.
- Inter-Frame Delay (IFDV) Threshold: 0.015 ms to 8000 ms.
- Frame Loss Ratio (FLR) Threshold: 0% to 5%.

If the threshold value for a parameter is not defined, it is considered as disabled (as in the example above for IFDV =).

The value of a parameter is validated to ensure it is within the supported range; otherwise the performance criteria entry is unsupported.

## Remote Details (iSAM)

The remote block automatically scan the remote modules for **DTS** and **Remote Loopback** modes and allows the selection of the remote module that is used to loop back the traffic via **Smart Loopback** or EtherSAM in **Dual Test Set** (DTS) mode for simultaneous bidirectional results. The number module available for remote connection is displayed. If the connection with the remote module is not manually established, the remote connection process is automatically performed when starting the test.

From the **Test** menu, tap **Setup, Test Configurator**, and the **More** button from the **Remote** block.

**Note:** *Not available with **Manual Loopback** remote operation mode.*

## For both DTS and Remote Loopback Operation Modes

### ➤ Discovered Remotes

The modules are discovered dynamically and listed with their **Name**, **IP** address, **Status**, **Connection**, and **Preferred** information. **Name** and **Status** are only available for remote FTB-700G/800 Series, FTB-800v2 Series, and FTB-88000 Series, modules. Only modules from the same subnet are automatically discovered. To access a module from a different subnet, use the **Add** button.

- **Preferred** check box when selected indicates that this module is part of the preferred module's list. Preferred remote modules will be considered first during the automatic connection process as follows:

| Priority | Preferred or not | Status           |
|----------|------------------|------------------|
| 1        | Preferred        | Available        |
| 2        |                  | Taken            |
| 3        |                  | Test in Progress |
| 4        | Non Preferred    | Available        |
| 5        |                  | Taken            |
| 6        |                  | Test in Progress |

- **Status**

| Background Color | Status           | Description                        |
|------------------|------------------|------------------------------------|
| Green            | Ready            | Connected with the local unit      |
|                  | Running          |                                    |
| Yellow           | Taken            | Connected with another unit        |
| Red              | Test in Progress | Test in progress with another unit |
| No color         | Unreachable      | Preferred remote does not reply    |
|                  | Available        | Not connected                      |

- **Connection** indicates **Connected** when the local unit is connected to a remote module.
- **Add** button is used to add a preferred remote module to the preferred list. Enter the IP address of the remote module and tap **OK**. This is useful to access a module from a different subnet.

### For Remote Loopback Operation Mode

- **Loop-Up** button establishes the connection with the selected remote module and sets the remote module into **Smart Loopback** test application.

Following a successful loop-up, the IP address of the remote module will be used as the destination IP address for the test.

- **Overtake** button manually establishes the connection with the remote module and set the remote module into Smart Loopback test application. Available when the status is **Taken** or **Test in Progress** with another unit. A confirmation is required to overtake a module.
- **Loop-Down** button ends the connection between the local and the remote modules.

### For DTS Operation Mode

- **Connect** button manually establishes the connection with the selected remote module and sets the remote module into DTS EtherSAM test application.

Following a successful connection, the IP address of the remote module will be used as the destination IP address for the test.

- **Overtake** button manually establishes the connection with the remote module and set the remote module into DTS EtherSAM test application. Available when the status is **Taken** or **Test in Progress** with another unit. A confirmation is required to overtake a module.

Following a successful connection, the IP address of the remote module will be used as the destination IP address for the test.

- **Disconnect** button, available once the connection with the remote module is established, terminates the connection with the remote module. Available when the status is **Ready**.

### For Manual Loopback Operation Mode

- **MAC**, available with layer L2, allows to enter the destination MAC address of the remote.
- **IP**, available with L3/L4, allows to enter the destination IP address of the remote.
- Resolved MAC address status, available with L3/L4, indicates:
  - **Resolving** when the ARP process is resolving.
  - **Resolved** when the ARP process is resolved.
  - **Failed** when the ARP process failed.
- **Quick Ping**, available with layer L3/L4, tests if the destination IP address can be reached. A message displays if the ping attempt is **Successful** or **Failed**.

# RFC 2544 - Global

From the **Test** menu, tap **Setup, Test Configurator**, tap on the RFC 2544 block, and on the **Global** tab.

## Dual Test Set

- **Dual Test Set (DTS)** check box when selected (cleared by default) enables RFC 2544 **Dual Test Set**. Once **Dual Test Set** is enabled, use the **Discover Remote** button to select a remote unit.

**Note:** *Alternatively it is possible to use the Discover Remote button to connect to a remote module and automatically enable the **Dual Test Set**. For more details, refer to Discover Remote Button on page 530.*

**Disconnected** indicates that there is no connection established with a remote module.

**Connected** indicates that the connection is established with a remote module.

- **Discover Remote** button allows to discover remote modules supporting **Remote Loopback** and/or **Dual Test Set**. For more details, refer to *Discover Remote Button* on page 530.

## Global Options

- **Flow Direction** allows the selection of the traffic direction as follows:
  - **TX to RX** for **Single Port** topology.
  - **Local to Remote, Remote to Local, and Bidirectional** for **Dual Test Set**.
- **Rate Unit** determines the unit used to display the rate values: %, **Mbit/s**, or **Gbit/s**.
- **Pass/Fail Verdict** check box when selected (default) enables the use of the pass/fail verdict.

## Subtests and Estimated Time

- **Subtests** allows to individually enable the **Throughput**, **Back-to-Back**, **Frame Loss**, and **Latency** subtests.
- **Estimated Time (H:MM)** indicates the estimated time required to complete each subtest at best conditions. The total estimated time to complete all subtests is also displayed.

## Frame Distribution

- **Frame Distribution** allows to select either **RFC 2544** (default) or **User Defined** distribution.
- **Quantity** is only available when **User Defined** is selected and allows to select the number of frames, from **1** to **10** (**7** by default), in the distribution.
- **Frame Size (Bytes)**: For **RFC 2544** distribution, gives predefined frame size distribution values. For **User Defined** distribution, enter up to seven frame size values.

| Distribution | Frame Size                                            |
|--------------|-------------------------------------------------------|
| RFC 2544     | 64 <sup>a</sup> , 128, 256, 512, 1024, 1280, and 1518 |
| User Defined | 64 <sup>a</sup> to 16000 <sup>b</sup>                 |

- The minimum frame size will be adjusted according to the frame structure and components selected.
- The maximum frame size is limited to 10000 for 10/100/1000Mbps electrical interface.

## Test Setup - Test Configurator, Timer, and System

### *RFC 2544 - Global*

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The following table lists each component that may affect the minimum size value.

| Component            | Description                              |
|----------------------|------------------------------------------|
| VLAN                 | 4 bytes per VLAN tag (up to 3 VLAN tags) |
| LLC and SNAP Headers | 8 bytes                                  |
| IPv4                 | 20 bytes                                 |
| IPv6                 | 40 bytes                                 |
| Using DTS            | 4 bytes                                  |

## Restore RFC 2544 Defaults

Reverts the configured parameters to their default values.

## RFC 2544 - Subtests

From the **Test** menu, tap **Setup**, **Test Configurator**, tap on the RFC 2544 block. and on the **Subtests** tab.

Allows the configuration of each enabled subtest.

### Throughput

The objective of this test is to find the throughput of the device under test for which there is no frame loss. Starting at the specified maximum rate (**Max. Rate**), the rate converges towards the highest throughput without frame loss. The search is done with a halving/doubling method until a final value is reached. The throughput measurement is validated the number of times specified (**Validations**) for the predefined duration (**Trial Duration**). The **Accuracy** setting specifies how precise the result must be. The test is performed for each defined frame size.

- **Max. Rate** is the maximum rate the test should begin with, in terms of a percentage of the line rate (%), **Mbit/s**, or **Gbit/s**. For **Dual Test Set** Max. Rate is configurable for both local to remote (**L->R**) and remote to local (**R->L**) directions.

| Interface Speed      | Max. Rate                       |                                |                                 |
|----------------------|---------------------------------|--------------------------------|---------------------------------|
|                      | %                               | Mbit/s                         | Gbit/s                          |
| 10 Mbit/s            | 0.0050 to 100.0000 <sup>a</sup> | 0.00001 to 10.000 <sup>a</sup> | Not Applicable                  |
| 100 Mbit/s           | 0.0050 to 100.0000 <sup>a</sup> | 0.0001 to 100.000 <sup>a</sup> | Not Applicable                  |
| 1000 Mbit/s          | 0.0050 to 100.0000 <sup>a</sup> | 0.001 to 1000.00 <sup>a</sup>  | 0.000001 to 1.000 <sup>a</sup>  |
| 10G LAN              | 0.0050 to 100.0000 <sup>a</sup> | 0.01 to 10000.000 <sup>a</sup> | 0.00001 to 10.000 <sup>a</sup>  |
| 10G WAN <sup>b</sup> | 0.0005 to 92.8571 <sup>a</sup>  | 0.01 to 9285.71 <sup>a</sup>   | 0.00001 to 9.28571 <sup>a</sup> |

a. Default value.

b. The maximum value for 10G WAN may be lower depending on the frame size. The maximum value will be adjusted for each frame size.

## Test Setup - Test Configurator, Timer, and System

### RFC 2544 - Subtests

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- **Trial Duration** is the time for each trial in minutes:seconds: **1** second (default) to **30** minutes.
- **Accuracy** is the accuracy measurement in percentage of the line rate (%), **Mbit/s**, or in **Gbit/s**. The accuracy is not based on the configured **Maximum Rate** but on the Ethernet line rate. The accepted values are as follows:

| Interface Speed | %                            | Max. Rate                          |                                   |
|-----------------|------------------------------|------------------------------------|-----------------------------------|
|                 |                              | Mbit/s                             | Gbit/s                            |
| 10 Mbit/s       | 0.1 to 10.0<br>(default 1.0) | 0.01 to 1.0<br>(default 0.10)      | Not Applicable                    |
| 100 Mbit/s      | 0.1 to 10.0<br>(default 1.0) | 0.1 to 10.0<br>(default 1.0)       | Not Applicable                    |
| 1000 Mbit/s     | 0.1 to 10.0<br>(default 1.0) | 1 to 100.0<br>(default 10)         | 0.001 to 0.100<br>(default 0.010) |
| 10G LAN         | 0.1 to 10.0<br>(default 1.0) | 10.0 to 1000.0<br>(default 100)    | 0.01 to 1.00<br>(default 0.10)    |
| 10G WAN         | 0.1 to 10.0<br>(default 1.0) | 10.0 to 1000.0<br>(default 100.00) | 0.01 to 1.00<br>(default 0.1)     |

- **Validations** represents the number of times the result should be validated: **1** (default) to **50** times.

### Back-to-Back

The objective of this test is to find the maximum number of frames that can be sent at maximum throughput without frame loss. A burst of frames (**Burst Time**) is sent with minimum inter-frame gaps to the device under test and the number of forwarded frames is counted. If the count of transmitted frames is equal to the number of forwarded frames, the length of the burst is increased and the test is rerun. If the number of forwarded frames is less than the number of transmitted frames, the length of the burst is reduced and the test is rerun. The Back-to-Back value is the number of frames in the longest burst that the Device Under Test (DUT) can handle without the loss of any frames. The test performs the number of defined trials (**Trials**). The **Accuracy** setting specifies how precise that result must be. The test is performed for each defined frame size.

- **Burst Time** is expressed in seconds: **1** to **5** seconds. The default setting is **2** seconds.
- **Trials** represents the number of times the Back-to-Back test will be generated: **1** (default) to **100** trials.
- **Accuracy (Frames)** is the accuracy measurement value in frames: **1** (default) to **50** frames.

## Frame Loss Configuration

The objective of this test is to find the percentage of frames that are lost due to lack of resources. Starting at the specified maximum rate (**Max. Rate**), the test is performed for a specific frame size and for the specified duration (**Trial Duration**). The test is repeated by decreasing the rate by 10 percent, then the test is repeated again until there are two successive trials in which no frames are lost. The test is performed for each defined frame size.

- **Max. Rate** is the maximum rate the test should begin with, in terms of a percentage of the line rate (%), **Mbit/s**, or **Gbit/s**. The accepted values are as shown in the Max. Rate table on page 209. For **Dual Test Set**, **Max. Rate** is configurable for both local to remote (**L->R**) and remote to local (**R->L**) directions.
- **Trial Duration** represents the time value for each trial in minutes:seconds: **1** second to **30** minutes (default is **00:01**).

## Latency Configuration

The objective of the test is to measure the time required for the frame to go through the device under test and return back to source. Starting by sending a stream of frames for the predefined duration (**Trial Duration**) and throughput (**Max. Rate**) at a particular frame size, an identifying dependent tag is included in one frame. The time at which this frame is transmitted is recorded (**timestamp A**). When the tagged frame comes back, the time is recorded again (**timestamp B**) and the Latency result is: **timestamp B - timestamp A**. The test is repeated for the defined number of times (**Trials**) and the average result is calculated. The test is performed for each defined frame size.

- **Trial Duration** represents the time value for each trial in “minutes:seconds”: **1** second (default) to **2** minutes.
- **Trials** represents the number of times the test will be generated: **1** (default) to **50** trials.
- **Copy From Throughput** check box, when selected (default), uses the Throughput subtest results max rate value for each corresponding frame size. When the check box is cleared, it is possible to set the **Max. Rate** by tapping on the **Config. per Frame Size** button.
- **Margin %**, available when **Copy From Throughput** check box is selected, decreases the max rate value(s) from the Throughput subtest by a value corresponding to the percentage of the line rate specified: **0** (default) to **10** percent.

- **Measurement Mode**, available with **Dual Test Set** for rates from 10M to 10GE, allows the selection of the latency measurement mode: **Round-Trip** (default) or **One-Way**.

Synchronization with an external 1PPS clock is required to perform One-Way Latency measurement. One-Way Latency is only possible when both the local and remote 1PPS signal clocks are valid. The following alarms are available with One-Way Latency measurement mode.

**LOPPS-L** and **LOPPS-R** (Loss Of Pulse Per Second - Local/Remote) are declared when either no pulse is received or when no pulse is received within 1 second  $\pm 6.6 \mu s$  after the previous pulse. LOPPS-R is only monitored once the DTS connection is established.

- **Config. per Frame Size** is available when the **Copy From Throughput** check box is cleared and allows to set the **Max. Rate** for each frame size. For **Dual Test Set** the **Max. Rate** is configurable for both local to remote (**L->R**) and remote to local (**R->L**) directions.

**All Frames** check box when selected (cleared by default) allows to enter the maximum rate that will be applied to all frame sizes.

## Thresholds Button

**Note:** For *Dual Test Set*, thresholds are configurable for **Local to Remote** and **Remote to Local** directions at the exception of Round-Trip Latency Threshold for which the value is unique.

- **Throughput Threshold** sets the threshold<sup>1</sup> value used to declare a pass/fail verdict and it applies to all frame sizes when applicable. The range is as follows:

| Interface Speed      | %                             | Max. Rate                      |                             |
|----------------------|-------------------------------|--------------------------------|-----------------------------|
|                      |                               | Mbit/s                         | Gbit/s                      |
| 10 Mbit/s            | 0.000 to 100.000 <sup>a</sup> | 0.000 - 10.000 <sup>a</sup>    | Not Applicable              |
| 100 Mbit/s           | 0.000 to 100.000 <sup>a</sup> | 0.000 - 100.000 <sup>a</sup>   | Not Applicable              |
| 1000 Mbit/s          | 0.000 to 100.000 <sup>a</sup> | 0.000 - 1000.000 <sup>a</sup>  | 0.000 - 1.000 <sup>a</sup>  |
| 10G LAN              | 0.000 to 100.000 <sup>a</sup> | 0.000 - 10000.000 <sup>a</sup> | 0.000 - 10.000 <sup>a</sup> |
| 10G WAN <sup>b</sup> | 0.000 to 92.8571 <sup>a</sup> | 0.000 - 9230.769 <sup>a</sup>  | 0.000 - 9.230 <sup>a</sup>  |

- a. Default value.
- b. The maximum value for 10G WAN may be lower depending on the frame size. The maximum value will be adjusted for each frame size.

- **Back-to-Back Threshold** sets the threshold<sup>1</sup> value in percentage of frames per burst to declare a pass/fail verdict. The range is from **0.0** to **100.0** (default) percent and it applies to all frames sizes when applicable.
- **Frame Loss Threshold (%)** sets the threshold<sup>2</sup> value of frame loss. The range is from **0.000** to **100.000** (default is **0.100**) and it applies to all frame sizes when applicable.

---

1. The verdict is PASS when the received/measured value is greater or equal to the threshold value.

2. The verdict is PASS when the received/measured value is lower or equal to the threshold value.

## Test Setup - Test Configurator, Timer, and System

### RFC 2544 - Subtests

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- **Latency Threshold / Round-Trip Latency Threshold** sets the threshold value as the maximum delay in **ms** or **μs**. The range is from **0.5 to 8000.0 ms** (default is **125.0 ms**) and it applies to all frame sizes when applicable. For **Dual Test Set**, only available with **Round-Trip Latency Measurement Mode** (see *Latency Configuration* on page 213).
- **One-Way Latency Threshold**, available for **Dual Test Set** with **One-Way Latency Measurement Mode** (see *Latency Configuration* on page 213), sets the maximum one-way latency value in millisecond, allowed for all frame sizes: **0.005 to 500 ms** (default is **125 ms**).
- **Latency Unit** allows to either select **ms** or **μs** as the reference unit for the **Latency Threshold**.

## RFC 6349

From the **Test** menu, tap **Setup**, **Test Configurator**, and the RFC 6349 block.

### Connection

- **Operation Mode** indicates the test operation mode: **Dual Test Set** (DTS). It is possible to select a remote unit by clicking on the **Discover Remote** button.

**Disconnected** indicates that there is no connection established with a remote module.

**Connected** indicates that the connection is established with a remote module.

- **Discover Remote** button allows to discover remote modules supporting **Dual Test Set**. For more details, refer to *Discover Remote Button* on page 530.
- **Direction** allows the selection of the traffic direction: **Local to Remote**, **Remote to Local**, and **Bidirectional** (default).

### Parameters

- **Multiple Connections** check box when selected (default) indicates that the applicable TCP Throughput phases are performed with multiple connections; otherwise TCP Throughput phases are performed within a single connection.
- **TCP Server Port**

**Local** TCP Server Port is the port used by the server located at the local side: **1** to **65535** (excluding **62819** that is used for DTS connection), default is **50201**.

**Remote** TCP Server Port is the port used by the server located at the remote side: range is **1** to **65535** (excluding **62819** that is used for DTS connection), default is **50201**.

### ➤ CIR

The Local-to-Remote CIR and Remote-to-Local CIR represent the Committed Information Rate of the Ethernet Service under test: **1.0 Mbit/s** to Line Rate. The CIR is not used to actually transmit frames at this rate but to calculate a Bandwidth Delay Product (BDP) which in turn is used to set the Max Window Size of the TCP connections.

**Rate Unit** determines the unit used to display the rate values: **Mbit/s** (default) or **Gbit/s**.

- **TOS/DS** (IPv4) allows to enter an hexadecimal value, **00** (default) to **FF**. Changing the **IP TOS/DS** value will affect the **TOS/DS Config** settings and vice versa.

## MTU

- **Max MTU (bytes)** determines the Maximum Transfer Unit (MTU) to use when the client is generating TCP traffic toward the server: from **1080** to **1500** bytes (default).
- **Path MTU Discovery** check box when selected (default) allows to perform a Packetization Layer Path MTU Discovery phase.

## Window Sweep

- **Window Sweep** check box when selected (default) allows to perform the Window Sweep phase.
- **Duration (per step)** is the duration of the Window Sweep phase per direction and per Window tested: 30 seconds (default) to 5 minutes.

### TCP Throughput

- **Duration** is the duration of the TCP Throughput phase per direction: 1 minute (default) to 30 days.
- **Pass/Fail Verdict** check box when selected (default) enables the use of the pass/fail verdict.
- **Threshold (% of ideal)** allows to enter the TCP Throughput as a percentage of the Ideal L4 Throughput that will be used to declare the pass/fail verdict for both directions: **0** to **100%**; default is 95%.

### Restore RFC 6349 Defaults

Reverts the configured parameters to their default values.

# S-OAM and MPLS-TP OAM

From the test menu, tap **Setup, Test Configurator**, and the **S-OAM (Y.1731/802.1ag/MEF)** or **MPLS-TP OAM (G.8113.1)** test block.

## OAM Mode

Allows the selection of the OAM mode.

| OAM Type    | OAM Mode                                                                                                                                                     |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S-OAM       | <b>Y.1731</b> (default) supports both Connectivity Fault Management and Performance Monitoring which includes all S-OAM functions supported by this module.  |
|             | <b>802.1ag</b> supports Connectivity Fault Management including only the Continuity Check, Loopback, Link Trace, and RDI functions.                          |
|             | <b>MEF</b> supports both Connectivity Fault Management and Performance Monitoring which includes all S-OAM functions supported by this module.               |
| MPLS-TP OAM | G.8113.1 (default) supports both Connectivity Fault Management and Performance Monitoring which includes all MPLS-TP OAM functions supported by this module. |

### S-OAM and MPLS-TP OAM Responder

**S-OAM Responder** or **MPLS-TP OAM Responder** check box when selected (default) allows to respond to LBM, LTM, DMM, LMM, and SLM valid messages (test running or not). LTM and SLM are only available with Ethernet OAM. Traffic statistics are also monitored (refer to *Responder* on page 452).

For S-OAM: A valid message must have its source MAC address matching the Peer MEP MAC address, destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address, VLANs matching the unit port VLANs, and MEG/MD Level matching the local MEG/MD Level. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 638 for more information.

For MPLS-TP OAM: A valid message must have its: destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; MPL Labels matching the local MPLS Label Stack configuration, including GAL; MEG Level matches the local MEG Level. For the Loopback function, a valid message must also have its: MEP ID of the target MEP ID TLV matching the Local MEP ID or ID Sub-Type is 0x00 (Discovery); and MEP ID and MEG ID of the requesting MEP ID TVL, if present, matching respectively the Peer MEP ID and the Local MEG ID.

| Respond to... message | Respond with... message |
|-----------------------|-------------------------|
| LBM                   | LBR                     |
| LTM <sup>a</sup>      | LTR                     |
| DMM                   | DMR                     |
| LMM                   | LMR                     |
| SLM <sup>a</sup>      | SLR                     |

a. Only available with Ethernet OAM.

## Pass/Fail Verdict

**Pass/Fail Verdict** check box when selected (default) enables the use of the pass/fail verdict. A global fail verdict is declared when any of the following condition is met: **Link Down** alarm, **Loss Continuity** alarm, or any fail verdict for **Frame Delay**, **Frame Loss**, **Synthetic Loss** (Only applicable to Ethernet OAM), **Frame Delay Failure**, **Frame Loss Failure**, **Synthetic Loss Failure** (Only applicable to Ethernet OAM), **Loopback Failure**, or **Test Failure**.

## Thresholds

Available with G.8113.1, Y.1731 and MEF OAM Modes when Pass/Fail verdict is enabled. The verdict is PASS when the measured value is lower or equal to the threshold value.

- **Frame Delay Threshold (ms)** allows to set the threshold value of frame delay: **0.001** to **8000** ms (default is **50** ms).
- **Frame Loss Threshold (%)** allows to set the threshold value of frame loss: **0.001** to **100%** (default is **10%**).
- **Synthetic Loss Threshold (%)**, available with Ethernet OAM (Y.1731 and MEF), allows to set the threshold value of Synthetic Loss: **0.001** to **100%** (default is **10%**).

### Next HOP Router (G.8113.1)

- **MAC Address**, available when **Resolve MAC** check box is cleared, allows to enter the Next HOP Router MAC address: 00:00:00:00:00:00 to FF:FF:FF:FF:FF:FF, default is 01:00:5E:90:00:00. The MAC Address 01:00:5E:90:00:00 is reserved for point-to-point link and can be used when the unicast address is unknown (as per RFC-7213).
- **Resolve MAC** check box, when selected (cleared by default), sends a request to the network to retrieve the MAC address corresponding to the selected IP address.
- **IP Address**, available when **Resolve MAC** check box is selected, allows to enter the Next HOP Router IP address: 0.0.0.0 to 255.255.255.255 for IPv4; default is the source IP address; ::1 to FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF for IPv6, default is 2001::.

### Local Parameters

- **MEG ID** (Y.1731 and G.8113.1) is the Maintenance Entity Group Level identification allowing to enter a 13-bytes MEG ID value/message to be generated (default value is **EXFO MEG ID**). Values should be ASCII suitable characters including the *ITU T.50 Characters* on page 39.

**Padding** allows the selection of the character (**Null** or **Space**) to used for remaining byte values.

- **MAID** (802.1ag and MEF) is a 45 bytes Maintenance Association Identification that is divided into two parameters:
  - **Domain ID** is an optional domain identification text field (0 byte (Domain ID not present), up to 44 bytes minus the **MA Name** field length) set to **EXFO Domain ID** by default.
  - **MA Name** (Short MA Name) is a Maintenance Association Name text field set to **EXFO MA Name** by default. The length of the **MA Name** field is from 1 to either 44 bytes minus the **Domain ID** field length when Domain ID is present or 45 bytes when not present.

## Test Setup - Test Configurator, Timer, and System

### *S-OAM and MPLS-TP OAM*

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- **MEG Level** (Y.1731, MEF, and G.8113.1) is the Maintenance Entity Group Level configurable from **0** to **7** (default).
- **MD Level** (802.1ag) is the Maintenance Domain Level and is configurable from **0** to **7** (default).
- **MEP ID** is the Maintenance Entity Group End Point Identification configurable from **0x0001** (default) to **0x1FFF**.

### Peer MEP Parameters

- **MAC Address**, available with S-OAM Mode, allows to enter the unique Media Access Control (MAC) address of the peer MEP (default is **00:00:00:00:00:00**).
- **MEP ID** is the Maintenance Entity Group End Point Identification configurable from **0x0001** (default) to **0x1FFF**.
- **OAM Quick Ping** verifies the bidirectional connectivity with the peer MEP. The **Successful** message is reported when at least one of three attempts has been successful otherwise **Failed** is reported.

### Continuity Check

- **CC Function** check box when selected (default) allows to transmit and monitor CCM frames.

The following parameters are only configurable when the **CC Function** check box is cleared.

- **Address Type**, available with S-OAM Mode, defines the destination address type of the CCM frames: **Unicast** or **Multicast** (default).
- **Priority**, available with S-OAM Mode or when VLAN is enabled (see *VLAN* on page 190), allows to select the VLAN user priority: **0** to **7** (default). Refer to *VLAN ID and Priority* on page 639 for more information.

- **Drop Eligible**, available with S-OAM Mode or when VLAN is enabled (see *VLAN* on page 190), is set to **No** (no frames will be dropped when congestion occurs) and is not configurable.
- **Period** determines the transmission period of the CCM frame: **3.33 ms**, **10 ms**, **100 ms** (default), **1 s**, **10 s**, **1 min**, or **10 min**.

### MPLS-TP Label Stack (G.8113.1)

#### ➤ MPLS-TP Mode

**PW** (Pseudo-Wire) (default) provides an emulation of a point-to-point connection over a packet-switching network. The PW begins and ends at the LER or PE (Provider Edge).

**LSP** (Label Switch Path) is a path through a MPLS network, it begins and ends at LER or LSR.

**Section** is a segment between two adjacent LER/LSR.

- **Label 2** check box when selected enables the MPLS Label 2. The Label 2 check box is configurable for PW and LSP (cleared by default) and is forced cleared for Section.
- **Label 1** check box when selected enables the MPLS Label 1. The **Label 1** check box is forced selected for PW and LSP and forced cleared for Section.
- **GAL** check box when selected enables the Generic Associated Channel Label. The GAL check box is forced selected for LSP and Section and is configurable for PW (selected by default).
- **Label** is configurable for **Label 1** and **Label 2**: **16** to **1048575**, default is **16**. Label is not configurable for GAL and is set to **13**.
- **TC** sets the Traffic Class: **0** (default) to **7**.
- **TTL** sets the Time To Live: **1** to **255**, default is **128**.

## Test Function

**Note:** *Test Function parameters are not configurable when the **TX Enable** check box is selected.*

- **Function** allows the selection of the test function to be performed.
  - **Loopback** (default) function is used to verify the bidirectional connectivity to a peer MEP (**Continuous** check box cleared) and to verify its capability to sustain close to line rate traffic (diagnostic test; **Continuous** check box selected).
  - **Test** function is used to generate a test signal and/or verify the integrity of received test signal from the peer MEP.
  - **Frame Delay** function is used to measure the round trip delay with the peer MEP.
  - **Frame Loss** function is used to measure the frame loss with the peer MEP in both directions from a single end point.
  - **Synthetic Loss** function is used to measure the frame loss with the peer MEP in both directions from a single end point using synthetic frames.
- **TX Enable** check box when selected (cleared by default) allows transmission of frames. However the transmission will only begin when the test is started or if the test is already running. When the **Continuous** check box is cleared, the **TX Enable** check box is automatically cleared once all frames have been transmitted.
- **Address Type**, available with S-OAM Mode, defines the destination address type of the frame: **Unicast** (default) or **Multicast**. Availability of address types depend on selected **S-OAM Mode** and **Test Function**.
- **Continuous** check box when selected (default) specifies that the frame generation is continuous. The **Continuous** check box is cleared for Multicast address type.

- **Requesting MEP ID TLV** (G.8113.1) check box when selected (default) determines if the Requesting MEP ID TLV is present in the LBM frame. The **Requesting MEP ID TLV** check box is cleared and not selectable when the **Continuous** check box is selected.
- **Priority**, available with S-OAM Mode or when VLAN is enabled (see *VLAN* on page 190), allows to select the VLAN user priority: **0** (default) to **7**. Refer to *VLAN ID and Priority* on page 639 for more information.
- **Drop Eligible**, available with S-OAM Mode or when VLAN is enabled (see *VLAN* on page 190), when set to **Yes** (DEI = 1), the transmitted frames will be dropped first on receipt when congestion occurs under test. Drop Eligible is only configurable with **Unicast** address type, otherwise is set to **No** (Default). Drop Eligible is set to **No** for **Frame Delay**, **Frame Loss**, and **Synthetic Loss** functions.
- **Period** determines the transmission period of frames which is set to **100 ms**. **Period** is not applicable for Multicast address type or when the **Continuous** check box is selected.
- **TX Rate (%)** is the transmission rate of the LBM frame: **0.0001** to **95%** for 10M, **99.5%** for 100M, **99.95%** for 1G, **99.995%** for 10G LAN, and **92.8521%** for 10G WAN. Only available with Loopback test function when the **Continuous** check box is selected.

## Test Setup - Test Configurator, Timer, and System

### S-OAM and MPLS-TP OAM

- **Frame Size** allows to enter the frame size. The frame size range for Ethernet II frame format is as follows:
  - S-OAM Mode: 64 to 1518<sup>1</sup>. The minimum frame size is adjusted according to the frame structure and parameters selected. For Frame Loss function, the frame size is not configurable and set to the minimum value.
  - MPLS-TP OAM Mode: Minimum and maximum values are as follows. The minimum frame size is adjusted according to the frame structure and parameters selected.

| Test Function           | MPLS-TP Mode                          |                          |                          |
|-------------------------|---------------------------------------|--------------------------|--------------------------|
|                         | PW                                    | LSP                      | Section                  |
| Loopback                | 68 <sup>a</sup> to 16000 <sup>1</sup> | 72 to 16000 <sup>1</sup> | 68 to 16000 <sup>1</sup> |
| Test                    | 68 to 1522                            | 68 to 1522               | 64 to 1518               |
| Frame Delay             | 68 <sup>a,b</sup> to 1522             | 72 <sup>b</sup> to 1522  | 68 <sup>b</sup> to 1518  |
| Frame Loss <sup>c</sup> | 68                                    | 68                       | 64                       |

- a. Add 4 bytes when the **GAL** check box is selected.
- b. Add 2 bytes when **Test ID** is selected as **TLV Type**.
- c. The frame size is not configurable and set to the minimum value.

The following table lists each parameter that may affect the minimum and maximum<sup>1</sup> frame size value.

| Parameter  | Number of bytes to be added     | Apply to              |
|------------|---------------------------------|-----------------------|
| 802.3 SNAP | 8 bytes                         | Y.1731, MEF, G.8113.1 |
| VLAN       | 4 bytes per VLAN (up to 3 VLAN) |                       |

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1. For the Loopback function the maximum frame size is 16000 bytes for all rates at the exception of 10/100/1000Mbps electrical interface which is 10000 bytes.

| Parameter             | Number of bytes to be added                                            | Apply to |
|-----------------------|------------------------------------------------------------------------|----------|
| Label 2               | 4 bytes                                                                | G.8113.1 |
| Continuous            | 18 bytes for <b>Data</b> TLV Type<br>21 bytes for <b>Test</b> TLV Type |          |
| Requesting MEP ID TLV | 56 bytes                                                               |          |

**Note:** Sending traffic with frame size >1518 in switched network may result in losing all frames.

- **Frame Count** is the quantity of frames to be transmitted: **1** to **1000** at the exception of **Frame Loss** function which is **2** to **1000** (default is **10**); set to **1** for Loopback function with Multicast address type; not applicable when the **Continuous** check box is selected at the exception of **Synthetic Loss** function.
- **TLV Type** defines the TLV Type included in the frame: **Data** (Default), **Test** (**Loopback** (**Y.1731** and **G.8113.1**) and **Test** functions), and **Test ID** (**Frame Delay** function); is set to **Test** for the **Test** function; set to **Data** for **Synthetic Loss** function; not available for **Frame Loss** function.
- **Payload**, available with **Data** TLV Type, defines the repeating byte pattern used to fill the payload of the **Data** TLV: **0x00** to **0xFF** (default is **0xCC**).
- **Test Pattern**, available with **Test** TLV Type, defines the test pattern used to fill the **Test** TLV: **PRBS31** (default), **NULL**.
- **Test ID**, available with **Test ID** TLV or **Synthetic Loss** function, defines the test ID: **0x00000000** to **0xFFFFFFFF** (default is **0x00000001**).

## Restore Carrier Ethernet OAM Defaults

Reverts the Carrier Ethernet OAM test application to its default factory settings.

## Services - Global

From the **Test** menu, tap **Setup**, **Test Configurator**, tap on the services block, the **Global** tab, and on the **General** button.

### General Button

The following parameters are displayed and configurable per service.

- Check boxes:
  - The first check box (top-left) allows to sequentially enable service(s) within the limit of the link capacity when the **Service Performance Test** is enabled or enable all services when the **Service Performance Test** is disabled.
  - The check boxes next to the service numbers allow to enable each service individually.

When the **Service Performance Test** is enabled, up to 10 services can be enabled one after the other, as long as the **Total TX Rate** (bandwidth) is not reached (**Committed**). For example, if the first service is using the full bandwidth available, then no other service can be enabled. If the first enabled service uses half bandwidth, then at least another service can be enabled using up to half bandwidth. Thus, to enable a second service, first set the CIR value within the non-used bandwidth (**Available**), then enable it.

When the **Service Performance Test** is disabled, up to 10 services can be enabled one after the other; the total TX rate is not limited.

- **Service Name** indicates the name of each service. Tap on the **Service Name** button to modify the name of each service. See *Services - Profile* on page 233 for more information.
- **Direction**, available with **Dual Test Set**, indicates results from local to remote (**L->R**) and remote to local (**R->L**).
- **Frame Size** indicates the frame size of each service. Tap on the **Frame Size** button to modify the frame size of each service.

- **Framing** indicates the framing of each service. Tap on the **Framing** button to modify the **Frame Format**, **Network Layer**, **Transport Layer**, **VLAN**, **S-OAM MEG/MD Level**, and **MPLS** when applicable (see **Modify Frame Structure** from the *MAC/IP/UDP* on page 172).
- **VLAN (ID/Priority)** indicates the ID and Priority of each VLAN level for each service. Tap on the **VLAN** button to modify the VLAN settings (see **VLAN** from the *MAC/IP/UDP* on page 172).
- **Addressing** indicates the source and destination IP or MAC addresses for each services. Tap on the **Addressing** button to modify the addressing (see **MAC** and **IP** from the *MAC/IP/UDP* on page 172).

**Batch** button allows bulk configuration for services addressing. Select the check box of each configuration parameter that needs to be copied and set its parameters. From **Apply To**, select all services the copy applies to and tap on the **Copy From** to proceed.

### SLA Button

The SLA parameters are displayed and configurable per service. Click on the desired column button to access the configuration settings.

See *General Button* on page 230 for more information on check boxes, **Direction**, and **Service Name**.

See *SLA Parameters* on page 238 for more information on **CIR**, **CIR+EIR**, **CBS**, **EBS**, **Max Jitter**, **Max Latency**, and **Frame Loss**.

## Total TX Rate

**Note:** Only available when the **Service Performance Test** check box is selected (see EtherSAM - Global on page 137). For **Dual Test Set**, the total TX rates are displayed for both **Local** and **Remote** directions.

- **Committed** displays the total enabled TX rate (bandwidth) that will be generated by the selected service(s).
- **Available** displays the total TX rate (bandwidth) available for traffic generation.

## Global Options

**Rate Unit** choices are % (default), **Mbit/s**, and **Gbit/s**.

## Copy Service Button

**Copy Service** button allows to copy the services configuration to one or several services.

- **Copy Service** allow to select the services number the configuration will be copied from.
- **To the following Services** allows to select all services that will inherit the configuration from the selected service. An orange background represents a selected service. A service that is already enabled cannot be selected for copy.
- **Copy** allows to confirm the service configuration copy for all selected services.

### Services - Profile

The EtherSAM test application supports the configuration of up to 10 different services individually. All parameters are configurable per service.

From the **Test** menu, tap **Setup**, **Test Configurator**, tap on the services block, and on the **Profile** tab.

#### Service Selection and Activation

Select the service to be configured by either using the left/right arrow or by tapping over the service numbers area then tapping on a specific service number. An orange background indicates the selected service while a green background indicates the services that are enabled.

- **Service** associates a name to the selected service number. Up to 16 characters are allowed. Default service names are **Service 1** to **Service 10**.
- **Enable** check box when selected (cleared by default) enables the selected service. However, the service will be generated only when the test is started. For **Dual Test Set**, services can only be enabled once the connection with the remote unit is established.

When the **Service Performance Test** is enabled, up to 10 services can be enabled one after the other, as long as the **Total TX Rate** (bandwidth) is not reached (**Committed**). For example, if the first service is using the full bandwidth available, then no other service can be enabled. If the first enabled service uses half bandwidth, then at least another service can be enabled using up to half bandwidth. Thus, to enable a second service, first set the CIR value within the non-used bandwidth (**Available**), then enable it.

When the **Service Performance Test** is disabled, up to 10 services can be enabled one after the other; the total TX rate is not limited.

## Total TX Rate

**Note:** Only available when the **Service Performance Test** check box is selected (see EtherSAM - Global on page 137).

Indicates the total transmit rate of all services enabled for transmission. Unit selection is available from the *SLA Parameters* on page 238.

## Profile

- **Profile** button allows to select the emulation profile. The selected service profile icon, name, and configuration (when applicable) is displayed next to the **Profile** button.

Select the emulation profile: **Voice**, **Video**, or **Data** (default).

### Voice

- **Voice Codec** choices are **VoIP G.711** (default), **VoIP G.723.1**, and **VoIP G.729**.
- **Number of Calls** allows the selection of the equivalent number of calls that will be generated for the selected stream (default is **1**).
- **CIR** indicates the committed information rate in Mbps based on the number of calls selected.

### Video

- **Video Codec** choices are **SDTV (MPEG-2)** - (default), **HDTV (MPEG-2)**, and **HDTV (MPEG-4)**. Only **SDTV (MPEG-2)** is available with the 10 Mbps interface.
- **Number of Channels** is the equivalent number of channels that will be generated for the selected service (default is **1**).
- **CIR** indicates the committed information rate in Mbps based on the number of channels selected.

**Note:** The **CIR** value will be calculated on the basis of the selected service profile and the value entered in the **Number of Calls** or **Number of Channels** field.

- **Frame Size (Bytes)** indicates the frame size for **Voice** and **Video** profiles and allows to change the frame size for **Data** profile:

**Fixed** (default)

| Profile and Codec                                              | Type                   | Frame Size (bytes)                              |      |
|----------------------------------------------------------------|------------------------|-------------------------------------------------|------|
|                                                                |                        | IPv4                                            | IPv6 |
| Voice Codec:<br>- VoIP G.711<br>- VoIP G.723.1<br>- VoIP G.729 | <b>Fixed</b>           |                                                 |      |
|                                                                |                        | 138                                             | 158  |
|                                                                |                        | 82                                              | 102  |
|                                                                |                        | 78                                              | 98   |
| Video Codec: All                                               | <b>Fixed</b>           | 1374                                            | 1394 |
| Data                                                           | <b>Fixed</b> (default) | 64 <sup>a</sup> (default) to 16000 <sup>b</sup> |      |
|                                                                | <b>Random</b>          | 64 <sup>a</sup> to 1518 <sup>c</sup>            |      |
|                                                                | <b>EMIX</b>            | 64 <sup>a</sup> to 16000 <sup>b</sup>           |      |

- The minimum value is adjusted according to the frame structure and components selected as shown in the following table.
- The maximum frame size is limited to 10000 for 10/100/1000Mbps electrical interface.
- The maximum frame size value is adjusted for each enabled VLAN (+4 bytes per VLAN).

## Test Setup - Test Configurator, Timer, and System

### Services - Profile

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The following table lists each component that may affect the minimum frame size value.

| Component            | Description                          |
|----------------------|--------------------------------------|
| VLAN                 | 4 bytes per VLAN (up to 2 VLAN)      |
| MPLS                 | 4 bytes per label (up to two labels) |
| UDP                  | 8 bytes                              |
| TCP                  | 20 bytes                             |
| Ethernet Header      | 14 bytes                             |
| LLC and SNAP Headers | 8 bytes                              |
| IPv4                 | 20 bytes                             |
| IPv6                 | 40 bytes                             |
| Using DTS            | 4 bytes                              |

**Note:** *Sending traffic with frame size > 1518 in switched network may results in losing theses frames.*

- **EMIX** button is available when EMIX type is selected. The EMIX frame sequence is repeated until the test ends.

**Quantity** allows to select from 2 to 8 frames size values (default is **5**).

**EMIX Frame Sizes** allows to set the EMIX frame sizes (default are **64, 128, 512, 1024, and 1518**). The minimum frame size value is adjusted according to the frame structure and components selected as shown in the above table.

**Restore Default** button reverts the quantity and EMIX frame sizes to their default values.

### Test Parameters

**Note:** *Unit selection is available from the SLA Parameters on page 238.*

For **Dual Test Set**, parameters are configurable for both local to remote (**L->R**) and remote to local (**R->L**) directions.

- **Traffic Policing** check box when selected (default) allows to stress the rate limiting of the network by sending traffic at higher rate than committed by the SLA.
- **Burst Max Rate** allows to set the rate that is used for the CBS and EBS burst tests. Only available when the **Burst Test** is enabled (see *EtherSAM - Global* on page 137).

**Note:** *Changing a criteria value (CIR, CIR+EIR, Ramp Traffic Policing, or Burst Max Rate) may affect the other criteria values in order to comply to the following rules:*

*$CIR \leq CIR+EIR \leq \text{Ramp Traffic Policing Rate} \leq \text{Line Rate}$*

*$CIR \leq CIR+EIR \leq \text{Burst Max Rate} \leq \text{Line Rate}$*

*However, make sure that the criteria values comply to the following rule with an adequate margin, as per ITU-T Y.1564 standard, for a burst test to be valid:*

*$CIR < CIR+EIR < \text{Burst Max Rate} \leq \text{Line Rate}$*

## SLA Parameters

The Service-Level Agreement (SLA) parameters allow enabling and defining the pass/fail verdict thresholds for the service.

For **Dual Test Set**, parameters are configurable for both local to remote (**L->R**) and remote to local (**R->L**) directions at the exception of Max Round-Trip Latency for which the value is unique.

### Information Rate

- Unit choices are % (default), **Mbit/s**, or **Gbit/s**. This unit is also used for **Total TX Rate** and for **Test Parameters (Traffic Policing and Burst Max Rate)**.

**Note:** *At least one check box (**CIR** or **CIR+EIR**) has to be selected. Thus, clearing the CIR check box while CIR+EIR check box is cleared, will automatically select the CIR+EIR check box and vice versa.*

- **CIR** (Committed Information Rate) check box when selected (default) sets the service rate guaranteed by the SLA. The threshold value is configurable from **0.0001**<sup>1</sup> to **100** percent (default is **50** percent). CIR and preceding steps are not performed for services that have the CIR check box cleared.
- **CIR+EIR** check box when selected (cleared by default) sets the best effort allowed traffic for the service. The EIR (Excess Information Rate) value is equal to the CIR+EIR value minus CIR. The threshold value is configurable from **0.0001**<sup>1</sup> to **100** percent (default is **75** percent).

**Burst Size** settings are only available when the **Burst Test** is enabled (see *EtherSAM - Global* on page 137).

- Burst Size unit choices are **Bytes** (default) or **ms**.

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1. The minimum rate is 1Mbit/s when the **Frame Size** is **Random**.

- **CBS** check box when selected (default) sets the maximum committed burst size to which services' frames will be sent and be CIR-compliant (default is **12144** bytes). The CBS minimum and maximum values are affected by the **CIR**, **Burst Max Rate**, and **Frame Size** values. CBS is only available when CIR check box is selected.
- **EBS** check box when selected (cleared by default) sets the maximum excess burst size to which services' frames will be sent and be CIR+EIR compliant (default is **12144** bytes). The EBS minimum and maximum values are affected by the **CIR+EIR**, **Burst Max Rate**, and **Frame Size values**. EBS is only available when **CIR+EIR** check box is selected.

### Performance Criteria

- **Max Jitter (ms)** allows to set the maximum jitter value in millisecond, allowed for the service: **0.015** to **8000 ms** (default is **2 ms**).
- **Max Round-Trip Latency (ms)** allows to set the maximum round-trip latency value in millisecond allowed for the service: **0.015** to **8000 ms** (default is **15 ms**). For **Dual Test Set**, only available with **Round-Trip Latency Measurement Mode** (see *Global Options* on page 140).
- **Max Latency**, available for **Dual Test Set** with **One-Way Latency Measurement Mode** (see *Global Options* on page 140), allows to set the maximum one-way latency value in millisecond, allowed for the service: **0.015** to **500 ms** (default is **15 ms**).
- **Frame Loss** allows to set the maximum percentage value of Frame Loss allowed for the service: **0** to **5** percent (default is **0.1** percent).

## **SFP/SFP+**

The SFP/SFP+ tab gives hardware information related to the inserted SFP/SFP+ module.

For iSAM: From the **Test** menu, tap **Setup, Test Configurator**, tap on the **Local** block, and on the SFP/SFP+ tab.

For all other tests: From the **Test** menu, tap **Setup, Test Configurator**, tap on the interface block, and on the SFP/SFP+ tab.

## Signal (Transport)

From the **Test** menu, tap **Setup, Test Configurator**, the interface block, and the **Signal** tab.

### Physical Interface - Optical

**Note:** *For electrical interface, see Physical Interface - Electrical on page 242.*

- **Laser** indicates the status of the laser: **ON** with the laser pictogram (emitting an optical laser signal) or **OFF**.
- **TX Power (dBm)** indicates, when supported, the transmit power level of the optical laser in dBm.
- **Wavelength (nm)** indicates, when supported, the detected laser wavelength.
- **RX Power (dBm)** indicates, when supported, the current received power level of the optical laser in dBm.

Green: Power level in range.

Yellow: Power level out-of-range.

Red: Loss of signal or power level is close to damage.

Gray: Invalid operational range value.

- **Min RX Power (dBm)** indicates, when supported, the minimum received power level of the optical laser in dBm.
- **Max RX Power (dBm)** indicates, when supported, the maximum received power level of the optical laser in dBm.

## Test Setup - Test Configurator, Timer, and System

### Signal (Transport)

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- **Lasers OFF at Start-Up** check box when selected automatically turns OFF the laser when starting the NetBlazer or when switching from one test application to another. However the laser remains ON, on a remote module receiving a request for a DTS connection or a loopback command. This check box is cleared by default.
- **Power Range (dBm)** indicates the SFP/SFP+ operational RX power range.

## Physical Interface - Electrical

**Note:** *The following settings are available with electrical signal and their availability depend on the signal itself and its mapping. For optical interface, see Physical Interface - Optical on page 241.*

- **LBO (Line Build Out):** The **LBO** allows to meet the interface requirements over the full range of cable lengths.

| Signal        | LBO                                                                                                                                                                                                                                                                                                                       |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DS1           | Preamplification values: <b>DSX-1 (0-133 ft)<sup>a</sup></b> , <b>DSX-1 (133-266 ft)</b> , <b>DSX-1 (266-399 ft)</b> , <b>DSX-1 (399-533 ft)</b> , <b>DSX-1 (533-655 ft)</b> , Cable simulation (CSU Emulation mode) values: <b>CSU (0.0 dB)</b> , <b>CSU (-7.5 dB)</b> , <b>CSU (-15.0 dB)</b> , <b>CSU (-22.5 dB)</b> . |
| DS3           | <b>0 to 225 ft range<sup>a</sup></b> , <b>225 to 450 ft range</b> , and <b>Cable Simulation 900 ft</b> .                                                                                                                                                                                                                  |
| E1/E3/E4      | Not available                                                                                                                                                                                                                                                                                                             |
| STS-1e/STM-0e | <b>0 to 225 ft range<sup>a</sup></b> , <b>225 to 450 ft range</b> , and <b>Cable Simulation 900 ft</b> .                                                                                                                                                                                                                  |
| STS-3e/STM-1e | <b>0 to 225 ft range</b> .                                                                                                                                                                                                                                                                                                |

a. Default value

### ➤ Line Coding

| Signal        | Line Coding               |
|---------------|---------------------------|
| DS1           | AMI and B8ZS <sup>a</sup> |
| DS3           | B3ZS                      |
| E1            | AMI and HDB3 <sup>a</sup> |
| E3            | HDB3                      |
| E4            | CMI                       |
| STS-1e/STM-0e | B3ZS                      |
| STS-3e/STM-1e | CMI                       |

a. Default value.

### ➤ RX Termination

| Signal                                | Termination                          |
|---------------------------------------|--------------------------------------|
| DS1/E1                                | Term <sup>a</sup> , Mon, and Bridge. |
| DS3/E3/E4/STS-1e/STM-0e/STS-3e/STM-1e | Term <sup>a</sup> , and Mon          |

a. Default value.

- **Power** indicates the received signal level in dBdsx for DS<sub>n</sub> or dBm for PDH and SONET/SDH.
- **Amplitude** indicates the received signal amplitude as well as its MIN, and MAX received values.

## TX Frequency

- **TX Frequency (GHz)** indicates the frequency (actual frequency + Frequency offset) used for transmission.
- **Offset (ppm)** check box, when selected (cleared by default), allows to set the frequency offset that will be generated. Use the “+” or “-” button to respectively increment or decrement the frequency offset value based on the defined **Increment/Decrement Size**, or directly type the frequency offset value in the field. Possible offsets are:

| Interface     | Frequency Offset <sup>a</sup>             | Nominal Frequency |
|---------------|-------------------------------------------|-------------------|
| DS1           | ±140 ppm                                  | 1544000 bit/s     |
| E1            | ± 70 ppm                                  | 2048000 bit/s     |
| E3            | ± 50 ppm                                  | 34368000 bit/s    |
| DS3           |                                           | 44736000 bit/s    |
| STS-1e/STM-0e |                                           | 51840000 bit/s    |
| E4            |                                           | 139264000 bit/s   |
| STS-3e/STM-1e |                                           | 155520000 bit/s   |
| OC-1/STM-0    | ± 50 ppm                                  | 51840000 bit/s    |
| OC-3/STM-1    |                                           | 155520000 bit/s   |
| OC-12/STM-4   |                                           | 622080000 bit/s   |
| OC-48/STM-16  |                                           | 2488320000 bit/s  |
| OC-192/STM-64 |                                           | 9953280000 bit/s  |
| OTU1          | ± 50 ppm                                  | 2666057143 bit/s  |
| OTU2          | ± 50 ppm (Framed)<br>± 120 ppm (Unframed) | 10709225316 bit/s |
| OTU1e         | ± 120 ppm                                 | 11049107143 bit/s |
| OTU2e         |                                           | 11095727848 bit/s |
| OTU1f         |                                           | 11270089286 bit/s |
| OTU2f         |                                           | 11317642405 bit/s |

- a. The frequency offset range is guaranteed for a source signal at 0 ppm. In the event that the source signal already has an offset, then the output signal may exhibit an offset larger than the range specified.

**Note:** Frequency offset is not available when **Through** mode is selected.

**Step Size (ppm)** allows to set the increment/decrement value (from 0.1 to the maximum offset) that will be used when changing the frequency offset with the “+” or “-” button.

### RX Frequency

- **Frequency (GHz)** indicates the frequency of the input signal.
- **Offset (ppm)** indicates the frequency offset between the standard rate specification and the rate at the input signal.

**Note:** For both **Frequency** and **Offset** the following background colors are used.

| Background color | Description                                                  |
|------------------|--------------------------------------------------------------|
| Green            | The frequency is in range.                                   |
| Red              | The frequency is out-of-range. <b>LOC</b> is also displayed. |
| Gray             | Pending state.                                               |

- **Max. Negative Offset (ppm)** indicates the maximum negative frequency offset between the standard rate specification and the rate from the received signal.
- **Max. Positive Offset (ppm)** indicates the maximum positive frequency offset between the standard rate specification and the rate from the received signal.

**Note:** Refer to Interface on page 311 for more information on standard rate specifications.

## Signal Configuration

- For OTN, refer to *Signal - Signal Configuration (OTN)* on page 256 for more information.
- For SONET/SDH, refer to *Signal - Signal Configuration (SONET/SDH)* on page 258 for more information.
- For DS<sub>n</sub>/PDH, refer to *Signal - Signal Configuration (DS<sub>n</sub>/PDH)* on page 247 for more information.

## Signal - Signal Configuration (DSn/PDH)

For SONET/SDH - DS<sub>n</sub>/PDH BERT, from the test menu, tap **Setup**, **Test Configurator**, and the protocol block. Only **Framing** setting and the **Loopback** button are available.

For DS<sub>n</sub>/PDH BERT and NI/CSU Emulation, from the test menu, tap **Setup**, **Test Configurator**, and the interface block.

### Framing

**Framing** allows the selection of the framing that will be used for transmission.

| DS1                                          | DS3                                          | E1                                                                    | E3/E4                           |
|----------------------------------------------|----------------------------------------------|-----------------------------------------------------------------------|---------------------------------|
| Unframed<br>SF<br>ESF <sup>a</sup><br>SLC-96 | Unframed<br>C-Bit Parity <sup>a</sup><br>M13 | Unframed<br>PCM30 <sup>a</sup><br>PCM30 CRC-4<br>PCM31<br>PCM31 CRC-4 | Unframed<br>Framed <sup>a</sup> |

a. Default value

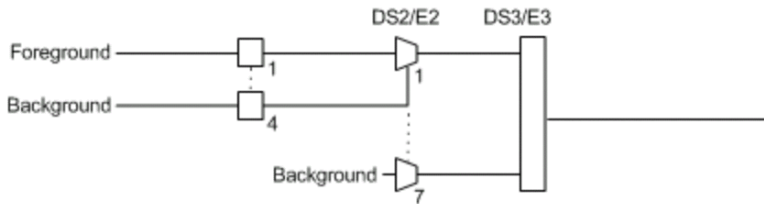
## Test Setup - Test Configurator, Timer, and System

### Signal - Signal Configuration (DSn/PDH)

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## Background

For multiplex test case, allows the selection of the default timeslot background traffic: **AIS** (default) or **All Zeros**.



The diagram above shows a test case defined with DSn/PDH traffic where the background traffic is also inserted for the unused timeslots in a test case data path. The insertion is similar to the low order path SONET/SDH terminated signal where the background traffic format inserted uses the same rate as the one defined in the test case data path.

## Channel

**Channel**, for multiplex text case, allows the selection of the channel number of the mapped signal.

## DS0/E0

**DS0/E0** check box when selected, cleared by default, activates the DS0/E0 testing. DS0/E0 configuration is not available when the framing is set to **Unframed**. Once selected, a summary of the payload content is displayed indicating the number of timeslot set to Pattern and Idle/Tone. The Modify DS0/E0 button is also displayed.

### Modify DS0/E0

**Modify DS0/E0** button is only available when the DS0/E0 check box is selected.

**Note:** For DS0, the framing structure have 23 timeslots. For E0, the framing structure PCM-30 and PCM30 CRC-4 have 30 channel timeslots while PCM-31 and PCM-31 CRC-4 have 31 channel timeslots.

- **DS0/E0 Size** sets the channel timeslot data rate for the pattern payload content to either **56K** or **64K** (default). A timeslot data rate of 56 Kbit/s uses 7 bits while 64 Kbit/s uses 8 bits to carry the payload information.
- **Zero Code Suppression** allows the selection of the Zero Code Suppression (ZCS) method used to replace the all-zero bytes of the Idle and Tone payload contents. The ZCS mechanism is a global parameter meaning that all channel timeslots configured with Tone/Idle data, use the same ZCS method. Choices are:

| ZCS               | Description                                                                                                | Available with |
|-------------------|------------------------------------------------------------------------------------------------------------|----------------|
| None <sup>a</sup> | No Zero Code Suppression                                                                                   | DS0 and E0     |
| Jammed Bit 8      | Every 8th (LSB) bit is forced to 1.                                                                        | DS0 and E0     |
| GTE               | Bit 8 of an all zero channel byte is replaced by 1, except in signaling frames where bit 7 is forced to 1. | DS0            |
| Bell              | Bit 7 of an all zero channel byte is replaced by 1.                                                        | DS0            |

a. Default value.

## Test Setup - Test Configurator, Timer, and System

### Signal - Signal Configuration (DSn/PDH)

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**Note:** Bit 8 is the Least-Significant Bit (LSB) and bit 1 is the Most-Significant Bit (MSB).

|       |     |   |   |   |   |   |   |     |
|-------|-----|---|---|---|---|---|---|-----|
| Bit # | 1   | 2 | 3 | 4 | 5 | 6 | 7 | 8   |
|       | MSB |   |   |   |   |   |   | LSB |

#### ► Payload Content and Set All

**Payload Content** allows the selection of the payload content that will be applied to all TX timeslots when tapping the **Set All** button: **Pattern**, **Idle**, or **Tone**.

#### ► TX

Select the payload content by tapping once or several times on each timeslot until the desired content appears: **Pattern** (default), **Idle**, or **Tone**.

**Note:** For **Pattern**, the pattern that will be used is the one selected from **Pattern** on page 117.

**Tone (Hz)** allows the selection of a tone for digital milliwatt testing. The signal output power, when converted to analog, is 0 dBm. Choices are **1000 Hz** and **1004 Hz** (default). The selected Tone applies to all timeslots set to Tone.

**Idle** uses the Idle code byte from the Idle field. Choices are **00** to **FF**. The selected Idle code applies to all timeslots set to Idle. The default setting is **7F**.

**Note:** The timeslots set to **Idle** or **Tone** can be changed from **Idle** to **Tone** and vice versa even when the test is running; the **Idle** and **Tone** values can also be changed.

**Binary** allows either displaying the Idle code values in binary (when selected) or in hexadecimal (default).

### ➤ RX

**Apply Channel TX to RX**, available for decoupled test, allows to apply the RX payload content based on the TX settings. **None** will be used when TX is set to either **Idle** or **Tone**.

**Note:** *The RX timeslot selection is only configurable in a **Decoupled** topology when the **Apply Channel TX to RX** check box is cleared. A warning is displayed when the number of Pattern timeslot does not match between TX and RX. This is to ensure pattern continuity between the TX and RX interface in a MUX/DEMUX test even if used through a cross-connect device.*

Select the payload content by tapping once or several times on each timeslot until the desired content appears.

**Pattern** (default) uses the pattern from the received signal.

**None** does not use the pattern.

## Loopback button

The Loopback feature generates a code that is interpreted by the DUT. The DUT interprets the command and implements the loopback.

Select the type of loopback that will be used to overwrite the traffic that will be generated. Choices are listed in the following table in addition with 10 predefined Loop Codes (see *Modify Loop Codes button* on page 253).

| Loopback Type          | Command         |           |
|------------------------|-----------------|-----------|
|                        | Loop-Up         | Loop-Down |
| CSU (10000/100)        | 10000 (default) | 100       |
| NIU FAC1 (1100/1110)   | 1100            | 1110      |
| NIU FAC2 (11000/11100) | 11000           | 11100     |
| NIU FAC3 (100000/100)  | 100000          | 100       |

- **Loop-Up** injects the selected loop up code. The loop code will be generated continuously for a maximum of 10 seconds or until the loopback is confirmed. After 10 seconds, if the loopback has failed, a Loop-Down command is sent. A pop-up window appears indicating the loop code injection progress and result. The text box next to the Loop-Up button indicates the selected loop up code.
- **Loop-Down** injects the selected loop down code. The loop code will be generated continuously for a maximum of 10 seconds or until the loopback is confirmed. After 10 seconds, if the loopback has failed, a Loop-Down command is sent. A pop-up window appears indicating the loop code injection progress and result. The text box next to the Loop-Down button indicates the selected loop down code.

➤ **Modify Loop Codes** button

Allows the configuration of 10 DS1 loop code pairs. Configure each loop code name, Loop-Up and Loop-Down values.

The name field allows up to 16 characters long. Loop-Up and Loop-Down range is from 3 to 16 bits (**000** to **1111111111111111**). The default DS1 loop codes correspond to the DS1 In-Band loop codes (Loop-Up= **10000**, and Loop-Down= **100**).

## DS1 Loopback - for NI/CSU Emulation Test

The Loopback feature generates a code that is interpreted by the DUT. The DUT interprets the command and implements the loopback.

➤ **Mode** selects the loopback control Mode; **Manual** or **Auto-Response**.

➤ **Type**

For **Manual**: Select the Type of loopback code that will be applied; **Line**, or **Payload**. Payload is not available when the framing is **Unframed**.

For **Auto-Response**: Select the Type of loopback code on which the NetBlazer will respond; **In-Band** or **Out-of-Band**. **Out-of-Band** is only available when the interface framing is set to ESF. The Loop-UP and Loop-Down values are automatically updated to the In-Band or Out-of-Band selection (Type).

➤ **Status** indicates either **Loopback Active** with a green loopback icon or **No Loopback** with a gray loopback icon.

➤ **Loop Code** selects the type of loopback that will be used to overwrite the traffic that will be generated.

| In-Band loop code      | Loop-UP Code                                          | Loop-Down Code |
|------------------------|-------------------------------------------------------|----------------|
| CSU (10000/100)        | 10000                                                 | 100            |
| NIU FAC1 (1100/1110)   | 1100                                                  | 1110           |
| NIU FAC2 (11000/11100) | 11000                                                 | 11100          |
| NIU FAC3 (100000/100)  | 100000                                                | 100            |
| Loop Code 1 to 10      | Refer to <i>Modify Loop Codes</i> button on page 253. |                |

| Out-of-Band loop code    | Loop-UP Code      | Loop-Down Code    |
|--------------------------|-------------------|-------------------|
| Line                     | 00001110 11111111 | 00111000 11111111 |
| Payload                  | 00010100 11111111 | 00110010 11111111 |
| Reserved For Network Use | 00010010 11111111 | 00100100 11111111 |
| ISDN Line (NT2)          | 00101110 11111111 | 00100100 11111111 |
| CI/CSU Line(NT1)         | 00100000 11111111 | 00100100 11111111 |

- **Force Release / Activate / Release**
  - **Force Release** button, available with **Auto-Response** mode, allows to release a loopback condition initiated from the network. Only available when a loopback is active.
  - **Activate** button, available with **Manual** mode when no loopback is active, allows to send a loopback condition.
  - **Release** button, available with **Manual** mode when a loopback is active, allows to release the loopback condition.
- **Loop-Up** indicates the selected loop up code.
- **Loop-Down** indicates the selected loop down code.
- **Modify Loop Codes** button: See *Modify Loop Codes button* on page 253 for more information.

## Signal - Signal Configuration (OTN)

**Note:** *The following signal configuration parameters are available from the interface block.*

From the **Test** menu, tap **Setup, Test Configurator**, the interface block, and on the **Signal** tab.

➤ **OTU2, OTU2f, OTU1f, OTU2e, OTU1e, or OTU1**

**Note:** *At least one of the two check boxes, **FEC** or **Scrambler**, must be selected in order to prevent potential alarms caused by a lack of bit transition on the optical signal. For example to disable **FEC**, first select the **Scrambler** check box then clear the **FEC** check box.*

- **FEC** check box, when selected (default), enables the FEC in TX/RX and allows to detect, report, and correct up to 8 symbol errors (Correctable) per codeword. If there are over 8 symbol errors detected, they are reported as uncorrectable errors.
- **Scrambler** check box, when selected (default), provides enough “0” and “1” transitions on the optical signal for clock recovery.

➤ **ODU2, ODU2f, ODU1f, ODU2e, ODU1e, or ODU1**

- **OPU Tributary Port**, available for each OPU level of a mapped signal, indicates the OPU tributary port used for the test. Tap the **Modify Trib Slots/Port** button to change the OPU tributary port.
- **OPU Tributary Slots**, available for each OPU level of a mapped signal, indicates the OPU tributary slots used for the test. Tap the **Modify Trib Slots/Port** button to change the OPU tributary slots.
- **TCM** indicates each Tandem Connection enabled; **No TCM** indicates that no TCM is enabled. To enable TCM, tap the **Config TCM** button.

➤ **Config TCM**

Allows to enable each TCM level (1 to 6) individually. All ODUx of a mapped signal are also available. All TCM check boxes are cleared by default (disabled). Refer to *Traces (OTN)* on page 281 for more information.

## Signal - Signal Configuration (SONET/SDH)

From the **Test** menu, tap **Setup, Test Configurator**, the interface block, and the **Signal** tab.

### OC/STM Signal

- **Synchronization Status Message (S1)**: Bits 5 through 8 of the S1 byte are used to convey synchronization status of the NE. Not available with **Through** topology.

| Bits<br>5 to 8    | Description                                 |                                |
|-------------------|---------------------------------------------|--------------------------------|
|                   | SONET                                       | SDH                            |
| 0000 <sup>a</sup> | Synchronized - Traceability Unknown (STU)   | Quality Unknown                |
| 0001              | Stratum 1 Traceable (ST1)                   | Reserved                       |
| 0010              | Reserved                                    | ITU G.811 (PRC)                |
| 0011              | Reserved                                    | Reserved                       |
| 0100              | Transit Node Clock Traceable (TNC)          | SSU-A                          |
| 0101              | Reserved                                    | Reserved                       |
| 0110              | Reserved                                    | Reserved                       |
| 0111              | Stratum 2 Traceable (ST2)                   | Reserved                       |
| 1000              | Reserved                                    | SSU-B                          |
| 1001              | Reserved                                    | Reserved                       |
| 1010              | Stratum 3 Traceable (ST3)                   | Reserved                       |
| 1011              | Reserved                                    | ITU-T G.813 Option I (SEC)     |
| 1100              | SONET Minimum Clock Traceable (SMC)         | Reserved                       |
| 1101              | Stratum 3E Traceable (ST3E)                 | Reserved                       |
| 1110              | Provisionable by the Network Operator (PNO) | Reserved                       |
| 1111              | Don't Use for Synchronization (DUS)         | Do not use for synchronization |

- a. Default message.

- **REI-L/MS-REI Computation Method** (OC-192/STM-64 only): Allows to select the default method used to calculate the REI-L/MS-REI error for OC-192 and STM-64 signals. Choices are **M1 Only** and both **M0 and M1**. The default setting is M1 only.

## STS/AU and VT/TU Mappings

### ➤ **Timeslot/Number**

**Timeslot** (SONET) allows the selection of the STS timeslot number. Refer to *SONET Numbering Convention* on page 630 for more information.

**Number** (SDH) allows the selection of the AU channel number. Refer to *SDH Numbering Convention* on page 631 for more information.

- **TCM** check box when selected (cleared by default) allows Tandem Connection Monitoring (TCM).
- **TC-UNEQ-P / TC-UNEQ-V / HPTC-UNEQ / LPTC-UNEQ** check boxes when selected (cleared by default) allows the monitoring of the corresponding Tandem Connection - Unequipped alarm. Only available when the **TCM** check box is selected.
- **Overwrite Fixed Stuff** (STS-1 only) check box when selected (default) fills up the bytes of the STS-1 SPE's columns 30 and 59 with the selected pattern from the tab *BERT* on page 117.
- **Background Traffic** allows the selection of the high order path background traffic: **AIS**, **Equipped** (PRBS23) - (default), or **Unequipped**.

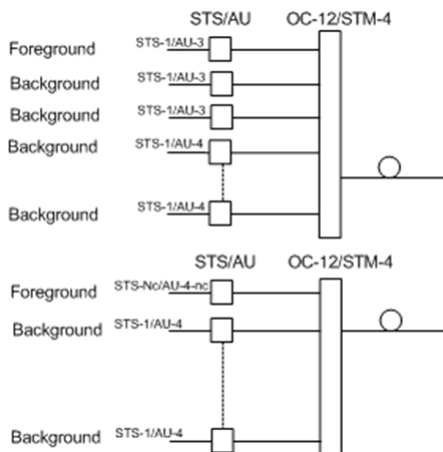
## Test Setup - Test Configurator, Timer, and System

### Signal - Signal Configuration (SONET/SDH)

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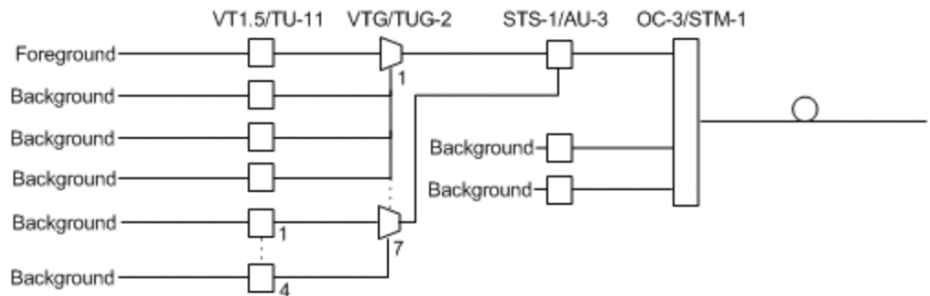
#### STS/AU Path (SONET/SDH HOP):

The following diagram shows a test case data path that is terminated right after SONET/SDH high order path. High order background traffic is automatically adapted to the rate (STS-1, AU-3, or AU-4) signal level for the paths that are not defined in the test case.



#### VT/TU Path (SONET/SDH LOP)

The following diagram shows a test case data path that is terminated at the SONET/SDH low order path. The remaining STS-1 or AU-3 timeslot not involved in the test case are filled with background traffic of STS-1 or AU-3 level depending on the interface being SONET or SDH. At the low order path level, the data path not involved in the data path defined in the test case are filled with a background traffic equivalent to the VT Group (VTG) or Tributary Unit Group (TUG) type defined by the traffic selected in the data path. Further, the remaining VTG or TUG within the high order path, selected in the test case, are respectively filled with traffic of equivalent rate for SONET and SDH data paths.



## Smart Loopback

**Note:** The Smart Loopback block is only displayed when the **Transparent (Pseudo-Physical)** check box is cleared (see Loopback Mode on page 107).

From the **Test** menu, tap **Setup, Test Configurator**, and the Smart Loopback block.

### Loopback

- **Mode** determines at which layer the Smart Loopback address/port swapping operation will be.
  - **Ethernet** swaps the MAC addresses of received packets having their **Destination MAC** address matching the MAC address of the loopback port.
  - **Ethernet (All Unicast)** swaps the MAC addresses of received packets having Unicast **Destination MAC** address.
  - **IP**, for Ethernet Layer 3 and 4, swaps the MAC and IP addresses of received packets having their **Destination IP** address matching the IP address of the loopback port. For Ethernet Layer 2, swaps the **MAC addresses** for packets having their **Destination MAC** address matching the MAC address of the loopback port.
  - **UDP/TCP** (default), for Ethernet Layer 4, swaps the UDP or TCP ports and the MAC and IP addresses of received packets having their **Destination IP** address matching the IP address of the loopback port. For Ethernet Layer 3, swaps the MAC and IP addresses for packets having their **Destination IP** address matching the IP address of the loopback port. For Ethernet Layer 2, swaps the **MAC addresses** for packets having their **Destination MAC** address matching the MAC address of the loopback port.
- **Matching & Swapping** indicates the Loopback parameters that will be used based on the Loopback Mode selected.

## S-OAM Responder

The S-OAM Responder check box when selected (default) allows to respond to LBM, LTM, DMM, LMM, and SLM valid messages (test running or not). Traffic statistics are also monitored (refer to *Responder* on page 452).

| Respond to... message | Respond with... message |
|-----------------------|-------------------------|
| LBM                   | LBR                     |
| LTM                   | LTR                     |
| DMM                   | DMR                     |
| LMM                   | LMR                     |
| SLM                   | SLR                     |

## Streams - Global

From the **Test** menu, tap **Setup, Test Configurator**, the protocol block, and the **Global** tab.

The following parameters are displayed and configurable per stream.

➤ **Check boxes:**

The first check box (top-left) allows to sequentially enable stream(s) within the limit of the link capacity.

The check boxes next to the stream numbers allow to enable each stream individually within the limit of the link capacity.

- **Stream Name**<sup>1</sup> indicates the name of each stream. Tap on the **Stream Name** button to modify the name of each stream.
- **Frame Size**<sup>1</sup> indicates the frame size of each stream. Tap on the **Frame Size** button to modify the frame size of each stream.
- **TX Rate**<sup>1</sup> indicates the transmission rate for each stream. Tap on the **TX Rate** button to modify the transmission rate (see page 271).
- **Framing** indicates the framing of each stream. Tap on the **Framing** button to modify the Network Layer, Transport Layer and VLAN (see **Modify Frame Structure** from the **MAC/IP/UDP** tab).
- **VLAN** indicates the ID and Priority of each VLAN level for each stream. Tap on the **VLAN** button to modify the VLAN settings (see **VLAN** from the **MAC/IP/UDP** tab).

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1. See the Profile tab for more information.

- **Addressing** indicates the source and destination IP addresses for each stream. Tap on the **Addressing** button to modify the addressing (see **MAC** and **IP** from the **MAC/IP/UDP** tab).

**Batch** button allows bulk configuration for stream addressing. Select the check box of each configuration parameter that needs to be copied and set its parameters. From **Apply To**, select all streams the copy applies to and tap on the **Copy From** to proceed.

The following parameters are global for all streams.

- **Total TX Rate** indicates the percentage of the total line utilization which is the TX rate sum of all enabled streams.
- **Link Capacity** indicates the total rate available for traffic generation.
- **Global Options:**
  - **Rate Unit** choices are % (default), **Mbit/s**, **Gbit/s**, **frame/s**, and **IFG**.
  - **QoS Metrics Tags Insertion** check box when selected (default) automatically adds a stream analysis tag containing Jitter, Latency, Throughput, and sequence tags in all frames that will be generated.
- **Copy Stream** button allows to copy the stream configuration to one or several streams.

Select the stream number the configuration will be copied from.

From **To the following Streams**, select all streams that will inherit the configuration from the selected stream. An orange background represents a selected stream. A stream that is already enabled (Enable TX) cannot be selected for copy.

Tap **Copy** to confirm the stream configuration copy for all selected streams.

- **Restore Default** button reverts the current test application to its default factory settings.

## Streams - Profile

The Traffic Gen & Mon test application supports the configuration of up to 16 different streams individually.

From the **Test** menu, tap **Setup**, **Test Configurator**, the protocol block, and the **Profile** tab.

**Note:** *All parameters are configurable per stream.*

## Stream Selection and Activation

Select the stream to be configured by either using the left/right arrow or by tapping over the stream numbers area then tapping on a specific stream number. An orange background indicates the selected stream while a green background indicates the streams that are enabled.

- **Stream** associates a name to the selected stream number. Default stream names are **Stream 1** to **Stream n**.
- **Enable** check box when selected (cleared by default) enables the selected stream. However, the stream will be generated only when the test is started while the global **Enable TX** check box is selected from the **Global** tab.

### Profile

- **Profile** button allows the selection and configuration of either **Voice**, **Video**, or **Data** (default) emulation profile. The selected profile icon and its Codec for Voice and Video are displayed next to the **Profile** button.

**Voice** when selected allows the configuration of the following parameters.

- **Voice Codec** allows the selection of the codec used by the voice profile: **VoIP G.711** (default), **VoIP G.723.1**, or **VoIP G.729**.
- **Number of Calls** allows the selection of the number of calls that will be generated for the selected stream. The minimum and default value is **1** for 10M to 1G interface, and **5** for 10G interfaces.
- **Rate** indicates the rate corresponding to the selected coded and the number of calls.

**Video** when selected allows the configuration of the following parameters.

- **Video Codec** allows the selection of the codec used by the video profile: **SDTV (MPEG-2)** - (default), **HDTV (MPEG-2)**, or **HDTV (MPEG-4)**.
- **Number of Channels** allows the selection of the number of channels (**1** by default) that will be generated for the selected stream.
- **Rate** indicates the rate corresponding to the selected coded and the number of channels.

## Test Setup - Test Configurator, Timer, and System

### Streams - Profile

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- **Frame Size (Bytes)** for Data profile is selectable: **Fixed** (default), **Random**, or **Sweep**. The Frame Size is forced to **Fixed** for Voice and Video profiles.
- For **Fixed** type, the frame size is as follow.

| Profile | Codec        | Frame Size                                              |      |
|---------|--------------|---------------------------------------------------------|------|
|         |              | IPv4                                                    | IPv6 |
| Voice   | VoIP G.711   | 138                                                     | 158  |
|         | VoIP G.723.1 | 82                                                      | 102  |
|         | VoIP G.729   | 78                                                      | 98   |
| Video   | All codec    | 1374                                                    | 1394 |
| Data    | -            | Programmable from 64 <sup>a</sup> to 16000 <sup>b</sup> |      |

- a. The minimum frame size will be adjusted according to the frame structure and components selected. The following table lists each component that may affect the minimum frame size value.
  - b. The maximum frame size is limited to 10000 for 10/100/1000Mbps electrical interface.
- For **Random** type, the frame size range is from 64 to 1518 bytes. However, the minimum frame size will be adjusted according to the frame structure and components selected. The following table lists each component that may affect the minimum frame size value. The maximum frame size value is also adjusted for VLAN (+4 bytes per VLAN).

- For **Sweep** type, the first frame is generated starting with the minimum number of bytes defined then each subsequent frame is incremented by 1 byte until the maximum number of bytes is reached and start over with minimum. The frame size range is from 64 to either 10000 bytes for electrical interfaces or 16000 bytes for optical interfaces; default is 1518 bytes. However, the minimum frame size will be adjusted according to the frame structure and components selected. The following table lists each component that may affect the minimum frame size value.

The following table lists each component that may affect the minimum frame size value.

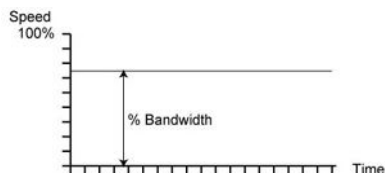
| Component       | Description                          |
|-----------------|--------------------------------------|
| VLAN            | 4 bytes per VLAN (up to 2 VLAN)      |
| MPLS            | 4 bytes per label (up to two labels) |
| UDP             | 8 bytes                              |
| Ethernet Header | 14 bytes                             |
| IPv4            | 20 bytes                             |
| IPv6            | 40 bytes                             |

## Shaping

- **TX Mode** allows the selection of the transmission mode for the selected stream when **Data** profile is selected. The TX Mode is forced to **Continuous** for Voice and Video profiles.

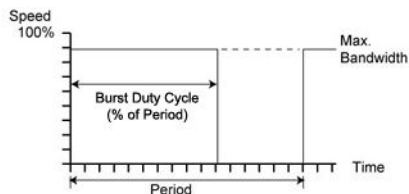
**Continuous** (default) transfers the selected frame continuously according to the selected percentage of bandwidth.

**n-Frame** transfers the selected number of frames.



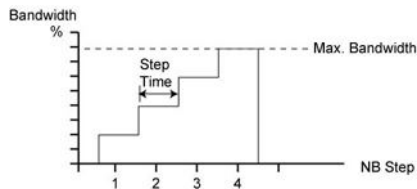
**Burst** transfers the selected frame at maximum bandwidth for the selected **Burst Duty Cycle** over the **Period**.

**n-Burst** transfers the selected number of Burst.



**Ramp** transfers the selected bandwidth in a stair shape according to the selected step time, number of steps, and maximum bandwidth.

**n-Ramp** transfers the selected number of Ramp.



- **TX Rate / Max TX Rate** indicates the transmission rate for Voice and Video profiles, and allows to enter the transmission rate for Data profile. The available stream transmission rate will be calculated according to the selected TX Mode. The default setting is 100 percent for all interfaces at the exception of 10Gig-E WAN which is 92.8571 percent (depending on the frame format).

Unit choices are % (default), **Mbit/s**, **Gbit/s**, **frame/s**, and **IFG**.

However **frame/s** and **IFG** are not available for **Random** and **Sweep** frame sizes.

- **Frame Count** is only available with n-Frame Transmit Mode. Enter the frame count number: **1** (default) to **267857142857**.
- **Shaping** button

For **Burst** and **n-Burst** TX modes.

- **Burst Duty Cycle (%)** represents the burst duration within the burst period: **1** to **100** percent (default is **50** percent).
- **Period** represents the burst pattern duration: **1** to **8000** milliseconds (default is **1000** ms).  
Unit choices are **ms** (default) and **s**.
- **Burst Count**, available with n-Burst TX Mode, represents the number of times the burst will be repeated: **1** (default) to **255**.

For **Ramp** and **n-Ramp** TX modes.

- **Ramp Nb. of Steps** represents the number of steps within the ramp: **2** to **100** (default is **10**).
- **Step Time** represents the duration of each step: **100** to **8000** milliseconds (default is **1000** ms).  
Unit choices are **ms** (default) and **s**.
- **Ramp Cycle Count**, available with n-Ramp TX mode only, represents the number of times the ramp will be repeated: **1** (default) to **255**.

## Test Setup - Test Configurator, Timer, and System

### Streams - Profile

---

- **Total TX Rate** indicates the percentage of the total line utilization which is the sum of all TX rate enabled streams.

**Note:** *The Individual stream can be enabled/disabled even when the test is started and running. The streams can be enabled one after the other, up to 16, as long as the maximum rate is not reached. For example, if the first stream is using the full rate available, then no other stream can be enabled. However, if the first enabled stream uses half rate, then at least another stream can be enabled using up to half rate. Thus, to enable a second stream, first set the TX rate value within the non-used rate, then enable it. A stream cannot be enabled if its MAC address is not valid (it can be either not resolved or wrongly entered).*

- **Link Capacity** indicates the total rate available for traffic generation.

## QoS Metrics

**Note:** *QoS Metrics settings apply to all streams.*

- **Global Pass/Fail Verdict** check box when selected (default) enables the pass/fail verdict for all streams.
- **Global Thresholds Type** button
  - **Throughput** allows to select if the verdict is based on the **Current Throughput** (default) or **Average Throughput**.
  - **Frame Loss** allows to select if the verdict is based on a frame loss **Count** (default) or **Rate**.
  - **Out-of-Sequence** allows to select if the verdict is based on an Out-of-Sequence **Count** (default) or **Rate**.
- **Throughput (%)** check box when selected enables the throughput pass/fail verdict and allows to set the minimum and maximum threshold values.

- **Frame Loss Count/Rate** check box when selected enables the Frame Loss pass/fail verdict and allows to set threshold of frame that are lost.

For **Count**, enter the maximum count of frame that are lost before declaring a fail verdict: **0** (default) to **9999999999**.

For **Rate**, enter the maximum rate of frame that are lost before declaring a fail verdict: **1.0E-14** (default) to **1.0E00**.

- **Out-of-Sequence Count/Rate** check box when selected enables the Out-of-Sequence pass/fail verdict and allows to set the threshold of frames that are Out-of-Sequence.

For **Count**, enter the maximum count of frames that are Out-of-Sequence before declaring a fail verdict: **0** (default) to **9999999999**.

For **Rate**, enter the maximum rate of frames that are Out-of-Sequence before declaring a fail verdict: **1.0E-14** (default) to **1.0E00**.

- **Jitter (ms)** check box when selected enables the Jitter verdict and allows to set the maximum Jitter in ms before declaring a fail verdict.
- **Latency (ms)** check box when selected enables the Latency verdict and allows to set the maximum Latency in ms before declaring a fail verdict.

### SyncE

From the **Test** menu, tap **Setup, Test Configurator**, and the **SyncE** test block.

### ESMC Monitoring

- **ESMC** (Ethernet Synchronization Message Channel) is a live value monitored even when the test is not started.

An arrow next to the ESMC label indicates that ESMC valid information frames are received or not.

- A green arrow indicates that at least one ESMC valid information frame, containing a valid FCS, was received within a second in the last 5-second interval.
- A red arrow indicates that no ESMC valid information frames were received for more than 5 seconds.
- A gray arrow indicates awaiting incoming data to provide a status.
- **Received QL** indicates the last Quality Level received. The **Received QL** is a live value monitored even when the test is not started.
- **QL Mismatch Monitoring** check box when selected (default) enables the Quality Level mismatch monitoring. The quality level characterizes the clock quality in terms of network synchronization.
- **Expected QL** available when the **QL Mismatch Monitoring** check box is selected, allows the selection of the Expected Quality Level value. See page 376 for more information.

- **Pass/Fail Verdict** check box when selected (default) enables the use of the pass/fail verdict. The global pass/fail verdict is based on the following criteria: **ESMC Rate Threshold** (when enabled), **QL Mismatch Monitoring** (when enabled), **ESMC Loss**, or **Link Down**.
- **ESMC Rate Threshold** check box when selected (default) enables the ESMC rate threshold monitoring which will declare a Fail verdict when the ESMC frame rate is outside the range of 0.8 to 10.2 frames/s.

### ESMC Generation

#### ➤ Generated QL

The **Generated QL** check box when selected (default) enables the generation of the selected QL message.

The **Generated QL** field allows the selection of the QL message that will be generated. See page 376 for the list of QL message (default is **QL-EEC2/ST3**).

**Note:** *For 1GE Electrical interface using **Local Clock** set to **Slave**, the **Generated QL** is not configurable and is set to **QL-DNU/DUS** with its check box selected.*

- **QL Rate (frame/s)** defines the frame rate at which the ESMC transmit the QL message value: **1** (default), **5**, or **10** frames per second. For 1GE Electrical interface using **Local Clock** set to **Slave**, the **QL Rate** is not configurable and is set to **1** frame/s.

### Restore SyncE Defaults

Reverts the SyncE test application to its default factory settings.

## System

From the **Test** menu, tap **Setup**, and **System**.

### Factory Default

- **Restore Default** button restores the factory default settings for all test applications.
- **Restore Default at Start-Up** check box when cleared (default), reloads the last configuration settings when the application is launched; when selected, the factory settings are restored.

## TCP Throughput

From the **Test** menu, tap **Setup**, **Test Configurator**, and tap on the test block.

### TCP Mode

Since two units are required to perform a TCP Throughput test, one unit must be the source (**Local**) unit and the other one the destination (**Remote**). Set the TCP Mode on both units: **Local** (default) or **Remote**.

### TCP Connection Configuration

- **Remote IP Address**, available with **Local** TCP mode, allows to enter the IP address of the remote unit.
- **Quick Ping** button automatically starts the quick Ping utility for the remote IP address and provides either a successful or failed result. The quick Ping uses 3 attempts, a Delay of 1 second, a Timeout of 2 seconds, and a Data Size of 32 Bytes. Refer to *Ping & Trace Route* on page 501 for more options.
- **Accept Connection from IP**, available with **Remote** TCP mode, allows to enter the IP address of the local unit. The IP address **0.0.0.0** (default) listens to any TCP stream.
- **IP TOS/DS**, available with **Local** TCP mode, is configurable from **0x00** (default) to **0xFF**.
- **TCP Port**, available with **Local** and **Remote** TCP modes, allows the selection of the TCP port number: **0** to **65535** (default is **50201**). For the local unit, the specified TCP port will be used for the TCP initialization algorithm with the remote unit. The following TCP segments sent by the local unit will use the TCP port number replied by the remote unit.

## TCP Throughput Configuration

**Note:** *TCP Throughput Configuration is only available on the local unit.*

- **Initial Window Size**<sup>1</sup> is the window size that is used when the test is started: **1024** Bytes to **65536** KBytes (default is **2** KBytes). The Initial Window Size value must be between the **Minimum Window Size** and the **Maximum Window Size** values.
- **Minimum Window Size**<sup>1</sup> is the minimum window size used for the test: **1024** Bytes to **65536** KBytes (default is **1** KBytes).
- **Maximum Window Size**<sup>1</sup> is the maximum window size used for the test: **1024** Bytes to **65536** KBytes (default is **64** MBytes).
- **Rate Unit** allows to select the unit that will be used to set the Throughput Pass/Fail Verdict Threshold and throughput results: % (default) or **MBit/s**.
- **Throughput Pass/Fail Verdict** check box when selected (default) enables the throughput verdict.
- **Threshold** allows to set the pass/fail verdict threshold value: **0** to **100%** (default).

## Restore TCP Throughput Defaults

Reverts the TCP Throughput test application to its default factory settings.

---

1. The entered value will be rounded to the closest multiple of 1024 Bytes. Unit choices are Bytes, KBytes (default), and MBytes.

## Timer

Allows to automatically start and/or stop the test at a given time or for a specific duration.

From the **Test** menu, tap **Setup**, and **Timer**.

### Timer

**Note:** *For RFC 2544 and RFC 6349, only **Start Time** and the **ARM** button are available.*

- **Duration:** Selects the test duration based on the test start time. The test start time can be either the time the user starts the test or the time the test is automatically started when the start time is enabled. The **Duration** check box has to be selected to be included in the test timer. Choices are **15 minutes** (default), **1, 2, 4, 6, 12, 24, 72 hours, 7 days**, and **User Defined**.

When **User Defined** is selected, the field next to it becomes available to enter the test duration using the format: dd:hh:mm:ss.

**Note:** *Duration cannot be enabled while stop time is enabled. When the test is started while duration is enabled, the stop time is calculated and the Stop Time field is updated to indicate the time the test will stop.*

- **Start Time** selects the time the test will automatically start. The **Start Time** check box has to be selected to be included in the test timer.

**Note:** *A valid start time has to be subsequent to the current time.*

## Test Setup - Test Configurator, Timer, and System

### Timer

---

- **Stop Time** selects the time the test will automatically stop. The **Stop Time** check box has to be selected to be included in the test timer.

**Note:** *A valid stop time has to be subsequent to the current time or to the start time, when enabled. The stop time must not exceed 30 days based on the start time. The stop time cannot be enabled while **Duration** is enabled.*

- **ARM** button, available when the **Start Time** check box is selected (cleared by default), enables the start test timer. Not available while the test is running. It is not possible to start the test case when the start time is armed.

**Note:** *An icon is displayed in the global test status area indicating that the timer is enabled. **Armed** is displayed when the test start time is armed while the test is not started. Refer to Global Indicator on page 31 for more information.*

### Traces (OTN)

From the **Test** menu, tap **Setup, Test Configurator**, tap on the signal block, and on the **Traces** tab.

#### OTUx, ODUx, and TCM Buttons

Tap on either OTUx or ODUx button. For ODUx when TCM is enabled (see **Modify TCM** on page 257), tap on a TCMx button to select a TCM level.

#### SM/PM/TCM TTI Traces

**Note:** *The TTI Traces are configurable for SM (OTUx), PM (ODUx), and TCM (ODUx when TCM is enabled; see **Modify TCM** on page 257).*

➤ **Generated Message**

Allows editing the SAPI, DAPI and Operator Specific messages to be generated.

➤ **Expected Message**

Allows editing the expected SAPI, and DAPI messages. The expected message settings are coupled with the **Expected Message** from *Traces - OTN* on page 443.

## Test Setup - Test Configurator, Timer, and System

### Traces (OTN)

---

- **SAPI** (Source Access Point Identifier) corresponds to the TTI bytes 1 to 15. A maximum of 15 characters are allowed. The TTI byte 0 is set to NULL (all 0's). The expected SAPI message is available when the **SAPI OTU/ODU-TIM** check box is selected.

| TTI Traces | Default Message |
|------------|-----------------|
| SM         | EXFO OTU SAPI   |
| PM         | EXFO ODU SAPI   |
| TCM        | EXFO TCMi SAPI  |

- **DAPI** (Destination Access point Identifier) corresponds to the TTI bytes 17 to 31. A maximum of 15 characters are allowed. The TTI byte 16 is set to NULL (all 0's). The expected DAPI message is available when the **DAPI OTU/ODU-TIM** check box is selected.

| TTI Traces | Default Message |
|------------|-----------------|
| SM         | EXFO OTU DAPI   |
| PM         | EXFO ODU DAPI   |
| TCM        | EXFO TCMi DAPI  |

- **Operator Specific** corresponds to the TTI bytes 32 to 63. A maximum of 32 characters are allowed.

| TTI Traces | Default Message             |
|------------|-----------------------------|
| SM         | EXFO OTU OPERATOR SPECIFIC  |
| PM         | EXFO ODU OPERATOR SPECIFIC  |
| TCM        | EXFO TCMi OPERATOR SPECIFIC |

- **SAPI OTU/ODU/TCM-TIM** check box, when selected (cleared by default), allows editing the expected Source Access Point Identifier (SAPI) and also enables OTU/ODU/TCM-TIM alarm monitoring.
- **DAPI OTU/ODU/TCM-TIM** check box, when selected (cleared by default), allows editing the expected Destination Access Point Identifier (SAPI) and also enables the OTU/ODU/TCM-TIM alarm monitoring.

Traces (SONET/SDH)

From the **Test** menu, tap **Setup, Test Configurator**, the interface block, and on the **Traces** tab.

**Note:** *Selecting a Trace byte to be generated will automatically update the corresponding OH byte. Refer to OH - SONET/SDH on page 487 for more information.*

Traces

➤ **Section/RS (J0), STS/AU/TU-3 Path (J1), and VT/TU Path (J2)**

**Format:** Allows the selections of the J0/J1/J2 format: **1 Byte** (default), **16 Bytes**, or **64 Bytes** format.

**Generated:** When the 16 bytes or 64 bytes format is selected, enter the J0/J1/J2 trace value/message to be generated.

Default values/messages

| Format (bytes) | Traces                                                     | J0/J1/J2     |
|----------------|------------------------------------------------------------|--------------|
| 1              | 01 <sup>a</sup>                                            | J0/J1/J2     |
| 16             | EXFO SONET/SDH                                             | J0/J1/J2     |
| 64             | EXFO SONET/SDH Analyzer Section/RS trace test message      | J0           |
|                | EXFO SONET/SDH Analyzer high order path trace test message | J1 (STS/AU)  |
|                | EXFO SONET/SDH Analyzer low order path trace test message  | J1 (TU-3)/J2 |

a. Hexadecimal value. Refer to OH - SONET/SDH on page 487 to change this value.

**Note:** *16-bytes selection allows typing up to 15 bytes (a CRC-7 byte will be added in front for a total of 16 bytes). 64-bytes selection allows typing up to 62-bytes (<C<sub>R</sub>> and <L<sub>F</sub>> bytes will be added at the end for a total of 64-bytes). Traces values should be ASCII suitable characters including the*

ITU T.50 Characters on page 39.

- **TIM-S/RS-TIM, TIM-P/HP-TIM, TIM-V/LP-TIM:** Enables the corresponding Trace Identifier Mismatch for the expected message defined. These settings are coupled with the *Result - Traces/Labels* configuration (refer to *Traces - SONET/SDH* on page 445).

**Format:** Allows the selection of the expected format:

**16 Bytes** (default), or **64 Bytes**.

**Expected:** Allows entering the expected J0 trace message for TIM-S/RS-TIM, J1 for TIM-P/HP-TIM, and J2 for TIM-V/LP-TIM. See *Default values/messages* on page 284.

### TCM Access Point Identifier

**Note:** Available when TCM is enabled from the Signal - Signal Configuration (SONET/SDH) on page 258.

- **STS/AU Path (N1), and VT/TU Path (Z6 or N1 (TU-3))**

Enter the N1/Z6 value/message to be generated.

- **TC-TIM-P/HPTC-TIM/TC-TIM-V/LPTC-TIM:** Enables the corresponding TCM Access Point Identifier for the expected message defined. These settings are coupled with the Traces configuration from *Traces (SONET/SDH)* on page 284.

**Copy RX** allows to use the received TIM message as the expected one.



## 9 Test Results

The Test Results menu offers the following structure:

### Intelligent Apps test application

| Tab     | Test Application<br>iSAM | Page |
|---------|--------------------------|------|
| Logger  | X                        | 362  |
| Summary | X                        | 411  |

### Transport test applications

| Tab                    | Available with |     |     |     |     |     | Page |
|------------------------|----------------|-----|-----|-----|-----|-----|------|
|                        | a              | b   | c   | d   | e   | f   |      |
| Alarms/Errors          | X              | X   | X   | X   | -   | X   | 292  |
| Alarms/Errors Logger   | -              | -   | -   | -   | -   | X   | 362  |
| FTFL/PT                | X              | -   | -   | -   | -   | -   | 349  |
| ISDN Logger            | -              | -   | -   | -   | -   | X   | 352  |
| Labels                 | -              | X   | -   | X   | -   | -   | 357  |
| Logger                 | X              | X   | X   | X   | X   | -   | 362  |
| Performance Monitoring | X              | X   | X   | X   | -   | -   | 365  |
| Summary                | 391            | 391 | 391 | 391 | 423 | 415 | <--- |
| Traces                 | 443            | 445 | -   | 445 | -   | -   | <--- |

- a. OTN BERT
- b. SONET/SDH BERT
- c. DS<sub>n</sub>/PDH BERT
- d. SONET/SDH - DS<sub>n</sub>/PDH BERT
- e. NI/CSU Emulation
- f. ISDN PRI

## Test Results

### Ethernet test applications

| Tab - Subtab                           | Test Application |     |     |     |     |     |     |     |            |     | Page |
|----------------------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|------------|-----|------|
|                                        | a                | b   | c   | d   | e   | f   | g   | h   | i          | j   |      |
| Alarms/Errors                          | X                | X   | X   | X   | X   | X   | X   | X   | X          | -   | 292  |
| Graph                                  | -                | -   | X   | -   | -   | -   | -   | -   | -          | -   | 351  |
| Link OAM                               | -                | -   | -   | -   | -   | -   | -   | -   | X          | -   | 358  |
| Logger                                 | X                | X   | X   | X   | X   | -   | X   | X   | X          | -   | 362  |
| S-OAM / MPLS-TP OAM                    | -                | -   | -   | -   | -   | -   | -   | -   | X          | -   | 379  |
| Service Configuration - Burst          | X                | -   | -   | -   | -   | -   | -   | -   | -          | -   | 384  |
| Service Configuration - Ramp           | X                | -   | -   | -   | -   | -   | -   | -   | -          | -   | 385  |
| Service Performance                    | X                | -   | -   | -   | -   | -   | -   | -   | -          | -   | 386  |
| Streams - Frame Loss / Out-of-Sequence | -                | -   | -   | -   | X   | -   | -   | -   | -          | -   | 388  |
| Streams - Jitter                       | -                | -   | -   | -   | X   | -   | -   | -   | -          | -   | 388  |
| Streams - Latency                      | -                | -   | -   | -   | X   | -   | -   | -   | -          | -   | 389  |
| Streams - MPLS                         | -                | -   | -   | -   | X   | -   | -   | -   | -          | -   | 364  |
| Streams - Throughput                   | -                | -   | -   | -   | X   | -   | -   | -   | -          | -   | 390  |
| Summary                                | 405              | 427 | 424 | 391 | 441 | 391 | 391 | 438 | 421<br>430 | 401 | <--- |
| Traffic - Ethernet                     | X                | X   | X   | X   | X   | X   | X   | X   | -          | -   | 446  |
| Traffic - Flow Control                 | -                | X   | X   | -   | X   | -   | X   | X   | -          | -   | 448  |
| Traffic - Graph                        | -                | -   | -   | -   | X   | -   | X   | -   | -          | -   | 450  |
| Traffic - MPLS                         | -                | -   | -   | -   | -   | -   | X   | -   | -          | -   | 364  |
| Traffic - S-OAM / MPLS-TP OAM          | -                | -   | -   | -   | -   | X   | -   | -   | X          | -   | 451  |
| Window Sweep                           | -                | X   | -   | -   | -   | -   | -   | -   | -          | -   | 453  |
| WIS                                    | X                | -   | X   | X   | X   | X   | -   | -   | X          | -   | 454  |

- a. EtherSAM
- b. RFC 6349
- c. RFC 2544
- d. EtherBERT
- e. Traffic Gen & Mon
- f. Smart Loopback
- g. Through Mode
- h. TCP Throughput
- i. Carrier Ethernet OAM
- j. Cable Test

### Packet Sync test applications

| Tab                      | Test Application |       | Page |
|--------------------------|------------------|-------|------|
|                          | 1588 PTP         | SyncE |      |
| Alarms/Errors            | X                | X     | 292  |
| Logger                   | X                | X     | 362  |
| PTP Stats                | X                | -     | 372  |
| Quality Level (1588 PTP) | X                | -     | 374  |
| Quality Level (SyncE)    | -                | X     | 376  |
| Summary                  | 397              | 435   | <--- |
| Traffic - Ethernet       | X                | X     | 446  |

### Fibre Channel test application

| Tab           | Test Application<br>Fibre Channel BERT | Page |
|---------------|----------------------------------------|------|
| Alarms/Errors | X                                      | 292  |
| Logger        | X                                      | 362  |
| Summary       | X                                      | 408  |

### Wireless Test Application

| Tab           | Test Application<br>CPRI/OBSAI BERT | Page |
|---------------|-------------------------------------|------|
| Alarms/Errors | X <sup>a</sup>                      | 292  |
| Logger        | X                                   | 362  |
| Summary       | X                                   | 391  |

a. Only available for Framed L2.

## Alarms/Errors Overview

Current and history alarms/errors are displayed using different background colors as defined in the following table.

| Background color | Alarm/Error | Description                                            |
|------------------|-------------|--------------------------------------------------------|
| Gray             | Current     | No test result available.                              |
|                  | History     |                                                        |
| Green            | Current     | No alarm/error has occurred in the last second.        |
|                  | History     | No alarm/error has occurred during the test.           |
| Red              | Current     | An alarm/error occurred in the last second.            |
|                  | History     |                                                        |
| Amber            | History     | At least one alarm/error has occurred during the test. |

- **Seconds** gives the total number of seconds in which one or more alarm/error occurred.
- **Count** gives the number of occurrences of a specific error. The count is displayed using integer value; exponential value (for example: 1.00000E10) is used when the count is bigger than the field display capacity.
- **Rate** calculates and displays the error rate. The rate is expressed using the exponential format with two decimal digits (example: 1.23E-04).

**Note:** Some Alarms/errors groups display a magnifying icon allowing to see more information on alarm/error like Second, Count, and Rate information.

## Pass/Fail Verdict

**Note:** *The verdict is not displayed when disabled or unavailable.*

The Pass/Fail verdict is represented by the following icons:

| Icon                                                                              | Verdict | Description                                                    |
|-----------------------------------------------------------------------------------|---------|----------------------------------------------------------------|
|  | PASS    | Result value meet the configured threshold criterion.          |
|  | FAIL    | Result value does not meet the configured threshold criterion. |

## Statistic Values

- **Current** indicates the average measurements in the last second.
- **Last** indicates the result of the last measurement.
- **Minimum** indicates the minimum value recorded.
- **Maximum** indicates the maximum value recorded.
- **Average** indicates the average value.

## Alarms/Errors

From the **Test** menu, tap **Results**, and the **Alarms/Errors** tab. Depending on the test structure, the Alarms/Errors page may be split in different tabs such as OTN and Ethernet; tap on the desired tab when required.

Alarms/errors blocks containing the magnifier (+) icon in its title, opens a zoomed view giving more details like errors in seconds, count, and rate.

When there is not enough room on the page to display the error in seconds, count, and rate, the error is displayed in **Seconds** per default. To select another unit, tap on the unit's button and select either **Seconds** (default), **Count**, or **Rate**.

The following table lists the availability of alarms/errors per layer for TX and RX.

| Layer         | Alarms/Errors                                          |                                                                         | Page |
|---------------|--------------------------------------------------------|-------------------------------------------------------------------------|------|
|               | TX/RX                                                  | RX only                                                                 |      |
| BER           | Pattern Loss                                           | No Traffic                                                              | 296  |
|               | Bit Error, Pattern Error                               | Mismatch '0', Mismatch '1',<br>Frame Loss, Out-of-Seq.                  |      |
| CLOCK         | -                                                      | LOC, LOPPS-L, LOPPS-R                                                   | 298  |
| CPRI          | LOF, R-LOS, R-LOF, RAI, SDI                            | Link Down                                                               | 299  |
|               | FAS                                                    |                                                                         |      |
| DS1           | AIS, OOF, RAI                                          | -                                                                       | 300  |
|               | CRC-6, Framing Bit                                     | -                                                                       |      |
| DS3           | AIS, Idle, OOF, RDI                                    | -                                                                       | 301  |
|               | CP-BIT, FEBE, F-Bit, P-Bit                             | -                                                                       |      |
| E1            | AIS, LOF, RAI, LOMF, RAI MF, TS16 AIS                  | -                                                                       | 302  |
|               | FAS                                                    | CRC-4, E-Bit                                                            |      |
| E2            | AIS, LOF, RAI                                          | -                                                                       | 303  |
| E3            | FAS                                                    | -                                                                       | 304  |
| E4            |                                                        |                                                                         | 305  |
| Ethernet      | Link Down, Remote Fault, Local Fault <sup>a</sup>      | Hi-BER, Local Fault Det.,<br>Local Fault Rcd.                           | 306  |
|               | FCS                                                    | Jabber, Oversize, Runt, Undersize                                       |      |
| FEC           | CORR-BIT, CORR-CW, CORR-SYM, STRESS,<br>UNCORR-CW      | CORR, UNCORR                                                            | 320  |
| Fibre Channel | -                                                      | Link Down, Local Fault Detected,<br>Local Fault Received, Remote Fault  | 309  |
|               | -                                                      | Symbol, Block, FCS, Oversize,<br>Undersize                              |      |
| Interface     | LOS, CV, K30.7                                         | Frequency, LOC                                                          | 311  |
| IP/UDP/TCP    | -                                                      | IP Chksum, UDP Chksum,<br>TCP Chksum                                    | 313  |
| ISDN          | -                                                      | D-CH Down, D-Ch FCS                                                     | 313  |
| MPLS-TP OAM   | RDI, AIS, LCK, C-LOS, C-FDI, C-RDI, C-DCI <sup>a</sup> | Loss Continuity, Mismatch,<br>Unexp MEG Lvl, Unexp MEP,<br>Unexp Period | 326  |

## Test Results

### Alarms/Errors

| Layer                 | Alarms/Errors                                                                                                                                                                                        |                                                                   | Page |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|------|
|                       | TX/RX                                                                                                                                                                                                | RX only                                                           |      |
| ODU <sub>x</sub>      | LOFLOM, AIS, OCI, LCK, BDI, FSF, BSF, FSD, BSD                                                                                                                                                       | TIM                                                               | 314  |
|                       | BEI, BIP-8                                                                                                                                                                                           | -                                                                 |      |
| ODU <sub>x</sub> -TCM | BDI, BIAE, IAE, LTC                                                                                                                                                                                  | TIM                                                               | 317  |
|                       | BEI, BIP-8                                                                                                                                                                                           | -                                                                 |      |
| OPU <sub>x</sub>      | AIS, MSIM, CSF                                                                                                                                                                                       | PLM                                                               | 319  |
| OTU <sub>x</sub>      | AIS, BDI, BIAE, IAE, LOF, LOM, OOF, OOM                                                                                                                                                              | TIM                                                               | 320  |
|                       | FAS, MFAS, BIP-8, BEI                                                                                                                                                                                | -                                                                 |      |
| PTP                   | -                                                                                                                                                                                                    | Loss Sync, Loss Announce, Unusable, QL Mismatch                   | 324  |
| QoS Metrics           | -                                                                                                                                                                                                    | Frame Loss, Out-of-Seq.                                           | 325  |
| S-OAM                 | RDI, AIS, LCK, C-LOS, C-FDI, C-RDI, C-DCI <sup>a</sup>                                                                                                                                               | Loss Continuity, Mismerge, Unexp MEG Lvl, Unexp MEP, Unexp Period | 326  |
| Section/Line / RS/MS  | LOF-S/RS-LOF, SEF/RS-OOF, AIS-L/MS-AIS, RDI-L/MS-RDI                                                                                                                                                 | TIM-S/RS-TIM                                                      | 330  |
|                       | FAS-S/RS-FAS, B1, B2, REI-L/MS-REI                                                                                                                                                                   | -                                                                 |      |
| STS-x / AU-x          | AIS-P/AU-AIS, LOP-P/AU-LOP, UNEQ-P/HP-UNEQ, PDI-P, RDI-P/HP-RDI, ERDI-PCD/ERDI-CD, ERDI-PPD/ERDI-PD, ERDI-PSD/ERDI-SD                                                                                | TIM-P/HP-TIM, PLM-P/HP-PLM                                        | 332  |
|                       | B3, REI-P/HP-REI                                                                                                                                                                                     | -                                                                 |      |
| SyncE                 | -                                                                                                                                                                                                    | ESMC, QL Mismatch                                                 | 335  |
| TCM (SONET/SDH)       | TC-UNEQ-P/HPTC-UNEQ, TC-LTC-P/HPTC-LTC, TC-IAIS-P/HPTC-IAIS, TC-ODI-P/HPTC-ODI, TC-RDI-P/HPTC-RDI, TC-UNEQ-V/LPTC-UNEQ, TC-LTC-V/LPTC-LTC, TC-IAIS-V/LPTC-IAIS, TC-ODI-V/LPTC-ODI, TC-RDI-V/LPTC-RDI | TC-TIM-P/HPTC-TIM, TC-TIM-V/LPTC-TIM                              | 336  |
|                       | TC-IEC-P/HPTC-IEC, TC-OEI-P/HPTC-OEI, TC-REI-P/HPTC-REI, TC-OEI-V/LPTC-OEI, TC-REI-V/LPTC-REI                                                                                                        | TC-VIOL-P/HPTC-VIOL, TC-VIOL-V/LPTC-VIOL                          |      |

| Layer | Alarms/Errors                                                                                                                         |                            | Page |
|-------|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------|
|       | TX/RX                                                                                                                                 | RX only                    |      |
| VT/TU | AIS-V/TU-AIS, LOP-V/TU-LOP, RDI-V/LP-RDI, RFI-V/LP-RFI, UNEQ-V/LP-UNEQ, ERDI-VSD/LP-ERDI-SD, ERDI-VCD/LP-ERDI-CD, ERDI-VPD/LP-ERDI-PD | TIM-V/LP-TIM, PLM-V/LP-PLM | 339  |
|       | -                                                                                                                                     | BIP-2, REI-V/LP-REI        |      |
| WIS   | SEF, LOP, AIS-L, RDI-L, AIS-P, RDI-P, LCD-P, LOP-P, UNEQ-P, ERDI-PSD, ERDI-PCD, ERDI-PPD                                              | WIS Link Down, PLM-P       | 342  |

- a. Available in TX only.

## **BER**

### **Alarms**

➤ **No Traffic** (Available with EtherBERT)

**RX:**

Ethernet: No pattern traffic has been received in the last second.

Fibre Channel: No traffic is being transmitted when Login Management fails; a pop up displays **No Data is being transmitted on Port(s) <port number>. The Login process has failed.**

➤ **Pattern Loss**

**RX:**

Ethernet: More than 20 percent of bit errors are received or the reference sequence can be unambiguously identified as out of phase.

Fibre Channel: bit error is detected on four consecutive words.

**Errors****➤ Bit Error**

**RX:** There are logic errors in the bit stream (i.e., zeros that should be ones and vice versa).

**➤ Pattern Error**

**RX:** Indicates a block mismatch. Only available with **Seed A** or **Seed B** pattern.

**➤ Mismatch '0' (Available with EtherBERT.)**

**RX:** There is a bit error on a binary '0' (for example ones that should be zeros) found in the test pattern only.

**➤ Mismatch '1' (Available with EtherBERT.)**

**RX:** There is a bit error on a binary '1' (for example zeros that should be ones) found in the test pattern only.

## Clock

➤ **LOC** (Loss Of Clock)

**RX:** The NetBlazer is unable to synchronize with the selected **Clock Mode**. No valid clock is generated/extracted to/from the EXT CLK port.

➤ **LOPPS-L** and **LOPPS-R** (Loss Of Pulse Per Second - Local/Remote) is only available with **Dual Test Set** in **One-Way Latency** measurement mode.

**RX:** Either no pulse is received or no pulse is received within 1 second  $\pm 6.6 \mu s$  after the previous pulse. **LOPPS-R** is only monitored once the DTS connection is established.

## CPRI

**Note:** CPRI alarms/errors are only available for Framed L2.

### Alarms

➤ **Link Down**

**RX:** Indicates that the start-up sequence is not in F (Operation) or G (Passive) link state.

➤ **LOF** (Loss Of Frame)

**RX:** The hyperframe alignment cannot be achieved or is lost.

➤ **R-LOS** (Remote - Loss Of Signal)

**RX:** Bit 3 of the Z.130.0 byte is set to 1.

➤ **R-LOF** (Remote - Loss Of Frame)

**RX:** Bit 4 of the Z.130.0 byte is set to 1.

➤ **RAI** (Remote Alarm Indication)

**RX:** Bit 1 of the Z.130.0 byte is set to 1.

➤ **SDI** (Service Access Point Defect Indication)

**RX:** Bit 2 of the Z.130.0 byte is set to 1.

### Errors

➤ **FAS** (Frame Alignment Signal)

**RX:** Error detected in the start of hyperframe (byte different of K28.5 while not in LOF).

## Test Results

### *Alarms/Errors*

---

## **DS1**

### **Alarms**

- **AIS** (Alarm Indication Signal)

**RX:** An unframed all-ones signal is received.

- **OOF** (Out-Of-Frame)

**RX:** Four consecutive frame bit errors are detected.

- **RAI** (Yellow) (Remote Alarm Indication)

**RX:**

SF framing: Bit 2 in each timeslot contains “0”.

ESF framing: Eight “ones” followed by eight “zeros” pattern is received continuously in the data link (FDL).

### **Errors**

- **Framing Bit**

**RX:** An incorrect value appeared in a bit position reserved for framing.

- **CRC-6** (Cyclical Redundancy Check) is only available with ESF framing.

**RX:** One or more bit errors have been detected in a block of data through cyclical redundancy check.

## **DS3**

### **Alarms**

➤ **AIS** (Alarm Indication Signal)

**RX:** The M-frame contains zeros (0) for C-bits, ones (1) for X-bits, 1010... repeating sequence with a one (1) immediately following any of the control bit positions for the information bits.

➤ **Idle** (DS3 Idle)

**RX:** Subframe 3 of the M-frame contains zeros (0) for the three C-bits, ones (1) for X-bits, 1100... repeating sequence with the first two bits following each control bit set to 11 for the information bits.

➤ **OOF** (Out-Of-Frame)

**RX:** Four consecutive frame bit errors are detected.

➤ **RDI** (Remote Defect Indicator)

**RX:** Both X-bits of the M-Frame are set to “0”.

### **Errors**

➤ **CP-Bit** (Control-Bit)

**RX:** The three C-bits reserved to control bit stuffing are different of “111” and “000”.

➤ **F-Bit** (Framing-Bit)

**RX:** The frame alignment pattern received is different of “1001”.

➤ **P-Bit** (Parity-Bit)

**RX:** The P-Bits does not match the parity of all the information bits following the first X-Bit of the previous DS3 frame.

➤ **FEBE** (Far-End Block Error)

**RX:** The three FEBE bits reserved for framing or parity error detection contain the “000” pattern.

## E1

### Alarms

**Note:** Only AIS is available when the framing is set to **Unframed**.

- **AIS** (Alarm Indication Signal)  
**RX:** An unframed all-ones signal is received.
- **LOF** (Loss Of Frame)  
**RX:** Three consecutive incorrect frame alignment signals is received.
- **RAI** (Yellow) (Remote Alarm Indication)  
**RX:** Bit 3 in timeslot 0 is set to “1”.
- **TS16 AIS** (TimeSlot 16 Alarm Indication Signal)  
**RX:** Timeslot 16 is received as all-ones for all frames of two consecutive multiframes.
- **LOMF** (Loss Of MultiFrame)  
**RX:** Two consecutive multiframes alignment signals (bits 1 through 4 of TS16 of frame 0) is received with an error.
- **RAI MF** (Remote Alarm Indication Multi-Frame)  
**RX:** Bit 6 of timeslot 16 of frame 0 is set to “1”.

## Errors

- **FAS** (Frame Alignment Signal) is only available with **PCM30 CRC-4** or **PCM31 CRC-4** framing.  
**RX:** Bits 2 to 8 of the frame containing the FAS differ from 0011011.
- **CRC-4** (Cyclical Redundancy Check)  
**RX:** One or more bit errors are detected in a block of data through cyclical redundancy check.
- **E-Bit** (CRC-4 Error Signal) is only available with **PCM30 CRC-4** or **PCM31 CRC-4** framing.  
**RX:** Bit 1 of sub-multiframe (SMF) II in frame 13 and/or 15 is set to 0 indicating a sub-multiframe error.

## E2

### Alarms

**Note:** Only AIS is available when the framing is set to Unframed.

- **AIS** (Alarm Indication Signal)  
**RX:** An unframed all-ones signal is received.
- **LOF** (Loss Of Frame)  
**RX:** Four consecutive incorrect frame alignment signals is received.
- **RAI** (Remote Alarm Indication)  
**RX:** Bit 11 of a framed E2 is set to “1”.

### Errors

- **FAS** (Frame Alignment Signal)  
**RX:** Bits 1 to 10 of the first frame differ from 1111010000.

## Test Results

### Alarms/Errors

---

## E3

### Alarms

**Note:** Only AIS is available when the framing is set to Unframed.

- **AIS** (Alarm Indication Signal)  
**RX:** An unframed all-ones signal is received.
- **LOF** (Loss Of Frame)  
**RX:** Four consecutive incorrect frame alignment signals is received.
- **RAI** (Remote Alarm Indication)  
**RX:** Bit 11 of a framed E3 is set to “1”.

### Errors

- **FAS** (Frame Alignment Signal)  
**RX:** Bits 1 to 10 of the first frame differ from 1111010000.

## **E4**

### **Alarms**

**Note:** *Only AIS is available when the framing is set to Unframed.*

➤ **AIS** (Alarm Indication Signal)

**RX:** An unframed all-ones signal is received.

➤ **LOF** (Loss Of Frame)

**RX:** Four consecutive incorrect frame alignment signals is received.

➤ **RAI** (Remote Alarm Indication)

**RX:** Bit 13 of a framed E4 is set to “1”.

### **Errors**

➤ **FAS** (Frame Alignment Signal)

**RX:** Bits 1 to 12 of the first frame differ from 111110100000.

## Test Results

### Alarms/Errors

---

## Ethernet

### Alarms

➤ **Link Down**

**RX:** The Ethernet connection is down meaning that there is a local or a remote fault condition.

➤ **Local Fault Det.**<sup>1</sup> (Local Fault Detected)

**RX:** At least one of the following events is detected: Loss of bit synchronization, Loss of Block synchronization, WIS Link down, or High BER.

➤ **Local Fault Rcd.**<sup>1</sup> (Local Fault Received)

**RX:** The received data path contains the **Local Fault** signal.

➤ **Remote Fault**<sup>1</sup>

**RX:** The received data path contains the **Remote Fault** status.

---

1. Available with Ethernet 10Gbit/s interface.

**Errors****➤ Symbol<sup>1</sup>**

**RX/TX:** Invalid code-group is detected/generated in the code.

**➤ Idle<sup>1</sup>**

**RX:** An error is detected between the end of a frame and the beginning of the next frame.

**➤ False Carrier<sup>1</sup>**

**RX:** Data is being received with invalid start of frame.

**➤ Block** (available with Ethernet 10G LAN/WAN interface)

**RX:** Error block received in frames.

**➤ Alignment** (available with 10/100Mbit/s interface)

**RX:** Frames without an integral number of octets in length are received.

**➤ FCS** (Frame Check Sequence)

**RX:** Frames with an invalid FCS are received.

**➤ Jabber**

**RX:** Frames larger than 1518 bytes<sup>2</sup> with an invalid FCS are received.

**➤ Oversize** (available when the **Oversize Monitoring** check box is selected.)

**RX:** Frames larger than 1518<sup>2</sup> bytes with a valid FCS.

**➤ Runt**

**RX:** Frames smaller than 64 bytes with an invalid FCS.

---

1. Available with Ethernet 100/1000Mbit/s interface.

2. 1518 bytes for no VLAN tag, 1522 for one VLAN tag, 1526 for two VLAN tags, or 1530 for 3 VLAN tags.

## Test Results

### *Alarms/Errors*

---

➤ **Undersize**

**RX:** Frames smaller than 64 bytes with a valid FCS.

- **Oversize Monitoring** check box, when selected (cleared by default), allows monitoring the **Oversize** frame errors.

The following errors are only available with **Half Duplex** mode (only for electrical interface at speeds of 10 Mbit/s and 100 Mbit/s).

➤ **Collision**

**RX:** Indicates the number of collisions on the link.

➤ **Late Coll.**

**RX:** Indicates the number of collisions that have occurred after a 64 bytes transmission.

➤ **Exc. Coll.**

**RX:** Indicates the number of frames that were sent 16 times unsuccessfully due to consecutive collisions.

## Fibre Channel

### Alarms

➤ **Link Down**

**RX:** The Fibre Channel connection is down meaning that there is a local or a remote fault condition.

➤ **Local Fault Detected (FC 10X)**

**RX:** Indicates that at least one of the following events is detected: **LOS**, **Loss of bit synchronization**, **Loss of Block synchronization**, **Link down**, or **High BER** (High BER is true when the bit error ratio  $> 10^{-4}$  on a fixed 125  $\mu s$  time period).

➤ **Local Fault Received (FC 10X)**

**RX:** Indicates that the received data path contains the Local Fault signal.

➤ **Remote Fault (FC 10X)**

**RX:** Indicates that a Remote Fault event is detected.

## Test Results

### *Alarms/Errors*

---

#### **Error**

➤ **Symbol** (FC 1X/2X/4X/8X)

**RX/TX:** Invalid code-group is detected/generated in the code.

➤ **Block** (FC 10X)

**RX:** The number of frames received with an errored block condition.

➤ **FCS** (Frame Check Sequence)

**RX:** Frames with an invalid FCS are received.

➤ **Oversize**

**RX:** The number of received FL-2 frames larger than 2148 bytes with a valid FCS.

➤ **Undersize**

**RX:** FL-2 frames smaller than 36 bytes with a valid FCS.

## Interface

### Alarms

#### ► LOS (Loss Of Signal)

**RX:** Absence of an input signal or an all-zeros pattern is received.

For CPRI Framed L2: Absence of an input signal or at least 16 8B/10B code violations occur in one hyperframe.

#### ► Frequency

**RX:** The received signal frequency meets the standard specifications (green) or not (red).

For Ethernet **10/100/1000M Electrical, 100M Optical, 1GE Optical, 10GE LAN/WAN**, or Fibre Channel **1X/2X/4X/8X/10X** interface/rate, the frequency range is  $\pm 100$  ppm.

| Interface                 | Standard Rate Specification |
|---------------------------|-----------------------------|
| DS1                       | 1544000 $\pm 36.6$ ppm      |
| E1                        | 2048000 $\pm 54.6$ ppm      |
| E3                        | 34368000 $\pm 24.6$ ppm     |
| DS3                       | 44736000 $\pm 24.6$ ppm     |
| STS-1e/STM-0e, OC-1/STM-0 | 51840000 $\pm 20$ ppm       |
| E4                        | 139264000 $\pm 19.6$ ppm    |
| STS-3e/STM-1e, OC-3/STM-1 | 155520000 $\pm 20$ ppm      |
| OC-12/STM-4               | 622080000 $\pm 20$ ppm      |
| OC-48/STM-16              | 2488320000 $\pm 20$ ppm     |
| OTU1                      | 2666057143 $\pm 20$ ppm     |
| OC-192/STM-64             | 9953280000 $\pm 20$ ppm     |
| OTU2                      | 10709225316 $\pm 20$ ppm    |
| OTU1e                     | 11049107143 $\pm 100$ ppm   |
| OTU2e                     | 11095727848 $\pm 100$ ppm   |
| OTU1f                     | 11270089286 $\pm 100$ ppm   |
| OTU2f                     | 11317642405 $\pm 100$ ppm   |

## Test Results

### Alarms/Errors

---

#### Error

- **BPV** (Bipolar Violation), available with DS1 and DS3, pulses of the same consecutive polarity were detected, in violation with the bipolar signal format.
- **BPV/CV** (Bipolar Violation/Code Violation), available with STS-1e and STS-3e, pulses of the same consecutive polarity were detected, in violation with the bipolar signal format.

- **CV** (Code Violation)

For E1, E3, E4, STM-0e, and STM-1e: Pulses of the same consecutive polarity were detected, in violation with the bipolar signal format.

For CPRI Framed L2: Invalid 10B code word received.

- **K30.7**, for CPRI Framed L2, code word /V/ with Error\_Propagation ordered\_set received.

- **EXZ** (Excessive Zeros):

For **DS1** with **AMI Line Coding**, more than 15 consecutive bit periods with no pulses have been received.

For **DS1** with **B8ZS Line Coding**, more than 7 consecutive bit periods with no pulses have been received.

For **DS3**, more than 2 consecutive bit periods with no pulses have been received.

## **IP/UDP/TCP**

### **Errors**

➤ **IP Chksum** (IP Checksum)

**RX:** The IP datagrams received have invalid IP header checksum. Only available for IPv4.

➤ **UDP Chksum** (UDP Checksum)

**RX:** The UDP segments received have invalid UDP checksum.

➤ **TCP Chksum** (TCP Checksum)

**RX:** The TCP segments received have invalid TCP checksum.

## **ISDN**

### **Alarms**

➤ **D-Ch Down** (D-Channel Down)

**RX:** The Data Link Layer is not in the multiple-frame established state.

### **Errors**

➤ **D-Ch FCS** (D-Channel FCS)

**RX:** D-Channel Frames have an invalid FCS.

## ODUx

**Note:** For OPUx alarms see page 319.

### Alarms

➤ **AIS** (Alarm Indication Signal)

**RX:** The STAT information in the PM byte 3, bits 6 to 8 is “111” for at least 3 consecutive frames.

**TX:** Generates an all "1"s pattern in the entire ODUk signal, excluding the frame alignment overhead (FA OH), OTUk overhead (OTUk OH) and ODUk FTFL.

➤ **BDI** (Backward Defect indication)

**RX:** The BDI bit in the PM overhead field (byte 3, bit 5) is “1” for at least 5 consecutive frames.

**TX:** Generates a “1” in the BDI (byte 3, bit 5) of the PM overhead field continuously.

➤ **BSD** (Backward Signal Degrade)

**RX:** The FTFL byte 128 is “00000010”.

**TX:** Generates a “00000010” pattern in the FTFL Byte 128 continuously.

➤ **BSF** (Backward Signal Fail)

**RX:** The FTFL byte 128 is “00000001”.

**TX:** Generates a “00000001” pattern in the FTFL Byte 128 continuously.

➤ **FSD** (Forward Signal Degrade)

**RX:** The FTFL byte 0 is “00000010”

**TX:** Generates a “00000010” pattern in the FTFL Byte 0 continuously.

➤ **FSF** (Forward Signal Fail)

**RX:** The FTFL byte 0 is “00000001”.

**TX:** Generates a “00000001” pattern in the FTFL Byte 0 continuously.

➤ **LCK** (Lock)

**RX:** STAT information in the PM byte 3, bits 6 to 8 is “101” for at least 3 consecutive frames.

**TX:** Generates a repeating "01010101" pattern in the entire ODUk signal, excluding the frame alignment overhead (FA OH) and OTUk overhead (OTUk OH).

➤ **OCI** (Open Connection Indication)

**RX:** STAT information in the PM byte 3, bits 6 to 8 is “110” for at least 3 consecutive frames.

**TX:** Generates a repeating "01100110" pattern in the entire ODUk signal, excluding the frame alignment overhead (FA OH) and OTUk overhead (OTUk OH).

➤ **TIM** (Trace Identification Mismatch)

**RX:** The received SAPI and/or DAPI do not math the expected SAPI and/or DAPI. This alarm is only available when the SAPI ODU-TIM and/or DAPI ODU-TIM check boxes are selected from *PT* on page 147.

## Test Results

### Alarms/Errors

---

#### Errors

➤ **BIP-8** (Bit Interleave Parity-8)

**RX:** There is a PM BIP-8 mismatch between the received value and locally computed value (0 to 8).

➤ **BEI** (Backward Error Indication)

**RX:** Interleaved block in error detected by the corresponding ODU path monitoring sink using the BIP-8 code.

| ODU BEI bits<br>(1234) | BIP violations | ODU BEI bits<br>(1234) | BIP violations |
|------------------------|----------------|------------------------|----------------|
| 0000                   | 0              | 0101                   | 5              |
| 0001                   | 1              | 0110                   | 6              |
| 0010                   | 2              | 0111                   | 7              |
| 0011                   | 3              | 1000                   | 8              |
| 0100                   | 4              | 1001 to 1111           | 0              |

## ODUx-TCM

### Alarms

- **BDI** (Backward Defect Indication)

**RX:** The BDI bit in the TCM overhead field Byte 3, bit 5 is “1” for at least 5 consecutive frames.

**TX:** Generates a "1" in the BDI bit of the TCM overhead field (byte 3, bit 5) continuously.
- **BIAE** (Backward Incoming Alignment Error)

**RX:** The BEI/BIAE bits in the TCM overhead field Byte 3, bits 1 to 4 are “1011” for at least 3 consecutive frames.

**TX:** Generates "1011" in the BEI/BIAE bits of the TCM overhead (byte 3, bits 1 to 4) continuously.
- **IAE** (Incoming Alignment Error)

**RX:** The STAT information in the TCM is “010” for at least 3 consecutive frames.

**TX:** Generates "1" in the IAE bit of the TCM overhead (byte 3, bit 6) continuously.
- **LTC** (Loss of Tandem Connection)

**RX:** The STAT information in the TCM Byte 3, bits 6, 7, and 8 are “000” for at least 3 consecutive frames.

**TX:** Generates "000" in the STAT field of TCM overhead (byte 3, bits 6 to 8) continuously.
- **TIM** (Trace Identification Mismatch)

**RX:** The SAPI and/or DAPI do not math the expected SAPI and/or DAPI. This alarm is only available when the Enable TIM SAPI and/or DAPI check boxes are selected from *PT* on page 147.

Test Results

Alarms/Errors

Errors

- **BIP-8** (Bit Interleave Parity-8)  
**RX:** There is a TCM BIP-8 mismatch between the received value and locally computed value (0 to 8).
- **BEI** (Backward Error Indication)  
**RX:** Interleaved block in error detected by the corresponding ODU tandem connection monitoring sink using the BIP-8 code.

| ODU TCM BEI bits (1234) | BIP violations | ODU BEI bits (1234) | BIP violations |
|-------------------------|----------------|---------------------|----------------|
| 0000                    | 0              | 0101                | 5              |
| 0001                    | 1              | 0110                | 6              |
| 0010                    | 2              | 0111                | 7              |
| 0011                    | 3              | 1000                | 8              |
| 0100                    | 4              | 1001 to 1111        | 0              |

## OPUx

**Note:** *OPUx is displayed under ODUx alarms/errors group.*

### Alarms

➤ **AIS** (Alarm Indication Signal)

**RX:** A PRBS11 pattern is received indicating a failure of the client signal.

**TX:** Generates a PRBS11 pattern.

➤ **CSF** (Client Signal Fail)

**RX:** Bit 1 of the OPUk PSI[2] byte is set to “1” indicating a failure of the client signal mapped into the OPUk of the OTN signal.

**TX:** Sets the bit 1 of the OPUk PSI[2] byte to “1”.

➤ **PLM** (Payload Mismatch) is available when OPU-PLM check box is selected.

**RX:** The Payload Structure Identifier (PSI) field does not match the expected PT for at least 3 consecutive frames.

## OTUx

**Note:** Available for OTU2, OTU2f, OTU1f, OTU2e, OTU1e, and OTU1.

### Alarms

➤ **AIS** (Alarm Indication Signal)

**RX:** Polynomial number 11 (PN-11) is over all OTU frame bits including FAS and MFAS for at least 3 consecutive 8192 bit-interval.

**TX:** Generates polynomial number 11 (PN-11) over all OTU frame bits including FAS and MFAS continuously.

➤ **BDI** (Backward Defect Indication)

**RX:** The BDI bit in the SM overhead field (byte 3, bit 5) is “1” for at least 5 consecutive OTU frames.

**TX:** Generates “1” for the BDI bit in the SM overhead field (byte 3, bit 5) continuously.

➤ **BIAE** (Backward Incoming Alignment Error)

**RX:** The BEI/BIAE bits in the SM overhead field (byte 3, bits 1 to 4) are “1011” for at least 3 consecutive frames.

**TX:** Generates “1011” for the BEI/BIAE bits in the SM overhead field (byte 3, bits 1 to 4) continuously.

➤ **IAE** (Incoming Alignment Error)

**RX:** The IAE bit in the SM overhead field (byte 3, bit 6) is “1” for at least 5 consecutive OTU frames.

**TX:** Generates “1” for the IAE bit in the SM overhead field (byte 3, bit 6) continuously.

- **LOF** (Loss of Frame)  
**RX:** OOF is present for at least 3 ms.  
**TX:** Generates error in all FAS bits continuously.
- **LOM** (Loss Of Multiframe)  
**RX:** OOM is present for at least 3 ms  
**TX:** Generates error in MFAS bits continuously.
- **OOF** (Out-Of-Frame)  
**RX:** FAS (bytes 3, 4, and 5) are in error for at least 5 consecutive OTU frames.  
**TX:** Generates error in all FAS bits for 5 consecutive OTU frames.
- **OOM** (Out-Of-Multiframe)  
**RX:** MFAS are in error for at least 5 consecutive OTU frames.  
**TX:** Generates error in multiframe number for 5 consecutive OTU frames.
- **TIM** (Trace Identifier Mismatch)  
**RX:** Expected SM SAPI and/or SM DAPI do not match the received SM SAPI and/or DAPI for at least 3 consecutive TTl. This alarm is only available when the Enable TIM SAPI OTU-TIM and/or DAPI OTU-TIM check boxes are selected from page 285.

## Test Results

### Alarms/Errors

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#### Errors

➤ **BEI** (Backward Error Indication)

**RX:** SM BEI errors are received from the DUT (value 0 to 8).

| OTU BEI bits<br>(1234) | BIP violations | ODUk BEI bits<br>(1234) | BIP violations |
|------------------------|----------------|-------------------------|----------------|
| 0000                   | 0              | 0101                    | 5              |
| 0001                   | 1              | 0110                    | 6              |
| 0010                   | 2              | 0111                    | 7              |
| 0011                   | 3              | 1000                    | 8              |
| 0100                   | 4              | 1001 to 1111            | 0              |

➤ **BIP-8** (Bit Interleave Parity-8)

**RX:** There is a SM BIP-8 mismatch between the received value and locally computed value (0 to 8).

➤ **FAS** (Frame Alignment Signal)

**RX:** The FAS bits are in error.

➤ **FEC-CORR** (Forward Error Correction - Correctable)

**RX:** Statistics on codewords (CW; default), symbols (SYMB), or bits (BIT) corrected by the FEC.

**TX:**

**FEC-CORR-CW** (Forward Error Correction - Correctable - Codeword): Generates 8 symbols (bytes) containing 8 bits in error each, in each codeword.

**FEC-CORR-SYM** (Forward Error Correction - Correctable - Symbol): Generates 1 symbol (byte) containing 8 bits in error.

**FEC-CORR-BIT** (Forward Error Correction - Correctable - Bit): Generates 1 symbol (byte) containing 1bit in error.

➤ **FEC-UNCORR** (FEC - Uncorrectable)

**RX:** Statistics on the detected codewords (CW) having uncorrectable errors.

**TX: FEC-UNCORR-CW** (Forward Error Correction - Uncorrectable - Codeword) generates 16 symbol (bytes) containing 8 bits in error each, in each codeword.

➤ **FEC-STRESS** (Forward Error Correction - Stress)

**TX:** Generates correctable errors composed of a random number of symbol errors (less or equal to 8) containing a random number of bits distributed all over the OTU frame.

➤ **MFAS** (Multiframe Alignment Signal)

**RX:** The MFAS bits are in error.

## PTP

### Alarms

#### ➤ Loss Sync

**RX:** The Slave Clock does not receive packet timing signal messages (Sync, Follow Up, Delay Resp) within their expected arrival time for a duration exceeding the configured **Receipt Timeout** (refer to *PTSF Alarm Timeout/Threshold* on page 115).

#### ➤ Loss Announce

**RX:** The Slave Clock does not receive Announce messages within their expected arrival time for a duration exceeding the configured **Receipt Timeout** (refer to *PTSF Alarm Timeout/Threshold* on page 115).

#### ➤ Unusable

**RX:** Either the maximum Sync IPDV value or the maximum Delay Req IPDV value in the last second exceeds the configured **IPDV Threshold** (refer to *PTSF Alarm Timeout/Threshold* on page 115).

#### ➤ QL Mismatch

**RX:** The received QL value does not match the Expected QL (refer to page 115 or page 374). The **QL Mismatch** alarm is only reported when at least one Announce message has already been received (**Last QL Received**) and that the **QL Mismatch Monitoring** check box is selected.

## QoS Metrics

**Note:** *Only available with Traffic Gen & Mon test application.*

### Errors

➤ **Frame Loss**

**RX:** A sequence number is missing in the received frames.

➤ **Out-of-Seq.** (Out-of-Sequence)

**RX:** The received frame sequence number is either smaller than the expected frame sequence number or is a duplicate number.

## S-OAM and MPLS-TP OAM

### Alarms

**Note:** The following alarms are available when the **CC Function** check box is selected (refer to page 224).

➤ **Loss Continuity**

**RX:** No CCM frames with same or lower MEG/MD Level were received from the peer MEP within an interval equal to 3.5 times the configured CCM transmission period. The alarm is cleared when at least 3 CCM frames with same or lower MEG/MD Level from the peer MEP are received within an interval equal to 3.5 times the configured CCM transmission period.

➤ **Mismerge**

**RX:** A CCM frame was received from the peer MEP with same MEG/MD Level but with incorrect MEG ID/MAID value or format. The MAID, composed of a Domain ID and a Short MA Name strings, is incorrect if one or both strings are not as expected. The alarm is cleared when no CCM frames with same MEG/MD Level but with incorrect MEG ID/MAID value or format are received within an interval equal to 3.5 times the configured CCM transmission period.

➤ **Unexp MEG/MD Lvl (Unexpected MEG/MD Level)**

**RX:** A CCM frames was received from the peer MEP with lower MEG/MD Level. The alarm is cleared when no CCM frames with lower MEG/MD Level are received within an interval equal to 3.5 times the configured CCM transmission period.

➤ **Unexp MEP** (Unexpected MEP)

**RX:** A CCM frame was received from the peer MEP with same MEG/MD Level, correct MEG ID/MAID, and correct source MAC Address (corresponds to the peer MEP) but with unexpected MEP ID. The alarm is cleared when no CCM frames with same MEG/MD Level, correct MEG ID/MAID, correct source MAC Address (corresponds to the peer MEP) but with an unexpected MEP ID are received within an interval equal to 3.5 times the configured CCM transmission period.

➤ **Unexp Period** (Unexpected Period)

**RX:** A CCM frame is received from the peer MEP with same MEG/MD Level, correct MEG ID/MAID, and correct MEP ID but with a period field value different than the one configured. The alarm is cleared when no CCM frames with same MEG/MD Level, correct MEG ID/MAID, and correct MEP ID but with incorrect period field value are received within an interval equal to 3.5 times the configured CCM transmission period.

➤ **RDI** (Remote Defect Indication)

**RX:** The RDI flag bit of a valid CCM frames is set to 1. A valid CCM frame has its source MAC address matching the Peer MEP MAC address, the destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address (refer to page 638), and VLANs matching the unit port VLANs.

**TX:** The RDI flag bit of transmitted CCM frames is set to 1.

## Test Results

### Alarms/Errors

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**Note:** The following alarms are available with G.8113.1, Y.1731 and MEF modes.

➤ **AIS** (Alarm Indication Signal)

**RX:** A valid AIS frame is received. A valid frame has its destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address (refer to page 638), VLANs matching the unit port VLANs, and MEG level matching the local MEG level. The alarm is cleared when during an interval equal to 3.5 times the AIS transmission period indicated in the last received AIS frame, no AIS frames are received.

➤ **LCK** (Locked)

**RX:** An valid LCK frame is received. A valid frame has its destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address (refer to page 638), VLANs matching the unit port VLANs, and MEG level matching the local MEG level. The alarm is cleared when during an interval equal to 3.5 times the LCK transmission period indicated in the last received LCK frame, no LCK frames are received.

➤ **C-LOS** (Client Signal Fail - Loss Of Signal)

**RX:** A CSF frame is received with CSF type equal to **000**. The alarm is cleared when no CSF (C-LOS) frames are received during an interval equal to 3.5 times the CSF transmission period indicated in the last received CSF (C-LOS) frame, or when a CSF frame is received with Client Defect Clear Indication (C-DCI) information (CSF Type 011).

**TX:** Generates a CSF frame with CSF type equal to **000**.

➤ **C-FDI** (Client Signal Fail - Forward Defect Indication)

**RX:** A CSF frame is received with CSF type equal to **001**. The alarm is cleared when no CSF (C-FDI) frames are received during an interval equal to 3.5 times the CSF transmission period indicated in the last received CSF (C-FDI) frame, or when a CSF frame is received with Client Defect Clear Indication (C-DCI) information (CSF Type 011).

**TX:** Generates a CSF frame with CSF type equal to **001**.

➤ **C-RDI** (Client Signal Fail - Remote Defect Indication)

**RX:** A CSF frame is received with CSF type equal to **010**. The alarm is cleared when no CSF (C-RDI) frames are received during an interval equal to 3.5 times the CSF transmission period indicated in the last received CSF (C-RDI) frame, or when a CSF frame is received with Client Defect Clear Indication (C-DCI) information (CSF Type 011).

**TX:** Generates a CSF frame with CSF type equal to **010**.

➤ **C-DCI** (Client Signal Fail - Defect Clear Indication)

**TX:** Generates a CSF frame with CSF type equal to **011**.

## Section/Line / RS/MS

### Alarms

- **LOF-S** (Loss Of Frame - Section) - SONET  
**RS-LOF** (Regeneration Section - Loss Of Frame) - SDH  
  
**RX:** A SEF (SONET)/RS-OOF (SDH) defect on the incoming optical signal persists for at least 3 milliseconds.  
  
**TX:** Generates non-valid framing bytes (A1 and A2).
- **SEF** (Severely Errored Framing) - SONET.  
**RS-OOF** (Regeneration Section - Out-Of-Frame) - SDH.  
  
**RX:** A minimum of four consecutive errored framing patterns are received.  
  
**TX:** Generates four consecutive errored framing patterns.
- **TIM-S** (Trace Identifier Mismatch - Section) - SONET  
**RS-TIM** (Regeneration Section - Trace Identifier Mismatch) - SDH  
  
**RX:** The received J0 Trace doesn't match the expected message value. Only available when Enable TIM-S/RS-TIM check box is selected (Refer to *Traces (SONET/SDH)* on page 284).
- **AIS-L** (Alarm Indication Signal - Line) - SONET  
**MS-AIS** (Multiplex Section - Alarm Indication Signal) - SDH  
  
**RX:** Bits 6, 7 and 8 of the K2 byte contain the "111" pattern in five consecutive frames.  
  
**TX:** Generates a SONET/SDH signal that contains a valid Section Overhead (SOH) / Regenerator Section Overhead (RSOH) and an all-ones pattern on the SPE.

- **RDI-L** (Remote Defect Indication - Line) - SONET  
**MS-RDI** (Multiplex Section - Remote Defect Indication) - SDH  
**RX:** Bits 6, 7, and 8 of the K2 byte contain the “110” pattern in five consecutive frames.  
**TX:** Generates a “110” pattern for the bits 6, 7 and 8 of the K2 byte.

### Errors

- **FAS-S** (Frame Alignment Signal - Section) - SONET  
**RS-FAS** (Regeneration Section - Frame Alignment Signal) - SDH  
**RX:** At least one A1 or A2 byte of the FAS word is in error.
- **B1** (BIP-8, Bit-Interleave Parity - 8 bits)  
**RX:** Indicates a Section (SONET) / Regeneration Section (SDH) parity error by performing a routine even-parity check over all frames of the previous STS-n/STM-n signal (located in the first STS-1/STM-1 of an STS-n/STM-n signal).
- **B2** (BIP-8, Bit-Interleave Parity - 8 bits)  
**RX:**
  - SONET: Indicates a Line parity error by performing an even-parity check over all bits of the LOH and SPE of the previous frame (located in every STS-1 of an STS-n signal).
  - SDH: Indicates a Multiplex Section parity error by performing an even-parity check over all bits (except those in the RSOH bytes) of the previous frame of a STM-N signal.
- **REI-L** (Remote Error Indicator - Line) - SONET  
**MS-REI** (Multiplex Section - Remote Error Indicator) - SDH  
**RX:** The M0, M1, or the combination of both M0 and M1 bytes indicate that one or more BIP violations have been detected. Refer to *M0 or M1/Z2 (SONET)* on page 491 for more information. For OC-192, also refer to *REI-L Computation Method* on page 259.

## STS-x/AU-x

### Alarms

- **AIS-P** (Alarm Indication Signal - Path) - SONET  
**AU-AIS** (Administrative Unit - Alarm Indication Signal) - SDH  
**RX:** The H1 and H2 bytes contain an all-ones pattern in three consecutive frames or more.  
**TX:** Generates an all-ones pattern over H1, H2, H3, and SPE.
- **LOP-P** (Loss Of Pointer - Path) - SONET  
**AU-LOP** (Administrative Unit - Loss Of Pointer) - SDH  
**RX:** A valid pointer is not found in N consecutive frames (where  $8 \leq N \leq 10$ ), or that N consecutive NDFs ("1001" pattern) are detected (non-concatenated payloads).  
**TX:** Generates a non-valid pointer.
- **UNEQ-P** (Unequipped - Path) - SONET  
**HP-UNEQ** (HP - Unequipped) - SDH  
**RX:** The C2 byte contains "00 H" in five consecutive frames. Only available when PLM-P/UNEQ-P / HP-PLM/HP-UNEQ is enabled (refer to *Labels* on page 169).  
**TX:** Generates an all-zeros pattern over POH and SPE.
- **H4-LOM** (H4 - Loss Of Multiframe)  
**RX:** For VT/TU structured optical frames, the system loss track of the H4 byte multiframe indicator sequence.  
**TX:** Generates a wrong H4 byte multiframe indicator sequence.
- **TIM-P** (Trace Identifier Mismatch - Path) - SONET  
**HP-TIM** (HP - Trace Identifier Mismatch) - SDH  
**RX:** J1 Trace doesn't match the expected message value. Only available when TIM-P/HP-TIM is enabled (refer to *Traces (SONET/SDH)* on page 284).

- **PLM-P** (Payload Label Mismatch - Path) - SONET  
**HP-PLM** (HP - Payload Label Mismatch) - SDH  
**RX:** Five consecutive frames have mismatched STS/VC signal labels (C2 byte). Only available when PLM-P/UNEQ-P / HP-PLM/HP-UNEQ is enabled (refer to *Labels* on page 169).
- **PDI-P** (Payload Defect Indication - Path) - SONET  
**RX:** For VT-structured STS-1 SPE, there is a LOP-V, AIS-V, DS3 AIS, DS3 LOS, or DS3 OOF defect on any VT or DS3 payload that it embeds into the STS SPE that it is originating. For non-VT-structured STS-1 or STS-Nc SPE, the C2 byte contains the hexadecimal FC code.  
**TX:** For VT-structured STS-1 SPE, generates a VT-structured STS-1 SPE with payload defect. For non-VT-structured STS-1 or STS-Nc SPE, inserts the hexadecimal FC code in the C2 byte.
- **RDI-P** (Remote Defect Indication - Path) - SONET  
**HP-RDI** (High Order Path - Remote Defect Indication) - SDH  
**RX:** Bits 5, 6, and 7 of the G1 byte contain the “100” or “111” pattern in five consecutive frames.  
**TX:** Generates a “100” pattern for bits 5, 6 and 7 of the G1 byte.
- **ERDI-PCD** (Enhanced RDI - Path Connectivity Defect) - SONET  
**ERDI-CD** (Enhanced RDI - Path Connectivity Defect) - SDH  
**RX:** Bits 5, 6 and 7 of the G1 byte contain the “110” pattern in five consecutive frames.  
**TX:** Generates a “110” pattern for bits 5, 6 and 7 of the G1 byte.
- **ERDI-PPD** (Enhanced RDI - Path Payload Defect) - SONET  
**ERDI-PD** (Enhanced RDI - Payload Defect) - SDH  
**RX:** Bits 5, 6 and 7 of the G1 byte contain the “010” pattern in five consecutive frames.  
**TX:** Generates a “010” pattern for bits 5, 6 and 7 of the G1 byte.

## Test Results

### *Alarms/Errors*

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- **ERDI-PSD** (Enhanced RDI - Path Server Defect) - SONET  
**ERDI-SD** (Enhanced RDI - Server Defect) - SDH

**RX:** Bits 5, 6 and 7 of the G1 byte contain the “101” pattern in five consecutive frames.

**TX:** Generates a “101” pattern for bits 5, 6 and 7 of the G1 byte.

### **Errors**

- **B3** (BIP-8, Bit-Interleave Parity - 8 bits)

**RX:** Indicates a high order path parity error by performing an even-parity check over all bits of the previous SPE (SONET) / VC-N (SDH).

- **REI-P** (Remote Error Indicator - Path) - SONET  
**HP-REI** (HP - Remote Error Indicator) - SDH

**RX:** Bits 1 through 4 of the G1 byte contain one pattern from the following binary range: “0001” through “1000” (1 to 8) (located in every STS-1/STM-1 of an STS-n/STM-n signal).

## **SyncE**

### **Alarms**

➤ **ESMC Loss**

**RX:** No ESMC valid information frames were received for more than 5 seconds.

➤ **QL Mismatch** (available when the **QL Mismatch Monitoring** check box is selected)

**RX:** The received QL value does not match the Expected QL (refer to page 274 or page 376).

## TCM (SONET/SDH)

**Note:** *TCM is displayed for rates up to OC-192/STM-64 under the STS-x/AU-x or VT/TU alarms/errors group when TCM is enabled.*

### Alarms

➤ **TC-UNEQ-P / HPTC-UNEQ** (Unequipped)

**RX/TX:** An all “0”s pattern is received/generated in the higher order path signal label byte (C2), the TCM byte (N1) and the path trace byte (J1), and a valid BIP-8 bytes (B3).

➤ **TC-UNEQ-V / LPTC-UNEQ** (Unequipped)  
(LPTC - Unequipped)

**RX/TX:** An all “0”s pattern is received/generated in the lower order path signal label (bit 5, 6, 7 of byte V5), the TCM byte (Z6/N2) and the path trace byte (J2), and a valid BIP-2 (bits 1, 2 of V5 byte).

➤ **TC-LTC-P / TC-LTC-V / HPTC-LTC / LPTC-LTC** (Loss of Tandem Connection)

**RX/TX:** A wrong FAS multiframe is received/generated.

➤ **TC-IAIS-P / HPTC-IAIS** (Incoming Alarm Indication Signal)

**RX/TX:** Bits 1 through 4 of the N1 byte are set to “1110”.

➤ **TC-IAIS-V / LPTC-IAIS** (Incoming Alarm Indication Signal)

**RX/TX:** Bit 4 of the Z6/N2 byte is set to “1”.

➤ **TC-ODI-P / TC-ODI-V / HPTC-ODI / LPTC-ODI** (Outgoing Defect Indication)

**RX/TX:**

➤ SONET: Bit 7 of the N1/Z6 byte frame 74 is set to “1”.

➤ SDH: Bit 7 of the N1/N2 byte multiframe 74 is set to “1”.

- **TC-TIM-P / TC-TIM-V / HPTC-TIM / LPTC-TIM** (Trace Identifier Mismatch)

**RX:** The received message differs from the defined expected message. The TC-TIM is also declared when receiving invalid ASCII characters or when errors are detected with CRC-7.

- **TC-RDI-P / TC-RDI-V / HPTC-RDI / LPTC-RDI** (Remote Defect Indication)

**RX/TX:**

- **SONET:** The TC-RDI is declared when bit 8 of the N1/Z6 byte frame 73 is set to “1”.
- **SDH:** The TC-RDI is declared when bit 8 of the N1/N2 byte multiframe 73 is set to “1”.

### **Errors**

- **TC-VIOL-P / HPTC-VIOL** (Violations)

**RX:** TC-VIOL indicates the number of B3 parity violation within the tandem connection for STS-1 SPE/VC-3 and above.

- **TC-VIOL-V / LPTC-VIOL** (Violations)

**RX:** TC-VIOL indicates the number of violation within the tandem connection for VT6 SPE/VC-2 and below.

## Test Results

### Alarms/Errors

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➤ **TC-IEC-P / HPTC-IEC** (Incoming Error Count)

**RX:** The TC-IEC indicates the number of B3 parity violations detected at the TC Source for STS-1 SPE/VC-3 and above (bits 1 to 4 of the N1 byte).

| Number of<br>BIP-8 violations | Bit |   |   |   | Number of<br>BIP-8 violations | Bit |   |   |   |
|-------------------------------|-----|---|---|---|-------------------------------|-----|---|---|---|
|                               | 1   | 2 | 3 | 4 |                               | 1   | 2 | 3 | 4 |
| 0                             | 0   | 0 | 0 | 0 | 8                             | 1   | 0 | 0 | 0 |
| 1                             | 0   | 0 | 0 | 1 | 0                             | 1   | 0 | 0 | 1 |
| 2                             | 0   | 0 | 1 | 0 | 0                             | 1   | 0 | 1 | 0 |
| 3                             | 0   | 0 | 1 | 1 | 0                             | 1   | 0 | 1 | 1 |
| 4                             | 0   | 1 | 0 | 0 | 0                             | 1   | 1 | 0 | 0 |
| 5                             | 0   | 1 | 0 | 1 | 0                             | 1   | 1 | 0 | 1 |
| 6                             | 0   | 1 | 1 | 0 | 0 (IAIS)                      | 1   | 1 | 1 | 0 |
| 7                             | 0   | 1 | 1 | 1 | 0                             | 1   | 1 | 1 | 1 |

➤ **TC-OEI-P / TC-OEI-V / HPTC-OEI / LPTC-OEI** (Outgoing Error Indication)

**RX:** Indicates errored blocks of the outgoing VTn/VC-n (bit 6 of the N1 or Z6/N2 byte).

**TX:** Bit 6 of the N1 or Z6/N2 byte is set to 1.

➤ **TC-REI-P / TC-REI-V / HPTC-REI / LPTC-REI** (Remote Error Indication)

**RX:** Indicates errored blocks caused within the Tandem Connection (bit 5 of the N1 or Z6/N2 byte).

**TX:** Bit 5 of N1 or Z6/N2 byte is set to 1.

## **VT/TU**

### **Alarms**

- **AIS-V** (Alarm Indication Signal - VT) - SONET  
**TU-AIS** (Tributary Unit - Alarm Indication Signal) - SDH  
  
**RX:** V1 and V2 bytes for the VT/TU path contain an all-ones pattern in three (SONET) / five (SDH) consecutive superframes.  
  
**TX:** Generates an all-ones pattern for the V1 and V2 bytes of the VT/TU path and payload.
- **LOP-V** (Loss Of Pointer - VT) - SONET  
**TU-LOP** (Tributary Unit - Loss Of Pointer) - SDH  
  
**RX:** A valid pointer is not found in N consecutive superframes (where  $8 \leq N \leq 10$ ), or if N consecutive NDFs ("1001" pattern).  
  
**TX:** Generates a non-valid pointer.
- **RDI-V** (Remote Defect Indication - VT) - SONET  
**LP-RDI** (Tributary Unit - Remote Defect Indication) - SDH  
  
**RX:** Bit 8 of the V5 byte contains "1" in five consecutive VT/TU superframes while bits 6 and 7 of the Z7 (SONET) / K4 (SDH) byte contain the "00" or "11" pattern.  
  
**TX:** Generates "1" for the bit 8 of the V5 byte and a "00" pattern for bits 6 and 7 of the Z7 (SONET) / K4 (SDH) byte.
- **RFI-V** (Remote Failure Indication - VT) - SONET  
**LP-RFI** (LOP - Remote Failure Indication) - SDH, available with VC-11 only.  
  
**RX:** Bit 4 of the V5 byte contains "1" in five consecutive superframes.  
  
**TX:** Generates "1" for the bit 4 of the V5 byte.

## Test Results

### Alarms/Errors

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- **TIM-V** (Trace Identifier Mismatch - VT) - SONET  
**LP-TIM** (LOP - Trace Identifier Mismatch) - SDH

**RX:**

- SONET: The J2 Trace doesn't match the expected message value. Only available when the **TIM-V** check box is selected (refer to page *Traces (SONET/SDH)* on page 284).
- SDH: None of the sampled LP trace strings match the expected message value. Only available when the **LP-TIM** check box is selected (refer to page *Traces (SONET/SDH)* on page 284).

- **PLM-V** (Payload Label Mismatch - VT) - SONET  
**LP-PLM** (LOP - Payload Label Mismatch) - SDH

**RX:** Five consecutive superframes with mismatched VT/LP Signal (bits 5 through 7 of the V5 byte are "000", "001" or "111"). Only available when the **PLM-V/UNEQ-V / LP-PLM/LP-UNEQ** check box is selected (refer to page *Labels* on page 169).

- **UNEQ-V** (Unequipped - VT) - SONET  
**LP-UNEQ** (LOP - Unequipped) - SDH

**RX:** Bit 5 through 7 of the V5 byte contain "000" for five consecutive superframes. Only available when the **PLM-V/UNEQ-V / LP-PLM/LP-UNEQ** check box is selected (refer to page *Labels* on page 169).

**TX:** Generates samples of unequipped VT/LP signal label (bits 5 through 7 of V5 byte are set to "000").

- **ERDI-VSD** (Enhanced RDI - VT Server Defect) - SONET  
**LP-ERDI-SD** (LOP - Enhanced RDI - Server Defect) - SDH

**RX:** Bits 5, 6, and 7 of the Z7 (SONET) / K4 (SDH) byte contain the "101" pattern, and bit 8 of the V5 byte contain "1", in five consecutive VT/LP superframes.

**TX:** Generates a "101" pattern for bits 5, 6, and 7 of the Z7 (SONET) / K4 (SDH) byte, and "1" for bit 8 of the V5 byte.

- **ERDI-VCD** (Enhanced RDI - VT Connectivity Defect) - SONET  
**LP-ERDI-CD** (LOP - Enhanced RDI - Connectivity Defect) - SDH

**RX:** Bits 5, 6, and 7 of the Z7 (SONET) / K4 (SDH) byte contain the “110” pattern, and bit 8 of the V5 byte contain “1”, in five consecutive VT/LP superframes.

**TX:** Generates a “110” pattern for bits 5, 6, and 7 of the Z7 (SONET) / K4 (SDH) byte, and “1” for bit 8 of the V5 byte.

- **ERDI-VPD** (Enhanced RDI - VT Path Payload Defect) - SONET  
**LP-ERDI-PD** (LOP - Enhanced RDI - Path Payload Defect) - SDH

**RX:** Bits 5, 6, and 7 of the Z7 (SONET) / K4 (SDH) byte contain the “010” pattern, and bit 8 of the V5 byte contain “0”, in five consecutive VT/LP superframes.

**TX:** Generates a “010” pattern for bits 5, 6, and 7 of the Z7 (SONET) / K4 (SDH) byte, and “0” for bit 8 of the V5 byte.

## **Errors**

- **BIP-2** (Bit-Interleave Parity - 2 bits)

### **RX:**

SONET: The BIP-2 error indicates a parity error by performing a routine even-parity check over all VT1.5 bytes of the previous frame of a composite signal (VT1.5/VT2/VT6).

SDH: The BIP-2 error indicates a Low Order Path parity error by performing a routine even-parity check over all bytes of the previous VC frame.

- **REI-V** (Remote Error Indicator - VT) - SONET  
**LP-REI** (Low Order Path - Remote Error Indicator) - SDH

**RX:** REI is declared when bit 3 of the V5 byte is set to “1”.

## WIS

**Note:** Available under the WIS sub tab for 10G WAN interface only.

### Alarms

#### ➤ WIS Link Down

**RX:** At least one of the following errors is present: AIS-P, LOF, PLM-P, SEF, LOP, or AIS-L.

#### ➤ SEF (Severely Errored Framing)

**RX:** A minimum of four consecutive errored framing patterns.

**TX:** Generates more than four consecutive errored framing patterns.

#### ➤ LOF (Loss Of Frame)

**RX:** A Severely Error Framing (SEF) defect on the incoming SONET signal persists for at least 3 milliseconds.

**TX:** Generates a non-valid framing pattern.

#### ➤ AIS-L (Alarm Indication Signal - Line)

**RX:** Bits 6, 7 and 8 of the K2 byte contain the "111" pattern in five consecutive frames.

**TX:** Generates a "111" pattern for the bits 6, 7 and 8 of the K2 byte.

#### ➤ RDI-L (Remote Defect Indication - Line)

**RX:** Bits 6, 7, and 8 of the K2 byte contain the "110" pattern in five consecutive frames.

**TX:** Generates a "110" pattern for the bits 6, 7 and 8 of the K2 byte.

#### ➤ AIS-P (Alarm Indication Signal - Path)

**RX:** The H1 and H2 bytes for a STS path contain an all-ones pattern in three consecutive frames or more.

**TX:** Generates an all-ones pattern for H1 and H2 bytes.

➤ **RDI-P** (Remote Defect Indication - Path)

**RX:** Bits 5, 6 and 7 of the G1 byte contain the “100” or “111” pattern in ten consecutive frames.

**TX:** Generates a “100” pattern for bits 5, 6 and 7 of the G1 byte.

➤ **LCD-P** (Loss of Code-Group Delineation - Path)

**RX:** The signal synchronization has been lost and the valid code-groups are no longer being delineated from the received payload stream being passed to the PCS.

**TX:** Generates a PCS link down.

➤ **LOP-P** (Loss Of Pointer - Path)

**RX:** For non-concatenated payloads, a valid pointer is not found in N consecutive frames (where  $8 \leq N \leq 10$ ), or N consecutive NDFs (“1001” pattern) are detected.

**TX:** Generates a non-valid pointer.

➤ **PLM-P** (Payload Label Mismatch - Path)

**RX:** Five consecutive frames have mismatched STS signal labels.

➤ **UNEQ-P** (Unequipped - Path)

**RX:** The C2 byte contains “00 H” in five consecutive frames.

**TX:** Generates samples of unequipped STS signal labels (C2 is set to “00 H”).

➤ **ERDI-PSD** (Enhanced RDI - Path Server Defect)

**RX:** Bits 5, 6 and 7 of the G1 byte contain the “101” pattern in five to ten consecutive frames.

**TX:** Generates a “101” pattern for bits 5, 6 and 7 of the G1 byte.

## Test Results

### Alarms/Errors

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➤ **ERDI-PCD** (Enhanced RDI - Path Connectivity Defect)

**RX:** Bits 5, 6 and 7 of the G1 byte contain the “110” pattern in five to ten consecutive frames.

**TX:** Generates a “110” pattern for bits 5, 6 and 7 of the G1 byte.

➤ **ERDI-PPD** (Enhanced RDI - Path Payload Defect)

**RX:** Bits 5, 6 and 7 of the G1 byte contain the “010” pattern in five to ten consecutive frames.

**TX:** Generates a “010” pattern for bits 5, 6 and 7 of the G1 byte.

**PLM-P/UNEQ-P** (Payload Label Mismatch - Path / Unequipped - Path) check box when selected (cleared by default) enables the Signal Label Mismatch for the expected message defined as well as **UNEQ-P** monitoring.

### Errors

➤ **B1** (BIP-8, Bit-Interleave Parity - 8 bits)

**RX:** Indicates a Section parity error by performing a routine even-parity check over all Section bits of the previous frame of a composite signal (located in the first STS-1 of an STS-n signal).

➤ **B2** (BIP-1536, Bit-Interleave Parity - 1536 bits)

**RX:** Indicates a Line parity error by performing a routine even-parity check over all Line bits of the LOH and STS-1 frame capacity of the previous frame of a composite signal (located in every STS-1 of an STS-n signal).

➤ **B3** (BIP-8, Bit-Interleave Parity - 8 bits)

**RX:** Indicates a Path parity error by performing a routine even-parity check over all Path bits of the previous SPE excluding the LOH and SOH.

➤ **REI-L** (Remote Error Indicator - Line)

**RX:** Bits 5 through 8 of the M0 byte contain one pattern from the following binary range: "0001" through "1000" (1 to 8) (located in the first STS-1 of an STS-n signal).

➤ **REI-P** (Remote Error Indicator - Path)

**RX:** Bits 1 through 4 of the G1 byte contain one pattern from the following binary range: "0001" through "1000" (1 to 8) (located in every STS-1 of an STS-n signal).

## Inject Button

Layer: BER

Type: Errors

Defect: Bit Error

Mode: Manual

Amount: 1

Inject Bit Error (1) Open/Close pop-up button

Selected Alarm/Error and status

- **Layer:** Allows to select on which layer is the alarm/error to be generated. Choices depend on the test application and its interface.
- **Type:** Allows to select the type of injection, either **Alarms** or **Errors**.
- **Defect:** Allows the selection of the alarm/error defect to be generated. Choices depend on the selected **Layer** and **Type**. Refer to *Alarms/Errors* on page 292 for more information.
- **Mode and Rate/Amount**
  - **Manual** allows to enter the amount of manual error to be generated: **1** (default) through **50** or **100** (depends on the selected error).
  - **Rate** allows the selection of the injection rate for the selected error. The rate must be within the minimum and maximum values specified.
  - **Max Rate** generates the selected error to its theoretical maximum rate.

The following settings are only available with Carrier Ethernet OAM test application.

- **Address Type** defines the destination address type of the frame: **Unicast** or **Multicast** (default).
- **Priority**<sup>1</sup> allows to select the VLAN user priority: **0** (default) to **7**. Refer to *VLAN ID and Priority* on page 639 for more information.
- **Drop Eligible**<sup>1</sup> is set to **No** (no frames will be dropped when congestion occurs) and is not configurable.
- **MEG Level** (Y.1731 and MEF) is the Maintenance Entity Group Level configurable from **0** to **7** (default).
- **Period** determines the transmission period of frames: **1 s** (default) and **1 min**. Not available with C-DCI.
- **Amount**, only available with C-DCI alarm, is set to **1**.

**Note:** *The RDI alarm is available when the **CC Function** is enabled and is using the parameters from the CC Function (refer to page 224 for more information).*

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1. Available when VLAN is enabled (see *VLAN* on page 190).

## Test Results

### Alarms/Errors

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#### ➤ **Inject button**

For **Manual** mode: Manually generates the selected errors according to the defect and the amount selected.

For **Rate** and **Max Rate**: Generates respectively the selected error at the rate specified or at its theoretical maximum rate.

**Note:** *The selected alarm/error as well as its injection mode and status are displayed next to the **Inject** button.*

- The open/close pop-up button allows to respectively expand (up arrow) or collapse (down arrow) a pop-up allowing to set the alarm/error injection parameters.

## FTFL/PT

From the **Test** menu, tap **Results**, and the **FTFL/PT** tab.

### FTFL

Indicates the Forward and Backward ODU Fault Type Fault Location.

- **Fault Indication** and **Code** displays the FTFL fault indicator message and its code in hexadecimal format (byte 0 for forward, byte 128 for backward).

| Fault Indication | Code         |
|------------------|--------------|
| No fault         | 00 (default) |
| Signal fail      | 01           |
| Signal Degrade   | 02           |
| Reserved         | 03           |

- **Operator Identifier** displays the received operator identifier (bytes 1 to 9 for forward, byte 129 to 137 for backward).
- **Operator Specific** displays the received operator specific (bytes 10 to 127 for forward, byte 138 to 255 for backward).

### PT (Payload Type)

➤ **Payload Type and Code**

**Received** displays the received payload signal type and its code in hexadecimal format.

**Expected** allows to select the expected payload signal type either by selecting the payload from the list or by typing its hexadecimal code.

**Note:** *Refer to PT on page 147 for the list.*

- **OPU-PLM**, when selected, enables the OPU-PLM alarm analysis.
- **Copy RX** uses the received payload type as the expected payload type.

## Graph (RFC 2544)

Displays the graph showing the **Throughput**, **Back-to-Back**, **Frame Loss**, and **Latency** measurements. For **Dual Test Set** the graph shows results from **Local to Remote** and **Remote to Local** using distinctive colors.

From the **Test** menu, tap **Results**, and the **Graphs** tab.

- **All** button allows to view the graphs of all subtests simultaneously.
- **Throughput**, **Back-to-Back**, **Frame Loss**, and **Latency** buttons allow to view an enlarged graph view of the selected subtest.
- **Displayed Results** allows to select the displayed results mode, either **Minimum**, **Maximum** (default), **Average**, or **Current**.
- **Step**, available with Frame Loss, allows to select the result step (100 percent by default) to be displayed.

The X axis shows the frame sizes while the Y axis shows the subtest results.

- **Frame Size (Bytes)** and **Step (%)**, available with Frame Loss, allows to select either **Frame Size** (default) or **Step** as the X axis criterion.

## ISDN Logger

The ISDN Logger page displays color-coded ISDN messages and pass/fail verdict.

From the **Test** menu, tap **Results**, and the **ISDN Logger** tab.

- **Sort By** selects the event sorting order: **ID/Time** (default), **Message Type**, **Dir.**, **Call Ref.**, **Ch#**, or **Call Type**.
- **Filter** selects the filtering criterion: **All** (default), **Layer 2**, or **Layer 3**.
- **Time Mode** selects the time representation mode. The **Time Mode** for the **ISDN Logger** and the **Alarms/Errors Logger** is coupled.
  - **Relative** displays the time relative to the beginning of the test or the last reset. The time format is Dd HH:MM:SS.
  - **Absolute** (default) displays the date and time the test has started. The time format depends upon the platform time which will be either **MM/DD HH:MM:SS** for 24 hours time format or **MM/DD HH:MM:SS <AM/PM>** for 12 hours time format.
- **Clear Logger** button clears the logger entries.
- **Message Type** column indicates the type of message which are classified into Layer 2 and Layer 3 messages as follows.

Layer 2 messages

- **SABME** (Set Asynchronous Balanced Mode Extended) command is used to place the addressed user side or network side into a modulo 128 multiple frame acknowledged operation.
- **UA** (Unnumbered Acknowledgment) response is used by a data link layer to acknowledge the receipt and acceptance of the mode-setting commands (SABME or DISC).
- **I** (Information) command is used to transfer, across a data link connection, sequentially numbered frames containing information fields provided by Layer 3. Used while multiple frame operation is in effect on point-to-point data link.

- **UI** (Unnumbered Information) command is used to send information.
- **DISC** (Disconnect) command is used to terminate the multiple frame operation.
- **DM** (Disconnect Mode) response is used to report that the data link layer is in a state such that multiple frame operation cannot be performed.
- **FRMR** (Frame Reject) response is used to report an error condition that is not recoverable by a retransmission.
- **XID** (Exchange Identification) command/response is used for connection management to exchange information.
- **RNR** (Receive Not Ready) command/response is supervisory frame used by a data link layer entity to indicate a busy condition or to ask the status of its peer data link layer entity.
- **REJ** (Reject) command/response supervisory frame is used by a data link layer entity to request retransmission or to ask the status of its peer data link layer entity.
- **RR** (Receive ready) supervisory frame is used by a data link layer entity to indicate it is ready to receive an I frame. Besides this, it is used to acknowledge previously received I frames numbered up to and including  $N(R)-1$  and clear a busy condition that was indicated by the earlier transmission of an RNR frame by the same data. In addition to indicating the status of a data link layer entity, the RR command with the P bit set to 1 may be used by the data link layer entity to ask for the status of its peer data link layer entity.

**Note:** *The RR message is not included in the logger as it would fill the logger in a short period since this message is used to keep alive.*

### Layer 3 messages

- **SETUP** message is sent by the calling user to the network and by the network to the called user to initiate call establishment.
- **CALL PROCEEDING** message is sent by the called user to the network or by the network to the calling user to indicate that requested call establishment has been initiated and no more call establishment information will be accepted.
- **ALERTING** message is sent by the called user to the network and by the network to the calling user to indicate that called user alerting has been initiated.
- **CONNECT** message is sent by the called user to the network and by the network to the calling user, to indicate call acceptance by the called user.
- **CONNECT ACK** message is sent by the network to the called user to indicate the user has been awarded the call.
- **DISCONNECT** message is sent by the user to request the network to clear an end-to-end connection or is sent by the network to indicate that the end-to-end connection is cleared.
- **RELEASE** message is sent by the user or the network to indicate that the equipment sending the message has disconnected the channel (if any) and intends to release the channel and the call reference. Thus the receiving equipment should release the channel and prepare to release the call reference after sending a RELEASE COMPLETE.
- **RELEASE COMPLETE** message is sent by the user or the network to indicate that the equipment sending the message has released the channel (if any) and call reference, the channel is available for reuse, and the receiving equipment shall release the call reference.

- **STATUS ENQUIRY** message is sent by the user or the network at any time to solicit a STATUS message from the peer layer 3 entity. Sending a STATUS message in response to a STATUS ENQUIRY message is mandatory.
- **STATUS** message sent is by the user or the network in response to a STATUS ENQUIRY message or at any time during a call to report certain error conditions.
- **PROGRESS** message is sent by the user or the network to indicate the progress of a call in the event of interworking or in relation with the provision of in-band information/patterns.
- **RESTART** message is sent by the user or network to request the recipient to restart (return to an idle condition) the indicated channel(s) or interface.
- **RESTART ACK** message is sent to acknowledge the receipt of the RESTART message and to indicate that the requested restart is complete.
- **Event XXX - Additional Information** displays additional information on the selected event having the icon . Additional information is available for six message types.

| Message Type     | Additional information                              |
|------------------|-----------------------------------------------------|
| DISCONNECT       | Cause Value, Cause Definition, Location             |
| RELEASE          |                                                     |
| RELEASE COMPLETE |                                                     |
| PROGRESS         | Progress Desc. No., Progress Description, Location  |
| SETUP            | Calling number, Called number                       |
| STATUS           | Cause Value, Cause Definition, Location, Call State |

## Test Results

### ISDN Logger

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- **Cause Value** reports the reason why a call has been terminated, or a problem with a received message. (7 bits).  
Supported Cause Value range: 1 to 127.
- **Cause Definition** is associated with each Cause Value but the Cause Definition is not received or transmitted with a message.  
Longest Cause Definition: 86 characters.
- **Location** reports from where the action is initiated. (4 bits)  
Longest **Location** definition: 45 characters.
- **Progress Desc. No.** indicates the number associated to the Progress Description.
- **Progress Description** indicates the progress of a call in the event of inter-working or in relation with the provision of in-band information/patterns.
- **Calling Number** indicates the number of the calling party.
- **Called Number** indicates the number of the called party.
- **Call State** indicates the state of the actual call.

## Labels

From the **Test** menu, tap **Results**, and **Labels**.

**Note:** *Selecting a Label byte to be generated will automatically update the corresponding OH byte. Refer to OH - SONET/SDH on page 487 for more information.*

### Labels

- **STS/AU Path (C2):** The C2 byte is allocated to indicate the content of the STS SPE / VC, including the status of the mapped payloads.

**Received:** Displays the received C2 byte. Refer to C2 on page 495 for more information.

- **PLM-P/UNEQ-P / HP-PLM/HP-UNEQ:** Enables the Payload Mismatch and STS/AU UNEQ monitoring. This setting is coupled with the configuration of *Labels* on page 169.

**Expected:** Select the expected C2 byte from the list. Refer to C2 on page 495 for more information.

- **VT/TU Path (V5):** The V5 byte is allocated to indicate the content of the VT/TU path, including the status of the mapped payloads.

**Received:** Displays the received V5 byte. Refer to V5 on page 498 for more information.

- **PLM-V/UNEQ-V / LP-PLM/LP-UNEQ:** Enables the Payload Mismatch and VT/TU UNEQ monitoring. This setting is coupled with the configuration of *Labels* on page 169.

**Expected:** Select the expected V5 byte from the list. Refer to V5 on page 498 for more information.

## Link OAM

From the **Test** menu, tap **Results**, and the **Link OAM** tab.

### Remote MAC Address

Indicates the remote OAM link partner MAC address.

### Remote OAM Information

- **OAM Version** indicates the protocol version supported by the DTE.
- **Revision** indicates the revision of the Information TLV.
- **Multiplexer Action** reports the Multiplexer Action:
  - Forward** indicates that the device is forwarding non-OAMPDUs to the lower sublayer.
  - Discard** indicates that the device is discarding non-OAMPDUs.
- **Parser Action** reports the Parser Action:
  - Forward** indicates that the device is forwarding non-OAMPDUs to the higher sublayer.
  - Loopback** indicates that the device is looping back non-OAMPDUs to the lower sublayer.
  - Discard** indicates that the device is discarding non-OAMPDUs.
- **OAM Mode** reports the OAM mode:
  - Active** indicates that the DTE is configured in **Active** mode.
  - Passive** indicates that the DTE is configured in **Passive** mode.
- **OUI** reports the 24-bit IEEE Organizationally Unique Identifier field identifying the vendor.
- **Maximum OAMPDU Size** reports the maximum OAMPDU size in bytes, supported by the DTE.

- **Vendor Specific Information** reports the 32-bit **Vendor Specific Information** field identifying the vendor's product model and version.
- **Unidirectional** reports unidirectional support capability:
  - Supported** indicates that the DTE is capable of sending OAMPDUs when the receive path is non-operational.
  - Unsupported** indicates that the DTE is not capable of sending OAMPDUs when the receive path is non-operational.
- **Remote Loopback** reports OAM remote loopback support capability:
  - Supported** indicates that the DTE is capable of OAM remote loopback mode.
  - Unsupported** indicates that the DTE is not capable of OAM remote loopback mode.
- **Variable Retrieval** reports variable retrieval capability:
  - Supported** indicates that the DTE supports sending Variable Response OAMPDUs.
  - Unsupported** indicates that the DTE does not support sending Variable Response OAMPDUs.
- **Link Events** reports link event capability:
  - Supported** indicates that the DTE supports interpreting Link Events.
  - Unsupported** indicates that the DTE does not support interpreting Link Events.

### Remote Error Event Statistics

- **Date Stamp**<sup>1</sup> indicates the date the last Event Notification OAMPDU frame was received.
- **Time Stamp**<sup>1</sup> indicates the time the last Event Notification OAMPDU event was received by the test equipment.
- **Window**

|               |                                                                            |
|---------------|----------------------------------------------------------------------------|
| Symbol Period | Errored symbol Window in second                                            |
| Frame         | Errored frame event Window in second                                       |
| Frame Period  | Errored frame period Window - duration period in number of 64 bytes frames |
| Frame Seconds | Errored frame seconds summary Window                                       |

- **Threshold**

|               |                                                   |
|---------------|---------------------------------------------------|
| Symbol Period | Errored symbol threshold in second                |
| Frame         | Errored frame event threshold in second           |
| Frame Period  | Errored frame period threshold in second          |
| Frame Seconds | Errored frame seconds summary threshold in second |

- **Error Count**

|               |                                                      |
|---------------|------------------------------------------------------|
| Symbol Period | The number of symbol errors in Window                |
| Frame         | The number of frame event errors in Window           |
| Frame Period  | The number of frame period errors in Window          |
| Frame Seconds | The number of frame seconds summary errors in Window |

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1. **Date Stamp** and **Time Stamp** parameters differ from the 802.3 standard definitions.

➤ **Error Running Total**

|                      |                                                                 |
|----------------------|-----------------------------------------------------------------|
| <b>Symbol Period</b> | The number of symbol errors since the last reset                |
| <b>Frame</b>         | The number of frame event errors since the last reset           |
| <b>Frame Period</b>  | The number of frame period errors since the last reset          |
| <b>Frame Seconds</b> | The number of frame seconds summary errors since the last reset |

➤ **Event Running Total**

|                      |                                                         |
|----------------------|---------------------------------------------------------|
| <b>Symbol Period</b> | The number of symbol events since the last reset        |
| <b>Frame</b>         | The number of frame events since the last reset         |
| <b>Frame Period</b>  | The number of frame period events since the last reset  |
| <b>Frame Seconds</b> | The number of frame seconds events since the last reset |

## **Inject Errored Frames**

Generates 5 consecutive packets with FCS errors within a 1 second period.

# Logger and Alarms/Errors Logger

The Logger page displays color-coded events and pass/fail verdict.

From the **Test** menu, tap **Results**, and the **Logger** or **Alarms/Errors Logger** tab.

## Sort By

- **Sort By:** Select the sorting order of the event logger entries:

**ID/Time** (default) displays the event logger entries in numeric ascending order based on the **ID** column of the event logger table.

**Event** displays the event Logger entries in alphanumeric ascending order based on the **Event** column of the event logger table.

- **Time Mode**

- **Relative** displays the time elapse since the beginning of the test or since the last test reset. The format of the time is Dd HH:MM:SS.

- **Absolute** (default) displays the date and time the event occurred. The time format depends on the FTB-1 time settings.

For 24 hours, the time format is MM/DD HH:MM:SS.

For 12 hours, the time format is MM/DD HH:MM:SS <AM or PM>.

The logger table provides the following event logger information.

- **ID:** Indicates the event identification number. The events are sequentially numbered.
- **Time:** Indicates when the event has been detected.
- **Event:** Provides the event type and threshold crossing information.
- **Duration:** Indicates the number of seconds within which the event occurred. Test events like **Test Started** and **Test Stopped** will have no duration.
- **Details:** Provides contextual information including the pass/fail verdict.

The following table displays the nature of information reported by type of event:

| Type of Event            | Nature of Information         |
|--------------------------|-------------------------------|
| Test Started             | Start Date                    |
| Test Stopped             | Pass/Fail Verdict             |
| Alarm Events             | Count value                   |
| Error Events             | Current Count and Total Count |
| SDT Events               | Service Disruption Time       |
| Threshold Crossing Event | Value at the end of the test  |

**Note:** *The Logger table can display up to 500 event entries. Once the Logger table reports 500 event entries, a log full indicator appears and no further entries is possible. However, the events in the Pending state will be updated if the test is still running.*

The Event Logger information will be cleared when:

- the test is reset or started.
- the unit is in suspended mode.
- stopping the current test and navigating to other tests
- the unit is restarted.

**Note:** *An entry event remains in the Pending state as long as the event is not completed and it is highlighted on a yellow background color.*

**Note:** *The Threshold Crossing events are displayed in red text color.*

## MPLS

From the **Test** menu, tap **Results**, and...

- for **Traffic Gen and Mon**, the **Streams**, and the **MPLS** tab.
- for **Through Mode**, the **Traffic**, and the **MPLS** tab.

### Label 1 and Label 2

The number of MPLS frames transmitted (TX) and received (RX) are displayed for both **Label 1** and **Label 2** for each **Stream**. Not available for **Through Mode** test application.

### Total TX/RX MPLS

- **Line Utilization** indicates the percentage of MPLS line rate utilization in TX and RX.
- **Ethernet BW (%)** (Ethernet Bandwidth) indicates the MPLS data rate in TX and RX.
- **Frame Rate (frames/s)** indicates the number of transmitted (TX) and received (RX) MPLS frames).
- **Frame Count** indicates the count of transmitted (TX) and received (RX) MPLS EtherType (0x8847 or 0x8848) frames regardless if FCS is good or not.

## Performance Monitoring

**Note:** This tab is only available with Transport test applications with Pattern client.

The Performance Monitoring tab gives error performance events and parameters for the circuit under test.

From the **Test** menu, tap **Results**, and the **Performance Monitoring** tab.

Each button on top of the window represents a level of the analyzed signal for which the Performance Monitoring (PM) is available. Each button also displays the PM standard(s) available for this level. Tap a signal level button to get its PM results.

| Analyzed Signal      | Standard's availability |           |           |           |            |             |            |
|----------------------|-------------------------|-----------|-----------|-----------|------------|-------------|------------|
|                      | G.821                   | G.826 ISM | G.828 ISM | G.829 ISM | M.2100 ISM | M.2100 OOSM | M.2101 ISM |
| DS3/DS1/E4/E3/E2/E1  |                         | X         |           |           | X          |             |            |
| Section/RS           |                         |           |           | X         |            |             |            |
| Line/MS              |                         |           |           | X         |            |             | X          |
| VTn/STS-n/AU-n/ TU-n |                         |           | X         |           |            |             | X          |
| BERT                 | X                       |           |           |           |            | X           |            |

**Note:** G.821 and M.2100 OOSM are only available when **No Pattern Analysis (Live)** check box is cleared (refer to page 117).

## Near-End

- **EFS** (Error Free Second) (**G.821**, **G.826**, **G.828**, and **G.829**): Gives the number of seconds within which no error occurred.
- **EC** (Error Count) (**G.821** only): Gives the number of bit errors.
- **EB** (Errored Block) (**G.826**, **G.828**, and **G.829**): Gives the count of blocks in which one or more bits are in error.
- **ES** (Errored Second)

For **G.821**, and **M.2100 OOSM**: Gives the number of seconds within which one or more bit error occurred, or during which Loss Of Signal (LOS) or AIS is detected.

For **G.826**, **G.828**, **G.829**, **M.2100 ISM**, and **M.2101**: Gives the number of seconds within which one or more anomalies (FAS (DSn/PDH), EB, etc.) occurred, or at least one defect occurred.

- **SES** (Severely Errored Second)

For **G.821**, and **M.2100 OOSM**: Gives the number of seconds within which a bit error ratio is  $\geq 10^{-3}$ , or during which one defect (LOS/AIS) is detected.

For **G.826**, **G.828**, **G.829** and **M.2101**: Gives the number of seconds within which anomalies (FAS (DSn/PDH), EB, etc.) are  $\geq X$  percent or at least one defect occurred. X=30 percent for DSn/PDH signals; see the following table for SONET/SDH signals SES threshold.

|            | <b>OC-1<br/>STS-1e<br/>STM-0<br/>STM-0e</b> | <b>OC-3<br/>STS-3e<br/>STM-1<br/>STM-1e</b> | <b>OC-12<br/>STM-4</b> | <b>OC-48<br/>STM-16</b> | <b>OC-192<br/>STM-64</b> |
|------------|---------------------------------------------|---------------------------------------------|------------------------|-------------------------|--------------------------|
| Path       | 30%                                         | 30%                                         | 30%                    | 30%                     | 30%                      |
| Line/MS    | 15%                                         | 15%                                         | 25%                    | 30%                     | 30%                      |
| Section/RS | 10%                                         | 30%                                         | 30%                    | 30%                     | 30%                      |

For **M.2100 ISM**: Gives the count of the seconds within which anomalies (frame bit errors, CRC block errors, etc.) are  $\geq Y$  or at least one defect occurred. Y depends on the type of DS<sub>n</sub>/PDH signal as described in the following table.

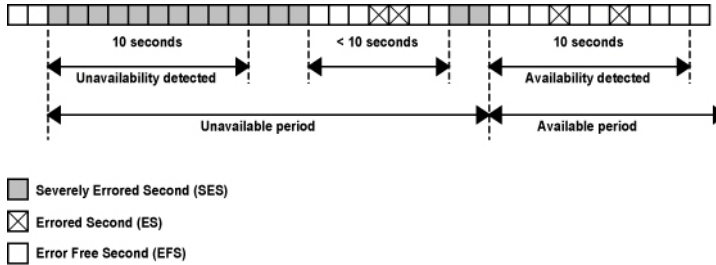
| Signal                    | SES Threshold                                                                        |
|---------------------------|--------------------------------------------------------------------------------------|
| DS1 (SF)                  | 8 frame bit errors (Near-End)                                                        |
| DS1 (ESF)                 | 320 CRC-6 block errors (Near-End) 320 CRC-6 block errors (Far-End, if FDL enabled)   |
| E1 (Framed without CRC-4) | 28 frame bit errors (Near-End)                                                       |
| E1 (Framed with CRC-4)    | 805 CRC-4 block errors (Near-End) 805 E-bit errors (Far-End)                         |
| DS3 (M13)                 | 2444 P-bit errors (Near-End) or 5 F-bit errors (Near-End)                            |
| DS3 (C-bit Parity)        | 2444 P-bit errors (Near-End) or 5 F-bit errors (Near-End) 2444 FEBE errors (Far-End) |
| E2 (Framed)               | 41 frame bit errors (Near-End)                                                       |
| E3 (Framed)               | 52 frame bit errors (Near-End)                                                       |
| E4 (Framed)               | 69 frame bit errors (Near-End)                                                       |

- **BBE (Background Block Error) (G.826, G.828, G.829, and M.2101)**: Gives the count of Errored Block not occurring as part of a SES.

## Test Results

### Performance Monitoring

- **UAS (Unavailable Second):** Gives the count of the seconds corresponding to the periods of unavailable time that begins at the onset of 10 consecutive SES events, including these 10 seconds. A period of available time shall begin at the onset of 10 consecutive non-SES events, including these 10 seconds.



- **ESR (Errored Second Ratio) (G.821, G.826, G.828, and G.829):** Gives the ratio of the number of ES in available time (AS) during a fixed measurement interval.  
$$ESR = ES \div AS$$
- **SESR (Severely Errored Second Ratio) (G.821, G.826, G.828, and G.829):** Gives the ratio of the number of SES in available time (AS) during a fixed measurement interval.  
$$SESR = SES \div AS$$
- **BBER (Background Block Error Ratio) (G.826, G.828, G.829, and M.2101):** Gives the ratio of BBE in available time (AS) to total blocks in available time during a fixed measurement interval. The count of total blocks excludes all blocks during SESs.
- **DM (Degraded Minutes) (G.821 only):** A Degraded Minute is the number of minutes in which the estimated error rate exceeds  $10^{-6}$  but does not exceed  $10^{-3}$ . DM is determined by collecting all of the Available Seconds, removing any SES grouping the result in 60-second long groups and counting a 60-second long group as degraded if the cumulative errors during the seconds present in the group exceed  $10^{-6}$ .

- **SEP** (Severely Errored Period) (**G.828** only): A sequence between 3 to 9 consecutive SES. The sequence is terminated by a second which is not a SES.
- **SEPI** (Severely Errored Period Intensity) (**G.828** only): Gives the count of SEP events in available time, divided by the total available time in seconds.

## Far-End

- **EFS** (Error Free Second): Gives the count of the seconds within which no error occurred or when a defect is detected on the near-end.
- **EC** (Error Count) (**G.821** only): Gives the number of bit errors.
- **EB** (Errored Block) (**G.826**, **G.828**, and **G.829**): Gives the count of blocks in which one or more bits are in error.
- **ES** (Errored Second): For **G.826**, **G.828**, **G.829**, **M.2100 ISM**, and **M.2101**: Gives the count of the seconds within which one or more anomalies (FAS (DSn/PDH), EB, etc.) occurred or at least one defect occurred.
- **SES** (Severely Errored Second)

**For G.826, G.828, G.829 and M.2101:** Gives the number of seconds within which anomalies (FAS (DSn/PDH), EB, etc.) are  $\geq X$  percent or at least one defect occurred.  $X=30$  percent for DSn/PDH signals; see the following table for SONET/SDH signals SES threshold.

|            | <b>OC-1<br/>STS-1e<br/>STM-0<br/>STM-0e</b> | <b>OC-3<br/>STS-3e<br/>STM-1<br/>STM-1e</b> | <b>OC-12<br/>STM-4</b> | <b>OC-48<br/>STM-16</b> | <b>OC-192<br/>STM-64</b> |
|------------|---------------------------------------------|---------------------------------------------|------------------------|-------------------------|--------------------------|
| Path       | 30%                                         | 30%                                         | 30%                    | 30%                     | 30%                      |
| Line/MS    | 15%                                         | 15%                                         | 25%                    | 30%                     | 30%                      |
| Section/RS | 10%                                         | 30%                                         | 30%                    | 30%                     | 30%                      |

## Test Results

### Performance Monitoring

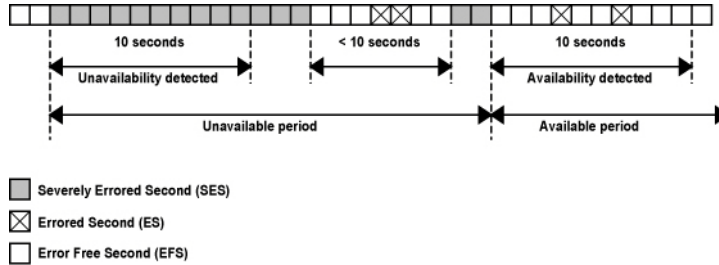
---

For M.2100 ISM: Gives the count of the seconds within which anomalies (frame bit errors, CRC block errors, etc.) are  $\geq Y$  or at least one defect occurred. Y depends on the type of DS<sub>n</sub>/PDH signal as described in the following table.

| Signal                    | SES Threshold                                                                        |
|---------------------------|--------------------------------------------------------------------------------------|
| DS1 (SF)                  | 8 frame bit errors (Near-End)                                                        |
| DS1 (ESF)                 | 320 CRC-6 block errors (Near-End) 320 CRC-6 block errors (Far-End, if FDL enabled)   |
| E1 (Framed without CRC-4) | 28 frame bit errors (Near-End)                                                       |
| E1 (Framed with CRC-4)    | 805 CRC-4 block errors (Near-End) 805 E-bit errors (Far-End)                         |
| DS3 (M13)                 | 2444 P-bit errors (Near-End) or 5 F-bit errors (Near-End)                            |
| DS3 (C-bit Parity)        | 2444 P-bit errors (Near-End) or 5 F-bit errors (Near-End) 2444 FEBE errors (Far-End) |
| E2 (Framed)               | 41 frame bit errors (Near-End)                                                       |
| E3 (Framed)               | 52 frame bit errors (Near-End)                                                       |
| E4 (Framed)               | 69 frame bit errors (Near-End)                                                       |

- **BBE** (Background Block Error) (G.828 and G.829 Line): Gives the count of Errored Blocks not occurring as part of an SES.

- **UAS (Unavailable Second):** Gives the count of the seconds corresponding to the period of unavailable time that begins at the onset of 10 consecutive SES events, including these 10 seconds. A period of available time shall begin at the onset of 10 consecutive non-SES events, including these 10 seconds.



- **ESR (Errored Second Ratio):** Gives the ratio of the number of ES in available time to total seconds in available time during a fixed measurement interval.

$$\text{ESR} = \text{ES} \div \text{AS}$$

- **SESR (Severely Errored Second Ratio):** Gives the ratio of the number of SES in available time to total seconds in available time during a fixed measurement interval.

$$\text{SESR} = \text{SES} \div \text{AS}$$

- **BBER (Background Block Error Ratio):** Gives the ratio of BBE in available time to total blocks in available time during a fixed measurement interval. The count of total blocks excludes all blocks during SESs.

PTP Stats

From the **Test** menu, tap **Results**, and the **PTP Stats** tab.

TX/RX PTP Message Count/Rate

Gives the transmitted/received count and average rate for each PTP message, and the total count for all messages.

| TX                                    | RX                                      |
|---------------------------------------|-----------------------------------------|
| Signaling Announce Req <sup>a</sup>   | Signaling Announce Grant <sup>a</sup>   |
| Signaling Sync Req <sup>a</sup>       | Signaling Sync Grant <sup>a</sup>       |
| Signaling Delay Resp Req <sup>a</sup> | Signaling Delay Resp Grant <sup>a</sup> |
| Delay Req                             | Delay Resp                              |
|                                       | Sync                                    |
|                                       | Follow Up                               |
|                                       | Announce                                |

- a. The rate value corresponds to an average rate because these messages are only transmitted/received when negotiating or renewing the lease with the Grand Master clock. If the connection with the Grand Master Clock was already established when the test is started, the 0 value is displayed. However, the value becomes available with the next lease renewal which happens every 150 seconds.

**Note:** *In the case where messages are lost while the Receipt Timeout is set to a large value (slow communication), the last valid recorded rate value will be preceded with “<” to indicate that the reception rate is not stable. This applies to **Delay Resp**, **Announce**, **Sync**, and **Follow UP**.*

**Note:** *When the rate is above 150 message/s, “> 150” is displayed.*

## IPDV

Inter Packet Delay Variation (IPDV) is available for **Sync** and **Delay Req** messages and is measured for all valid in-sequence messages (see *Delay Measurement* on page 400). **Current**, **Average**, **Minimum**, **Maximum**, and **Standard Deviation** measurement values are displayed. The **Standard Deviation** is the measure of the dispersion of messages from its mean. When a value is below  $1\mu$  second, “< **1 $\mu$ s**” is displayed. The pass/fail verdict is also displayed beside the maximum value when enabled.

## Test Results

### Quality Level (1588 PTP)

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The quality level characterizes the clock quality in terms of network synchronization.

From the **Test** menu, tap **Results**, and the **Quality Level** tab.

- **Last QL Received** indicates the last Quality Level value received. The pass/fail verdict is also displayed when both **QL Mismatch Monitoring** and **Pass/Fail Verdict** check boxes are selected.
- **Last Change** indicates the date and time of the Last QL has changed.
- **QL Mismatch Monitoring** when selected (default) enables the Quality Level mismatch monitoring.
- **Expected QL** allows the selection of the Expected Quality Level value. Available when the **QL Mismatch Monitoring** check box is selected.

| Quality Level value | PTP Clock Class | Description                                                                       |
|---------------------|-----------------|-----------------------------------------------------------------------------------|
| QL-PRS (default)    | 80              | Primary Reference Source Traceable (G.811)                                        |
| QL-STU/UNK          | 82              | Synchronized - Traceability Unknown                                               |
| QL-PRC              | 84              | Primary Reference Clock Traceable (G.811)                                         |
| QL-ST2              | 86              | Traceable to Stratum 2 (G.812 Type II)                                            |
| QL-INV3             | 88              | Quality Level Invalid 3                                                           |
| QL-SSU-A/TNC        | 90              | Type I or V slave clock (G.812)<br>Traceable to Transit Node Clock (G.812 Type V) |
| QL-INV5             | 92              | Quality Level Invalid 5                                                           |
| QL-INV6             | 94              | Quality Level Invalid 6                                                           |
| QL-SSU-B            | 96              | Type VI slave clock (G.812)                                                       |
| QL-INV9             | 98              | Quality Level Invalid 9                                                           |
| QL-ST3E             | 100             | Traceable to Stratum 3E (G.812 Type III)                                          |
| QL-EEC2/ST3         | 102             | Ethernet Equipment Clock Option 2<br>Traceable to Stratum 3 (G.812 Type IV)       |

| Quality Level value | PTP Clock Class | Description                                                                                  |
|---------------------|-----------------|----------------------------------------------------------------------------------------------|
| QL-EEC1/SEC         | 104             | Ethernet Equipment Clock Option 1<br>Synchronous Equipment Clock (G.813 or G.8262, Option 1) |
| QL-SMC              | 106             | Traceable to SONET Minimum Clock (G.813 or G.8262, Option 2)                                 |
| QL-PROV             | 108             | Provisionable by the Network Operator (PNO)                                                  |
| QL-DNU/DUS          | 110             | Do Not Use<br>Do Not Use for Synchronization                                                 |

- **Count** gives the count for each QL code (PTP Clock Class) included in the announce message received.
- **Other** includes all clock class codes (0 to 255) included in the announce message received other than the QL codes (see table above). Refer to page 399 for the complete list.
- **Total** indicates the total count of all QL code messages received.

# Test Results

## Quality Level (SyncE)

The quality level characterizes the clock quality in terms of network synchronization.

From the **Test** menu, tap **Results**, and the **Quality Level** tab.

- **Generated QL** indicates the Quality Level value that is generated.  
**Last Change** indicates the date and time of the Generated Quality Level value has changed. For 1GE Electrical interface using **Local Clock** set to **Slave**, the **Last Change** is not available.
- **Last QL Received** indicates the last Quality Level value received. The pass/fail verdict is also displayed when both **QL Mismatch Monitoring** and **Pass/Fail Verdict** check boxes are selected.  
**Last Change** indicates the date and time of the Last QL Received has changed.
- **QL Mismatch Monitoring** when selected (default), enables the Quality Level mismatch monitoring.
- **Expected QL** allows the selection of the Expected Quality Level value. Available when the **QL Mismatch Monitoring** check box is selected.

| Quality Level value | SSM | Description                                                                       |
|---------------------|-----|-----------------------------------------------------------------------------------|
| QL-STU/UNK          | 0   | Synchronized - Traceability Unknown                                               |
| QL-PRS              | 1   | Primary Reference Source Traceable (G.811)                                        |
| QL-PRC              | 2   | Primary Reference Clock Traceable (G.811)                                         |
| QL-INV3             | 3   | Quality Level Invalid 3                                                           |
| QL-SSU-A/TNC        | 4   | Type I or V slave clock (G.812)<br>Traceable to Transit Node Clock (G.812 Type V) |
| QL-INV5             | 5   | Quality Level Invalid 5                                                           |
| QL-INV6             | 6   | Quality Level Invalid 6                                                           |
| QL-ST2              | 7   | Traceable to Stratum 2 (G.812 Type II)                                            |

| Quality Level value   | SSM | Description                                                                                  |
|-----------------------|-----|----------------------------------------------------------------------------------------------|
| QL-SSU-B              | 8   | Type VI slave clock (G.812)                                                                  |
| QL-INV9               | 9   | Quality Level Invalid 9                                                                      |
| QL-EEC2/ST3 (default) | 10  | Ethernet Equipment Clock Option 2<br>Traceable to Stratum 3 (G.812 Type IV)                  |
| QL-EEC1/SEC           | 11  | Ethernet Equipment Clock Option 1<br>Synchronous Equipment Clock (G.813 or G.8262, Option 1) |
| QL-SMC                | 12  | Traceable to SONET Minimum Clock (G.813 or G.8262, Option 2)                                 |
| QL-ST3E               | 13  | Traceable to Stratum 3E (G.812 Type III)                                                     |
| QL-PROV               | 14  | Provisionable by the Network Operator (PNO)                                                  |
| QL-DNU/DUS            | 15  | Do Not Use<br>Do Not Use for Synchronization                                                 |

- **QL Mismatch Frame Count** gives the total count of information and/or event frames received not matching the expected Quality Level. Only available when the **QL Mismatch Monitoring** check box is selected.

## Test Results

### *Quality Level (SyncE)*

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#### ➤ TX

- **Information** gives the count of information frames generated for each Quality Level as well as the total of all Quality Level values. For 1GE Electrical interface using **Slave** as **Master-Slave Clock**, only the count for **QL-DNU/DUS** is reported.
- **Event** gives the count of event frames generated for each Quality Level as well as the total of all Quality Level values. Not available with 1GE Electrical using **Slave** as **Master-Slave Clock**.

#### ➤ RX

- **Information** gives the count of information frames received for each Quality Level as well as the total of all Quality Level values.
- **Event** gives the count of event frames received for each Quality Level as well as the total of all Quality Level values.

## S-OAM and MPLS-TP OAM

From the **Test** menu, tap **Results**, and the **S-OAM** or **MPLS-TP OAM** tab.

### Loopback

- **Status** displays the status of the test function (refer to page 433).
- **TX LBM** indicates the count of transmitted LBM frames.
- **RX LBR** indicates the count of valid LBR frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address, destination MAC address matching the unit port MAC address, and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPLS Labels matching the local MPLS Label Stack configuration.
- **LBR Timeout**

For connectivity verification (Continuous check box cleared), indicates the count of LBR Timeout event which occurs if a reply (LBR frame with matching Transaction ID) to a transmitted LBM frame is not received within 5 seconds.

For diagnostic test (Continuous check box selected), indicates the difference between the transmitted LBM frames and the received LBR frames.
- **Invalid LBR**

For connectivity verification (Continuous check box cleared), indicates the count of LBR frames received from the peer MEP with incorrect MEG/MD Level or with an unexpected Transaction ID.

For diagnostic test (Continuous check box is selected), indicates the count of LBR frames received from the peer MEP with incorrect MEG/MD Level.

## Test Results

### *S-OAM and MPLS-TP OAM*

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- **Invalid Payload** indicates the count of received LBR frames having either a TLV type different than the one transmitted, Bit error or wrong data value detected in the data payload of a Data TLV, Bit error, Pattern Loss, or Pattern Type mismatch of a Test TLV.
- **Successful** indicates the count of received LBR frames having no errors.
- **Failed** indicates the count of LBR frames declared as invalid.

## Test

- **Status** displays the status of the test function (refer to page 433).
- **TX TST** indicates the count of transmitted TST frames.
- **RX TST** indicates the count of valid TST frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address; destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address<sup>1</sup>; and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPLS Labels matching the local MPLS Label Stack configuration.
- **Invalid TST** indicates the count of TST frames received from the peer MEP with incorrect MEG/MD level.
- **Invalid Payload** indicates the count of received TST frames having either an unsupported pattern type, or bit error / pattern loss detected in the payload.
- **Successful** indicates the count of received TST frames having no errors.
- **Failed** indicates the count of TST frames declared as invalid.

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1. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 638 for more information.

## Frame Delay

- **Status** displays the status of the test function (refer to page 433).
- **TX DMM** indicates the count of transmitted DMM frames.
- **RX DMR** indicates the count of valid DMR frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address; destination MAC address matching the unit port MAC address; and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPLS Labels matching the local MPLS Label Stack configuration..
- **Invalid DMR** indicates the count of received DMR frames from the peer MEP having an incorrect MEG/MD Level, an incorrect Test ID (when applicable), or with a valid MEG/MD Level and valid Test ID (when applicable) but with a Frame Delay outside the 0.001 to 8000.000 ms range.
- **Delay (ms): Current** indicates the average of frame delay measured in the last second. **Minimum**, **Maximum**, and **Average** indicates respectively the minimum, maximum, and average frame delays measured since the beginning of the test.
- **Successful** indicates the count of received DMR frames having no errors.
- **Failed** indicates the count of DMR frames declared as invalid.

## Test Results

### *S-OAM and MPLS-TP OAM*

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#### Frame Loss

- **Status** displays the status of the test function (refer to page 433).
- **TX LMM** indicates the count of transmitted LMM frames.
- **RX LMR** indicates the count of valid LMR frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address; destination MAC address matching the unit port MAC address; and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPLS Labels matching the local MPLS Label Stack configuration.
- **Invalid LMR** indicates the count of LMR frames received from the peer MEP with incorrect MEG/MD level.
- **Frame Loss** is calculated (count and %) for both Near-End and Far-End over all valid LMR frames received.
- **Successful** indicates the count of received LMR frames having no errors.
- **Failed** indicates the count of LMR frames declared as invalid.

## Synthetic Loss

**Note:** Only available with Ethernet OAM.

- **Status** displays the status of the test function (refer to page 433).
- **TX SLM** indicates the count of transmitted SLM frames.
- **RX SLR** indicates the count of valid SLR frames received. A valid frame has its source MAC address matching the Peer MEP MAC address; destination MAC address matching the unit port MAC address; and VLANs matching the unit port VLANs.
- **Invalid SLR** indicates the count of SLR frames received from the peer MEP with incorrect MEG/MD level, incorrect source MEP ID, or incorrect Test ID.
- **Synthetic Loss** is calculated (count and %) for both Near-End and Far-End over all frames received and is updated after each Synthetic Loss measurement period (after receiving the defined **Frame Count**, refer to page 229).
- **Successful** indicates the count of received SLR frames having no errors.
- **Failed** indicates the count of SLR frames declared as invalid.

## Service Configuration - Burst

From the **Test** menu, tap **Results**, **Service Configuration**, and the **Burst** tab.

### Service Name and Selection

**Service Name** indicates the name of the selected service.

Select the service to be displayed by either using the left/right arrow or by tapping over the service numbers area then tapping on a specific service number. An orange background indicates the selected service while a green background indicates the services that are enabled.

### Committed/Excess

- **Committed - Burst test** is the **CBS** subtest.
- **Excess - Burst test** is the **EBS** subtest.
- **Direction**, available with **Dual Test Set**, indicates results from local to remote (**L->R**) and remote to local (**R->L**).
- **Burst Size** indicates the size in bytes of the burst used for each subtest.
- **SLA Verified** indicates the committed SLA parameters that are used to declare the pass/fail verdict. See *Summary (EtherSAM)* on page 405 for more information on **Frame Loss**, **Max Jitter**, **Round-Trip Latency**, **Max Latency**, and **Max RX Rate**.
- **Informational** parameters are for information purpose only, they are not included in the test pass/fail verdict. See *Summary (EtherSAM)* on page 405 for more information on **Frame Loss**, **Max Jitter**, **Max Latency**, and **Round-Trip Latency**.
- **Average RX Rate** indicates the measured average utilization throughput for the CBS subtest.

## Service Configuration - Ramp

From the **Test** menu, tap **Results**, **Service Configuration**, and the **Ramp** tab.

### Service Name and Selection

**Service Name** indicates the name of the selected service. Select the service to be displayed by either using the left/right arrow or by tapping over the service numbers area then tapping on a specific service number. An orange background indicates the selected service while a green background indicates the services that are enabled.

### Committed/Excess Steps

- **Committed Steps** indicate the pre CIR and CIR steps specified in the ramp configuration.
- **Excess Steps** indicate the **CIR+EIR** and **Traffic Policing** steps specified in the ramp configuration.
- **Direction**, available with **Dual Test Set**, indicates results from local to remote (**L->R**) and remote to local (**R->L**).
- **TX Rate** indicates the transmission rate for each step.
- **SLA Verified** indicates the committed SLA parameters that are used to declare the pass/fail verdict. See *Summary (EtherSAM)* on page 405 for more information on **Frame Loss**, **Max Jitter**, **Round-Trip Latency**, and **Max RX Rate**.
- **Informational** parameters are for information purpose only, they are not included in the test pass/fail verdict. See *Summary (EtherSAM)* on page 405 for more information on **Frame Loss**, **Max Jitter**, and **Round-Trip Latency**.
- **Average RX Rate** indicates the measured average utilization throughput for each step.

## Service Performance

From the **Test** menu, tap **Results**, and the **Service Performance** tab.

### Service Name and Selection

**Service Name** indicates the name of the selected service.

Select the service to be displayed by either using the left/right arrow or by tapping over the service numbers area then tapping on a specific service number. An orange background indicates the selected service while a green background indicates the services that are enabled.

### SLA Parameters

The configured **CIR**, **Max Jitter**, **Frame Loss** and **Max Latency/Max Round-Trip Latency** SLA parameters are displayed. Refer to *Services - Profile* on page 233 for more information. For **Dual Test Set**, parameters are displayed for both local to remote (**L->R**), remote to local (**R->L**) directions.

### Metrics

**Current**, **Average**, **Minimum**, **Maximum**, and **Estimate (Jitter)** measured values for each metric are reported. **Direction**, available with **Dual Test Set** indicates results from local to remote (**L->R**) and remote to local (**R->L**), and Round-Trip for Latency when in Round-Trip Latency Measurement Mode (see *Global Options* on page 140). For **Dual Test Set**, results for remote to local are obtained at the end of each step.

- **RX Rate** indicates the measured utilization throughput.
- **Jitter (ms)** indicates the measured delay variation.
- **Latency (ms)** indicates the measured round-trip latency (delay).

**Note:** For the **Current** value, 0 is displayed when no RX rate has been measured in the last second.

**Note:** *Delay variation measurements smaller than 15  $\mu$ s will be discarded, not used for the sampling process, and “< 0.015” is displayed as the minimum value. For the **Current** value, **Not measurable** is displayed when no delay has been measured in the last second.*

## Errors

For **Dual Test Set**, errors are reported for both local to remote (**L->R**) and remote to local (**R->L**).

- **Frame Loss** indicates that a sequence number is missing in the received frames. The pass/fail verdict when enabled reports only the verdict when it is fail. **Seconds**, **Count**, and **Rate** values are reported.
- **Out-of-Sequence** indicates that the received frame sequence number is either smaller than the expected frame sequence number or is a duplicate number. The Out-Of-Sequence will not be considered in the global verdict. **Seconds**, **Count**, and **Rate** values are reported.

## RX Frame Count

The **RX Frame Count** indicates the number of frames received matching the selected service ID. For **Dual Test Set**, the count is reported for both local to remote (**L->R**) and remote to local (**R->L**).

## Streams - Frame Loss / Out-of-Sequence

From the **Test** menu, tap **Results**, **Streams**, and the **Frame Loss / Out-Of-Sequence** tab.

- **Stream:** Indicates the stream identification number.
- **Thresholds** button allows to set the pass/fail thresholds (refer to *QoS Metrics* on page 272).
- **Frame Loss:** See *QoS Metrics* on page 325.
- **Out-Of-Sequence:** See *QoS Metrics* on page 325.

## Streams - Jitter

From the **Test** menu, tap **Results**, **Streams**, and the **Jitter** tab.

- **Stream:** Indicates the stream identification number.
- **Jitter (ms)** is measured for each stream on all valid frames (in-sequence frames, valid Jitter tag, and no FCS error) received. **Current**, **Average**, **Minimum**, **Maximum**, and **Estimate** delay values are reported.

**Note:** *Delay variation measurements smaller than 15  $\mu$ s will be discarded, not used for the sampling process, and “< 0.015” will be displayed as the minimum value. For the **Current** value, **Not measurable** is displayed when no delay has been measured in the last second.*

- **Thresholds** button allows to set the pass/fail thresholds (refer to *QoS Metrics* on page 272).

## Streams - Latency

From the **Test** menu, tap **Results**, **Streams**, and the **Latency** tab.

- **Stream:** Indicates the stream identification number.
- **Latency (ms)** is measured for each stream on all valid frames (valid Latency tag, expected originator identifier value, and no FCS error) received. **Current**, **Average**, **Minimum**, and **Maximum** round-trip latency (delay) are reported.

**Note:** *Latency statistics are only available in loopback test topology.*

**Note:** *Delay measurements smaller than 15  $\mu$ s will be discarded, not used for the sampling process, and “< 0.015” will be displayed. For the **Current** value, **Not measurable** is displayed when no delay has been measured in the last second.*

- **Thresholds** button allows to set the pass/fail thresholds (refer to *QoS Metrics* on page 272).

## Streams - Throughput

From the **Test** menu, tap **Results**, **Streams**, and the **Throughput** tab.

- **Stream** indicates the stream identification number.
- **TX Rate** indicates the transmitted throughput rate.
- **RX Rate** is measured for each stream on all valid frames (valid Throughput tag with no FCS error). **Current**, **Average**, **Minimum**, and **Maximum** throughput results are reported. Refer to *Unit* on page 265 for unit selection.

**Note:** A **Current** value of **0** indicates that no RX rate has been measured in the last second.

- **Total** indicates the total TX and current measured RX throughput of all valid frames (valid Throughput tag with no FCS error).
- **Thresholds** button allows to set the pass/fail thresholds (refer to *QoS Metrics* on page 272).

## Summary

**Note:** *Available with Transport, Ethernet (EtherBERT, Through Mode, Smart Loopback), and Wireless test applications. For other test applications see the corresponding test summary page.*

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Status** indicates the actual test status as follows.
  - “--”: The test is not running or results are not available.
  - **In Progress**: The test is running.
  - **Completed**: The test is completed, stopped at the planned time, or manually stopped when there is no set timer.
- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 559.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 362.

## Test Results

### Summary

---

## Interface

**Note:** Only available with CPRI/OBSAI Unframed test application.

➤ **Alarms**

LOS indicates that there is no input signal.

➤ **Errors**

CV (Code Violation) indicates that invalid 10B code word are received.

## BER and Multi-Pattern BER

**Note:** See BER on page 296 for a description of each alarm/error.

**Note:** For Multi-Pattern, alarms/errors are available for each pattern. An arrow in front of a specific pattern indicates the pattern that is currently generated/analyzed. **All** represents the sum of alarms/errors as well as the consolidated rate for all patterns.

- **Receiving Live Traffic - RX Pattern Analysis Disabled** when displayed, indicates that the **No Pattern Analysis (Live)** check box is selected and in this case no other information/statistics are available.
- **BER Threshold** is available when **Pass/Fail Verdict** is enabled<sup>1</sup>.
- **Restart Sequence** button, available with multi-pattern, clears results and restarts the multi-pattern sequence with the first enabled pattern in the list. This is the only way to restart the multi-pattern sequence and to allow synchronization between two test sets.

For back-to-back testing using two test sets, create a multi-pattern test on both units, tap the **Restart Sequence** button on each unit within 5 seconds apart. Once synchronized, start the test on each unit.

---

1. Refer to *BERT* on page 117 or *EtherBERT*, *FC BERT*, *BERT (CPRI)*, and *Unframed BERT* on page 129.

- **Bit/Pattern Error Rate/Count** graphically displays a meter representing either the bit/pattern error rate or the bit/pattern error count depending on the Pass/Fail Verdict selection<sup>1</sup>.

When the verdict is enabled<sup>1</sup>, the values under the threshold are presented in green while the values above are in red.

When the verdict is disabled, the bit/pattern error rate is displayed in blue.

The arrow pointer indicates the current received bit/pattern error rate/count.

The Pass/Fail verdict is displayed just on top of the meter when enabled<sup>1</sup>.
- **Bit/Pattern Error, Amount/Rate, and Inject:** The bit/pattern error injection and settings are coupled with the *Inject Button* on page 346. For Transport test applications, not available in Through modes or with Multi-Pattern.

## Service Disruption

**Note:** *Service Disruption results are only available with Transport, CPRI, and EtherBERT test applications when **Disruption Monitoring** is enabled (refer to BERT on page 117 or EtherBERT, FC BERT, BERT (CPRI), and Unframed BERT on page 129). When Service Disruption is disabled, the message **Service disruption monitoring disabled** is displayed.*

Service Disruption is the time during which there is a disruption of service due to the detection of defects.

➤ **Disruption Time**

**Longest (ms):** Indicates the longest measured disruption time.

**Shortest (ms)** indicates the shortest measured disruption time.

**Last (ms)** indicates the length of the last measured disruption time.

**Average (ms)** indicates the average duration of all measured disruption times.

**Total (ms)** indicates the total duration of all measured disruption times.

➤ **Defect**, available with Transport test applications, indicates on which layer and defect the service disruption time test is performed.

➤ **Disruption Count:** Indicates the number of disruption events detected since the beginning of the SDT test.

**Note:** *When a disruption event is equal or longer than the test period which is fixed to 5 minutes, then the measured disruption time is equal to the test period.*

➤ **SDT Threshold (ms)** allows to enter the SDT threshold value that will be used to declare the pass/fail verdict: 0.005 to 299999.995 ms in step of 0.005 ms (default is **50** ms). This setting is only accessible when Pass/Fail Verdict is enabled and is coupled with the SDT Threshold set from the test setup (refer to page 121).

## Traffic / Traffic Ethernet

**Note:** The **Traffic** statistics are available for Smart Loopback and Through Mode test applications. See Traffic - Ethernet on page 446 for more information.

## CPRI

**Note:** Available with CPRI Framed L2.

- **Sequence** indicates the last Sequence State parameter: **Standby (A)**, **L1 Sync (B)**, **Protocol (C)**, **L2 C&M (D)**, **Vendor (E)**, **Operation (F)**, and **Passive (G)**. The pass/fail verdict is also displayed when enabled.
- **Frame Sync** indicates that the startup sequence synchronization status as per L1 Sync Status parameter: active (green) or inactive (red).
- **Protocol** indicates either the last received (**Version 1** or **Version 2**) or negotiated (**Auto**) protocol version. A red background indicates a Protocol version mismatch.
- **C&M** indicates either the received (HDLC or Ethernet) or negotiated (Auto) C&M for Ethernet subchannel and HDLC rates in Mbit/s. A red background indicates either a C&M type mismatch or HDLC Rate/Ethernet subchannel mismatch. An arrow is displayed indicating which C&M Channel, Ethernet or HDLC, is selected following the negotiation process.
- **Code Word (CW)** indicates the transmitted and received Code Word count.
- **Hyperframe** indicates the transmitted and received hyperframe count.
- **L1 Reset**, available when **Remote Radio Head** emulation mode is selected, indicates the number of times a request to reset the RRH interface was received.

## Test Results

### Summary

---

## RX Frequency

**Note:** *RX Frequency is available for Through Mode test application on both ports (**Port 1** and **Port 2**).*

- **Frequency (GHz)** indicates the frequency of the input signal.
- **Offset (ppm)** indicates the frequency offset between the standard rate specification and the rate at the input signal.

**Note:** *For both **Frequency** and **Offset** the following background colors are used.*

| Background color | Description                                                  |
|------------------|--------------------------------------------------------------|
| Green            | The frequency is in range.                                   |
| Red              | The frequency is out-of-range. <b>LOC</b> is also displayed. |
| Gray             | Pending state.                                               |

## Summary (1588 PTP)

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Test Status** displays the current status of the 1588 PTP test. The global test pass/fail verdict is displayed next to the **Test Status** field when enabled (see *Pass/Fail Verdict* on page 116).

| Test Status | Description                                                                                                                                                                                        |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| --          | Idle state, the test is not running or results are not available.                                                                                                                                  |
| In Progress | The test is running.                                                                                                                                                                               |
| Completed   | The test is completed, stopped at the planned time, or manually stopped when there is no set timer.                                                                                                |
| Aborted     | The test is interrupted; stopped before the set timer.<br>[Message type] <b>Request Denied</b> , <b>Session Canceled</b> , or <b>No Reply</b> is displayed next to <b>Aborted</b> when applicable. |

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 559.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 362.

## Test Results

### Summary (1588 PTP)

---

#### ➤ Negotiation Status

The status of the PTP Negotiation is displayed while in Unicast negotiation.

| Negotiation Status                      | Description                                                                                                                                                                                                                                                                                                                                                    | Background Color <sup>a</sup> |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| <b>Request Granted</b>                  | All the Signaling request types have been granted.                                                                                                                                                                                                                                                                                                             | Green                         |
| [Message type]<br><b>Request Denied</b> | The Signaling grant message has not been granted.                                                                                                                                                                                                                                                                                                              | Red                           |
| <b>Session Canceled</b>                 | The Grand Master has canceled the Unicast session.                                                                                                                                                                                                                                                                                                             | Red                           |
| <b>No Reply</b>                         | No message is received from the Grand Master following transmission of 3 Signaling requests for a message type.<br><br>Make sure that both IP address and Domain (refer to <i>1588 PTP</i> on page 112) of the Grand Master Clock are valid as well as the IP address of the unit's port used to connect on the network (refer to <i>Network</i> on page 185). | Red                           |
| <b>Pending</b>                          | Unicast negotiation has started and no message has been received from the Grand Master.                                                                                                                                                                                                                                                                        | Gray                          |
| <b>Inactive</b>                         | The Unicast negotiation is not active.                                                                                                                                                                                                                                                                                                                         | Gray                          |

a. The gray background color is also used for a Link Down.

➤ **GM Info**

**Note:** Only available when Grand Master clock information is available.

The Grand Master Information window displays the decoded clock information.

- **Identity** report the 8-byte identification code of the Grand Master Clock.
- **Clock Class** reports the description and code of the Grand Master Clock Class.

| Code                                                                                 | Description                            |
|--------------------------------------------------------------------------------------|----------------------------------------|
| 0-5, 8-12, 15-51, 53-57, 59-67, 123-132, 171-186, 188-192, 194-215, 233-247, 249-254 | Reserved                               |
| 6                                                                                    | Sync to primary reference              |
| 7, 14                                                                                | Holdover                               |
| 13                                                                                   | Sync to application-specific reference |
| 52, 58, 187, 193                                                                     | Degraded                               |
| 68 to 79, 81-109 (odd values), 11-122, 133-170, 216-232                              | Alternate PTP profiles                 |
| 80-110 (even values) <sup>a</sup>                                                    | Quality Level (QL-xxx <sup>a</sup> )   |
| 248                                                                                  | Default                                |
| 255                                                                                  | Slave only                             |

a. Refer to QL table on page 374 for the list of Quality Level values that will be used as the description.

- **Clock Mode** reports the description of the Grand Master Clock Mode: **Two-step** or **One-step**.

- **Start Time** indicates the time the test was started.

## Test Results

Summary (1588 PTP)

---

### Delay Measurement

- **Sync IPDV** meter displays the average of the inter packet delay variation of consecutive Sync messages in the last second. The value and the pass/fail verdict is also displayed when enabled.
- **Delay Req IPDV** meter displays the average of the inter packet delay variation of consecutive Delay Req messages in the last second. The value and the pass/fail verdict is also displayed when enabled.

**Note:** When a value is below 1 $\mu$  second, “< 1 $\mu$ s” is displayed.

**Note:** When the Pass/Fail verdict is enabled, the green region is delimited from 0 to the IPDV Threshold (refer to PTSF Alarm Timeout/Threshold on page 115) corresponding to a **PASS** verdict. The red region beyond the threshold corresponds to a **FAIL** verdict. There is neither green nor red region when the Pass/Fail verdict is disabled.

### Quality Level

- **Last QL Received** indicates the last Quality Level received. The pass/fail verdict is also displayed when both **QL Mismatch Monitoring** and **Pass/Fail Verdict** check boxes are selected.
- **Last Change** indicates the date and time of the Last QL change.

### Total PTP Messages

Gives respectively the total count of transmitted (TX) and received (RX) PTP messages.

## Summary (Cable Test)

From the **Test** menu, tap **Results**, and the **Summary** tab.

### Test Status

**Test Status** indicates the progress of the cable test as follows:

- **Idle** (test has not started)
- **In Progress**
- **Completed**

The Pass/Fail verdict is displayed next to the **Test Status** field, when enabled, based on the following criteria: The worst pair's **Wire Map**, **Prop. Delay**, **Delay Skew**, and **Length**.

### Start Time

Indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.

### Cable

**Note:** When no value is available, "--" is displayed.

- **Wire Map** indicates the Wire Map result for the pair having the worst Wire Map. The distance to fault is also displayed when a fault is identified. The Pass/Fail verdict is also displayed, when enabled.
- **Prop. Delay (ns)** indicates the propagation delay value for the pair having the longest propagation delay. The Pass/Fail verdict is also displayed when enabled.

## Test Results

### Summary (Cable Test)

---

- **Delay Skew (ns)** indicates the delay skew value for the pair having the worst delay skew. The Pass/Fail verdict is also displayed when enabled. The Delay Skew result is only available for 1000 Base-T interface when the link is up.
- **Length (m/ft)** indicates the length for the pair having the worst cable length value. The Pass/Fail verdict is also displayed when enabled.

## Pairs

**Note:** When no value is available, "--" is displayed.

- **Pair** indicates the pair number.
- **Pins** indicates the pair's pin numbers and color of each wire corresponding to the selected wiring standard.

|      |              |
|------|--------------|
| W-BL | White-Blue   |
| BL   | Blue         |
| W-O  | White-Orange |
| O    | Orange       |
| W-G  | White-Green  |
| G    | Green        |
| W-BR | White-Brown  |
| BR   | Brown        |

- **Wire Map Test Result** gives the wire map test result for each pair. When the link is up: The wire map result for each pair is given as seen by the FTB-700G/800 Series to get a link up. This means that the wire map result may not correspond to the type of cable tested depending on the cable(s) used and/or the configuration of the cable mode (MDI, MDIX, or auto-detection) on both the FTB-700G/800 Series and the far end equipment. For example, two crossed pair cables end to end used between the FTB-700G/800 Series and a far end equipment may give a straight pair (MDI) wire map result.

|                 |                                                                                                                                                                                                              |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MDI</b>      | Straight pair.                                                                                                                                                                                               |
| <b>MDIX</b>     | Crossed pair.                                                                                                                                                                                                |
| <b>MDI (-)</b>  | For 1Gbit/s, straight pair with swapped wires within pair.                                                                                                                                                   |
| <b>MDIX (-)</b> | For 1Gbit/s, crossed pair with pair A swapped with pair B and/or pair C swapped with pair D.                                                                                                                 |
| <b>Noise</b>    | Excessive noise on a pair most likely caused by a link partner running in 10/100 Mbit/s forced mode. In this case, no propagation delay or length is reported and there is no comparison with any threshold. |

**Note:** For 1Gbit/s, both MDI and MDIX can be reported simultaneously since crossed pairs detection is performed independently for pairs A-B and C-D.

## Test Results

### Summary (Cable Test)

---

When the link is down:

|                     |                                                                                                                                                                                           |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Short               | Short-circuit between Tip and Ring wires of a pair or Tip or ring wire of a pair is connected with an alien wire grounded.                                                                |
| Open                | No cable plugged in, remote end open, or either one or two wires of a pair are not connected.                                                                                             |
| Short-between-pairs | Short between one or two wires of a pair with one or two wires of another pair. Short between more than two pairs, including one or two wires for each pair.                              |
| Noise               | Excessive noise on a pair most likely caused by a link partner running in 10/100 Mbit/s forced mode. In this case, no distance is reported and there is no comparison with any threshold. |
| Unknown             | No fault has been identified but the link is down. To maximize the cable test result, it is preferable to have the far end equipment powered up.                                          |

If the determined **Wire Map** is either **MDI**, **MDIX**, **MDI (-)**, **MDIX (-)**, or **Noise** (Link up), the test is declared as **PASS**. If the determined Wire Map is either **Short**, **Short-between-pair**, **Open**, **Noise** (Link down), or **Unknown**, the test is declared as **FAIL**.

**Note:** Refer to Ethernet Cables on page 606 for cable pinout.

- **Distance To Fault (m/ft)** gives the distance to fault from the near end for each pair, unless the problem is due to excessive noise. Noise may be due to electrical noise causing communication error.
- **Prop. Delay (ns)** indicates the propagation delay of a signal through each pair.
- **Length (m/ft)** indicates the cable length of each pair.

## Summary (EtherSAM)

From the **Test** menu, tap **Results**, and the **Summary** tab.

**Note:** For *Dual Test Set*, only *Start Time* is displayed on the remote module.

- **Service Configuration/Performance Test Status** indicates the actual test status as follows:

| Test Status          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "--"                 | Test has not started.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Disabled             | Test/subtests is/are disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Running              | Test/subtest is currently running.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Data Transfer        | Test/subtest is running but no test traffic is being transmitted.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Completed, <Verdict> | Test/subtest has completed with the test pass/fail verdict. A fail verdict is declared when a <b>Link Down</b> or <b>LOS</b> is detected, or when any SLA parameter fails.                                                                                                                                                                                                                                                                                                                                                      |
| Aborted, <reason>    | Test/subtest has been aborted either manually (Stop) or automatically from an alarm and the reason why the test has been aborted is also displayed as follows:<br><b>Link down alarm, LOS alarm, Timeout during execution, DTS connection failed, Loss of remote connection (DTS), LOPPS-L Alarm<sup>a</sup>, LOPPS-R Alarm<sup>a</sup>, LOPPS-L / LOPPS-R Alarm<sup>a</sup>, Unresolved addresses, No test enabled, Invalid Burst Configuration, CIR disabled for all services, Excessive Refill Time<sup>b</sup>, Stopped</b> |

- a. Available for **Dual Test Set** in **One-Way Latency** measurement mode.
- b. An excessive refill occurs when the pre-burst and/or post-burst duration last for more than 2 seconds.

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted.
- **Remote unit in use and locked for Dual Test Set** indicates that this module is used for **Dual Test Set** as the remote module.

## Test Results

### *Summary (EtherSAM)*

---

- **Remote unit in Dual Test Set Mode** indicates that this module is set as remote but the DTS Connection is not established.
- **Service Configuration/Performance Test:** Tap **Service Configuration Test** or **Service Performance Test** button to view the result summary of the corresponding test.
  - **Service** indicates the service's number and name. For **Service Configuration Test**, the number/name is highlighted in red per service when VLAN mismatch occurred; in **Dual Test Set**, the direction is also highlighted; in Dual Test Set, the **R -> L** direction label is gray when **VLAN Preservation** is not supported by the remote module.
  - **Direction**, available with **Dual Test Set**, indicates results from local to remote (**L->R**) and remote to local (**R->L**).
  - **Service Performance Test** column displays the pass/fail verdict icon indicating if the service complies to the configured SLA parameters.
  - **Service Configuration Test** column displays the pass/fail verdict icon indicating if the service complies to the configured SLA parameters.

### Committed

- **Frame Loss** indicates the percentage of frames that are lost. The reported value is the maximum percentage of Frame Loss from all burst sequences and ramp steps excluding the **CIR+EIR**, **EBS**, and **Traffic Policing** steps.
- **Max. Jitter (ms)** indicates the maximum measured delay variation.
- **Max Latency (ms)** indicates the maximum measured round-trip latency (delay). For Dual Test Set the local to remote and remote to local values are reported for One-Way Latency Measurement Mode while a single round-trip value is reported for Round-Trip Latency Measurement Mode (see *Global Options* on page 140).
- **Avg RX Rate**, for **Service Performance Test**, indicates the measured average utilization throughput.

### Excess

**Max RX Rate**, for **Service Configuration Test**, indicates the measured maximum utilization throughput.

- **VLAN Preservation** indicates if any VLAN mismatch occurred during any step of a Ramp or Burst tests as follows:

Grey: Undefined

Green: No Mismatch detected

Red: Mismatch detected

## Summary (FC BERT)

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Test Status** indicates the actual test status as follows.
  - “--”: The test is not running or results are not available.
  - **In Progress**: The test is running.
  - **Completed**: The test is completed, stopped at the planned time, or manually stopped when there is no set timer.

Once the test is stopped, the test pass/fail verdict is displayed next to the **Status** field when enabled. The verdict is Pass when all verdicts are Pass, the verdict is Fail as soon as one of the verdict is Fail. Refer to *Bit/Pattern Error* on page 130 and *Latency Tag Insertion* on page 132 for more information.

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 559.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 362.

## BER

**Note:** See BER on page 296 for a description of each alarm/error.

- **BER Threshold** is available when **Pass/Fail Verdict** is enabled (refer to page 130).
- **Bit Error Rate/Count** graphically displays a meter representing either the bit error rate or the bit error count depending on the Pass/Fail Verdict selection (refer to page 130).

When the verdict is enabled, the values under the threshold are presented in green while the values above are in red.

When the verdict is disabled, the bit error rate is displayed in blue.

The arrow pointer indicates the current received bit error rate/count.

The Pass/Fail verdict is displayed just on top of the meter when enabled.

- **Bit Error and Rate/Amount**
  - **Manual** allows to enter the amount of manual error to be generated: **1** (default) through **50**.
  - **Rate** allows the selection of the injection rate for the selected error.
  - **Max Rate** generates the selected error to its theoretical maximum rate.
- **Inject** generates, if the test is running, the amount of bit error configured.

## Test Results

*Summary (FC BERT)*

---

### Round-Trip Latency

- **Round Trip Latency (ms)** is measured for each local and remote port.  
**Current, Average, Minimum, and Maximum** indicates respectively the current, average, minimum, and the maximum round trip latency from the local to the remote port in the last one second. The pass/fail verdict is also displayed for the maximum round trip latency.  
**Samples** indicates the number of samples used for the round trip latency.
- **Estimated BB\_Credit** indicates the estimated number of packets that can be transmitted on the optical line at the same time.
- **Round-Trip Latency Threshold (ms)** sets the round trip latency threshold: **0.015 to 8000 ms** (default is **15**). This setting is only available when both **Latency Tags** and **Pass/Fail Verdict** check boxes are selected (refer to *Latency Tag Insertion* on page 132).

### Traffic

- **Line Utilization (%)** indicates the current percentage of the transmitting/receiving line rate utilization.
- **Frame Rate (frame/s)** indicates the current transmitted/received number of frames (including frame with error and aborted frames) in frame per second.
- **Byte Count** indicates the total number of transmitted/received bytes including the frame delimiters.
- **Frame Count** indicates the total number of transmitted/received frames including link service control frames.

## Summary (iSAM)

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted.
- **Configuration/Performance Results** and **RFC 6349 Results** buttons are used to respectively display summary results for **Service Configuration Test** and **Service Performance Test**, or **RFC 6349 Test** when results don't fit on one page.

## Service Configuration Test and Service Performance Test

- The actual test status is displayed as follows:

| Test Status          | Description                                                                                                                                                                                                                                                                                                          |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "_"                  | Test has not started.                                                                                                                                                                                                                                                                                                |
| Disabled             | Test/subtests is/are disabled.                                                                                                                                                                                                                                                                                       |
| Running              | Test/subtest is currently running.                                                                                                                                                                                                                                                                                   |
| Data Transfer        | Test/subtest is running but no test traffic is being transmitted.                                                                                                                                                                                                                                                    |
| Completed, <Verdict> | Test/subtest has completed with the test pass/fail verdict. A fail verdict is declared when a Link Down or LOS is detected, or when any SLA parameter fails.                                                                                                                                                         |
| Aborted, <reason>    | Test/subtest has been aborted either manually (Stop) or automatically from an alarm and the reason why the test has been aborted is also displayed as follows:<br><b>Link down alarm, LOS alarm, Timeout during execution, DTS connection failed, Loss of remote connection (DTS), Unresolved addresses, Stopped</b> |

## Test Results

### *Summary (iSAM)*

---

For **Dual Test Set** the following values are reported for both local to remote (**L->R**) and remote to local (**R->L**).

- **Service** indicates the service's number and name.  
The pass/fail verdict icon is displayed next to the service name indicating if the service complies to the configured SLA parameters.
- **TX CIR (Mbit/s)** indicates the transmitted Committed Information Rate.
- **FD (ms) (RTT<sup>1</sup>) (Latency)** indicates the maximum measured round-trip latency (Frame Delay). The pass/fail verdict is also displayed.
- **IFDV (ms) (Jitter)** indicates the maximum measured Inter Frame Delay Variation. The pass/fail verdict is also displayed.
- **FLR (%) (Frame Loss)** indicates the maximum percentage of frames that are lost (Frame Loss Ratio) from the CIR step. The pass/fail verdict is also displayed.
- **RX Rate (Mbit/s)** indicates either the measured maximum utilization throughput for **Service Configuration Test** or the measured average utilization throughput for **Service Performance Test**. The pass/fail verdict is also displayed.
- **Total RX Rate**, available for **Service Performance Test**, indicates the average utilization throughput for all services (both directions are displayed for **Dual Test Set**).

---

1. RTT is only displayed for Dual Test Set.

## RFC 6349 Test

- **Test Status** indicates the actual test status as follows.

| Test Status          | Description                                                                                                                                                                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "--"                 | Test has not started.                                                                                                                                                                                                                                                                                                                       |
| In Progress          | The test is running.                                                                                                                                                                                                                                                                                                                        |
| Completed, <Verdict> | Test has completed and the test pass/fail verdict is displayed when enabled. A fail verdict is declared if any of the following conditions occurs: Link Down, LOS, TCP Throughput verdict failed, or an abort condition (Timeout, DTS connection lost, unresolved address, user stopped, configuration synchronization error, invalid MTU). |
| Aborted, <reason>    | Test has been aborted either manually (Stop) or automatically from an alarm and the reason is displayed as follows:<br><b>Link down alarm, LOS alarm, Timeout during execution, DTS connection failed, Invalid Configuration, Unresolved addresses, Invalid MTU, User Stopped</b>                                                           |

- **MTU (bytes)** is the validated Maximum Transfer Unit.
- **Minimum RTT (ms)** is the minimum time between the first bit of a segment sent and the last bit of the corresponding acknowledge.
- **TCP Throughput**
  - **Service** indicates the service's number and name. The pass/fail verdict icon is displayed next to the service name. A fail verdict is declared if any of the following conditions occurs: Link Down, LOS, TCP Throughput verdict failed, or an abort condition (Timeout, DTS connection lost, unresolved address, user stopped, configuration synchronization error, invalid MTU).
  - **L->R** and **R->L** indicates respectively the direction from local to remote and remote to local.
  - **Window** indicates the total Max Window (1 KiB = 1024 bytes) followed by the number of connections and KiB per connection in parenthesis as follows: (n conn.@ n KiB).

## Test Results

### *Summary (iSAM)*

---

- **Ideal L4** indicates the ideal TCP throughput metric.
- **Actual L4** indicates the average of actual TCP Throughput metric. The pass/fail verdict icon is displayed next to the this metric. A value greater or equal to the defined threshold gives a pass verdict.
- **TCP Efficiency (%)** indicates the TCP Efficiency metric based on transmitted and retransmitted bytes.
- **Buffer Delay (%)** indicates the Buffer Delay percentage metric which represents the increase in RTT during a TCP Throughput test versus the **Minimum RTT**.

## Summary (ISDN PRI)

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Status** indicates the actual test status as follows.
  - “--”: The test is not running or results are not available.
  - **In Progress**: The test is running.
  - **Completed**: The test is completed, stopped at the planned time, or manually stopped when there is no set timer.

The Pass/Fail verdict is displayed next to the **Status** field when enabled (see *Call Establishment/Termination Pass/Fail Verdict* on page 165).

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 559.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 362.

## Test Results

### Summary (ISDN PRI)

---

## Channel Buttons

The channel buttons allow the selection of a channel for which the information is displayed. The selected channel has its button highlighted with a blue border.

The top left corner of each button indicates the channel number on a background color as follows. The color coding remains when the test is stopped or when the call ends.

| Channel Number<br>Background Color | Description                                                |
|------------------------------------|------------------------------------------------------------|
| Yellow                             | At least one alarm/error occurred during a data call.      |
| Red                                | An alarm/error occurred in the last second of a data call. |
| Green                              | No alarm/error has occurred during a data call.            |

The channel buttons also used background colors as follows:

| Button                   | Description                                                                                                            |
|--------------------------|------------------------------------------------------------------------------------------------------------------------|
| Red                      | An alarm/error occurred in the last second of a data call. The Status <b>Bit Error</b> or <b>Pattern</b> is displayed. |
| Green                    | No alarm/error has occurred in the last second of a data call. The status <b>No Alarm</b> is displayed.                |
| Blue                     | Either a Speech or 3.1 kHz call is established, any call type is terminated, or the test is stopped.                   |
| (Greyed Out)<br>Disabled | When a channel button is disabled, it implies that no call was established on the channel after the test started.      |

The Pass/Fail verdict icon is displayed on the top right corner of a channel button as follows.

| Verdict | Call              | Description                                                                                                         |
|---------|-------------------|---------------------------------------------------------------------------------------------------------------------|
| Pass    | Data              | BER result value meets the configured threshold criterion and the call establishment/termination succeeded.         |
|         | Speech or 3.1 kHz | The call establishment/termination succeeded.                                                                       |
| Fail    | Data              | BER result value does not meet the configured threshold criterion and/or the call establishment/termination failed. |
|         | Speech or 3.1 kHz | The call establishment/termination failed.                                                                          |

## Channel

This section at the right of the channel buttons, displays information on the selected channel.

- **Call Reference** is a unique value assigned to an established call.
- The icon next to **Call Reference** indicates whether the call is incoming or outgoing followed by the duration of the call. An incoming call has an arrow pointing towards the receiver whereas, for an outgoing call the arrow points outwards.
- The Call Timer next to the incoming/outgoing call icon displays the duration of a call.
- **Calling Number** indicates the number of the calling party.
- **Called Number** indicates the number of the called party.
- **BERT**
  - **Alarms**, see *BER* on page 296 for more information.
  - **Errors**, see *BER* on page 296 for more information.
  - **Performance**

## Test Results

### Summary (ISDN PRI)

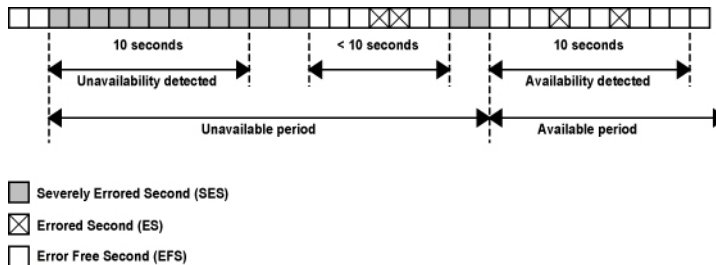
---

**EFS** (Error Free Second) gives the number of seconds within which no error occurred.

**ES** (Errored Second) gives the number of seconds in which one or more bits are in error.

**SES** (Severely Errored Second) gives the number of seconds in which bit error ratio is  $\geq 1 \times 10^{-3}$ .

**UAS** (Unavailable Second) gives the count of the seconds corresponding to the periods of unavailable time that begins at the onset of 10 consecutive SES events, including these 10 seconds. A period of available time shall begin at the onset of 10 consecutive non-SES events, including these 10 seconds.



- **Bit Error Rate/Count** graphically displays a meter representing either the bit error rate or the bit error count depending on the Pass/Fail Verdict selection (refer to *ISDN PRI - ISDN Settings* on page 167).

When the verdict is enabled, the values under the threshold are presented in green while the values above are in red.

When the verdict is disabled, the bit error rate is displayed in blue.

## Statistics

- **Active Call** column displays the quantity of active calls.

| Active Call | Description                    |
|-------------|--------------------------------|
| Data        | Number of active Data calls    |
| Speech      | Number of active Speech calls  |
| 3.1 kHz     | Number of active 3.1 kHz calls |
| Total       | Total number of active calls   |

- **Total Calls Count** column displays statistics of **Connected**, **Cleared**, **Failed/Rej.**, and **Placed** calls.

| Total Calls Count | Description                                                 |
|-------------------|-------------------------------------------------------------|
| Connected         | Number of calls that have been connected.                   |
| Cleared           | Number of calls that have been cleared.                     |
| Failed/Rej.       | Number of calls that failed or have been remotely rejected. |
| Placed            | Number of outgoing calls.                                   |

## Test Results

### Summary (ISDN PRI)

---

- **Frequency** column displays the following information:

**RX (MHz)** indicates the monitored frequency of the input signal. The following table lists the supported frequency monitoring range:

| Interface | Standard Rate Specification |
|-----------|-----------------------------|
| DS1       | 1544000 $\pm$ 140 ppm       |
| E1        | 2048000 $\pm$ 100 ppm       |

**Offset (ppm)** indicates the offset between the standard rate specification and the rate of the input signal.

**Max (+) Offset (ppm)** indicates the offset between the standard rate specification and the largest rate recorded from the received signal.

**Max (-) Offset (ppm)** indicates the offset between the standard rate specification and the smallest rate recorded from the received signal.

**Note:** *Values inside the standard range are presented on a green background while the value outside are presented on a red background.*

## Summary (Link OAM)

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Test Status** displays the current status of the Link OAM test. The global test pass/fail verdict is displayed next to the **Test Status** when enabled (see **Pass/Fail Verdict** on page 275).

| Test Status | Description                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------|
| --          | The test is not running or results are not available.                                               |
| In Progress | The test is running.                                                                                |
| Completed   | The test is completed, stopped at the planned time, or manually stopped when there is no set timer. |
| Aborted     | The test is interrupted; stopped before the set timer.                                              |

- **Start Time** Indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 559.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 362.

## Alarms

- **Link OAM** indicates that no OAM Information PDUs were received for 5 seconds.
- **Critical Event**: Indicates that the OAM link partner has sent a critical event notification (bit 2 of the Flags field is set to 1).

## Test Results

### *Summary (Link OAM)*

---

- **Dying Gasp:** Indicates that the OAM link partner has sent an unrecoverable local failure notification (bit 1 of the Flags field is set to 1).
- **Link Fault:** Indicates that the OAM link partner has sent a link fault notification (bit 0 of the Flags field is set to 1).

## Loopback

- **Local** indicates the **Status** of the local loopback (**Enabled** or **Disabled**) and allows to **Enable** or **Disable** it.
- **Remote**<sup>1</sup> indicates the **Status** of the remote loopback (**Enabled** or **Disabled**), the number of **Successful** remote loopback requests, the number of **Fail** remote loopback requests, and allows to **Enable** or **Disable** it.

## OAMPDU Frame Count

- Indicates the number of transmitted and received OAMPDU frames of the following types:
  - **Information**
  - **Loopback Control**
  - **Event Notification** (received only)
- **Total** indicates the total number of transmitted and received OAMPDU frames.

---

1. Statistics are influenced by both the protocol (Parser Action is set to "01") and physical loopback. The Fail and Successful counters will be affected by successive enable/disable loopback requests when sending loopback request to a remote FTB-700G/800 Series module running Link OAM test since it does not provide physical loopback.

## Summary (NI/CSU Emulation)

From the **Test** menu, tap **Results**, and the **Summary** tab.

### Status

**Status** indicates the progress of the cable test as follows:

- **Idle** (test has not started)
- **In Progress**
- **Completed**

The Pass/Fail verdict is displayed next to the **Test Status** field, when enabled, based on the following criteria: The worst pair's **Wire Map**, **Prop. Delay**, **Delay Skew**, and **Length**.

### Start Time

Indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.

### Auto-Response/Manual Loopback Status

Indicates the status of the loopback:

- **Loopback Active**
- **No Loopback.**

### Interface

See *Interface* on page 311 for more information on Interface alarms/errors.

### DS1

See *DS1* on page 300 for more information on DS1 alarms/errors.

## Summary (RFC 2544)

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset. For **Dual Test Set**, this is the only information available on the remote module.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 559.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 362.
- **Remote unit in use and locked for Dual Test Set** indicates that this module is used for **Dual Test Set** as the remote module.
- **Remote unit in Dual Test Set Mode** indicates that this module is set as remote but the DTS Connection is not established.

## Throughput, Back-to-Back, Frame Loss, and Latency Subtests

### ➤ Throughput, Back-to-Back, Frame Loss, and Latency

For each subtest, its status (-- (Idle), **In Progress**, **Completed**, or **Aborted** - (reason)) and duration are displayed.

- **TX Frames**<sup>1</sup> and **RX Frames**<sup>1</sup> display the transmitted and received frame counts of the subtest in progress. For **Dual Test Set**, frame counts are available for both directions: from local to remote (**L->R**) and remote to local (**R->L**).
- **Trial #**<sup>1</sup> displays the current trial iteration of the subtest in progress when applicable.
- **Val. #**<sup>1</sup> displays the current validation iteration of the subtest in progress when applicable.
- **Step**<sup>1</sup> displays the current step of the subtest in progress when applicable.
- **Displayed Results:** Select the displayed result mode: **Current**, **Minimum** (default), **Maximum**, or **Average**.
- **Throughput/Back-to-Back/Frame Loss/Latency** table.

Each frame size used for the test is displayed with its subtest statistics. Statistics values are displayed based on the **Displayed Results** setting.

“--” indicates that the result is not available because the test has not run yet. While testing, one of the following messages is displayed for each frame size: **Initializing**, **Learning**, **Testing**, **Waiting**, **Not measurable**, **Aborted**, **Link is Down**, or **MAC not resolved**.

**Dir.** (Direction), available with **Dual Test Set**, indicates results from local to remote (**L->R**) and remote to local (**R->L**).

---

1. Only displayed once the test is started.

## Test Results

*Summary (RFC 2544)*

---

- **Unit:** Select the subtest result unit:  
For Throughput: **Mbit/s, Gbit/s, frame/s**, and %.  
For Back-to-Back: **Mbit/s, Gbit/s, frame/burst**, and %.  
Frame Loss: %.  
Latency: **ms**, and **μs**.
- **Layer:** For Throughput and Back-to-Back subtests, select the subtest layers used to calculate the throughput.  
**All** (default): Layer 1,2,3 contains the Idle, Preamble, Start of Frame Delimiter, MAC address, IP address, and data.  
**Ethernet:** Layer 2,3 contains the MAC layer, IP layer, and data.  
**IP:** Layer 3 contains the IP layer, and data.
- **Step:** For Frame Loss subtest, selects the step (%) of the testing rate to be displayed.
- **Mode:** For Latency subtest, selects the propagation time mode.  
**Cut Through** (default) allows the calculation of the propagation time of a bit (Bit Latency).  
**S. & F.** (Store and Forward) allows the calculation of the propagation time of a frame (Frame Latency).

## Summary (RFC 6349)

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Status** indicates the actual test status as follows.

| Test Status          | Description                                                                                                                                                                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "--"                 | Test has not started.                                                                                                                                                                                                                                                                                                                       |
| In Progress          | The test is running.                                                                                                                                                                                                                                                                                                                        |
| Completed, <Verdict> | Test has completed and the test pass/fail verdict is displayed when enabled. A fail verdict is declared if any of the following conditions occurs: Link Down, LOS, TCP Throughput verdict failed, or an abort condition (Timeout, DTS connection lost, unresolved address, user stopped, configuration synchronization error, invalid MTU). |
| Aborted, <reason>    | Test has been aborted either manually (Stop) or automatically from an alarm and the reason is displayed as follows:<br><b>Link down alarm, LOS alarm, Timeout during execution, DTS connection failed, Invalid Configuration, Unresolved addresses, Invalid MTU, User Stopped</b>                                                           |

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset. This is the only information available on the remote module.
- **Test/Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Test/Power Recovery** field. Refer to *Power Failure Recovery* on page 559.

## Test Results

*Summary (RFC 6349)*

---

- **Logger Full**<sup>1</sup>, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 362.
- **Remote unit in use and locked for Dual Test Set**<sup>2</sup> indicates that this module is used for **Dual Test Set** as the remote module.
- **Remote unit in Dual Test Set Mode**<sup>2</sup> indicates that this module is set as remote but the DTS Connection is not established.

**MTU (bytes)** is the validated Maximum Transfer Unit.

**Minimum RTT (ms)** is the minimum time between the first bit of a segment sent and the last bit of the corresponding acknowledge.

## Window Sweep

- **L->R** and **R->L** indicates respectively the direction from local to remote and remote to local.
- **Actual L4** indicates for each step the average TCP throughput metric.

## TCP Throughput

- **L->R** and **R->L** indicates respectively the direction from local to remote and remote to local.
- **Window (KiB)** indicates the total Max Window (1 KiB = 1024 bytes) followed by the number of connections and KiB per connection in parenthesis as follows: (n conn.@ n KiB).
- **Ideal L4** indicates the ideal TCP throughput metric.
- **Actual L4** indicates the average of actual TCP Throughput metric. The pass/fail verdict icon is displayed next to the this metric when enabled. A value greater or equal to the defined threshold gives a pass verdict.
- **TCP Efficiency (%)** indicates the TCP Efficiency metric based on transmitted and retransmitted bytes.

---

1. Displayed on local module only.

2. Displayed on Remote module only.

- **Buffer Delay (%)** indicates the Buffer Delay percentage metric which represents the increase in RTT during a TCP Throughput test versus the **Minimum RTT**.
- **TCP Throughput Threshold (% of ideal)** allows to enter the TCP Throughput as a percentage of the defined CIR that will be used to declare the pass/fail verdict for both directions: **0** to **100%**; default is 95%. The calculated throughput based on the selected threshold is displayed for both directions.

## Test Results

*Summary (S-OAM and MPLS-TP OAM)*

---

### Summary (S-OAM and MPLS-TP OAM)

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Test Status** displays the current status of the S-OAM / MPLS-TP OAM test. The global test pass/fail verdict is displayed next to the **Test Status** when enabled (see **Pass/Fail Verdict** on page 275).

| Test Status | Description                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------|
| --          | The test is not running or results are not available.                                               |
| In Progress | The test is running.                                                                                |
| Completed   | The test is completed, stopped at the planned time, or manually stopped when there is no set timer. |
| Aborted     | The test is interrupted; stopped before the set timer.                                              |

- **Start Time** Indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 559.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 362.

## Continuity Check (Peer MEP)

- **Status** displays the status of the continuity check with the peer MEP.

| Status               | Description                                               |
|----------------------|-----------------------------------------------------------|
| Loss Continuity      | Loss of Continuity alarm is active.                       |
| Mismerge             | Mismerge alarm is active.                                 |
| Unexpected MEG Level | Unexpected MEG Level alarm is active.                     |
| Unexpected MEP       | Unexpected MEP alarm is active.                           |
| Unexpected Period    | Unexpected Period alarm is active.                        |
| Unexpected MD Level  | Unexpected MD Level alarm is active.                      |
| Receiving CCMs       | CCM frames from the peer MEP are received without alarms. |

- **TX CCM** indicates the count of transmitted CCM frames.
- **RX CCM** indicates the count of valid CCM frames received. A valid frame for S-OAM has its source MAC address matching the Peer MEP MAC address; destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address (refer to 638); and VLANs matching the unit port VLANs. A valid frame for MPLS-TP OAM has its destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPL Labels matching the local MPLS Label Stack configuration.

## Test Results

### Summary (S-OAM and MPLS-TP OAM)

---

- **CCM** indicates the content of the last received CCM frame including **MEG ID** (Y.1731 and G.8113.1), **Domain ID** (802.1ag and MEF), **MA Name** (802.1ag and MEF), **MEG Level** (Y.1731, MEF, and G.8113.1), **MD Level** (802.1ag), **MEP ID**, and **Period**.

For unsupported **Domain ID**, **MA Name**, and **MEG ID**, the **Unexpected Format** message is displayed.

|                  | Supported Format                                               |
|------------------|----------------------------------------------------------------|
| <b>Domain ID</b> | 1 (No Maintenance Domain Name present)<br>4 (Character String) |
| <b>MA Name</b>   | 2 (Character String)                                           |
| <b>MEG ID</b>    | 32 (ICC based format)<br>33 (CC and ICC based format)          |

## Loopback / Test / Frame Delay / Frame Loss / Synthetic Loss

**Note:** *Either Loopback, Test, Frame Delay, Frame Loss, or Synthetic Loss (available with Ethernet OAM) statistics are displayed according with the selected test function (refer to Test Function on page 226).*

➤ **Status** displays the status of the test function.

For **Loopback, Frame Delay, Frame Loss, and Synthetic Loss** (available with Ethernet OAM) functions:

| Status      | Description                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Idle        | No Results (function did not run yet).                                                                                                                                                                                                                                                                                                                                                    |
| In Progress | Test is in progress. Frames are being transmitted and monitored.                                                                                                                                                                                                                                                                                                                          |
| Completed   | Test is completed:<br>The test with continuous transmission is manually stopped and replies have been received or timed out.<br>The test with continuous transmission is automatically stopped by a test timer and replies have been received or timed out.<br>All frames of the test with non-continuous transmission have been transmitted and replies have been received or timed out. |
| Aborted     | Test is aborted. The test with non-continuous transmission is stopped before all the frames are transmitted.                                                                                                                                                                                                                                                                              |

For **Test** function:

| Status      | Description                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------|
| Idle        | No Results (function did not run yet).                                                        |
| In Progress | Test is in progress. RX TST frames are being monitored.                                       |
| Completed   | Test is completed. The test is stopped or function is disabled after being In Progress state. |

## Test Results

*Summary (S-OAM and MPLS-TP OAM)*

---

- **RX Line Utilization** meter and value, available with **Loopback** function, indicate the line rate utilization percentage (only LBR frames are considered) received in the last second.
- **TST RX Rate** meter and value, available with **Test** function, indicate the quantity of TST frames received in the last second.
- **Frame Delay** meter and value, available with **Frame Delay** function, indicate the average of the measured frame delays in the last second.
- **Frame Loss Ratio** meter, available with **Frame Loss** function, indicates for both Near-End and Far-End the last measured frame loss ratio in the last second.
- **Synthetic Loss Ratio** meter, available with **Synthetic Loss** function which is available with Ethernet OAM, indicates for both Near-End and Far-End the last measured Synthetic Loss ratio in the last second.

**Note:** *Refer to S-OAM and MPLS-TP OAM on page 379 for more alarms/errors/statistics information.*

## Summary

Refer to *S-OAM and MPLS-TP OAM* on page 379 for more information on alarms.

## Thresholds

Refer to *Thresholds* on page 222 for more information.

## Summary (SyncE)

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Test Status** displays the current status of the SyncE test. The global test pass/fail verdict is displayed next to the **Test Status** when enabled (see **Pass/Fail Verdict** on page 275).

| Test Status | Description                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------|
| --          | The test is not running or results are not available.                                               |
| In Progress | The test is running.                                                                                |
| Completed   | The test is completed, stopped at the planned time, or manually stopped when there is no set timer. |
| Aborted     | The test is interrupted; stopped before the set timer.                                              |

- **Start Time** indicates the time the test was started.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 559.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 362.

## Test Results

### Summary (SyncE)

---

## ESMC

Indicates the current (meter and value), average, minimum, and maximum ESMC frame rate (including information and event frames) received in frame/s. A fail verdict is also displayed beside the minimum and/or maximum values when the ESMC frame rate is outside the range while the Pass/Fail Verdict is enabled.

**ESMC RX Rate** meter displays the current ESMC frame rate (including information and event frames) in frame/s averaged over the last 11 frames received. The pass/fail verdict is also displayed when enabled.

**Note:** When the **Pass/Fail Verdict** and **ESMC Rate Threshold** check boxes are selected (see page 275), the green region is delimited from 0.8 to 10.2 frames/s corresponding to a **PASS** verdict. The red regions above and beyond the threshold correspond to a **FAIL** verdict. There is neither green nor red region when the Pass/Fail verdict is disabled.

## **RX**

- **Last QL Message** indicates the last Quality Level value received. The pass/fail verdict is also displayed when both **QL Mismatch Monitoring** and **Pass/Fail Verdict** check boxes are selected.

**Last Change** indicates the date and time of the Last QL Message has changed.

- **Information/Event Count** gives respectively the count of information and event frames generated for all Quality Level values.
- **QL Mismatch Frame Count** gives the total count of information and/or event frames received not matching the expected Quality Level. Only available when the **QL Mismatch Monitoring** check box is selected.
- **Frequency/Offset** indicates respectively the frequency and the offset between the standard rate specification and the rate of the input signal.
- **Max. (-/+) Offset (ppm)** indicates respectively the minium and maximum offset between the standard rate specification and the largest/smallest rate recorded from the received signal.

## **TX**

- **QL Message** indicates the Quality Level value that is generated.

**Last Change** indicates the date and time of the QL Message value has changed. For 1GE Electrical interface using **Local Clock** set to **Slave**, the **Last Change** is not available.

- **Information/Event Count** gives respectively the count of information and event frames generated for all Quality Level values. **Event Count** is not available with 1GE Electrical interface using remote local clock.

## Test Results

### Summary (TCP Throughput)

---

## Summary (TCP Throughput)

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Test Status** indicates the actual test status as follows.

| Test Status        | Description                                                                                                                             |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| "--"               | The test is not running or results are not available.                                                                                   |
| In Progress        | The test is running.                                                                                                                    |
| Completed          | The test is completed, stopped at the planned time, or manually stopped when there is no set timer.                                     |
| Aborted - <Reason> | The test is interrupted; stopped before the set timer. Possible <Reason> are: <b>TCP Session Closed</b> or <b>Remote IP Not Found</b> . |

- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 559.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 362.

## TCP Throughput

- **TCP Connection Status** indicates the actual TCP connection status.

| Test Status         | Description                                                                                                                                                                                                                       |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "--"                | The test is not running or results are not available.                                                                                                                                                                             |
| In Progress         | The TCP initialization algorithm is in progress.                                                                                                                                                                                  |
| Waiting             | Indicates on the remote unit that the test is started but the TCP initialization algorithm is not initiated by the local unit.                                                                                                    |
| Established         | The TCP session has been successfully established between the local and remote units.                                                                                                                                             |
| Closed              | The session is closed. Either no TCP initialization algorithm has been received, the remote unit has received and completed the request to close the TCP session, or no data has been received at the remote unit for 30 seconds. |
| Closing             | The TCP protocol is closing down the connection.                                                                                                                                                                                  |
| Remote IP not found | The local unit didn't received an answer to the ARP request sent to the IP address of the remote unit.                                                                                                                            |

- **Transmitted Frames** indicates the total of frames transmitted by the local unit excluding the re-transmitted frames.
- **Re-transmitted Frames** indicates the total of frames that have been re-transmitted by the local unit.
- **Efficiency (%)** indicates the percentage of bytes that were not retransmitted.
- **Window Size Unit** allows to select the unit used for **Window Size**: **Bytes**, **KBytes**, or **MBytes** (default).
- **Throughput Threshold** allows to set the pass/fail verdict threshold value: **0** to **100%** (default). This setting is available when the **Throughput Pass/Fail Verdict** check box is selected (refer to *TCP Throughput* on page 277).
- **Throughput** meter displays the last second TCP Throughput measurement.

## Test Results

### *Summary (TCP Throughput)*

---

- **TCP Throughput** displays respectively the last, minimum, maximum, and average TCP Throughput measurement.
- **Window Size** displays respectively the last, minimum, and maximum TCP window size.
- **Round Trip Latency (ms)** displays respectively the last, minimum, maximum, and average round trip time gathered from the TCP Throughput test.

## Ethernet Traffic

**Note:** See Traffic - Ethernet on page 446 for more information.

## Summary (Traffic Gen & Mon)

From the **Test** menu, tap **Results**, and the **Summary** tab.

- **Test Status** indicates the actual test status as follows. The global test pass/fail verdict is displayed next to the **Test Status** when enabled (see *QoS Metrics* on page 272).
  - “--”: The test is not running or results are not available.
  - **In Progress**: The test is running.
  - **Completed**: The test is completed, stopped at the planned time, or manually stopped when there is no set timer.
- **Start Time** indicates the date and time the test has been started. The date and time is reset every time the test is restarted or reset.
- **Power Recovery** when displayed, indicates that the test has automatically recovered from a power failure. The number of occurrences is also displayed next to the **Power Recovery** field. Refer to *Power Failure Recovery* on page 559.
- **Logger Full**, when displayed, indicates that the logger is full. Refer to *Logger and Alarms/Errors Logger* on page 362.

## Stream

The following statistics are available for each stream.

- **Current Throughput**: See *Streams - Throughput* on page 390.
- **Frame Loss Rate**: See *Streams - Frame Loss / Out-of-Sequence* on page 388.
- **Jitter**: See *Streams - Jitter* on page 388.
- **Latency**: See *Streams - Latency* on page 389.

## Test Results

*Summary (Traffic Gen & Mon)*

---

- **Out-of-Sequence:** See *Streams - Frame Loss / Out-of-Sequence* on page 388.
- **Stream** indicates the stream number and provides stream detailed statistics when tapping on its button.

The following statistics are displayed for the selected stream.

- **Stream Selection:** Select a stream by either using the left/right arrow or by tapping over the stream numbers area then tapping on a specific stream number. An orange background indicates the selected stream.
- **Throughput, Jitter, and Latency** meters display respectively the measured Throughput, Jitter, and Latency for the selected stream.

**Note:** *The green region is delimited from 0 to the Threshold corresponding to a **PASS** verdict. The red regions beyond the threshold corresponds to a **FAIL** verdict. The Pass/Fail verdict is only displayed when enabled (see QoS Metrics on page 272).*

- **Jitter:** See *Streams - Jitter* on page 388.
- **Latency:** See *Streams - Latency* on page 389.
- **RX Rate:** See *Streams - Throughput* on page 390.
- **RX Frame Count** indicates the number of frame received matching the selected stream.
- **TX Rate:** See *Streams - Throughput* on page 390.
- **TX Frame Count** indicates the number of transmitted frames matching the selected stream.
- **Frame Loss and Out-of-Sequence:** See *Streams - Frame Loss / Out-of-Sequence* on page 388.

## Traces - OTN

From the **Test** menu, tap **Results**, **Traces**, and the **OTN** sub-tab.

### OTUx, ODUx, and TCM Buttons

Tap on either OTUx, or an ODUx button. For ODUx when TCM is enabled (see Modify TCM on page 257), tap on a TCMx button to select a TCM level.

### SM/PM TTI Traces

**Note:** *The TTI Traces are configurable for SM (OTUx), PM (ODUx), and TCM (ODUx when TCM is enabled; refer to Modify TCM on page 257).*

#### Received Message

- **SAPI** indicates the received TTI (Trail Trace Identifier) Source Access Point Identifier.
- **DAPI** indicates the received TTI Destination Access Point Identifier.
- **Operator Specific** indicates the received TTI Operator Identifier.

#### Expected Message

**Note:** *The following settings are coupled with the Expected Message from Traces - OTN on page 443.*

- **SAPI** allows editing the expected Source Access point Identifier (TTI bytes 1 to 15). Available when the SAPI OTU/ODU-TIM check box is selected. The default setting is **EXFO OTU SAPI** for OTUx, and **EXFO ODU SAPI** for ODUx. The TTI byte 0 is set to NULL (all 0's).
- **DAPI** allows editing the expected Destination Access point Identifier (TTI bytes 17 to 31). Available when the DAPI OTU/ODU-TIM check box is selected. The default setting is **EXFO OTU DAPI** for OTUx, and **EXFO ODU DAPI** for ODUx. The TTI byte 16 is set to NULL (all 0's).

## Test Results

### *Traces - OTN*

---

- **SAPI OTU/ODU-TIM** check boxes, when selected (cleared by default), allows editing the expected Source Access Point Identifier (SAPI) and also enables OTU/ODU-TIM alarm monitoring.
- **DAPI OTU/ODU-TIM** check box, when selected (cleared by default), allows editing the expected Destination Access Point Identifier (SAPI) and also enables the OTU/ODU/TCM-TIM alarm monitoring.
- **Copy RX** uses the received SAPI/DAPI message as the expected SAPI/DAPI message.

## Traces - SONET/SDH

From the **Test** menu, tap **Results**, **Traces**, and the **SONET/SDH** sub-tab.

**Note:** *Selecting a Trace byte to be generated will automatically update the corresponding OH byte. Refer to OH - SONET/SDH on page 487 for more information.*

### Traces

➤ **Section/RS (J0), and STS/AU/TU-3 Path (J1), and VT/TU Path (J2)**

Displays the received J0/J1/J2 value in 16 or 64-bytes format. The <crc7> represents the CRC-7 for a 16-bytes format. The last two bytes of a 64-bytes format, <C<sub>R</sub>> and <L<sub>F</sub>>, represent respectively a carriage return and a line feed.

➤ **TIM-S/RS-TIM, TIM-P/HP-TIM, TIM-V/LP-TIM:** Enables the corresponding Trace Identifier Mismatch for the expected message defined. These settings are coupled with the Traces configuration from *Traces (SONET/SDH)* on page 284.

**Copy RX** allows to use the received TIM message as the expected one.

### TCM Access Point Identifier

**Note:** *Available when TCM is enabled (refer to page 258).*

➤ **STS/AU Path (N1), and VT/TU Path (Z6 or N1 (TU-3))**

Displays the received N1/Z6 value.

➤ **TC-TIM-P/HPTC-TIM/TC-TIM-V/LPTC-TIM:** Enables the corresponding TCM Access Point Identifier for the expected message defined. These settings are coupled with the Traces configuration from *Traces (SONET/SDH)* on page 284.

**Copy RX** allows to use the received TIM message as the expected one.

## Traffic - Ethernet

From the **Test** menu, tap **Results**, **Traffic**, and when applicable the **Ethernet** tab.

**Note:** *For Through Mode test application, the traffic statistics are displayed for both port directions (P1->P2 and P2->P1).*

### Traffic

- **Line Utilization (%)** indicates the current percentage of the transmitting/receiving line rate utilization.
- **Ethernet BW (Mbit/s)** indicates the current transmitting/receiving data rate expressed in Mbit/s.
- **Frame Rate (frame/s)** indicates the current transmitted/received number of frames (including bad frames, Broadcast frames and Multicast frames) in frame per second.
- **Frame Count** indicates the total number of transmitted/received valid and invalid frames.

### Frame Type

Displays the TX and RX count of the following frame types.

- **Multicast** indicates the number of multicast frames transmitted/received without FCS errors. Broadcast frames are not counted as multicast frames.
- **Broadcast** indicates the number of broadcast frames transmitted/received without FCS errors.

- **Unicast** indicates the number of unicast frames transmitted/received without FCS errors.
- **Non-Unicast** indicates the number of multicast and broadcast frames transmitted/received without FCS errors.
- **Total** indicates the total number of all frames transmitted/received without FCS error.

## Frame Size

Displays the RX count of each received frame size (valid and invalid), and the percentage (%) ratio of each received frame size based on the total count of frames. The the percentage (%) ratio is not available for Through Mode test application.

- **< 64**: frames with less than 64 bytes.
- **64**: frames equal to 64 bytes.
- **65 - 127**: frames from 65 to 127 bytes.
- **128 - 255**: frames from 128 to 255 bytes.
- **256 - 511**: frames from 256 to 511 bytes.
- **512 - 1023**: frames from 512 to 1023 bytes.
- **1024 - 1518**: frames from 1024 to 1518, or 1522 (1 VLAN tag), 1526 (2 VLAN tags), or 1530 (3 VLAN tags) bytes.
- **> 1518**: frames with more than 1518, or 1522 (1 VLAN tag), 1526 (2 VLAN tags), or 1530 (3 VLAN tags) bytes.
- **Total** indicates the total count of all received frames (valid and invalid).

## Traffic - Flow Control

From the **Test** menu, tap **Results**, **Traffic**, and the **Flow Control** tab.

### Frame Count - RX

- **Pause Frames** indicates the number of received valid flow-control frames. Frames that have a type/length field equal to 0x8808 will be counted as a pause frame.
- **Abort Frame** indicates the number of received pause frames with a Quanta equal to zero; cancelling the pause frames.
- **Total Frame** indicates the total number of pause time received from the link partner.

### Pause Time

Indicates respectively the total, last, maximum, and minimum pause time received from the link partner in **Quanta** (default) or **Microsecond** ( $\mu s$ ).

## Pause Injection

**Note:** *Pause injection is only available for Traffic Gen & Mon test application.*

- **Packet Pause Time:** Enter the pause time value to be transmitted in **Quanta** or **Microsecond** (default is **100** Quanta).

| Interface   | Range      |               |
|-------------|------------|---------------|
|             | Quanta     | $\mu$ s       |
| 10 Mbit/s   | 0 to 65535 | 0 to 3355392  |
| 100 Mbit/s  | 0 to 65535 | 0 to 335539.2 |
| 1000 Mbit/s | 0 to 65535 | 0 to 33553.92 |
| 10 Gbit/s   | 0 to 65535 | 0 to 3355.392 |

**Note:** *When entering a value in  $\mu$ s it will be rounded to the closest multiple of 0.0512 for 10 Gbit/s, 5.12  $\mu$ s for 100 Mbit/s, 0.512 $\mu$ s for 1000 Mbit/s, and 0.0512 $\mu$ s for 10 Mbit/s, .*

- **Inject** button allows to generate the defined packet pause time.
- **Destination MAC Address** check box, when selected (cleared by default), enables and allows to set the destination MAC address. The default destination MAC address is the control protocol multicast address: **01:80:C2:00:00:01**.

## Test Results

### *Traffic - Graph*

---

## Traffic - Graph

From the **Test** menu, tap **Results**, **Traffic**, and the **Graph** tab.

The graph displays the received line utilization. The X axis shows the time in seconds while the Y axis shows the percentage utilization.

## Traffic - OAM, S-OAM, and MPLS-TP OAM

From the **Test** menu, tap **Results**, **Traffic**, and the **OAM, S-OAM**, or **MPLS-TP OAM** tab.

### Traffic Monitoring

**Note:** Only available with *Carrier Ethernet OAM* test application.

- In TX, reports counts of CCM, LBM, LTM, DMM, LMM, SLM, TST, AIS, LCK, and CSF frames transmitted. LTM and SLM are only available with Ethernet OAM. Total count is reported as well as unicast and/or multicast frame counts when applicable.
- In RX, reports counts of CCM, LBR, LTR, DMR, LMR, SLR, TST AIS, LCK, and CSF frames (LTR and SLR are only available with Ethernet OAM) received regardless of the sender as long as the following criteria are met:
  - **S-OAM:** The destination MAC address matches either the local MEP Unicast MAC address or a Multicast class 1 or class 2 address; and the VLANs matches the unit port VLANs. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 638 for more information.
  - **MPLS-TP OAM:** The destination MAC address matches either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; the VLANs matches the unit port VLANs; and MPL Labels matches the local MPLS Label Stack configuration. For AIS, LCK, and CSF, valid messages must also have the MEG Level matching the Local MEG Level.

Total count is reported as well as unicast and/or multicast frame counts when applicable.

## Test Results

*Traffic - OAM, S-OAM, and MPLS-TP OAM*

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### Responder

**Note:** Available when the **S-OAM Responder** or **MPLS-TP OAM Responder** check box is selected (refer to S-OAM and MPLS-TP OAM Responder on page 221).

For **Carrier Ethernet OAM** test application:

- In TX, reports counts of LBR, LTR, DMR, LMR, and SLR total frames transmitted. LTR and SLR are only available with Ethernet OAM.
- In RX, reports counts of valid LBM, LTM, DMM, LMM, and SLM unicast, multicast, and total frames received. LTM and SLM are only available with Ethernet OAM. A valid messages must have its:

**S-OAM:** source MAC address matching the Peer MEP MAC address; destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 or class 2 address; VLANs matching the unit port VLANs, and MEG/MD Level matching the local MEG/MD Level. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 638 for more information.

**MPLS-TP OAM:** destination MAC address matching either the unit MAC address, FF:FF:FF:FF:FF:FF, or 01:00:5E:90:00:00; VLANs matching the unit port VLANs; and MPL Labels matching the local MPLS Label Stack configuration.

For **Smart Loopback** test application:

- In TX, reports counts of LBR, LTR, DMR, LMR, and SLR total frames transmitted.
- In RX, reports counts of valid LBM, LTM, DMM, LMM, and SLM total frames received. A valid messages must have its destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 or class 2 address. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 638 for more information.

## Window Sweep

Displays the graph showing the Ideal L4 and Actual L TCP Throughput measured for each Window Sweep step. The number of connections and KiB per connection is also displayed in parenthesis as follows:  
(n conn.@ n KiB)

From the **Test** menu, tap **Results**, and the **Window Sweep** tab.

### WIS

From the **Test** menu, tap **Results**, and the **WIS** tab.

#### Traces/Label

- **J0 Trace** displays the **J0 Trace** value in 16-bytes format.
- **J1 Trace** displays the **J1 Trace** value in 16-bytes format.
- **Path Signal Label (C2)** displays the content of the STS SPE including the status of the mapped payload.

# 10 Test Functions

The Test Functions menu offers the following structure:

Transport Test Applications

| Tab                              | Available with |   |   |   |   |   | Page |
|----------------------------------|----------------|---|---|---|---|---|------|
|                                  | a              | b | c | d | e | f |      |
| APS                              | -              | X | - | X | - | - | 457  |
| FDL - Bit-Oriented Message       | -              | - | X | X | X | - | 460  |
| FDL - Performance Report Message | -              | - | X | X | X | - | 464  |
| FEAC                             | -              | - | X | X | - | - | 481  |
| OH - OTN                         | X              | - | - | - | - | - | 481  |
| OH - SONET/SDH                   | -              | X | - | X | - | - | 487  |
| Pointer Adjustment               | -              | X | - | X | - | - | 506  |
| RTD                              | X              | X | X | X | - | - | 516  |
| Signaling Bits                   | -              | - | X | - | - | - | 523  |
| Spare Bits                       | -              | - | X | X | - | X | 524  |

- a. OTN BERT
- b. SONET/SDH BERT
- c. DS<sub>n</sub>/PDH BERT
- d. SONET/SDH - DS<sub>n</sub>/PDH BERT
- e. NI/CSU Emulation
- f. ISDN PRI

# Test Functions

## Ethernet Test Applications

| Tab - Sub Tab      | Test Application |   |   |   |   |   |   |   |   |   | Page |
|--------------------|------------------|---|---|---|---|---|---|---|---|---|------|
|                    | a                | b | c | d | e | f | g | h | i | j |      |
| Filters            | -                | - | - |   | X | - | X | - | X | - | 471  |
| Packet Capture     | -                | - | - |   | X | - | X | - | X | - | 475  |
| Ping & Trace Route | X                | X | X | X | X | X |   | X | X | X | 501  |
| S-OAM Link Trace   | -                | - | - | - | - | - | - | - | X | - | 521  |

- a. EtherSAM
- b. RFC 6349
- c. RFC 2544
- d. EtherBERT
- e. Traffic Gen & Mon
- f. Smart Loopback
- g. Through Mode
- h. TCP Throughput
- i. Carrier Ethernet OAM
- j. Cable Test

## Packet Sync Test Applications

| Tab                | Test Application |       | Page |
|--------------------|------------------|-------|------|
|                    | 1588 PTP         | SyncE |      |
| Filters            | X                | X     | 471  |
| Packet Capture     | X                | X     | 475  |
| Ping & Trace Route | X                | X     | 501  |

## Wireless Test Application

| Tab | Test Application<br>CPRI/OBSAI BERT | Framing   | Page |
|-----|-------------------------------------|-----------|------|
| RTD | X                                   | Unframed  | 516  |
|     | X                                   | Framed L2 | 519  |

## APS

From the **Test** menu, tap **Functions**, and the **APS** tab.

### TX/RX

- **Switching Mode**, available for both TX and RX, selects the switching mode: **Linear** (default) or **Ring**.

- **K1**

**Request:** Bits 1 through 4 of the K1 byte.

| Bits<br>1 to 4 | Request                        |                                     |
|----------------|--------------------------------|-------------------------------------|
|                | Linear mode                    | Ring mode                           |
| 0000           | No Request <sup>a</sup>        | No Request (default) <sup>a</sup>   |
| 0001           | Do Not Revert                  | Reverse Request - Ring              |
| 0010           | Reverse Request                | Reverse Request - Span              |
| 0011           | Unused                         | Exerciser - Ring                    |
| 0100           | Exerciser                      | Exerciser - Span                    |
| 0101           | Unused                         | Wait-to-Restore                     |
| 0110           | Wait-to-Restore                | Manual Switch - Ring                |
| 0111           | Unused                         | Manual Switch - Span                |
| 1000           | Manual Switch                  | Signal Degrade - Ring               |
| 1001           | Unused                         | Signal Degrade - Span               |
| 1010           | Signal Degrade - Low Priority  | Signal Degrade (Protection)         |
| 1011           | Signal Degrade - High Priority | Signal Fail - Ring                  |
| 1100           | Signal Fail - Low Priority     | Signal Fail - Span                  |
| 1101           | Signal Fail - High Priority    | Force Switch - Ring                 |
| 1110           | Force Switch                   | Force Switch - Span                 |
| 1111           | Lockout of Protection          | Lockout of Protection - Span/SF - P |

a. Default value.

# Test Functions

APS

**Channel (Linear switching mode) or  
Destination Node ID (Ring switching mode):**  
Bits 5 through 8 of the K1 byte.

| Bits<br>5 to 8 | Channel ID<br>(Linear mode) | Destination Node ID<br>(Ring mode) | Bits<br>5 to 8 | Channel ID<br>(Linear mode) | Destination Node ID<br>(Ring mode) |
|----------------|-----------------------------|------------------------------------|----------------|-----------------------------|------------------------------------|
| 0000           | 0 - Null <sup>a</sup>       | 0 <sup>a</sup>                     | 1000           | 8                           | 8                                  |
| 0001           | 1                           | 1                                  | 1001           | 9                           | 9                                  |
| 0010           | 2                           | 2                                  | 1010           | 10                          | 10                                 |
| 0011           | 3                           | 3                                  | 1011           | 11                          | 11                                 |
| 0100           | 4                           | 4                                  | 1100           | 12                          | 12                                 |
| 0101           | 5                           | 5                                  | 1101           | 13                          | 13                                 |
| 0110           | 6                           | 6                                  | 1110           | 14                          | 14                                 |
| 0111           | 7                           | 7                                  | 1111           | 15 - Extra Traffic          | 15                                 |

a. Default value.

➤ K2

**Protected Channel (Linear switching mode) or  
Source Node ID (Ring switching mode):**  
Bits 1 through 4 of the K2 byte.

| Bits<br>1 to 4 | Protected Channel<br>(Linear mode) | Source Node ID<br>(Ring mode) | Bits<br>1 to 4 | Protected Channel<br>(Linear mode) | Source Node ID<br>(Ring mode) |
|----------------|------------------------------------|-------------------------------|----------------|------------------------------------|-------------------------------|
| 0000           | 0 - Null <sup>a</sup>              | 0 <sup>a</sup>                | 1000           | 8                                  | 8                             |
| 0001           | 1                                  | 1                             | 1001           | 9                                  | 9                             |
| 0010           | 2                                  | 2                             | 1010           | 10                                 | 10                            |
| 0011           | 3                                  | 3                             | 1011           | 11                                 | 11                            |
| 0100           | 4                                  | 4                             | 1100           | 12                                 | 12                            |
| 0101           | 5                                  | 5                             | 1101           | 13                                 | 13                            |
| 0110           | 6                                  | 6                             | 1110           | 14                                 | 14                            |
| 0111           | 7                                  | 7                             | 1111           | 15 - Extra Traffic                 | 15                            |

a. Default value.

**Architecture (Linear switching mode) or**

**Bridge Request (Ring switching mode):**

Bit 5 of the K2 byte. The default setting is **1+1** for Linear switching mode and **Short Path Request** for Ring switching mode.

| Bit 5 | Architecture<br>(Linear mode) | Bridge Request<br>(Ring mode) |
|-------|-------------------------------|-------------------------------|
| 0     | 1+1 <sup>a</sup>              | Short Path <sup>a</sup>       |
| 1     | 1:n                           | Long Path                     |

a. Default value.

**Operation Mode:** Bits 6 through 8 of the K2 byte.

| Bits 6 to 8 | Linear mode                             | Ring mode                               |
|-------------|-----------------------------------------|-----------------------------------------|
| 000         | Reserved <sup>a</sup>                   | Idle <sup>a</sup>                       |
| 001         | Reserved                                | Bridged                                 |
| 010         | Reserved                                | Bridged and Switched                    |
| 011         | Reserved                                | Extra Traffic - Protection              |
| 100         | Unidirectional                          | Reserved                                |
| 101         | Bidirectional                           | Reserved                                |
| 110         | RDI-L <sup>b</sup> /MS-RDI <sup>c</sup> | RDI-L <sup>b</sup> /MS-RDI <sup>c</sup> |
| 111         | AIS-L <sup>b</sup> /MS-AIS <sup>c</sup> | AIS-L <sup>b</sup> /MS-AIS <sup>c</sup> |

a. Default value.

b. Operation mode for SONET.

c. Operation mode for SDH.

## FDL - Bit-Oriented Message

Allows to set and configure the Bit-Oriented Messages (BOM) of the Extended Super-Frame (ESF).

**Note:** *FDL is only available for DS1 interface with ESF framing. For Dual RX test, FDL is only available for the DS1 TX/RX port 1.*

From the **Test** menu, tap **Functions**, **FDL**, and the **Bit-Oriented Message** tab.

## Generated Messages

### ► Priority

**Codeword:** The Bit-Oriented Message codewords are priority messages sent over the Data-Link. These messages are mostly used for networking operation and maintenance. A Bit-Oriented Message consists of 8 consecutive ones followed by a byte starting and ending by zeros.

| Codeword                           | Pattern           |
|------------------------------------|-------------------|
| RAI                                | 00000000 11111111 |
| Loopback Retention and Acknowledge | 00101010 11111111 |
| RAI-CI                             | 00111110 11111111 |

**Injects** generates the selected codeword priority message.

### ► Command/Response

**Amount** allows the selection of the number of message to be generated. Choices are **1** to **15**. The default value is **10**.

**Inject** manually generates the selected amount of messages.

### Codeword

| Command/Response Codeword       | Pattern                        | Command/Response Codeword            | Pattern           |
|---------------------------------|--------------------------------|--------------------------------------|-------------------|
| Line Loopback Activate          | 00001110 11111111              | Protection Switch Line 22            | 01101100 11111111 |
| Line Loopback Deactivate        | 00111000 11111111              | Protection Switch Line 23            | 01101110 11111111 |
| Payload Loopback Activate       | 00010100 11111111              | Protection Switch Line 24            | 01110000 11111111 |
| Payload Loopback Deactivate     | 00110010 11111111              | Protection Switch Line 25            | 01110010 11111111 |
| Reserved for Network Use        | 00010010 11111111 <sup>a</sup> | Protection Switch Line 26            | 01110100 11111111 |
| Universal Loopback (Deactivate) | 00100100 11111111              | Protection Switch Line 27            | 01110110 11111111 |
| ISDN Line Loopback (NT2)        | 00101110 11111111              | Protection Switch Acknowledge        | 00011000 11111111 |
| CI/CSU Line Loopback (NT1)      | 00100000 11111111              | Protection Switch Release            | 00100110 11111111 |
| For network use                 | 00011100 11111111 <sup>b</sup> | Do Not use for Synchronization       | 00110000 11111111 |
| Protection Switch Line 1 b      | 01000010 11111111              | Stratum 2 Traceable                  | 00001100 11111111 |
| Protection Switch Line 2        | 01000100 11111111              | SONET Minimum Clock Traceable        | 00100010 11111111 |
| Protection Switch Line 3        | 01000110 11111111              | Stratum 4 Traceable                  | 00101000 11111111 |
| Protection Switch Line 4        | 01001000 11111111              | Stratum 1 Traceable                  | 00000100 11111111 |
| Protection Switch Line 5        | 01001010 11111111              | Synchronization Traceability Unknown | 00001000 11111111 |
| Protection Switch Line 6        | 01001100 11111111              | Stratum 3 Traceable                  | 00010000 11111111 |
| Protection Switch Line 7        | 01001110 11111111              | Reserved for Network Synchronization | 01000000 11111111 |
| Protection Switch Line 8        | 01010000 11111111              | Transmit Node Clock (TNC)            | 01111000 11111111 |
| Protection Switch Line 9        | 01010010 11111111              | Stratum 3E Traceable                 | 01111100 11111111 |
| Protection Switch Line 10       | 01010100 11111111              | Under study for maintenance          | 00101100 11111111 |
| Protection Switch Line 11       | 01010110 11111111              | Under study for maintenance          | 00110100 11111111 |
| Protection Switch Line 12       | 01011000 11111111              | Reserved for network use             | 00010110 11111111 |
| Protection Switch Line 13       | 01011010 11111111              | Reserved for network use             | 00011010 11111111 |
| Protection Switch Line 14       | 01011100 11111111              | Reserved for network use             | 00011110 11111111 |
| Protection Switch Line 15       | 01011110 11111111              | Reserved for network use             | 00111010 11111111 |
| Protection Switch Line 16       | 01100000 11111111              | Reserved for customer                | 00000110 11111111 |
| Protection Switch Line 17       | 01100010 11111111              | Reserved for customer                | 00001010 11111111 |
| Protection Switch Line 18       | 01100100 11111111              | Reserved for customer                | 00000010 11111111 |
| Protection Switch Line 19       | 01100110 11111111              | Reserved for customer                | 00110110 11111111 |
| Protection Switch Line 20       | 01101000 11111111              | Reserved for customer                | 00111100 11111111 |
| Protection Switch Line 21       | 01101010 11111111              | Reserved for customer                | 01111010 11111111 |

- a. Loopback Activate.  
b. Indication of NT1 power off.

## Receive Messages

- **Link Activity** indicates the activity of the following parameters during the last second of measurement.
  - **Idle** indicates that only idle codes have been detected in the last second.
  - **Priority** indicates that at least one valid priority message has been detected in the last second.
  - **C/R** (Command/Response) indicates that at least one valid command and response has been detected in the last second.
  - **Unassigned** indicates that at least one unassigned message has been detected in the last second. Therefore, since an unassigned message is part of a Command/Response codewords, the Command/Response LED will also be red.
  - **PRM** indicates that at least one PRM has been detected in the last second.
- **Priority:** The Bit-Oriented Messages are priority messages send over the Data-Link. These messages are mostly used for networking operation and maintenance. A Bit-Oriented Message consists of 8 consecutive 1s followed by a byte starting and ending by zeros.

**Current** indicates the priority message detected in the last second. If no priority message has been detected, "--" is displayed.

**Previous** indicates the last priority message detected excluding the current message. If no priority message has been detected since the beginning of the test, "--" is displayed.

**Note:** See Priority on page 460 for the list of possible priority codeword messages.

➤ **Command/Response**

**Current** indicates the command/response message detected in the last second. If no priority message has been detected, "--" is displayed.

**Previous** indicates the last command/response message detected excluding the current message. If no command/response message has been detected since the beginning of the test, "--" is displayed.

**Note:** *See Command/Response on page 460 for the list of possible Command/Response codeword messages.*

Test Functions

FDL - Performance Report Message

**Note:** FDL PRM is only available for DS1 interface with ESF framing. For Dual RX test, FDL is only available for the DS1 TX/RX port 1. For NI/CSU Emulation, only available in the RX direction.

From the **Test** menu, tap **Results**, tap the **FDL**, and **Performance Report Message** tab.

Generated Messages

- **Circuit** allows the selection of the circuit type: **CI to Network** (default) or **Network to CI**.
- **ANSI T1-403** check box when selected allows the generation of a compliant ANSI T1.403 PRM Message.
- **Injection**  
**Single** sends the selected PRM Message(s) manually.  
**Continuous** generates the selected PRM Message(s) continuously.
- **Event Count** indicates the number of PRM messages sent.
- **PRM Bit Events** allows the activation of the following PRM bit events. All PRM bit events are disabled by default.

|                                  |                                       |
|----------------------------------|---------------------------------------|
| G1: CRC = 1                      | FE: Frame sync. bit error ≥ 1         |
| G2: 1 < CRC ≤ 5                  | LV: Line code violation event ≥ 1     |
| G3: 5 < CRC ≤ 10                 | LB: Payload loopback activated        |
| G4: 10 < CRC ≤ 100               | SL: Slip ≥ 1                          |
| G5: 100 < CRC ≤ 319              | R Bit (Reserved - Default value is 0) |
| G6: CRC ≥ 320                    | U1: Bit                               |
| SE: Severely errored framing ≥ 1 | U2: Bit                               |

## Received Messages

- **Event Counts** lists received PRM bit event counts. See **PRM Bit Events** below.
- **Report Content** lists received performance information. See **Performance Information** below.
- **Circuit** indicates the selected circuit type: **CI to Network** or **Network to CI**.
- **Valid Event Count** indicates the number of valid PRM messages received.
- **Link Activity**, see page 462 for more information.
- **PRM Bit Events** table, available when the **Event Counts** button is selected, reports the count of the detected valid PRM bit events.

|                                 |                                       |
|---------------------------------|---------------------------------------|
| G1: CRC = 1                     | SE: Severely errored framing $\geq 1$ |
| G2: $1 < \text{CRC} \leq 5$     | FE: Frame sync. bit error $\geq 1$    |
| G3: $5 < \text{CRC} \leq 10$    | LV: Line Code Violation $\geq 1$      |
| G4: $10 < \text{CRC} \leq 100$  | LB: Payload loopback activated        |
| G5: $100 < \text{CRC} \leq 319$ | SL: Slip $\geq 1$                     |
| G6: CRC $\geq 320$              |                                       |

## Test Functions

### *FDL - Performance Report Message*

---

- **Performance Information** table, available when the **Report Content** button is selected, reports the time t0, t0-1, t0-2, and t0-3 for each PRM.

#### **Time**

- **T0** represents the valid PRM message received in the last second of measurement (bytes 5 and 6).
- **T0-1** represents the message one PRM ago (bytes 7 and 8).
- **T0-2** represents the message two PRM ago (bytes 9 and 10).
- **T0-3** represents the message three PRM ago (bytes 11 and 12).

#### **PRM**

**G3:**  $5 < \text{CRC Error Event} \leq 10$

**LV:** Line Code Violation Event  $\geq 1$

**G4:**  $10 < \text{CRC Error Event} \leq 100$

**U1:** Under study for synchronization

**U2:** Under study for synchronization

**G5:**  $100 < \text{CRC Error Event} \leq 319$

**SL:** Controlled Slip Event  $\geq 1$

**G6:** CRC Error Event  $\geq 320$

**FE:** Frame Sync. Bit Error Event  $\geq 1$

**SE:** Severely-Errored Framing Event  $\geq 1$

**LB:** Payload Loopback Activated

**G1:** CRC Error Event = 1

**R:** Reserved

**G2:**  $1 < \text{CRC Error Event} \leq 5$

**Nm** and **Nl:** One-second report modulo 4 counter.

## FEAC

The Far-End Alarm and Control signal (FEAC) provides Communication Channel capability over a DS3 in a network applications using C-bit Parity configuration (see page 247).

From the test menu, tap **Functions**, and the **FEAC** tab.

### Generated Messages

Allows to configure and send alarms/status information and control signals (loopback commands) to other network elements.

#### ► Alarm/Status and Unassigned

- **Codeword** allows the selection of the codeword alarm/status to be generated either manually or continuously.

The FEAC message format is a 16 bit codeword (0xxxxxx0 1111111) with the rightmost bit transmitted first. The 0xxxxxx0 represents the message codeword.

| Codeword                                |                                      |                         |
|-----------------------------------------|--------------------------------------|-------------------------|
| DS3 Equipment Failure SA (00110010)     | Single DS1 LOS (00111100)            | User Defined (00100000) |
| DS3 Loss of Signal (LOS) (00011100)     | DS1 Equipment Failure NSA (00000110) | User Defined (00100010) |
| DS3 Out-of-Frame (00000000)             | User Defined (00000010)              | User Defined (00101000) |
| DS3 AIS Received (00101100)             | User Defined (00000100)              | User Defined (00101110) |
| DS3 Idle Signal Received (00110100)     | User Defined (00001000)              | User Defined (00110000) |
| DS3 Equipment Failure NSA (00011110)    | User Defined (00001100)              | User Defined (00111110) |
| DS3 NUI Loop Up (00010010)              | User Defined (00010000)              | User Defined (01000000) |
| DS3 NUI Loop Down (00100100)            | User Defined (00010100)              | User Defined (01111010) |
| Common Equipment Failure NSA (00111010) | User Defined (00010110)              | User Defined (01111100) |
| Multiple DS1 LOS (00101010)             | User Defined (00011000)              | User Defined (01111110) |
| DS1 Equipment Failure SA (00001010)     | User Defined (00011010)              |                         |

- **Mode** is the alarm/status injection mode: **Manual** or **Continuous**.

## Test Functions

FEAC

---

- **Amount** is the amount of codeword to be generated: **1 to 15** (default is **10**).
- **Inject** generates error(s) according to the Codeword and mode selected.
- **Loopback Commands**
  - **Control**

**Codeword** is the loopback control codeword to be generated: **Line Loopback Activate (00001110)** - (Default) or **Line Loopback Deactivate (00111000)**.

**Amount** is the number of **Control Codeword** to be generated: **1 to 15** (default is **10**).
  - **Channel**

**Codeword** is the channel codeword to be generated.

| Channel Codeword        |                          |                          |
|-------------------------|--------------------------|--------------------------|
| DS3 Line (00110110)     | DS1 Line-No10 (01010100) | DS1 Line-No20 (01101000) |
| DS1 Line-No1 (01000010) | DS1 Line-No11 (01010110) | DS1 Line-No21 (01101010) |
| DS1 Line-No2 (01000100) | DS1 Line-No12 (01011000) | DS1 Line-No22 (01101100) |
| DS1 Line-No3 (01000110) | DS1 Line-No13 (01011010) | DS1 Line-No23 (01101110) |
| DS1 Line-No4 (01001000) | DS1 Line-No14 (01011100) | DS1 Line-No24 (01110000) |
| DS1 Line-No5 (01001010) | DS1 Line-No15 (01011110) | DS1 Line-No25 (01110010) |
| DS1 Line-No6 (01001100) | DS1 Line-No16 (01100000) | DS1 Line-No26 (01110100) |
| DS1 Line-No7 (01001110) | DS1 Line-No17 (01100010) | DS1 Line-No27 (01110110) |
| DS1 Line-No8 (01010000) | DS1 Line-No18 (01100100) | DS1 Line-No28 (01111000) |
| DS1 Line-No9 (01010010) | DS1 Line-No19 (01100110) | DS1 Line-All (00100110)  |

- Amount** is the number of Channel Codeword to be generated: **1 to 15** (Default is **10**).
- **Inject** generates the defined loopback command.

## Received Messages

Displays current and previous alarms/status and loopback commands as well as the link activity for the received DS3 signal.

### ➤ Link Activity

- **None (All 1's):** An all ones pattern (11111111 11111111) has been detected in the last second.
- **Alarm/Status:** An Alarm/Status codeword has been detected in the last second. An Alarm/Status is only detected when receiving at least 10 consecutive occurrences of a specific codeword.
- **Loopback:** A Loopback command message has been detected in the last second. A valid loopback command is detected only when receiving 10 consecutive occurrences of a specific **Loopback Command** immediately followed by 10 occurrences of a specific **Channel Codeword**.
- **Unassigned:** An unassigned message has been detected in the last second. An Unassigned message is only detected when receiving at least 10 consecutive occurrences of a specific unassigned codeword. An **Alarm/Status** codeword is also reported since **Unassigned** is part of the **Alarm/Status** group.
- **Alarm/Status and Unassigned** displays the current and previously received **Codeword** messages.
  - **Current** indicates the last valid message, if any, received in the last second of measurement.
  - **Previous** indicates the message, if any, that was received just before the current measurement.

## Test Functions

FEAC

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### ➤ Loopback Commands

- **Current** displays the valid message received in the last second of measurement. A valid message is detected only when receiving 10 consecutive occurrences of a specific **Loopback Command** immediately followed by 10 occurrences of a specific **Channel Codeword**.
- **Previous** displays the last valid message received excluding the actual **Current** message.

## Filters

Allows gathering statistics according to the programmed filters. Filters provide the capability to analyze a specific stream's behavior in order to monitor a single protocol's behavior, perform SLA verification, or precisely troubleshoot unwanted behavior. Up to 4 filters having up to four operands each can be defined and enabled.

From the **Test** menu, tap **Functions**, and the **Filters** tab.

### Filters

Allows the selection of the filter number (1 to 4). The filter criteria, if defined, will be displayed. A filter used (enabled) for data capture will not be configurable and the message **Filter in use for data capture** is displayed.

### Enable

Once the filter is configured, select the **Enable** check box to enable the current filter. However, if the filter configuration contains errors, it will not be possible to enable it. A filter can be enabled or disabled even when the test is running. It is not possible to modify or disable a filter that is already in use for capture until either another filter or **Interface** (see *Capture Source* on page 475) is assigned to capture.

### Enabled Time

Indicates the time during which the filter is enabled.

## Assign to Capture

**Note:** *Only available when the ETH-CAPTURE software option is enabled. Refer to Software Option on page 34 for more information.*

Assigns the selected filter for packet capture. See *Packet Capture* on page 475.

## Filter Configuration

**Note:** *Multiple filter criteria is only available when the ADV-FILTERS option is enabled; otherwise only one criterion is possible. Refer to Software Option on page 34 for more information.*

The filter configuration section allows to configure the filter criteria for the selected filter. The configuration is only possible when the **Enable** check box is cleared.

- “(“ and “)“, the open and close parenthesis controls the precedence of operands when more than two operands are used. Only one level of parenthesis is supported. When no parenthesis are used, a logical AND has precedence over a logical OR.
- **Not** check box when selected, adds the logical negation (not equal) operator for the operand filter defined at its right.

- **Filter** specifies the filter to be used (**None** by default).

| Category          | Filter                                                                                                                                                   |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ethernet          | MAC Destination Address, MAC Source Address, EtherType <sup>a</sup> , C-VLAN ID, S-VLAN ID, E-VLAN ID, C-VLAN Priority, S-VLAN Priority, E-VLAN Priority |
| IPv4              | IPv4 Destination Address, IPv4 Source Address, IPv4 TOS, IPv4 Precedence, IPv4 Protocol, IPv4 DiffServ                                                   |
| IPv6 <sup>b</sup> | IPv6 Destination Address, IPv6 Source Address, IPv6 Flow Label, IPv6 Next Header <sup>c</sup> , IPv6 Traffic Class, IPv6 Precedence, IPv6 DiffServ       |
| Higher Layer      | TCP Destination Port, TCP Source Port, UDP Destination Port, UDP Source Port                                                                             |
| MPLS <sup>b</sup> | MPLS Label 1, MPLS Label 2, MPLS COS 1, MPLS COS 2                                                                                                       |

- a. Applies only to the last EtherType occurrence when VLAN is used.
- b. Available when the corresponding software option is enabled (refer to page 34).
- c. Applies only to the last next header occurrence when extension headers are used.

- **Value** is the value associated to the selected filter.

## Test Functions

### Filters

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- **Mask** allows masking the defined filter value. A bit mask of 1 indicates that the corresponding bit in the value is compared for the match. A bit mask of 0 indicates that the corresponding bit in the value is ignored.

For binary values, enter the mask value in binary format.

For decimal values, enter the mask value in hexadecimal format.

For IP address field, enter the mask in decimal format.

For MAC address, enter the mask value in hexadecimal format.

- **Oper.** specifies the logical operator (AND or OR) used between two operands.

## Filter Statistics

Indicates throughput statistics of frame matching the configured filter's criteria.

- **Line Utilization** gives the percentage of line rate utilization.
- **Ethernet BW** (Bandwidth) gives the receiving data rate expressed in Mbit/s.
- **Frame Rate** gives the receiving number of frames (including bad frames) in frame/s.
- **Frame Count** indicates the number of frame matching the configured filter's criteria.
- **Error Count** indicates respectively the number of frames matching the configured filter's criteria having **IP Checksum**, **UDP Checksum**, **TCP Checksum**, **FCS**, **Jabber**, **Oversize**, **Runt**, or **Undersize** errors. Refer to *Ethernet* on page 306 and *IP/UDP/TCP* on page 313 for more information on errors.

## Packet Capture

Capture is used to analyze all or filtered data traffic and save complete or truncated frames into a buffer. It allows to precisely observe network truncated data, or to understand errors and unwanted behavior.

From the **Test** menu, tap **Functions**, and the **Packet Capture** tab.

### Capture Source

Specifies what kind of data to be captured.

- **Interface** captures all received frames and saves them in the capture buffer.
- **Filter x** captures only frames that match the selected filter and saves them in the capture buffer. Select the filter number from the list. Only enabled filters are available, see *Filters* on page 471.

The selected filter will be reserved for data capture and will not be available for filter configuration.

## Frame Length

Specifies the length of the frame that will be saved in the capture buffer.

- **Complete** captures the entire frames.
- **Truncated** captures only the first specified number of bytes per frame. Use either the Bytes field to manually enter the number of bytes per frame or tap on the **Truncation Calculator** button for automatic bytes per frame calculation.

**Bytes** allows the selection of the number of bytes that will be saved in the capture buffer for each frame captured. Choices are from 14 (default) to 1536 bytes.

**Truncation Calculator** allows to easily determine at what byte to truncate the frame captured by selecting the desired frame header components.

- **Header Layer** specifies the header layer level: **Layer 2 (Ethernet)**, **Layer 3 (IP)**, or **Layer 4 (TCP/UDP)**.
- **IP Version** specifies the IP version: **IPv4** or **IPv6**.
- **Encapsulation** parameters are optional and not selected by default.

**VLAN** check box, when selected, enables VLAN and allows to select the number of VLANs: 1, 2, or 3.

**MPLS** check box, when selected, enables MPLS and allows to select the number of labels: 1 or 2.

- **Additional Payload (bytes)** allows to optionally select the number of additional payload bytes (1 to 1400 bytes).
- **Total Number of Bytes** indicates the number of bytes for the selected frame parameters. This value will be used as the truncated frame length (**Truncated** field).

## Trigger

- **Trigger Type** defines the trigger source criterion that will be used to automatically start/stop the capture when a received frame matches the filter and the trigger criteria.
  - **Manual** automatically starts the frame capture when the Capture button is on (green LED) and the test is started (refer to *Start/Stop | TX Button* on page 558).
  - **On Error** starts the frame capture when the selected error occurs.

**FCS**

**Jabber**

**Oversize** (Available when **Oversize Monitoring** is enabled)

**Runt**

**Undersize**

**IP Checksum**

**UDP Checksum**

**TCP Checksum**

**Any Type** (Any of the above errors).

- **Field Match** starts the frame capture when the configured field match is encountered. Use the **Configuration** button to select the field match criteria (see **Filter Configuration** from the **Filters** tab).

**Cfg. Status** indicates the status of the configured field match configuration: **Valid** or **Invalid**. A valid status is required to be able to start the capture.

## Test Functions

### Packet Capture

---

- **Trigger Position** selects the triggered frame position within the buffer.
  - **Post-Trigger** for a trigger frame located at the beginning of the buffer. The buffer will contain the triggered frame with the following frames.
  - **Mid-Trigger** for a trigger frame located at the middle of the buffer. The buffer will contain the triggered frame with the preceding and following frames.
  - **Pre-Trigger** for a trigger frame located at the end of the buffer. The buffer will contain the triggered frame with the preceding frames.

## Status and Controls

- **Capture Status** indicates the status of the data capture:
  - “--”: The capture is not started and has not run yet.
  - Armed...:** The capture is started but waiting for the trigger event.
  - Capturing...:** The capture is in progress. For Post-Trigger and Mid-Trigger mode, the trigger event has been captured and the buffer is filling up.
  - Completed:** The capture is completed.
- **Frame Count** indicates the number of frames captured that matches the selected filter criteria. However, for Mid-trigger and Pre-Trigger, the frame counter will only be available when the capture is completed.
- **Buffer Usage** indicates the percentage of the buffer capacity used.
- **Triggered Error** is available when trigger on error is selected and indicates the error that activated the trigger.

- **Triggered Frame - Details** gives details on the triggered frame.

The triggered frame corresponds to the first received frame that matches the filter and the trigger settings.

**Frame Number** indicates the triggered frame position in the buffer.

The framing MAC/IP/UDP/TCP source and destination addresses are displayed in a table.

- **Capture** button allows to start/stop the data capture. The test must be running (refer to *Start/Stop | TX Button* on page 558) in order to start capturing and recording data into the buffer. The Capture button is not available when the trigger on field match is selected while its trigger parameters are not valid.

No data will be recorded in the buffer if no frame matches the filter and the trigger criteria during the data capture.

The data capture stops automatically once the buffer is full. The maximum buffer capacity is 64 KBytes or a maximum of 2078 frames.

When the capture stops or is manually stopped, the following message is displayed: **Capture completed. Press Export to save captured data (the test must be stopped)**. To avoid losing the captured data, the data must be exported and saved into a file before restarting the test or creating a new test.

- **Export** button, available when the test application is stopped, allows to export the data captured into a .pcap file format and to view the file using Wireshark.

- **Save In:** Allows to select the folder to save the capture file.

The capture file is saved in the following folder by default:

*d:\ToolBox\User Files\<Product Name>\Capture Data*

*d:\IQSManager\User Files\<Product Name>\Capture Data*

- **View File After Generation:** Allows to display the report once it is generated using the Wireshark application. The **View File After Generation** check box is not selected by default.

## Test Functions

### Packet Capture

---

#### ➤ **Generate & Save**

Allows to generate and save the capture data. The name of the captured file is automatically selected and contains the date and time of the capture. Capture file bigger than 100Mbytes will be split into multiple files.

Tapping on the **Cancel** button stops the capture generation. The captured data already processed will be saved.

**Note:** *The export process may take several minutes.*

Once generated, the capture file will be automatically opened in Wireshark when the **View File After Generation** check box is selected.

The capture file report may also be manually opened within Wireshark typically using Windows Explorer.

## OH - OTN

From the **Test** menu, tap **Functions**, and the **OH** tab.

### TX and RX buttons

Allows to respectively modify (**TX** button) the overhead information to be transmitted or to view (**RX** button) the overhead information received.

### Default OTN OH

Returns all TX overhead bytes to their factory default values.

### TX/RX

Overhead bytes are organized using rows and columns structure as per G.709 standard.

Row 1

- **OA1** and **OA2**, columns 1-6, OTU FAS: All the Frame Alignment Signal **OA1** bytes and **OA2** bytes are individually configurable from **00** to **FF**. The default values are **F6** for all **OA1** bytes and **28** for all **OA2** bytes.
- **MFAS**, column 7, OTU MFAS: The Multi-Frame Alignment Signal byte is not configurable.
- **SM**, columns 8-10, OTU OH: The Section Monitoring contains the following bytes.

The first SM byte (column 8) contains the TTI multiframe byte that is only configurable from *Traces (OTN)* on page 281.

The second SM byte (column 9) contains the BIP-8 byte that is automatically generated for each frame. This byte is not configurable.

## Test Functions

### OH - OTN

---

The third SM byte (column 10) contains the following sub-fields. This byte is configurable from **00** (default) to **FF**.

| Bit 1-4  | Bit 5 | Bit 6 | Bit 7-8 |
|----------|-------|-------|---------|
| BEI/BIAE | BDI   | IAE   | RES     |

- **GCC0**, columns 11-12, OTU OH: The two General Communication Channel-0 bytes are configurable from **00** (default) to **FF**.
- **RES**, columns 13-14, OTU OH: The two Reserved (RES) bytes are configurable from **00** (default) to **FF**.
- **RES**, column 15, OPU OH: The Reserved (RES) byte is configurable from **00** (default) to **FF**.
- **JC**, column 16, OPU OH:
  - Bits 1-6, Reserved (RES), are configurable from binary **000000** (default) to **111111**.
  - Bits 7-8, Justification Control (JC), are configurable from binary **00** (default) to **11**. Not available with ODU mux. Changing the JC value will corrupt the payload.

Row 2

- **RES**, columns 1-2, ODU OH: The two Reserved (RES) bytes are configurable from **00** (default for each byte) to **FF**.
- **PM & TCM**, column 3, ODU OH: The Path Monitoring and Tandem Connection Monitoring byte is configurable from **00** (default) to **FF**.
- **TCM ACT**, column 4, ODU OH: The Tandem Connection Monitoring Activation is configurable from **00** (default) to **FF**.
- **TCM6/TCM5/TCM4**, column 5-13, ODU OH: The Tandem Connection Monitoring overhead contains the following bytes.

The first TCMi byte contains the TTI multiframe byte and is only configurable from *Traces (OTN)* on page 281.

The second TCMi byte contains the BIP-8 byte and is automatically generated for each frame. This byte is not configurable.

The third TCMi byte contains the following sub-fields. This byte is configurable from **00** to **FF**. The default value is **00** when TCMi is disabled, and 01 when enabled.

| Bit 1-4  | Bit 5 | Bit 6-8 |
|----------|-------|---------|
| BEI/BIAE | BDI   | STAT    |

- **FTFL**, column 14, ODU OH: The Fault Type Fault Location multiframe byte is only configurable from *FTFL/PT* on page 146.
- **RES**, column 15, OPU OH: The Reserved (RES) byte is configurable from **00** (default) to **FF**.

## Test Functions

### OH - OTN

---

- **JC**, column 16, OPU OH:
  - Bits 1-6, Reserved (RES), are configurable from binary **000000** (default) to **111111**.
  - Bits 7-8, Justification Control (JC), are configurable from binary **00** (default) to **11**. Not available with ODU mux. Changing the JC value will corrupt the payload.

#### Row 3

- **TCM3/TCM2/TCM1**, columns 1-9, ODU OH: See *TCM6/TCM5/TCM4* on page 483 for more information.
- **PM**, column 10-12, ODU OH: The Path Monitoring overhead contains the following bytes.

The first PM byte (column 10) contains the TTI byte that is not configurable.

The second PM byte (column 11) contains the BIP-8 byte and is automatically generated for each frame. This byte is not configurable.

The third PM byte (column 12) contains the following sub-fields. This byte is configurable from **00** to **FF**. The default value is **01**.

| Bit 1-4 | Bit 5 | Bit 6-8 |
|---------|-------|---------|
| BEI     | BDI   | STAT    |

- **EXP**, column 13-14, ODU OH: The two Experimental overhead bytes are configurable from **00** (default for each byte) to **FF**.
- **RES**, column 15, ODU OH: The Reserved (RES) bytes are configurable from **00** (default) to **FF**.

- **JC**, column 16, OPU OH:
  - Bits 1-6, Reserved (RES), are configurable from binary **000000** (default) to **111111**.
  - Bits 7-8, Justification Control (JC), are configurable from binary **00** (default) to **11**. Not available with ODU mux. Changing the JC value will corrupt the payload.

### Row 4

- **GCC1**, column 1-2, ODU OH: The two General Communication Channel-1 bytes are configurable from **00** (default for each byte) to **FF**.
- **GCC2**, column 3-4, ODU OH: The two General Communication Channel-2 bytes are configurable from **00** (default for each byte) to **FF**.
- **APS/PCC**, column 5-8, ODU OH: The Automatic Protection Switching / Protection Communication Channel overhead bytes are defined in the ITU-T G.709 standard. These bytes are configurable from **00** (default) to **FF**.
- **RES**, column 9-14, ODU OH: The six Reserved (RES) bytes are configurable from **00** (default for each byte) to **FF**.
- **PSI**, column 15, OPU/ODU OH: Tap the PSI field to configure (TX) or display (RX) the Payload Structure Identifier.
  - **TX**: Select any TX byte from the list and its content is displayed below the list. Tap the **Edit** button to change its value.
  - **RX**: Select any RX byte from the list and its content is displayed below the list.
- **NJO**, column 16, ODU OH: The Negative Justification Opportunity byte is not configurable. Available either for non-concatenated signal or on the LO of a concatenated signal.

## Test Functions

*OH - OTN*

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### **RX**

- **RX OH Byte Details** displays the content of the selected OH RX byte.  
Tap on any OH RX byte to see its content
- **Legend TX/RX** indicates the path level for all OH bytes.

## **OH - SONET/SDH**

The SONET/SDH OH page allows to modify (TX) the overhead information to be transmitted and to view (RX) the overhead information received.

From the **Test** menu, tap **Functions**, and the **OH** tab.

Tap on any overhead byte in TX to modify its value.

Tap on any overhead byte in RX to see its detailed content/value.

**Note:** *A byte in TX that has no value displayed or is grayed out, is not configurable from the OH tab.*

### **TX and RX Buttons (SDH)**

Tap on the TX or RX button to respectively access the overhead bytes in transmission or receive mode.

### **STS-1 Timeslot/STM-1 Channel**

Allows to select the timeslot number for the Transport OH bytes. The STS/AU/TU-3 overhead bytes are always for the timeslot selected in the test configuration. Furthermore when modifying the Transport OH bytes H1 SS bits, the modification applies to all timeslots when the test topology is **Coupled**. Choices are **1** (default) to **192** (SONET) / **64** (SDH) depending on the OC-N/STM-N interface selected.

## Transport OH - Section/RS

- **A1 and A2:** Framing. The value should be hexadecimal **F6** for A1 and **28** for A2. They must appear in every STS-1/STM-1 frame of a composite signal.

SONET: Provide frame alignment of each STS-1 frame within a composite signal (STS-1 to STS-n).

SDH: Indicate the beginning of the STM-N frame.

- **J0/Z0**

- **J0:** The J0 (Trace) byte is used to trace the origin of an STS-1/STM-1 frame as it travels across the SONET/SDH network. This byte is only defined for the first STS-1/STM-1 frame of a composite signal.

Available when the Trace format is set to 1 Byte (Refer to *Traces (SONET/SDH)* on page 284).

- **Z0:** Growth.

SONET: The Z0 byte was used to uniquely identify the STS in question. This byte has to be defined in every STS-1 to STS-n frame of a composite signal. This byte is only defined for the STS-1 #2 to STS-1 #N of a OC-N signal.

SDH: These bytes are reserved for future international standardization. They are located at positions  $S[1,6N+2]$  to  $S[1,7N]$  of an STM-N signal ( $N > 1$ ).

- **B1:** BIP-8 (Bit-Interleaved Parity) byte provides section error monitoring. This byte is only defined for the first STS-1/STM-1 frame of a composite signal. The byte is calculated by performing a routine even-parity check over all bits of the previous STS-N/STM-N frame of a composite signal.
- **E1:** Orderwire. Provides a 64 Kbit/s voice channel for communication between two STEs (Section Terminating Equipment). This byte is only defined for the first STS-1/STM-1 frame of a composite signal.

- **F1:** User/User Channel. This byte is reserved for user purposes. This byte is only defined for the first STS-1/STM-1 frame of a composite signal.
- **D1, D2, and D3:** Data Communications Channel (DCC). Provides a 192 Kbit/s data communication between two STEs for operation functions such as OAM&P. These bytes are only defined for the first STS-1/STM-1 frame of a composite signal.

## Transport OH - Line/MS

- **H1 and H2:** Pointer.

SONET: H1 and H2 bytes are combined to form a pointer indicating where the path overhead begins within each SPE.

SDH: H1 and H2 bytes are combined to form a pointer indicating where the VC (Virtual Container) frame begins within each SPE.

Bits 5 and 6 of the H1 byte represent the SS bits and are configurable as follows.

| SS Bits | Description |
|---------|-------------|
| 00      | SONET       |
| 01      | Undefined   |
| 10      | SDH         |
| 11      | Undefined   |

- **H3:** Pointer Action. H3 is an extra byte used to compensate for the SPE timing variation. The H1 and H2 pointer tell the receiver when the H3 pointer is used.

SONET: This byte must be defined in every STS-1 to STS-n frame of a composite signal.

SDH: This byte must be defined in every STM-1 of an STM-N signal in the event of negative justification, otherwise it is not defined.

➤ **B2: BIP-8**

SONET: The BIP-8 (Bit-Interleaved Parity) byte provides line error monitoring. This byte is only defined for the first STS-1/STM-1 frame of a composite signal. The byte is calculated by performing a routine even-parity check over all bits of the LOH and the STS-1 frame capacity of the previous frame of a composite signal (STS-1 to STS-n). Note that the SOH is not used to calculate the parity check.

SDH: The MS BIP-N\*24 (Bit-Interleaved Parity) byte provides line error monitoring. The byte is calculated by performing a routine even-parity check over all bits of the MSOH and the STM-N frame of the previous STM-N frame. Note that the RSOH is not used to calculate the parity check.

➤ **K1 and K2: Automatic Protection Switching (APS):** The K1 and K2 bytes communicate APS between two LTE. These bytes are only defined for the first STS-1/STM-1 frame of a composite signal.

➤ **D4 through D12: Data Communications Channel (DCC):** The D4 through D12 bytes provide a 576 Kbit/s data communications channel between two LTEs for administration, monitoring and other communications. These bytes are only defined for the first STS-1/STM-1 frame of a composite signal.

➤ **S1/Z1 (SONET)**

**S1:** Synchronization Status: The S1 byte is used to carry the synchronization status of the SONET device. This byte is only defined for the first STS-1/STM-1 frame of a composite signal.

**Z1:** Growth. This byte is located in the second STS-1 through STS-n frame of a composite signal (STS-1 #2, STS-1 #3, up to STS-1 #N of a OC-N (N>3) signal).

➤ **S1 (SDH): Synchronization Status.** Bits 5 to 8 of the S1 byte are used to carry the synchronization messages of the SDH device. This byte is only defined for the first STS-1/STM-1 frame of a composite signal.

➤ **M0 or M1/Z2 (SONET)**

**M0:** REI-L: The M1 byte is used for line Remote Error Indication (REI-L)

- For STS-1e and OC-1: The M0 byte located in the STS-1 indicates BIP violations.

| <b>M0, bits<br/>234 5678</b> | <b>Indicates</b> |
|------------------------------|------------------|
| 000 0000                     | 0 BIP violation  |
| 000 0001                     | 1 BIP violation  |
| :                            | :                |
| 000 1000                     | 8 BIP violations |
| 000 1001 to<br>1111 1111     | 0 BIP violation  |

- For OC-192: The M0 bytes located in the STS-1 #4 indicates BIP violations when combined with the M1 byte (see M1 byte below for more information).

**M1:** REI-L. The M1 byte is used for line Remote Error Indication (REI-L).

- For STS-3e and OC-3: The M1 byte located in the STS-1 #3 indicates BIP violations.

| <b>M1, bits 234 5678</b> | <b>Indicates</b>  |
|--------------------------|-------------------|
| 000 0000                 | 0 BIP violation   |
| 000 0001                 | 1 BIP violation   |
| :                        | :                 |
| 001 1000                 | 24 BIP violations |
| 001 1001 to<br>1111 1111 | 0 BIP violation   |

## Test Functions

OH - SONET/SDH

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- For OC-12: The M1 byte located in the STS-1 #7 indicates BIP violations.

| M1, bits 234 5678        | Indicates         |
|--------------------------|-------------------|
| 000 0000                 | 0 BIP violation   |
| 000 0001                 | 1 BIP violation   |
| :                        | :                 |
| 110 0000                 | 96 BIP violations |
| 110 0001 to<br>1111 1111 | 0 BIP violation   |

- For OC-48: The M1 byte located in the STS-1 #7 indicates BIP violations.

| M1        | Indicates          |
|-----------|--------------------|
| 0000 0000 | 0 BIP violation    |
| 0000 0001 | 1 BIP violation    |
| :         | :                  |
| 1111 1111 | 255 BIP violations |

- For OC-192: Either the M1 byte located in the STS-1 #7, or the combination of the M0 and M1 bytes indicates BIP violations (refer to *REI-L Computation Method* on page 259).

For **M1 Only** computation method:

| M1        | Indicates          |
|-----------|--------------------|
| 0000 0000 | 0 BIP violation    |
| 0000 0001 | 1 BIP violation    |
| :         | :                  |
| 1111 1111 | 255 BIP violations |

For **M0 and M1** computation method:

| M0<br>Located in STS-1 #4 | M1<br>Located in STS-1 #7 | Indicates           |
|---------------------------|---------------------------|---------------------|
| 0000 0000                 | 0000 0000                 | 0 BIP violation     |
| 0000 0000                 | 0000 0001                 | 1 BIP violation     |
| :                         | :                         | :                   |
| 0000 0110                 | 0000 0000                 | 1536 BIP violations |
| 0000 0110 to<br>1111 1111 | 0000 0001 to<br>1111 1111 | 0 BIP violation     |

**Z2:** Growth. Available with OC-3, OC-12, and OC-48 signal, this byte is located in STS-1 #1 up to STS-1 #48 except for timeslots used by M0 and M1.

**Undefined “--”** for all other timeslots not covered by M0, M1, and Z2.

## Test Functions

### OH - SONET/SDH

---

➤ **M0 or M1 (SDH)**

**M0:** MS-REL. STM-1 channel #1 of a STM-0e and STM-0 signal.

**M1:** MS-REL. STM-1 channel #1 of a STM-1e and STM-1 signal;  
channel #3 of an STM-N signal (N>1).

**Undefined “--”** for all other channels not covered by M0, and M1.

- **E2:** Orderwire. Provides a 64 Kbit/s voice channel for communication between LTEs. This byte is only defined for the first STS-1/STM-1 frame of a composite signal.

## STS/AU/TU-3

- **J1:** Trace. Available when the Trace format is set to 1 Byte (Refer to *Traces (SONET/SDH)* on page 284).

SONET: The J1 Trace byte provides a 16 or 64 byte fixed string to verify connection between path transmitting equipment and path receiving equipment.

SDH: The higher-order (AU)/low-order (TU) VC-N path trace byte provides a 64 byte fixed string to verify connection between path transmitting equipment and path receiving equipment.

- **B3:** BIP-8. The BIP-8 (Bit-Interleaved Parity) byte provides path error monitoring. The byte is calculated by performing a even-parity check over all bits of the previous SPE.

- **C2: Signal Label.** Entering a C2 byte value will automatically update the Path Signal Label (C2) selection and vice versa. Refer to *STS/AU Path (C2)* on page 169 for more information.

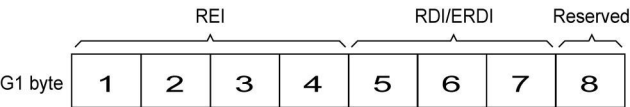
| <b>C2<br/>(Hex.)</b>                  | <b>Description</b>                                                    |                                 |
|---------------------------------------|-----------------------------------------------------------------------|---------------------------------|
|                                       | <b>SONET</b>                                                          | <b>SDH</b>                      |
| 00 <sup>a</sup>                       | Unequipped                                                            | UNEQ or supervisory-UNEQ        |
| 01                                    | Equipped - Non-Specific                                               | RES (Equipped - Non-Specific)   |
| 02                                    | Floating VT Mode (Default)                                            | TUG Structure                   |
| 03                                    | Locked VT Mode                                                        | Locked TU-n                     |
| 04                                    | Async Mapping for DS3                                                 | Async Mapping of 34M/45M in C-3 |
| 05                                    | Mapping under development                                             | Experimental Mapping            |
| 12                                    | Async Mapping for 140M (DS4NA)                                        | Async Mapping of 140M in C-4    |
| 13                                    | Mapping for ATM                                                       | ATM Mapping                     |
| 14                                    | Mapping for DQDB                                                      | MAN DQDB                        |
| 15                                    | Async Mapping for FDDI                                                | FDDI [3]-[11] Mapping           |
| 16                                    | Mapping of HDLC over SONET                                            | Mapping of HDLC/PPP             |
| 17                                    | SDL with self-sync scrambler                                          | RES (SDL self-synch scrambler)  |
| 18                                    | Mapping of HDLC/LAPS                                                  | Mapping of HDLC/LAPS            |
| 19                                    | SDL with a set-reset scrambler                                        | RES (SDL set-reset scrambler)   |
| 1A                                    | 10 Gbit/s Ethernet (IEEE 802.3)                                       | 10 Gbit/s Ethernet (IEEE 802.3) |
| 1B                                    | GFP                                                                   | GFP                             |
| 1C                                    | Not supported                                                         | Mapping 10 Gbit/s FC            |
| 20                                    | Not supported                                                         | Async Mapping of ODUk           |
| CF                                    | RES (Obsolete HDLC/PPP framed)                                        | RES (obsolete HDLC/PPP framed)  |
| E1 <sup>a</sup> to<br>FC <sup>a</sup> | STS-1 w/1 VTx PD, STS-1 w/2 VTx PD, ... STS-1 w/28 VTx or STS-n/nc PD | Not supported                   |
| FE                                    | Test Signal, ITU-T 0.181                                              | Test Signal, ITU-T 0.181        |
| FF <sup>a</sup>                       | STS SPE AIS (TCM)                                                     | VC-AIS (TCM)                    |

- a. These values cannot be selected as Expected Path Signal Label.

Test Functions

OH - SONET/SDH

- **G1:** Path Status. The G1 byte provides a method to communicate the far-end path status back to the path originating equipment.



REI:

| Bits 1 to 4 of G1 | Description |
|-------------------|-------------|
| 0000              | No error    |
| 0001              | 1 error     |
| 0010              | 2 errors    |
| :                 | :           |
| 1000              | 8 errors    |
| 1001 to 1111      | No error    |

RDI/ERDI:

| Bits 5, 6, 7 of G1 | Description |
|--------------------|-------------|
| 000, 001, 011      | No defect   |
| 100, 111           | RDI         |
| 010                | ERDI-PD     |
| 101                | ERDI-SD     |
| 110                | ERDI-CD     |

- **F2:** User Channel. The User Channel provides a 64 Kbit/s channel for communication between two PTEs. This byte is only defined for the first STS-1/STM-1 frame of a composite signal.
- **H4:** Multiframe Indicator. The H4 byte provides a multiframe phase indication of a VT/TU payload.

➤ **Z3 and Z4:**

SONET only: Growth.

➤ **F3:**

SDH only: User Channel. The Path User Channel provides a channel for communication purposes between path elements and is payload dependent.

➤ **K3:**

SDH only: Automatic Protection Switching (APS). Bits 1 to 4 of the K3 byte are used for APS signaling. K3 bits 5 to 8 are reserved for future use.

➤ **N1:**

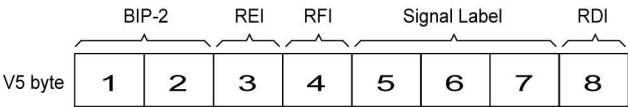
SONET: The N1 byte (formerly referred to as the Z5 byte) is allocated for Tandem Connection Maintenance (TCM) and the Path Data Channel.

SDH: (Network operator byte) The N1 byte is allocated to provide a Higher-Order Tandem Connection Monitoring (HO-TCM) function.

VT/TU

➤ V5 VT/TU Path Overhead

The V5 byte is allocated to indicate the content of the VT/TU path, including the status of the mapped payloads. It provides the same functions for VT/VC paths that the B3, C2, and G1 bytes provide for STS/STM paths.



- **BIP-2** is not configurable.
- **REI, RFI, and RDI:** Choices are **0** (disabled), and **1** (enabled).
- Signal Label

| Bits 5, 6, 7<br>of V5 | Description                               |                                         |
|-----------------------|-------------------------------------------|-----------------------------------------|
|                       | SONET                                     | SDH                                     |
| 000 <sup>a</sup>      | Unequipped                                | Unequipped or<br>supervisory-unequipped |
| 001                   | Reserved (Equipped - Non-specific)        |                                         |
| 010                   | Asynchronous                              |                                         |
| 011                   | Bit Synchronous                           |                                         |
| 100                   | Byte Synchronous                          |                                         |
| 101                   | Extended Signal Label                     |                                         |
| 110                   | Test Signal, ITU-T 0.181 specific mapping |                                         |
| 111 <sup>a</sup>      | VT SPE AIS (TCM)                          | VC-AIS (TCM)                            |

a. These bytes cannot be selected in receive mode.

If the signal label in V5 (bits 5, 6, and 7) is 101 the contents of the extended signal label is valid and contains in a 32 bit multiframe as shown below. See Z7/K4 Structure shown below.

Z7/K4 Structure

|                             |   |   |   |   |                    |   |   |   |    |    |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-----------------------------|---|---|---|---|--------------------|---|---|---|----|----|--------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1                           | 2 | 3 | 4 | 5 | 6                  | 7 | 8 | 9 | 10 | 11 | 12                       | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
| Multiframe Alignment Signal |   |   |   |   |                    |   |   |   |    |    | Extended<br>Signal Label |    |    |    |    |    |    |    | 0  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  | R  |    |
| Frame Count                 |   |   |   |   | Sequence Indicator |   |   |   |    |    |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

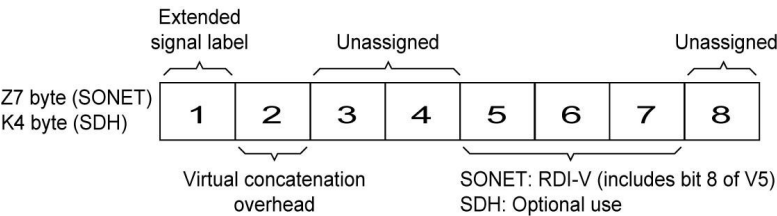
R = Reserved

- **J2 Trace.** Available when the Trace format is set to 1 Byte (Refer to *Traces (SONET/SDH)* on page 284).  
  
SONET: VT Path Trace: The J2 Trace byte provides a 16 or 64 bytes fixed string allowing the receiving VT PTE to verify its continued connection to the intended transmitting VT PTE.  
  
SDH: Path Trace: The J2 byte is used to repetitively transmit a Lower-Order Access Path Identifier so that a path receiving terminal can verify its continued connection to the intended transmitter.
- **Z6/N2**  
  
**Z6 (SONET):** VT Tandem Connection Monitoring or VT Path Growth. The Z6 byte is allocated for future growth.  
  
**N2 (SDH):** (Network operator byte) Tandem Connection Monitoring for the VC2, VC-12, and VC-11 level.

Test Functions

OH - SONET/SDH

➤ Z7 /K4 : Extended signal label



| Bits  | Description                                                                                                                                                                                                                      |               |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
|       | Z7 (SONET)                                                                                                                                                                                                                       | K4 (SDH)      |
| 1     | Extended signal label. Bits 12 to 19 of the 32 bit frame multiframe (see Z7/K4 Structure on page 499) contain the extended signal label.                                                                                         |               |
| 2     | Virtual concatenation. Bits 1 to 5 of the 32 bit frame multiframe (see Z7/K4 Structure on page 499) contain the LO virtual concatenation frame count while bits 6 to 11 contain the LO virtual concatenation sequence indicator. |               |
| 3 - 4 | unassigned and reserved for APS signaling for protection at the lower order path level.                                                                                                                                          |               |
| 5 - 7 | These bits in combination with bit 8 of V5 are allocated for RDI -V/ERDI-V signal                                                                                                                                                | Optional use. |
| 8     | unassigned and reserved for a lower order path data link.                                                                                                                                                                        |               |

Default all OH

Returns all TX overhead bytes to their factory default values.

## Ping & Trace Route

From the **Test** menu, tap **Functions**, and the **Ping & Trace Route** tab.

### Source IP Address

Displays the configured **Source IP Address**. Refer to *MAC/IP/UDP* on page 172 for RFC 2544 and EtherBERT tests, and to *Smart Loopback* on page 262 for Smart Loopback test.

### Destination IP Address

Enter the **Destination IP Address** of the network device to be detected. The destination IP address is configurable only with **IPv4 Network Layer** (refer to *Modify Structure Button* on page 97). The accepted range for IPv4 is **0.0.0.0** (default) to **255.255.255.255**.

The default setting for IPv6 is **2001:0000:0000:0000:0000:0000:0000** or is set automatically to the IP address of the target module from the Remote Loopback mode. The destination IP address is configured only when **Ethernet/IPv6/UDP** is selected. The **IPv6 Address** can either be the **Link-Local IPv6 Address** or the **Global IPv6 Address**. The acceptable range for IPv6 is from **000:0000:0000:0000:0000:0000:0000:0001** to **FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF**.

### Stream

**Stream** is available with EtherSAM and Traffic Gen & Mon and allows to select a stream/service to use its source and destination IP addresses for the Ping and Trace Route tests.

### Use Stream

**Use Stream** is available with test application using stream/services and allows to use the source and destination IP of the defined or selected stream/services.

## Ping

- **Data Size (Bytes):** Enter the data size that will be sent to the network device to be detected. Choices are **0** to **1452 bytes**; **32 bytes** by default.
- **TTL for IPv4 and Hop Limit (TTL) for IPv6:** Enter the maximum number of hops the packet can go through. Choices are **1** to **255**; **128** by default.
- **IP TOS/DS for IPv4 and Traffic Class (TOS/DS) for IPv6:** Enter the type of service. Choices are **00** (default) to **FF**.
- **Flow Label (IPv6)** value acceptable range is from **0** (default) to **1048575**.
- **Timeout (ms):** Enter the maximum time allowed between an ICMP echo and response. Choices are **200 ms** to **10000 s**; **4000 ms** by default.
- **Delay (ms):** Enter the delay between each attempt (PING). Choices are **100** to **10000 ms**; **1000 ms** by default.
- **Attempts:** Select **n-Attempts** to specify the number of ping requests to send following a ping activation or select **Continuous** to ping continuously until manually stopped. If **n-Attempts** is selected, enter the number of ping attempts from **1** to **100**. The default setting is **n-Attempts** with **4** attempts.
- **Ping** button starts the ping tool with the specified settings.

## Trace Route

- **Max Hop Count:** Enter the maximum network device the packet is allowed to go through. Choices are **1** to **255**; **128** by default.
- **Timeout (ms):** Enter the maximum time allowed between an ICMP echo and response at each hop. Choices are **200 ms** to **10000 ms**; **4000 ms** by default.
- **Trace Route** button starts the trace route tool with the specified settings.

## Results

To succeed, a ping command shall be acknowledged by the network device within a given delay (**Timeout**). Typically a ping command can fail for the following reasons:

- The IP address is unavailable or unknown.
- The time allowed to perform the ping command is too short.
- The remote device is not supporting ICMP messaging.

To succeed, a trace route command shall be acknowledged by the network device within a given delay (Timeout). Typically a trace route command can fail for the following reasons:

- The IP address is unavailable or unknown.
- The time allowed to perform the trace route command is too short.
- The remote device is not supporting ICMP messaging.

The ping and trace route results are displayed with the following columns:

- **No.:** Indicates the attempt number.

## Test Functions

### *Ping & Trace Route*

---

➤ **Status:** Indicates the status of the attempt as follows:

| Status                         | Description                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Successful                     | Valid ICMP echo reply received.                                                                                                                                                                                                                                                                                                                               |
| User Aborted                   | When a user has manually stopped the ping/trace route function before the end of attempts.                                                                                                                                                                                                                                                                    |
| Time Out                       | When an ICMP echo reply was not received within the defined timeout.                                                                                                                                                                                                                                                                                          |
| Destination Invalid            | With reserved IP addresses:<br>For IPv4: 0.0.0.0, 127.0.0.0, and all addresses above 240.0.0.0 (Class E and above).<br>For IPv6: 0::/8 (reserved/unspecified), 0::1/128 (Loopback), FF00::/8 (Multicast).                                                                                                                                                     |
| TTL Expired (ping test)        | When the number of TTL was insufficient to reach the destination host.                                                                                                                                                                                                                                                                                        |
| Hop Reached (trace route test) | When a Time Exceeded message is received from a host while executing the trace route function.                                                                                                                                                                                                                                                                |
| Destination Unreachable        | For IPv4: When the IP address is unreachable (no default gateway for an IP address, not in the same subnet, or an ICMP Unreachable message is received).<br>For IPv6: When the IP address is unreachable (no default gateway for an IP address, not in the same subnet, or address resolution failed or an ICMP Destination Unreachable message is received). |
| Data Corrupted                 | Parameter problem message is received or data corruption is found for IPv4.                                                                                                                                                                                                                                                                                   |
| Discarded                      | Congestion has been detected and the request cannot be transmitted.                                                                                                                                                                                                                                                                                           |
| Packet Too Big                 | Packet Too Big message is received in response to a packet that the router cannot forward because the packet is larger than the MTU of the outgoing link. It is only applicable for the <b>IPv6 version</b> .                                                                                                                                                 |
| Undefined                      | For any other errors in ping/trace route that do not fall into one of the above description.                                                                                                                                                                                                                                                                  |

➤ **Replied Details**

For ping, indicates the IP address of the replier, the buffer size of the ICMP echo response, the time of response in milliseconds, and the TTL of the ICMP echo response.

For trace route, indicates the IP address of the replier, and the time of response in milliseconds.

**Statistics**

➤ **Packets Transmitted** indicates the number of sent packets.

➤ **Packets Received** indicates the number of received packets.

The following statistics are only available for the ping test.

➤ **Percentage Lost (%)** indicates the percentage of packets lost.

➤ **Min Round Trip Time (ms)** indicates the minimum time recorded for a ping request to be answered.

➤ **Max Round Trip Time (ms)** indicates the maximum time recorded for a ping request to be answered.

➤ **Avg. Round Trip Time (ms)** indicates the average time required for a ping request to be answered.

## Pointer Adjustment

From the **Test** menu, tap **Functions**, and the **Pointer Adjustment** tab.

### TX Pointer Adjustment

**Note:** *Only available in **Coupled** topology.*

The pointer adjustment supports two modes of operation: **Manual** and **Sequence**. Both modes offer the generation of pointer events even when the test is not started.

### TX Pointer Adjustment - Manual Button

#### Step

##### ➤ Value

For STS/AU: Select the number of positive (Increment) or negative (Decrement) pointer adjustments to include into the STS-n (SONET) or AU-n (SDH): **1** (default) to **1000**. For multiple pointer adjustments, the pointer adjustment rate is 1 adjustment at every 4 frames.

For VT/TU: Select the number of positive (Increment) or negative (Decrement) pointer adjustment to include into the VTn (SONET) or TU-n (SDH): **1** (default) to **1000**. For multiple pointer adjustments, the pointer adjustment rate is 1 adjustment at every 4 multiframes.

- **Increment** button sends the positive pointer adjustment defined.
- **Decrement** button sends the negative pointer adjustment defined.
- **Pointer Value** indicates the current pointer value.

## Jump

- **New Pointer** allows to select a new pointer value:

For STS/AU: **0** (default) to **782**

For VT/TU:

| Path  | Range    |
|-------|----------|
| VT1.5 | 0 to 103 |
| VT2   | 0 to 139 |
| TU-3  | 0 to 764 |
| TU-11 | 0 to 103 |
| TU-12 | 0 to 139 |

- **Inject** button sends the new pointer value.
- **New Data Flag** (NDF) check box when selected inserts a New Data Flag with the pointer adjustment when the Inject button is tapped.

For STS/AU: When NDF is enabled, bits 1 to 4 of the pointer word (H1 and H2 bytes) are set to “1001” when executing a pointer jump.

For VT/TU: When NDF is enabled, bits 1 to 4 of the pointer word (V1 and V2 bytes) are set to “1001” when executing a pointer jump.

## TX Pointer Adjustment - Sequence Button

**Note:** The pointer sequence is only supported on one test layer; either on VT/TU layer or on STS/AU when the test doesn't contain VT/TU mapping. The field next to the **Sequence** operation mode button indicates the path level used for the sequence pointer adjustment.

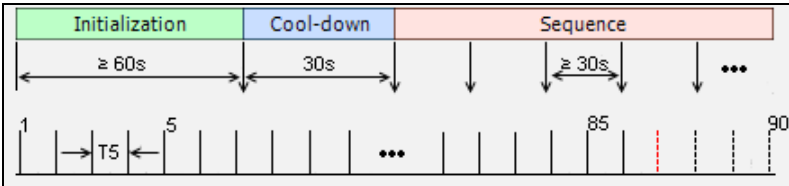
- **Sequence: T.105-03/GR-253** allows the selection of the pointer sequence pattern based on the **T.105-03/GR-253** standard.

| Pointer Sequence Pattern                           | Available with                                 |
|----------------------------------------------------|------------------------------------------------|
| Single pointers of opposite polarity               | AU-x, TU-3, TU-11, TU-12                       |
| Regular pointers plus one double pointer           | AU-x, TU-3, TU-11, TU-12                       |
| Regular pointers with one missing pointer          | AU-x, TU-3, TU-11, TU-12                       |
| Double pointers of opposite polarity               | AU-x, TU-3, TU-11, TU-12                       |
| Single pointer adjustment                          | STS-x, VT1.5, VT2,<br>AU-x, TU-3, TU-11, TU-12 |
| Burst pointer adjustment                           | STS-x, VT1.5, VT2,<br>AU-x, TU-3, TU-11, TU-12 |
| Phase transient                                    | STS-x, VT1.5, VT2,<br>AU-x, TU-3, TU-11, TU-12 |
| Periodic pointer adjustment 87-3 pattern           | STS-x, AU-x, TU-3                              |
| Periodic 87-3 with Add                             | STS-x, AU-x, TU-3                              |
| Periodic 87-3 with Cancel                          | STS-x, AU-x, TU-3                              |
| Periodic pointer adjustment continuous             | STS-x, VT1.5, VT2,<br>AU-x, TU-3, TU-11, TU-12 |
| Periodic pointer adjustment continuous with Add    | STS-x, VT1.5, VT2,<br>AU-x, TU-3, TU-11, TU-12 |
| Periodic pointer adjustment continuous with Cancel | STS-x, VT1.5, VT2,<br>AU-x, TU-3, TU-11, TU-12 |
| Periodic pointer adjustment 26-1 pattern           | VT1.5, TU-11                                   |
| Periodic 26-1 with Add                             | VT1.5, TU-11                                   |
| Periodic 26-1 with Cancel                          | VT1.5, TU-11                                   |

► **Initialization / Cool Down / Sequence**

The following time line examples show the initialization, cool down, and the pointer sequence according to the selected sequence and parameters.

**Example 1: Periodic 87-3 with Cancel**



**Example 2: Regular pointers plus one double pointer**



Legend:

|  | Description                                                                                                                                                                          |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | When located at the end (right) of the sequence, indicates a continuous repetition of the pointer sequence.<br>When located within the sequence, indicates a repetition of pointers. |
|  | Regular pointer event or sequence.                                                                                                                                                   |
|  | Cancel event.                                                                                                                                                                        |
|  | Special event like an extra cancel event (for example in <b>Periodic 87-3 with Cancel</b> ) or a missing event from the <b>Regular pointers with one missing pointer</b> sequence.   |
|  | Special event like add, double pointer, etc.                                                                                                                                         |
|  | Indicates that the sequence is periodic with special event.                                                                                                                          |

## Test Functions

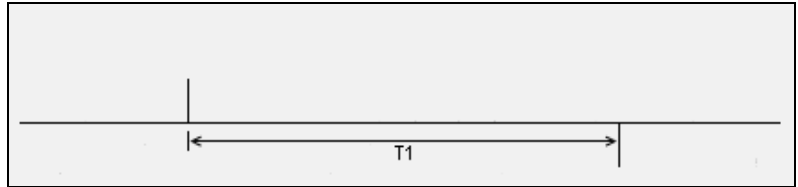
### Pointer Adjustment

- **T1 to T6** are configurable duration parameters. The range of the duration parameters as well as their availability versus pointer sequence are described in the following table.

| Pointer Sequence Pattern                           | Parameter | Duration range                                                                                  |
|----------------------------------------------------|-----------|-------------------------------------------------------------------------------------------------|
| Single pointers of opposite polarity               | T1        | 10 to 30 s (default 10 s)                                                                       |
| Regular pointers plus one double pointer           | T2        | AU/TU-3: 7.5 ms to 30 s (default 0.333 s)<br>TU-11/12: 0.2 s to 30 s (default 0.75 s)           |
|                                                    | T3        | AU/TU-3: 0.5 ms<br>TU-11/12: 2 ms                                                               |
| Regular pointers with one missing pointer          | T2        | AU/TU-3: 7.5 ms to 30 s (default 0.333 s)<br>TU-11/12: 0.2 s to 30 s (default 0.75 s)           |
| Double pointers of opposite polarity               | T1        | 10 to 30 s (default 10 s)                                                                       |
|                                                    | T3        | STS-x/AU-x/TU-3: 0.5 ms to 1 s (default 0.5 ms)<br>VT-x/TU-11/12: 2 ms to 1 s (default 2 ms)    |
| Single pointer adjustment                          | T6        | 30 to 60 s (default 30 s)                                                                       |
| Burst pointer adjustment                           | T4        | STS-x/AU-x/TU-3: 0.5 ms<br>VT-x/TU-11/12: 2ms                                                   |
|                                                    | T6        | 30 to 60 s (default 30 s)                                                                       |
| Phase transient                                    | T6        | 30 to 60 s (default 30 s)                                                                       |
| Periodic pointer adjustment 87-3 pattern           | T5        | 7.5 ms to 10 s (default 0.333 s)                                                                |
| Periodic 87-3 with Add                             | T4        | 0.5 ms                                                                                          |
|                                                    | T5        | 7.5 ms to 10 s (default 0.333 s)                                                                |
| Periodic 87-3 with Cancel                          | T5        | 7.5 ms to 10 s (default 0.333 s)                                                                |
| Periodic pointer adjustment continuous             | T5        | STS-x/AU-x/TU-3: 7.5 ms to 10 s (default 0.333 s)<br>VT-x/TU-11/12: 0.2 s to 10s (default 1 s)  |
| Periodic pointer adjustment continuous with Add    | T4        | STS-x/AU-x/TU-3: 0.5 ms<br>VT-x/TU-11/12: 2 ms                                                  |
|                                                    | T5        | STS-x/AU-x/TU-3: 7.5 ms to 10 s (default 0.333 s)<br>VT-x/TU-11/12: 0.2 s to 10 s (default 1 s) |
| Periodic pointer adjustment continuous with Cancel | T5        | STS-x/AU-x/TU-3: 7.5 ms to 10 s (default 0.333 s)<br>VT-x/TU-11/12: 0.2 s to 10 s (default 1 s) |
| Periodic pointer adjustment 26-1 pattern           | T5        | 0.2 s to 10 s (default 1 s)                                                                     |
| Periodic 26-1 with Add                             | T4        | 2 ms                                                                                            |
|                                                    | T5        | 0.2 s to 10 s (default 1 s)                                                                     |
| Periodic 26-1 with Cancel                          | T5        | 0.2 s to 10 s (default 1 s)                                                                     |

- **T1 (s)** represents the interval between two pointer events.

Example of **Single pointer of opposite polarity** sequence.



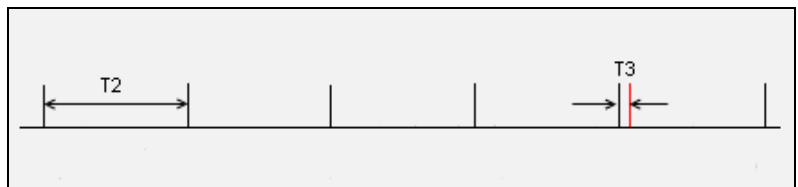
- **T2 (s)** represents the interval between successions of pointer events.

Example of **Regular pointers with one missing pointer** sequence.



- **T3 (ms)** represents the interval between back to back pointer events.

Example of **Regular pointers plus one double pointer** sequence.

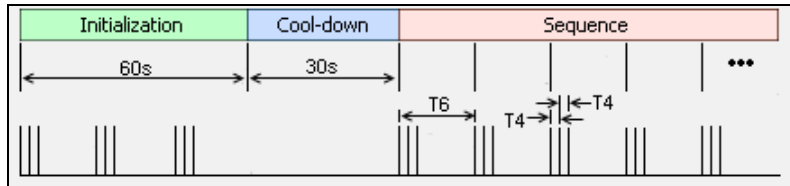


## Test Functions

### Pointer Adjustment

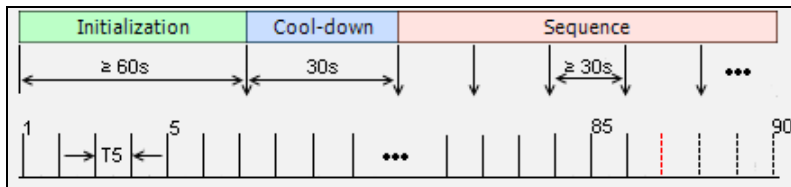
- **T4 (ms)** represents the interval between back to back pointer events in periodic pointer sequence.

Example of **Burst pointer adjustment** sequence.



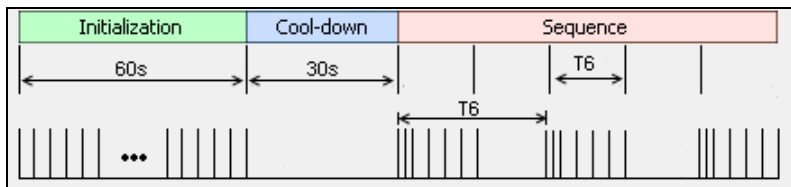
- **T5 (s)** represents the interval between successions of pointer events in a Periodic pointer sequence.

Example of **Periodic 87-3 with Cancel** sequence.



- **T6 (s)** represents the interval between successions of pointer events.

Example of **Phase transient** sequence.



- **Increment/Decrement** allows to determine if the pointer sequence will increment (positive) or decrement (negative) the pointer values.
- **Periodic** check box when selected, generates the pointer sequence continuously. The pointer sequence is generated only once when the **Periodic** check box is cleared. The capability to clear the **Periodic** check box is only available for the following pointer sequences:
  - Single pointers of opposite polarity
  - Regular pointers plus one double pointer
  - Regular pointers with one missing pointer
  - Double pointers of opposite polarity
- **Init-Cool** check box when selected, generates pointer action with three phases: initialization, Cool-down, and pointer sequence. Only the pointer sequence is generated when the **Init-Cool** check box is cleared.
- **Status** indicates the pointer event activity status.
  - **Initialization** indicates that the pointer sequence test is started and is running the initialization phase.
  - **Cool-down** indicates that the pointer sequence test is started and is running the cool down phase.
  - **Sequence** indicates that the pointer sequence test is started and is running the sequence phase; this phase runs until the Sequence is turn off.
  - **Static pointer** indicates that the pointer sequence is not started. The signal generator transmits a fix pointer value.
- **Pointer Value** indicates the current pointer value. Available even if the test is not started or if the sequence is not enabled.

## Test Functions

### Pointer Adjustment

- **Sequence** button when enabled, generates pointer events on a regular basis. The initialization and cool down sequence are described below for each pointer sequence pattern.

| Pointer Sequence Pattern                           | Initialization                                    | Cool down                                         |
|----------------------------------------------------|---------------------------------------------------|---------------------------------------------------|
| Single pointers of opposite polarity               | Basic sequence <sup>ab</sup><br>Duration ≥ 60 sec | Basic sequence <sup>ab</sup><br>Duration = 30 sec |
| Regular pointers plus one double pointer           | Add sequence<br>Duration ≥ 60 sec                 | Add sequence<br>Duration = 30 sec                 |
| Regular pointers with one missing pointer          | Cancel sequence<br>Duration ≥ 60 sec              | Cancel sequence<br>Duration = 30 sec              |
| Double pointers of opposite polarity               | Basic sequence <sup>ab</sup><br>Duration ≥ 60 sec | Basic sequence <sup>ab</sup><br>Duration = 30 sec |
| Single pointer adjustment                          | One pointer event per second<br>Duration = 60 sec | No pointer event<br>Duration = 30 sec             |
| Burst pointer adjustment                           |                                                   |                                                   |
| Phase transient                                    |                                                   |                                                   |
| Periodic pointer adjustment 87-3 pattern           | Basic sequence <sup>a</sup><br>Duration ≥ 60 sec  | Basic sequence <sup>a</sup><br>Duration = 30 sec  |
| Periodic 87-3 with Add                             |                                                   | Add sequence<br>Duration = 30 sec                 |
| Periodic 87-3 with Cancel                          |                                                   | Cancel sequence<br>Duration = 30 sec              |
| Periodic pointer adjustment continuous             | Basic sequence <sup>a</sup><br>Duration = 60 sec  | Basic sequence <sup>a</sup><br>Duration = 30 sec  |
| Periodic pointer adjustment continuous with Add    |                                                   | Add sequence<br>Duration = 30 sec                 |
| Periodic pointer adjustment continuous with Cancel |                                                   | Cancel sequence<br>Duration = 30 sec              |
| Periodic pointer adjustment 26-1 pattern           | Basic sequence <sup>a</sup><br>Duration ≥ 60 sec  | Basic sequence <sup>a</sup><br>Duration = 30 sec  |
| Periodic 26-1 with Add                             |                                                   | Add sequence<br>Duration = 30 sec                 |
| Periodic 26-1 with Cancel                          |                                                   | Cancel sequence<br>Duration = 30 sec              |

- The basic sequence corresponds to the pointer event pattern defined in the standard without any Add or extra Cancel event.
- Only available when the **Periodic** check box is selected.

## **RX Pointer Adjustment**

### ➤ **Pointer Value**

For STS/AU: Displays the value for the pointer, H1 and H2, indicating the offset in bytes between the pointer and the first byte of the STS-n (SONET) or AU-n (SDH).

For VT/TU: Displays the value of the pointer, V1 and V2, indicating the offset in bytes between the pointer and the first byte of the VTn (SONET) or TU-n (SDH) of the high order path. However, TU-3 considered a low order path, uses the H1, H2, H3 bytes for its location.

- **Cumulative Offset** indicates the difference between the pointer increment and the pointer decrement. A pointer jump will reset this value to **0**.
- **Ptr. Incr.** (Pointer Increment) gives statistics on positive pointer adjustment detected.
- **Ptr. Decr.** (Pointer Decrement) gives statistics on negative pointer adjustment detected.
- **NDF** (New Data Flag) gives statistics on pointer jumps containing a New Data Flag.

For STS/AU: Bits 1 to 4 of the pointer word (H1 and H2) detected are "1001".

For VT/TU: Bits 1 to 4 of the pointer word (V1 and V2) detected are "1001".

- **No NDF** (No New Data Flag) gives statistics on normal pointer jumps containing no NDF.

For STS/AU: Bit 1 to 4 of the pointer word (H1 and H2) detected are "0110".

For VT/TU: Bit 1 to 4 of the pointer word (V1 and V2) detected are "0110".

## RTD

**Note:** *Not available in Decoupled, or Through mode.*

Round Trip Delay (RTD) measurements are needed to quantify the time it takes for a signal to cross the network and come back. Usually, transport delay is due to two factors: long configured paths and transit times through the network elements along the path. Therefore, RTD measurements are significant in systems that require two-way interactive communication, such as voice telephony, or data systems where the round-trip time directly affects the throughput rate.

From the **Test** menu, tap **Functions**, and the **RTD** tab.

**Note:** *To do Round Trip Delay test, the remote NE should be configured to provide a loopback. However a local DSn test can be configured to use loopback codes allowing RTD testing.*

**Note:** *Be aware that RTD requires error free operation conditions to provide reliable results. Therefore, RTD results could be affected by error injection or error introduced by the network.*

## Mode

Allows the selection of the round trip delay test mode. Choices are **Single** (default) and **Continuous**. For CPRI/OBSAI test application, RTD operates in **Single** mode only.

- **Single** allows testing the round trip delay once.
- **Continuous** allows testing the round trip delay continuously in a repetitive manner (one RTD measurement every 2 seconds).

## Measure Delay Button

Allows enabling the round trip delay measurement.

For **Single** mode, the test is performed once and stops (the **Measure Delay** button turns off by itself). The **Measure Delay** button is only available when the test is running.

For **Continuous** mode, the test is performed continuously until the RTD test or the test case itself is stopped. However, the measurement will only start if the test is running or when it will be started. The **Measure Delay** button turns off by itself when the auto-calibration fails.

**Note:** *The Round Trip Delay (RTD) auto-calibration generates some bit errors when turning on the RTD measurement while the test is running or when starting the test while the **Measure Delay** button is enabled. A far end testing equipment will detect those bit errors.*

## Status

Indicates the test status of the RTD test. The status is only available when the test case is running.

- **Ready** indicates that the last calibration sequence has been successful and the test is now ready to perform RTD measurement.
- **Running** indicates that the RTD test is running.
- **Cancelled** indicates that the RTD test has been stopped before its completion.
- **Calibration Failed** indicates that the test calibration failed due to at least one of the following conditions:
  - Internal errors.
  - Presence of high number of bit errors.

Therefore the RTD statistics becomes unavailable since the test does not allow RTD testing.

## Test Functions

### RTD

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- **Disabled:** Indicates that the RTD feature is disabled. For example, this condition occurs for DS0/E0 test case having all its timeslots set to Idle/Tone.
- **--:** Indicates that the RTD measurement is not ready.

## Reset

Resets the RTD results and measurement counts.

## Delay

Indicates the time required for a bit to travel from the transmitter back to its receiver after crossing a far-end loopback.

- **Last** indicates the result of the last Round Trip Delay measurement.
- **Minimum** indicates the minimum Round Trip Delay recorded.
- **Maximum** indicates the maximum Round Trip Delay recorded.
- **Average** indicates the average Round Trip Delay value.
- **Unit** measurement selections are **ms** (default) and **μs**.

## Count

Indicates the total number of successful and failed measurements.

- **Successful:** A measurement is declared successful when the RTD is smaller or equal to 2 seconds.
- **Failed:** A measurement is declared failed when the RTD is > 2 seconds.

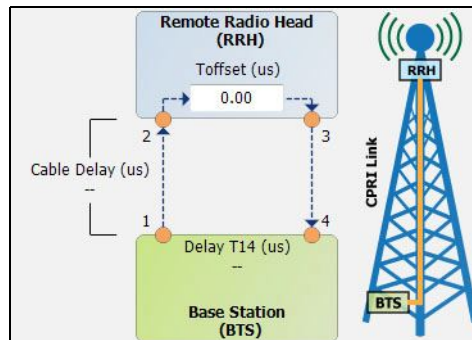
## RTD (CPRI Framed L2)

**Note:** Only available with CPRI Framed L2 in **Base Station** emulation mode.

Round Trip Delay (RTD) measurements are needed to quantify the time it takes for a signal to cross the remote radio head and come back.

**Note:** Be aware that RTD requires error free operation conditions to provide reliable results. Therefore, RTD results could be affected by error injection or error introduced by the network.

From the **Test** menu, tap **Functions**, and the **RTD** tab.



### Round Trip Delay

Indicates the time required for a bit to travel from one point to another.

- **Delay T14** indicates the round trip delay measurement from the Base Station going through the Remote Radio Head (including **Toffset**) and back to the Base Station. The **Delay T14** appearing on the diagram corresponds to the average value.
- **Cable Delay** indicates the cable delay measured from the Base Station to the Remote Radio Head (RRH) or vice-versa assuming that the cabling in both directions are the same. The **Cable Delay** appearing on the diagram corresponds to the average value.
- **Last** indicates the result of the last delay measurement.
- **Minimum** indicates the minimum delay recorded.
- **Maximum** indicates the maximum delay recorded.
- **Average** indicates the average delay value.
- **Unit** measurement selections are **μs** (default) and **ns**.
- **Toffset** allows the configuration of the internal delay introduced by the electronic components in the Radio Equipment (RE): 0 μs (default) to 66.67 μs.

**Note:** A warning icon appears next to the **Toffset** value when this value is larger than the **Delay T14** value measured indicating that the **Toffset** configured value maybe invalid thus corrupting the **Cable Delay** values reported.

## S-OAM Link Trace

From the **Test** menu, tap **Functions**, and the **S-OAM Link Trace** tab.

### Link Trace

- **Priority**<sup>1</sup> allows to select the VLAN user priority: **0** (default) to **7**. Refer to *VLAN ID and Priority* on page 639 for more information.
- **Drop Eligible**<sup>1</sup> is set to **No** (no frames will be dropped when congestion occurs) and is not configurable.
- **TTL** sets the Time To Live value: **1** to **255** (default is **128**).
- **Link Trace** button when ON (OFF by default) starts the link trace process. The **Link Trace** button turn OFF automatically once the link trace process is completed.

### Result

The table reports the following information for each valid LTR frames received in response to the last LTM frame sent: **TTL**, **MEP/MIP MAC Address**, **Forward**, and **Term MEP**.

- **Last Link Trace Status** displays the last link trace status.

| Status               | Description                                  |
|----------------------|----------------------------------------------|
| Pending              | No Results                                   |
| Successful           | Last Link Trace was successful               |
| Failed – LTR Timeout | Last Link Trace failed due to a LTR Timeout  |
| Failed – Invalid LTR | Last Link Trace failed due to an Invalid LTR |

- **TX LTM** indicates the count of transmitted LTM frames.

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1. Available when VLAN is enabled (see *VLAN* on page 190).

## Test Functions

### *S-OAM Link Trace*

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- **RX LTR** indicates the count of received LTR frames having their destination MAC address matching the unit port MAC address, and VLANs matching the unit port VLANs.
- **LTR Timeout** indicates the count of LTR Timeout event which occurs if a reply (LTR) from the Peer MEP is not received within 5 seconds.
- **Invalid LTR** indicates the count of LTR frames received with incorrect MEG/MD Level or Transaction ID.

## Signaling Bits

**Signaling Bits** is only available for **DSn/PDH BERT** test with DS1 interface, DS0 enabled, and SF, ESF, or SLC-96 framing.

From the **Test** menu, tap **Functions** and the **Signaling Bits** tab.

The monitoring of signaling bits of the 24 - DS0 channels is performed when test is running. Two signaling bits (**AB**) are monitored for SF or SLC-96 framing while four signaling bits (**ABCD**) are monitored for ESF.

# Spare Bits

**Note:** *Spare Bits are not available when the framing is set to **Unframed**.*

From the **Test** menu, tap **Functions**, tap the **Spare Bits** tab.

## TX

Tap a spare bits field to set its value.

**Note:** *All spare bits are reserved for national use and should be set to 1 when not used.*

➤ E4

**G.751 Bit 14, 15, 16:** Choices are **000** to **111** (default).

➤ E3

**G.751 Bit 12:** Choices are **0** and **1** (default).

➤ E1

- **S<sub>i0</sub>** is located in the bit 1 of the frame containing the frame alignment signal (FAS). Choices are **0** and **1** (default).
- **S<sub>i1</sub>** is located in the bit 1 of the frame not containing the frame alignment signal (FAS). Choices are **0** and **1** (default).
- **S<sub>a4</sub>** to **S<sub>a8</sub>** are located in bit 4 to 8 of frame number 1, 3, 5, and 7 of sub-multiframe 1 and 2. Choices are **0** and **1** (default) or **0000** to **1111** (default) depending on the selected framing.
- **TS16 Frame 0 Bit 5, 7, 8** are located in bit 5, 7, and 8 from Timeslot 16 of frame 0 of a E1 signal. Choices are **000** to **111** (default).

## **RX**

➤ E4

**G.751 Bit 14, 15, 16** are reserved for national use.

➤ E3

**G.751 Bit 12** is reserved for national use.

➤ E2

**G.742 Bit 12** represents Bit 12 from Timeslot 1, 2, 3, and 4 respectively.

➤ E1

➤ **S<sub>i0</sub>** is located in the bit 1 of the frame containing the frame alignment signal (FAS).

➤ **S<sub>i1</sub>** is located in the bit 1 of the frame not containing the frame alignment signal (FAS).

➤ **S<sub>a4</sub> to S<sub>a8</sub>** are located in bit 4 to 8 of frame number 1, 3, 5, and 7 of sub-multiframe 1 and 2. Possible values are either **0** and **1** or **0000** to **1111** depending on the framing.

➤ **TS16 Frame 0 Bit 5, 7, 8** are located in bit 5, 7, and 8 from Timeslot 16 of frame 0 of a E1 signal.

# Traffic Scan

The traffic scan tool provides the capability to discover and monitor VLAN traffic flows on the network.

*Not available with Framed Layer 1.* From the **Test** menu, tap **Functions**, and the **Traffic Scan** tab.

## Level

Allows the selection of the criteria that will be used to filter the incoming VLAN traffic flows. The default setting is **All**. Choices are:

| Level    | Description                                                                                                         |
|----------|---------------------------------------------------------------------------------------------------------------------|
| All      | Monitors untagged frames and up to 3 levels of stacked VLAN frames                                                  |
| Untagged | Monitors untagged frames only (no VLAN)                                                                             |
| C-VLAN   | Discovers/monitors only frames where the outer VLAN is a C-VLAN (TPID of 0x8100)                                    |
| S-VLAN   | Discovers/monitors only frames where the outer VLAN is a S-VLAN (TPID of 0x8100, 0x88A8, 0x9100, 0x9200, or 0x9300) |
| E-VLAN   | Discovers/monitors only frames where the outer VLAN is a E-VLAN (TPID of 0x8100, 0x88A8, 0x9100, 0x9200, or 0x9300) |

## Rate Layer

Allows the selection of the rate unit used for **Link Rate** and **Rate** statistics.

- **Line Utilization** is used to express the real line rate including the Preamble, SFD, and IFG.
- **Ethernet BW** (Bandwidth) is used to express the Ethernet bandwidth rate excluding the Preamble, SFD, and IFG.

## Discovered

Indicates the number of different traffic flows monitored based on the scan criteria.

## Link Rate (Mbit/s)

Indicates the network link rate based on the received frames with a valid FCS regardless if the frame matches or not the traffic flows, and regardless if the traffic flow was ignored due to the limit reached (see *Limit Reached*). The rate is expressed either in **Line Utilization** or **Ethernet Bandwidth** depending on the **Rate Layer** selected.

## Limit Reached

Up to 128 different traffic flows can be monitored, the **Limit Reached** text appears with a red background next to the **Discovered** field when the limit is reached.

## Scan

Starts/stops the traffic scan test.

## Monitored Frames Table

Statistics are gathered for each different traffic flow matching the scan criteria. Each different monitored traffic flow creates a separate entry in the scan table. When the limit is reached, new traffic flows are not considered in the table but the existing traffic flows are still monitored.

The level of VLAN (untagged, E-VLAN, S-VLAN, C-VLAN), and values of VLAN ID, Priority, and TPID are used to identify a traffic flow. Any difference in one of these values will create a separated entry in the table. PBB-TE frames are ignored.

**Note:** *Scan statistics are cleared when restarting the scan.*

### ➤ E-VLAN / S-VLAN / C-VLAN

- **ID** indicates the VLAN ID of the received traffic flow.
- **Priority** indicates the VLAN Priority of the received traffic flow.

**Note:** *The TPID indicating the Tag Protocol Identifier of the received traffic flow is reported in the test report.*

### ➤ Statistics

- **Frame Count** indicates for each traffic flow, the number of frames matching the selected scan criteria.

**Total** indicates the total number of frames matching the selected scan criteria.

- **Rate (Mbit/s)** indicates for each traffic flow, the rate of frames matching the selected scan criteria. The rate is expressed either in **Line Utilization** or **Ethernet Bandwidth** (see *Rate Layer*).

**Total** indicates the total rate of frames matching the selected scan criteria.

# 11 Test Control

This chapter describes the test control buttons available on the right navigation bar of the application.

| Button          | For more information, see:                          |
|-----------------|-----------------------------------------------------|
| Discover Remote | Discover Remote Button <i>on page 530</i>           |
| Headset DTMF    | Headset/DTMF Button <i>on page 533</i>              |
| Inject          | Inject Button <i>on page 535</i>                    |
| Laser           | Laser Button <i>on page 535</i>                     |
| Lpbk Tool       | Lpbk Tool Button (Loopback Tool) <i>on page 536</i> |
| Phone Book      | Phone Book Button <i>on page 543</i>                |
| Report          | Report Button <i>on page 547</i>                    |
| Reset           | Reset Button <i>on page 551</i>                     |
| Save/Load       | Save/Load Button <i>on page 552</i>                 |
| Start/Stop TX   | Start/Stop TX Button <i>on page 558</i>             |

## More/Less Button

The **More/Less** button appears when there is not enough room to display all available test control buttons. The **More** button expands the control buttons area to display all control buttons while the **Less** button closes the expanded area. The pin button can be used to keep open the expanded area.

## Discover Remote Button

The Discover Remote function allows to perform Ethernet tests in conjunction with a second test set (module) by scanning and connecting to any available EXFO Datacom remote module. The remote module is used to loop back the traffic via Smart Loopback or **Dual Test Set (DTS)** for simultaneous bidirectional RFC 2544, RFC 6349, or EtherSAM results.

**Note:** Only available with *EtherSAM, EtherBERT, RFC 2544, RFC 6349, and Traffic Gen & Mon* test applications.

## Remote Modules Discovery

- **Target** defines how to perform the scan to discover remote modules.
  - **Subnet** indicates to perform the scan based on the current subnet.
  - **Specific IP** indicates to perform the scan for a specific remote module IP address. Enter the IP address of the target module.

**Quick Ping** tests if the destination IP address can be reached. A message displays if the ping attempt is **Successful** or **Failed**.

- **Scan** button scans the subnet or a specific IP (see **Target**) to discover remote EXFO compatible module(s).

The discovered modules are listed in the table with their **IP Address**, **Remote ID**, **Capabilities**, and **Status** information. **Remote ID**, **Capabilities**, and **Status** are only available for remote MAX-800 Series, FTB-700G/800 Series, FTB-800v2 Series, and FTB-88000 Series modules.

- **Capabilities** indicates the loopback capabilities of the remote module using the following test application icons:  
Smart Loopback, RFC 2544, RFC 6349, and/or EtherSAM.

- **Status** indicates the status of the remote module.

| Status                                       | Description                                                                                                 |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| <b>Idle</b> -<test application> <sup>a</sup> | The specified test application is selected but not running.                                                 |
| <b>Busy</b> -<test application> <sup>b</sup> | The specified test application is running.                                                                  |
| <b>Not Responding</b>                        | No response from the specified IP address (only possible when <b>Target</b> is set to <b>Specific IP</b> ). |

- Possible test applications: EtherSAM, RFC 2544, RFC 6349, EtherBERT, Traffic Gen & Mon, Smart Loopback, Through Mode, TCP Throughput, Carrier Ethernet OAM, Cable Test, 1588 PTP, or SyncE.
- Possible test applications: EtherSAM, RFC 2544, RFC 6349, EtherBERT, Traffic Gen & Mon, Smart Loopback, TCP Throughput, Carrier Ethernet OAM, 1588 PTP, or SyncE.

- **Loop Up** and **Loop Down** buttons (Not available with RFC 6349 test application)

- **Loop Up** establishes the connection with the selected remote module and sets the remote module into **Smart Loopback** test application.

If a remote module is in any busy status a user confirmation is required to proceed with the Loop Up command.

Following a successful loop up, the IP address of the remote module will be used as the destination IP address for the test.

Once the connection is established with the remote module, the local module can be set for EtherSAM, RFC 2544, EtherBERT, or Traffic Gen & Mon testing.

- **Loop Down** ends the connection between the local and the remote modules.

## Test Control

### *Discover Remote Button*

---

- **Connect** and **Disconnect** buttons are only available with RFC 2544, RFC 6349, and EtherSAM test applications.
- **Connect** establishes the connection with the selected remote module and sets the remote module into either DTS RFC 2544, DTS RFC 6349, or DTS EtherSAM test application, depending on the active test on the local module.

If a remote module is in any busy status a user confirmation is required to proceed with the Loop Up command.

Following a successful connection, the IP address of the remote module will be used as the destination IP address for the test.

- **Disconnect** ends the connection between the local and the remote modules.

## Local Module Identification

**Module ID** is used to easily identify this module in case another NetBlazer is performing a discovery scan. Up to 16 alpha-numeric characters are allowed.

## Headset/DTMF Button

**Note:** Only available with **ISDN PRI** test application.

The **Headset/DTMF** allows to connect a B-Channel (Speech or 3.1 kHz) to the headset and DTMF tones can be generated using the keyboard.

### Enable/Disable Headset and DTMF

- **Enable Headset and DTMF** button is used to enable the Headset and DTMF on the selected channel. The button is only available when one or more **Speech** or **3.1 kHz** calls are active, otherwise the button is grayed out.
- **Disable Headset and DTMF** button indicates that the Headset and DTMF is enabled on the selected channel. Tapping on the **Disable Headset and DTMF** button disables the Headset and DTMF from the selected channel.

### Channel

Allows to select the channel used to connect the Headset and DTMF. Only active **Speech** and **3.1 kHz** channels are displayed. Other channels including the D-Channel will not be available.

## Headset

**Note:** *The settings here and on the platform are independent but platform settings may limit level control. For more information, refer to Adjusting Microphone and Speaker Volume from the platform user guide.*

- **Speaker Volume:** The slide bar and +/- buttons are used to increase or decrease the volume of the speaker.
- **MIC Volume:** The slide bar and +/- buttons are used to increase or decrease the volume of the microphone.

## DTMF

The DTMF phone-style button grid is used to enter the standard DTMF tone (0-9, \*, #). Alternatively the hard keyboard of the FTB-1 platform can be used.

## Inject Button

Injects alarms/errors based on settings from the *Inject Button* on page 346.

## Laser Button

The **Laser** button enables or disables the laser for optical interfaces.

| Laser Button                                                                      | Border Color | Description   |
|-----------------------------------------------------------------------------------|--------------|---------------|
|  | Black        | Laser is off. |
|  | Red          | Laser is on.  |

**Note:** For SFP+ power level 2, a delay of up to 90 seconds may be required before generating/transmitting (TX) the laser signal as defined in the *Specifications for Enhanced Small Form Factor Pluggable Module (SFF-8431)*.

## Lpbk Tool Button (Loopback Tool)

The Loopback Tool provides the capability of looping back the Ethernet frames/packets that are received on the loopback tool port.

Pressing the **Lpbk Tool** button opens the Loopback Tool pop-up and powers up the port unused by the main test application (it does not start looping back the frames yet). The Loopback Tool starts looping back the Ethernet frames/packets that are received when pressing on the **Loopback** button from the **Loopback Tool** tab.

**Note:** *The **Lpbk Tool** button is available when the main test application is any Ethernet test application at the exception of **Through mode**.*

**Note:** *The Loopback Tool is independent from the main test **Start/Stop**, **Reset** and **Test Timer**.*

**Note:** *Enabling/disabling the Laser control affects both the main test application and the Loopback Tool when applicable (if both test and tool are using an optical port).*

## Loopback Tool tab

The **Loopback Tool** tab allows the configuration of the loopback parameters and displays the traffic statistics as well as the S-OAM Responder statistics.

Press the **Lpbk Tool** button and select the **Loopback Tool** tab.

- **Status:** The status field displays the current status of the Loopback test.
  - **-- (Idle):** Loopback Tool is not looping back frames and results are not available.
  - **In Progress:** Loopback Tool is looping back frames.
  - **Completed:** Loopback Tool is not looping back frames but results are available. The test **Status** indicates **Completed** when the loopback tool has been stopped.
- **Start Time:** The time when the Loopback Tool was started.
- **Transparent (Pseudo-Physical)** check box when selected (cleared by default), determines that the Loopback tool operates as a physical loopback by transmitting all received frames unaltered and without discrimination.

**In transparent mode, the Network tab and the S-OAM Responder statistics are not available.**

**Note:** *The **Transparent** mode is intended to be used for point-to-point topology; not for switched or routed networks. Use the **Transparent** mode with caution because all received frames are looped back without discrimination.*

## Test Control

### *Lpbk Tool Button (Loopback Tool)*

---

- **Loopback Mode** determines at which layer the address/port swapping is limited.
  - **Ethernet** swaps the MAC addresses of received packets having their **Destination MAC** address matching the MAC address of the loopback port.
  - **Ethernet (All Unicast)** swaps the MAC addresses of received packets having Unicast **Destination MAC** address.
  - **IP**, for Ethernet Layer 3 and 4, swaps the MAC and IP addresses of received packets having their **Destination IP** address matching the IP address of the loopback port. For Ethernet Layer 2, swaps the **MAC addresses** for packets having their **Destination MAC** address matching the MAC address of the loopback port.
  - **UDP/TCP** (default), for Ethernet Layer 4, swaps the UDP or TCP ports and the MAC and IP addresses of received packets having their **Destination IP** address matching the IP address of the loopback port. For Ethernet Layer 3, swaps the MAC and IP addresses for packets having their **Destination IP** address matching the IP address of the loopback port. For Ethernet Layer 2, swaps the **MAC addresses** for packets having their **Destination MAC** address matching the MAC address of the loopback port.
- **Traffic**
  - **Line Utilization (%)** indicates the current percentage of the transmitting/receiving line rate utilization.
  - **Ethernet BW (Mbit/s)** indicates the current transmitting/receiving data rate expressed in Mbit/s.
  - **Frame Rate (frame/s)** indicates the current transmitted/received number of frames (including bad frames, Broadcast frames and Multicast frames) in frame per second.
  - **Frame Count** indicates the total number of transmitted/received valid and invalid frames.

- **S-OAM Responder** check box when selected (default) allows to respond to LBM, LTM, DMM, LMM, and SLM valid messages (**Lpbk Tool** must be started, see **Loopback** button below). Traffic statistics are also monitored (refer to *Responder* on page 452).

| Responds to... message | Responds with... message |
|------------------------|--------------------------|
| LBM                    | LBR                      |
| LTM                    | LTR                      |
| DMM                    | DMR                      |
| LMM                    | LMR                      |
| SLM                    | SLR                      |

**Responder - TX Count** reports respectively the count of LBR, LTR, DMR, LMR, SLR, and the total of frames transmitted.

**Responder - RX Count** reports counts of valid LBM, LTM, DMM, LMM, SLM, and the total of frames received. A valid messages must have its destination MAC address matching either the unit port Unicast MAC address or a Multicast class 1 address<sup>1</sup>.

- **Loopback** button starts/stops looping back the frames/packets that are received. The default value is disabled.

---

1. Refer to *Unicast/Multicast Addresses for Ethernet OAM* on page 638 for more information.

### Interface Tab

#### ➤ Physical Interface

- **Interface/Rate** allows the selection of the loopback tool interface rate: **10/100/1000M Electrical** (default), **100M Optical**, **1GE Optical**, or **10GE LAN**. **10GE LAN** is only available when the loopback tool runs on Port #1.
- **Connector** displays the NetBlazer's port for the selected interface/rate.

| Interface/Rate              | Connector         |                   |
|-----------------------------|-------------------|-------------------|
|                             | When using Port 1 | When using Port 2 |
| 10GE LAN                    | Port 1 - SFP+     |                   |
| 1GE Optical<br>100M Optical | Port 1 - SFP      | Port 2 - SFP      |
| 10/100/1000M Electrical     | Port 1 - RJ45     | Port 2 - RJ45     |

- **Clock Mode:** Displays the clock mode  
**Internal:** Internal clock of the unit (STRATUM 3).
- **RX Power (dBm)** indicates the current received power level of the optical laser in dBm.  
Green: Power level in range.  
Yellow: Power level out-of-range.  
Red: Loss of signal or power level is close to damage.  
Gray: Invalid operational range value or not supported by the optical transceiver.
- **Power Range (dBm)** indicates, when supported, the received power level range of the optical laser in dBm.
- **RX Frequency (MHz/GHz)** indicates the frequency of the input signal. When no frequency reading is possible, "--" is displayed.

➤ **LINK**

- **Auto-Negotiation** check box when selected, enables the link auto-negotiation and allows to set the port **Speed**, **Duplex**, **Flow Control**, and **Local Clock** parameters. Those settings are not applied immediately to the port, they are used only when the negotiation process is started and take effect only when the auto-negotiation succeeds. However current settings are applied immediately to the port when the **Auto-Negotiation** check box is cleared. The **Auto-Negotiation** check box is automatically selected for 1GE Electrical interface and is not configurable. Available with **10/100/1000M Electrical** interface.
- **Speed**, available with **10/100/1000M Electrical** interface, allows the selection of the interface rate: **10M**, **100M**, **1GE**, or **Auto**<sup>1</sup>. The negotiated speed will be displayed next to the **Speed** field selection.
- **Duplex** choices for **10M** and **100M** electrical interfaces are **Full Duplex** (default), **Half Duplex**, and **Auto**<sup>1</sup>. For other rates the Duplex is set to **Full Duplex**. The negotiated duplex will be displayed next to the **Duplex** field selection.
- **Flow Control** choices are **TX**, **RX**, **RX and TX**, **None** (default), and **Auto**<sup>1</sup>. When the **Flow Control** is set to **None**, pause frames received are ignored.

---

1. **Auto** is only available when the **Auto-Negotiation** check box is selected.

## Test Control

*Lpbk Tool Button (Loopback Tool)*

---

- **Cable Mode** is available with **10/100/1000M Electrical** interface.  
**Manual** mode is selected when the **Auto-Negotiation** check box is cleared and allows to select the type of cable: **MDI** (default) for straight through cable or **MDIX** for crossover cable.  
**Automatic** mode is selected when the **Auto-Negotiation** check box is selected and allows to automatically detect the MDI or MDIX cable type.
- **Local Clock** is only available with 1GE electrical interface and allows to set the provenance of the clock: **Master** (default), or **Slave**, or **Auto**<sup>1</sup>.

## Network tab

Refer to *Network* on page 185 for more information.

## SFP/SFP+ tab

Refer to *SFP/SFP+* on page 240 for more information.

---

1. **Auto** is only available when the **Auto-Negotiation** check box is selected.

## Phone Book Button

**Note:** Only available with *ISDN PRI* test application.

The **Phone Book** is used to configure, save, load, import, and export phone numbers and phone books.

### Configure tab

The **Configure** tab allows to save a phone number and associate a name to it.

#### ***To save an entry to the Phone Book:***

1. From the **Configure** tab, tap the **Create New Entry** button.
2. Enter a name associated to the phone number in the **Name** field. A maximum of 20 characters is allowed.
3. Enter the phone number in the **Number** field. A maximum of 30 digits is permitted.

A phone book can contain up to 100 entries. The list of phones is presented in alphabetical order.

#### ***To delete an entry from the Phone Book:***

1. Select the check box of each entry to be deleted. Alternatively, tap the **(Un)Select All** button to select or un-select all entries in a phone book.
2. Tap the **Delete** button.
3. Tap **Yes** to confirm.

#### ***To edit an entry in the Phone Book:***

1. Highlight the entry to be edited.
2. Enter the new name and/or phone number.

### Save/Load tab

The save function stores the phone book.

***To save a phone book:***

1. From the **Save/Load** tab, select the media where the file will be saved: **Internal Storage**<sup>1</sup> or **Removable Drives** (USB media for example) if present.
2. Tap on the **Save** button.
3. Type the name of the phone book file to be saved.
4. Tap **OK**.

The load function opens a previously saved phone book.

***To load a phone book:***

1. From the **Save/Load** tab, select the media from where the file is located: **Internal Storage**<sup>1</sup> or **Removable Drives** (USB media for example) if present.
2. Select the file from the list.
3. Tap the **Load** button.
4. Tap **OK**.

---

1. **Internal Storage** specifies that the file is saved in Documents\810-880-NetBlazer\PhoneBook.

***To rename a phone book file:***

- 1.** From the **Save/Load** tab, select the media from where the file is located: **Internal Storage**<sup>1</sup> or **Removable Drives** (USB media for example) if present.
- 2.** Select the file from the list.
- 3.** Tap the **Rename** button.
- 4.** Change the name of the phone book file.
- 5.** Tap **OK**.

***To delete a phone book file:***

- 1.** From the **Save/Load** tab, select the media from where the file is located: **Internal Storage**<sup>1</sup> or **Removable Drives** (USB media for example) if present.
- 2.** Select the file from the list.
- 3.** Tap the **Delete** button.
- 4.** Tap **Yes** to confirm the deletion.

### Import/Export tab

The import/export function allows to copy multiple files from a **Removable Drives to Internal Storage** (Import) or from **Internal Storage to Removable Drives** (Export).

#### ***To import/export phone book file(s):***

1. From the **Import/Export** tab, select the media from where the files are located: **Internal Storage**<sup>1</sup> or **Removable Drives** (USB media for example) if present.
2. Select the check box of each phone book file to be imported/exported. Alternatively, tap the **(Un)Select All** button to select or un-select all phone book files.
3. Select the destination where the file will be copied (**Copy To**).
4. Tap the **Copy** button.
5. Tap **Yes**.

#### ***To delete phone book file(s):***

1. From the **Import/Export** tab, select the media from where the files are located: **Internal Storage**<sup>1</sup> or **Removable Drives** (USB media for example) if present.
2. Select the check box of each phone book file to be deleted. alternatively, tap the **(Un)Select All** button to select or un-select all phone book files.
3. Tap the **Delete** button.
4. Tap **Yes** to confirm.

---

1. **Internal Storage** specifies that the file is saved in Documents\810-880-NetBlazer\PhoneBook.

## Report Button

The report contains all information about the current test including its setup and results.

**Note:** *Nothing prevents the configuration and alarm/error injection setup while the test has been stopped; thus, the report should be saved/printed before changing any test parameters to avoid printing discrepancy between the configuration and results.*

The **Report** button is available when the test is running or stopped, but the report generation is only possible when the test is stopped. It is possible to save, open, import, export, and delete test report(s).

## Config/Save Tab

The **Config/Save** tab allows to configure the report parameters and generate/save the report.

Tap the **Report** button and the **Config/Save** tab.

- **Job Information** parameters are used to identify the source of the report and are not mandatory. Enter the following job information if required: **Job ID**, **Contractor Name**, **Customer Name**, **Operator Name**, **Circuit ID**, and **Comment**. Up to 30 characters are allowed for each parameter at the exception of **Comment** for which 256 characters are allowed.

**Restore Default** reverts all **Job Information** parameters back to the default values.

## Test Control

### Report Button

---

- **Report Headlines and Content** parameters are used to identify the report and are not mandatory. Up to 30 characters are allowed for each parameter.
  - **Report Header** could be the company name.
  - **Report Title** could be the name of the product, name of test, test number, etc.
  - **Optional Content** allows to choose the optional content that can be part of the report:
    - All** (default) includes all optional content to the report.
    - None** excluded all optional content from the report.
    - Custom** allows to select the optional content to be part of the report.
  - **Choose Content**, available when the **Optional Content** is set to **Custom**, allows to select what will be part of the custom content.
- **Save Report**
  - **Auto-Generate File Name** check box, when selected (default), automatically generates the report file name which contains the name of the test, the date (YY.MM.DD), and time (HH.MM.SS). Clear the **Auto-Generate File Name** check box to enter a specific file name.
    - File Name** is the name of the report to be generated.
  - **Save To** is the media where the report file will be saved: **Internal Storage** (default), or **Removable Disk**. **Removable Disk** is available only when there is a removable disk/key connected to the FTB-1 USB port. **Internal Storage** specifies to save the report in **Documents\810-880-NetBlazer\Reports**.
  - **Display Report after Saving** check box when selected (default) automatically displays the report once it is generated.

**Note:** Once generated, the report can be opened from the Open Tab on page 549.

- **Turn on Report Generation Prompt** check box when selected (default) displays a pop-up every time a test case is stopped or completed to ask if a report generation is desired.
- **Format** is the file format for the report: **PDF** (default) and **Text**.
- **Logo** check box when selected (default) allows to include a logo to the report. Only available with the PDF file format. Select the logo picture that will be displayed on the report.
- To select another logo, first add a new logo by either copying the logo picture file to the following folder or by using the Import/Export (see page 550) then select the new logo from the list.  
**Documents\810-880-NetBlazer\Reports\Images**  
Supported picture file formats are jpg, gif, bmp, and png.
- **Save Report** button generates and saves the report on the selected media (**Save to**).

## Open Tab

Report files can be opened from this page.

Tap the **Report** button and the **Open** tab.

### ***To open a saved report:***

1. Select the media containing the file to open: **Internal Storage**, or a removable drive (USB key for example) if present. **Internal Storage** lists reports from **Documents\810-880-NetBlazer\Reports**.
2. Select the report file to open from the list.
3. Tap the **Open** button.

## Import/Export Tab

Allows to transfer and delete report files from an external USB media. Also allows to import images that can be used as the Logo for reports.

Tap the **Report** button and select the **Import/Export** tab.

### ***To import/export a report or image:***

1. Select either **Report** or **Image** as **File Type**.
2. Select the media from where the file(s) will be copied:  
**Internal Storage**<sup>1</sup>, or a removable drive (USB media for example) if present.
3. From the **Copy To** drop list, select where the file(s) will be copied:  
**Internal Storage** or **Removable Drives**.
4. Select the file(s) to be copied by selecting its corresponding check box or tap the **(Un)Select All** button to select or unselect all files in the list.
5. Tap the **Copy** button.
6. A confirmation is displayed, tap **OK**.

### ***To delete a report or image:***

1. Select either **Report** or **Image** as **File Type**.
2. Select the media from where the file(s) will be deleted;  
**Internal Storage**<sup>1</sup>, or a removable drive (USB media for example) if present.
3. Select the file(s) to be deleted by selecting its corresponding check box or tap the **(Un)Select All** button to select or unselect all files.
4. Tap the **Delete** button.
5. Tap **YES** to confirm the deletion.

---

1. **Internal Storage** lists files from **Documents\810-880-NetBlazer\Reports** for reports or **Documents\810-880-NetBlazer\Reports\Images** for images.

## Reset Button

Tap the **Reset** button to clear results, statistics, and logger content. The **Reset** button is only available when the test is running.

**Note:** *The **Reset** button is not available for EtherSAM, RFC 2544, RFC 6349, Cable Test, and Smart Loopback test applications.*

## Save/Load Button

The **Save/Load** button allows to save, load, import, export, and delete configuration file(s).

**Note:** *Save/Load is only possible when the test is stopped.*

## Save/Load Tab

Tap the **Save/Load** button and the **Save/Load** tab.

The save function stores the configuration of the NetBlazer including all test settings to a file.

### **To save a configuration:**

1. Select the media where the file will be saved: **Favorites**, **Others**, or a removable drive (USB media for example) if present.

**Favorites** specifies that the configuration file is saved in **Documents\810-880-NetBlazer\Configuration\Favorites**.

**Others** specifies that the configuration is saved in **Documents\810-880-NetBlazer\Configuration**.

2. Tap on the **Save** button.
3. Type the name of the configuration file to be saved and a description (**Config Summary**) if needed.
4. Select the **Add to Favorites** check box to save the configuration file in the **Favorites** list.
5. Tap **OK**.

The load function opens and applies the test configuration from a previously saved configuration file.

***To load a configuration:***

1. Select the media from where the file will be loaded; **Favorites**, **Factory Defined**, **Others**, or a removable drive (USB key for example) if present.

**Favorites** lists configuration files from:

Documents\810-880-NetBlazer\Configuration\Favorites.

**Factory Defined** lists the factory configuration files.

**Others** lists configuration files from:

Documents\810-880-NetBlazer\Configuration.

2. Select the file from the list.
3. Select or clear the **Overwrite report settings** check box as required. The **Overwrite report settings** check box when selected (default) replaces the current report settings by those from the configuration that is loaded.
4. Tap the **Load** button.

**Note:** *Configuration file has a limited backward compatibility (Typically the backward compatibility period is one year or three software releases).*

## Test Control

### *Save/Load Button*

---

#### **To rename a configuration file:**

1. Select the media where the file is located: **Favorites**, **Others**, or a removable drive (USB key for example) if present.

**Favorites** lists configuration files from:

Documents\810-880-NetBlazer\Configuration\Favorites.

**Others** lists configuration files from:

Documents\810-880-NetBlazer\Configuration.

2. Select the file from the list.
3. Tap the **Rename** button.
4. Change the name of the configuration file.
5. Select the **Add to Favorites** check box to save the configuration file in the **Favorites** list.
6. Tap **OK**.

***To delete a configuration file:***

1. Select the media where the file is located: **Favorites**, **Others**, or a removable drive (USB key for example) if present.

**Favorites** lists configuration files from:

Documents\810-880-NetBlazer\Configuration\Favorites.

**Others** lists configuration files from:

Documents\810-880-NetBlazer\Configuration.

2. Select the file from the list.
3. Tap the **Delete** button.
4. Tap **Yes** to confirm the deletion.

***To add a configuration file to the Favorites list:***

1. Select the media where the file is located: **Others**, or a removable drive (USB key for example) if present.

**Others** lists configuration files from:

Documents\810-880-NetBlazer\Configuration.

2. Select the file from the list.
3. Tap the **Add to Favorites** button.

***To remove a configuration file from the Favorites list:***

1. Select the **Favorites** internal storage. The configuration files from the following folder are listed:

**Documents\810-880-NetBlazer\Configuration\Favorites.**

2. Select the file from the list.
3. Tap the **Remove from Favorites** button. The file will be moved into the **Others** internal storage corresponding to the following folder:  
**Documents\810-880-NetBlazer\Configuration.**

### Import/Export Tab

Configuration files can be transferred to and from an external USB media as well as deleted.

Tap the **Save/Load** button and the **Import/Export** tab.

***To import/export a test configuration:***

1. Select the media from where the test configuration file(s) will be copied: **Favorites**, **Others**, or a removable drive (USB media for example) if present.

**Favorites** lists configuration files from:

Documents\810-880-NetBlazer\Configuration\Favorites.

**Others** lists configuration files from:

Documents\810-880-NetBlazer\Configuration.

2. From the **Copy To** drop list, select either **Favorites**, **Others**, or a **Removable Drives** as the destination location where the file(s) will be copied.

**Favorites** lists configuration files from:

Documents\810-880-NetBlazer\Configuration\Favorites.

**Others** lists configuration files from:

Documents\810-880-NetBlazer\Configuration.

3. Select the file(s) to be copied by selecting its corresponding check box or tap the **(Un)Select All** button to select or unselect all files in the list.
4. Tap the **Copy** button.
5. A confirmation is displayed, tap **OK**.

**To delete a test configuration:**

1. Select the media from where the file(s) will be deleted: **Favorites**, **Others**, or a removable drive (USB media for example) if present.

**Favorites** lists configuration files from:

Documents\810-880-NetBlazer\Configuration\Favorites.

**Others** lists configuration files from:

Documents\810-880-NetBlazer\Configuration.

2. Select the file(s) to be deleted by selecting its corresponding check box or tap the **(Un)Select All** button to select or unselect all files in the list.
3. Tap the **Delete** button.
4. Tap **YES** to confirm the deletion.

### Start/Stop | TX Button

The **Start/Stop | TX** button allows to manually start or stop any test as well as to enable traffic generation (Traffic Gen & Mon).

**To start the test:**

Tap the **Start** button to start the test. **Start** is available when the test is not running.

**To stop the test:**

Tap the **Stop** button to stop the test; the traffic generation (Traffic Gen & Mon) also stops if it was enabled (TX button). **Stop** is available when the test is running.

By default, a message is displayed when the test stops asking to generate a report. To disable this feature, see *Turn on Report Generation* on page 549. Nothing prevents the configuration and alarm/error injection setup while the test has been stopped; thus, if a report is required, it should be saved before changing any test parameters to avoid discrepancy between the configuration and results. See *Report Button* on page 547 to generate and save a report file.

**To enable traffic generation (available with Traffic Gen & Mon):**

Tap the **TX** button to enable traffic generation for all enabled streams; the test is also started if it was not running. While the test is running the **TX** button is available to enable/disable traffic generation. Some conditions, such as ARP not resolved, link down, etc., may prevent the stream to be transmitted.

## 12 **Power Failure Recovery**

The automatic power failure recovery is used to select, configure, and restart<sup>1</sup> the test that was running before the power failure; a test that was not running will be selected and configured but not started. To provide this level of protection, the configuration of the current test is automatically saved; the logger, injections, and configuration are periodically saved.

A power failure occurs when the AC power is down while the unit's battery has not sufficient power to keep the unit running. Pressing the FTB-1 power button for 5 seconds performs a power down reset and is also considered as a power failure condition.

When the power returns, the automatic power failure recovery restarts the FTB-1, the NetBlazer, then selects, configures, and starts the test if it was running before the power failure.

**Note:** *If the automatic power failure recovery is not used, restarting the NetBlazer after a power failure automatically selects, configures, and starts the test if it was running before the power failure.*

---

1. Not applicable for EtherSAM, RFC 2544, TCP Throughput, and Cable Test applications; these tests must be started manually.

## Enabling Power Failure Recovery

### ***To enable the automatic power failure recovery:***

- 1.** Enable launching the application when starting the FTB-1 (Refer to the FTB-1 user guide for more information):

From Mini ToolBox, tap on the **System Settings** button, the **Startup Applications** button, and select the NetBlazer's check box.

- 2.** Enable the FTB-1 automatic power on feature (Refer to the FTB-1 user guide for more information):

**2a.** From Mini ToolBox, tap on the **System Settings** button, and the **Startup Applications** button.

**2b.** Select the **Power on the unit when AC outlet is connected or after power outage** check box.

- 3.** Make sure that Windows does not require a user name and password. The FTB-1 is set to require user name and password by default. To disable Windows user name and password:

**3a.** From Mini ToolBox, tap on the **System Settings** button and the **Automatic Logon** button.

**3b.** Clear the **User must enter a user name and password to use this computer** check box and enter the password to confirm.

**Note:** *The power failure recovery is not used when the application closes normally.*

## When Using the Test Timer

Refer to *Timer* on page 279 for more information on test timer.

The test that was running will be re-created and started after a power failure if conditions described above are met in addition with the following test time conditions:

- The start time has not expired during the power failure.
- The stop time or the duration has not expired during the power failure.



## 13 *Suspend and Resume*

Suspend and Resume allow respectively the FTB-1 and its running applications to stop (Suspend) and to be quickly re-initialized (Resume) when the unit is turned back on.

### **Suspend Mode**

To enter the suspend mode, refer to the FTB-1 user guide. In Suspend Mode, the NetBlazer module is directly turned off and its configuration and injection information are kept. The Suspend Mode remains active as long as battery power or AC power is available. If the battery is drained the information is lost and the Resume operation is no more possible.

The following conditions prevent the activation of the Suspend Mode:

- A firmware download is in-progress
- Resume operation is in-progress.

**Note:** *The test will be stopped when entering the suspend mode meaning that the test logger content will be lost.*

## Suspend and Resume

### Resume Operation

---

## Resume Operation

To enter the resume operation, turn on the FTB-1 by pressing the power button. During the resume operation, the module is re-initialized.

**Note:** *In the event a manual shutdown of the FTB-1 occurs, while the resume operation is in-progress, the resume operation is terminated and all the test configuration information is lost.*

The following conditions prevent the resume operation:

- The module status has changed (mismatch in serial number or module is missing).
- A module failure is detected.

## 14 **Maintenance**

To help ensure long, trouble-free operation:

- Always inspect fiber-optic connectors before using them and clean them if necessary.
- Keep the unit free of dust.
- Clean the unit casing and front panel with a cloth slightly dampened with water.
- Store unit at room temperature in a clean and dry area. Keep the unit out of direct sunlight.
- Avoid high humidity or significant temperature fluctuations.
- Avoid unnecessary shocks and vibrations.
- If any liquids are spilled on or into the unit, turn off the power immediately, disconnect from any external power source, remove the batteries and let the unit dry completely.



### **WARNING**

The use of controls, adjustments and procedures, namely for operation and maintenance, other than those specified herein may result in hazardous radiation exposure or impair the protection provided by this unit.

## Cleaning LC Connectors

Under normal circumstances the cleaning of the LC connector is not required. However if the connector shows signs of debris or contamination, cleaning may be required.

### ***To clean a LC/SC/MPO-24 connector***

- 1.** Use a clean dry air (CDA) or a air gun to blow out the dust or contamination.
- 2.** Re-inspect the connector.
- 3.** If the connector is still not clean, use a commercial cleaner recommended by the SFP/SFP+ manufacturer.

**Note:** *Refer to the transceiver manufacturer for more detailed cleaning recommendations and instructions.*

## **Recalibrating the Unit**

EXFO manufacturing and service center calibrations are based on the ISO/IEC 17025 standard (*General Requirements for the Competence of Testing and Calibration Laboratories*). This standard states that calibration documents must not contain a calibration interval and that the user is responsible for determining the re-calibration date according to the actual use of the instrument.

The validity of specifications depends on operating conditions. For example, the calibration validity period can be longer or shorter depending on the intensity of use, environmental conditions and unit maintenance, as well as the specific requirements for your application. All of these elements must be taken into consideration when determining the appropriate calibration interval of this particular EXFO unit.

Under normal use, the recommended interval for your FTB-700G/800 Series is: 2 years.

For newly delivered units, EXFO has determined that the storage of this product for up to six months between calibration and shipment does not affect its performance (EXFO Policy PL-03).

## Maintenance

### *Recycling and Disposal*

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To help you with calibration follow-up, EXFO provides a special calibration label that complies with the ISO/IEC 17025 standard and indicates the unit calibration date and provides space to indicate the due date. Unless you have already established a specific calibration interval based on your own empirical data and requirements, EXFO would recommend that the next calibration date be established according to the following equation:

**Next calibration date = Date of first usage (if less than six months after the calibration date) + Recommended calibration period (2 years)**

To ensure that your unit conforms to the published specifications, calibration may be carried out at an EXFO service center or, depending on the product, at one of EXFO's certified service centers. Calibrations at EXFO are performed using standards traceable to national metrology institutes.

**Note:** *You may have purchased a FlexCare plan that covers calibrations. See the Service and Repairs section of this user documentation for more information on how to contact the service centers and to see if your plan qualifies.*

## Recycling and Disposal



This symbol on the product means that you should recycle or dispose of your product (including electric and electronic accessories) properly, in accordance with local regulations. Do not dispose of it in ordinary garbage receptacles.

For complete recycling/disposal information, visit the EXFO Web site at [www.exfo.com/recycle](http://www.exfo.com/recycle).

# 15 *Troubleshooting*

## Solving Common Problems

Before calling EXFO's technical support, please read the following common problems that can occur and their respective solution.

| Problem                                                                  | Possible Cause                                                                                      | Solution                                                                                                                  |
|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| Optical Laser LED is off and the connector is not generating the signal. | The <b>Laser On</b> option is disabled.                                                             | Ensure that the <b>Laser</b> button is enabled (On).                                                                      |
|                                                                          | There is a configuration mismatch between the inserted SFP and the rate selected for the test case. | Ensure that the SFP is supporting the rate used for the test case.                                                        |
|                                                                          | The SFP is not compatible with the FTB-700G/800 Series.                                             | Ensure to use a compatible SFP. Refer to <i>Modify Structure Button</i> on page 97 and <i>Specifications</i> on page 575. |

# Contacting the Technical Support Group

To obtain after-sales service or technical support for this product, contact EXFO at one of the following numbers. The Technical Support Group is available to take your calls from Monday to Friday, 8:00 a.m. to 7:00 p.m. (Eastern Time in North America).

### Technical Support Group

400 Godin Avenue  
Quebec (Quebec) G1M 2K2  
CANADA

1 866 683-0155 (USA and Canada)  
Tel.: 1 418 683-5498  
Fax: 1 418 683-9224  
support@exfo.com

For detailed information about technical support, and for a list of other worldwide locations, visit the EXFO Web site at [www.exfo.com](http://www.exfo.com).

If you have comments or suggestions about this user documentation, you can send them to [customer.feedback.manual@exfo.com](mailto:customer.feedback.manual@exfo.com).

To accelerate the process, please have information such as the name and the serial number (see the product identification label), as well as a description of your problem, close at hand.

## Transportation

Maintain a temperature range within specifications when transporting the unit. Transportation damage can occur from improper handling. The following steps are recommended to minimize the possibility of damage:

- Pack the unit in its original packing material when shipping.
- Avoid high humidity or large temperature fluctuations.
- Keep the unit out of direct sunlight.
- Avoid unnecessary shocks and vibrations.

# 16 **Warranty**

## **General Information**

EXFO Inc. (EXFO) warrants this equipment against defects in material and workmanship for a period of one year from the date of original shipment. EXFO also warrants that this equipment will meet applicable specifications under normal use.

During the warranty period, EXFO will, at its discretion, repair, replace, or issue credit for any defective product, as well as verify and adjust the product free of charge should the equipment need to be repaired or if the original calibration is erroneous. If the equipment is sent back for verification of calibration during the warranty period and found to meet all published specifications, EXFO will charge standard calibration fees.



### **IMPORTANT**

The warranty can become null and void if:

- unit has been tampered with, repaired, or worked upon by unauthorized individuals or non-EXFO personnel.
- warranty sticker has been removed.
- case screws, other than those specified in this guide, have been removed.
- case has been opened, other than as explained in this guide.
- unit serial number has been altered, erased, or removed.
- unit has been misused, neglected, or damaged by accident.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL EXFO BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

## Warranty

### *Liability*

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## Liability

EXFO shall not be liable for damages resulting from the use of the product, nor shall be responsible for any failure in the performance of other items to which the product is connected or the operation of any system of which the product may be a part.

EXFO shall not be liable for damages resulting from improper usage or unauthorized modification of the product, its accompanying accessories and software.

## Exclusions

EXFO reserves the right to make changes in the design or construction of any of its products at any time without incurring obligation to make any changes whatsoever on units purchased. Accessories, including but not limited to fuses, pilot lamps, batteries and universal interfaces (EUI) used with EXFO products are not covered by this warranty.

This warranty excludes failure resulting from: improper use or installation, normal wear and tear, accident, abuse, neglect, fire, water, lightning or other acts of nature, causes external to the product or other factors beyond the control of EXFO.



## IMPORTANT

In the case of products equipped with optical connectors, EXFO will charge a fee for replacing connectors that were damaged due to misuse or bad cleaning.

## Certification

EXFO certifies that this equipment met its published specifications at the time of shipment from the factory.

## Service and Repairs

EXFO commits to providing product service and repair for five years following the date of purchase.

***To send any equipment for service or repair:***

- 1.** Call one of EXFO's authorized service centers (see *EXFO Service Centers Worldwide* on page 574). Support personnel will determine if the equipment requires service, repair, or calibration.
- 2.** If equipment must be returned to EXFO or an authorized service center, support personnel will issue a Return Merchandise Authorization (RMA) number and provide an address for return.
- 3.** If possible, back up your data before sending the unit for repair.
- 4.** Pack the equipment in its original shipping material. Be sure to include a statement or report fully detailing the defect and the conditions under which it was observed.
- 5.** Return the equipment, prepaid, to the address given to you by support personnel. Be sure to write the RMA number on the shipping slip. *EXFO will refuse and return any package that does not bear an RMA number.*

**Note:** *A test setup fee will apply to any returned unit that, after test, is found to meet the applicable specifications.*

After repair, the equipment will be returned with a repair report. If the equipment is not under warranty, you will be invoiced for the cost appearing on this report. EXFO will pay return-to-customer shipping costs for equipment under warranty. Shipping insurance is at your expense.

Routine recalibration is not included in any of the warranty plans. Since calibrations/verifications are not covered by the basic or extended warranties, you may elect to purchase FlexCare Calibration/Verification Packages for a definite period of time. Contact an authorized service center (see *EXFO Service Centers Worldwide* on page 574).

## **Warranty**

*EXFO Service Centers Worldwide*

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### **EXFO Service Centers Worldwide**

If your product requires servicing, contact your nearest authorized service center.

#### **EXFO Headquarters Service Center**

400 Godin Avenue  
Quebec (Quebec) G1M 2K2  
CANADA

1 866 683-0155 (USA and Canada)  
Tel.: 1 418 683-5498  
Fax: 1 418 683-9224  
[support@exfo.com](mailto:support@exfo.com)

#### **EXFO Europe Service Center**

Winchester House, School Lane  
Chandlers Ford, Hampshire S053 4DG  
ENGLAND

Tel.: +44 2380 246800  
Fax: +44 2380 246801  
[support.europe@exfo.com](mailto:support.europe@exfo.com)

#### **EXFO Telecom Equipment (Shenzhen) Ltd.**

3rd Floor, Building 10,  
Yu Sheng Industrial Park (Gu Shu  
Crossing), No. 467,  
National Highway 107,  
Xixiang, Bao An District,  
Shenzhen, China, 518126

Tel: +86 (755) 2955 3100  
Fax: +86 (755) 2955 3101  
[support.asia@exfo.com](mailto:support.asia@exfo.com)

# **A** *Specifications*



## **IMPORTANT**

The following technical specifications can change without notice. The information presented in this section is provided as a reference only. To obtain this product's most recent technical specifications, visit the EXFO Web site at [www.exfo.com](http://www.exfo.com).



## **CAUTION**

The operation and storage temperatures, as well as the altitude, humidity and IP rating of some modules may differ from those specified for your FTB-1. In this case, always ensure that you comply with the most restrictive conditions (either module or FTB-1).

Specifications

General Specifications

General Specifications

|                                                                                                 |                                                                                                                                      |
|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Size (H x W x D)<br>- 860/860G/860GL/870:<br><br>- 810/880/720G/720G+/<br>730G/730G+:           | 130 mm x 252 mm x 36 mm<br>(5 1/8 in x 9 15/16 in x 1 7/16 in)<br><br>130 mm x 252 mm x 56 mm<br>(5 1/8 in x 9 15/16 in x 2 3/16 in) |
| Weight (without transceiver)<br>- 860/860G/860GL/870:<br>- 810/880:<br>- 720G/720G+/730G/730G+: | 0.58 kg (1.3 lb)<br>0.97 kg (2.1 lb)<br>1.02 kg (2.25 lb)                                                                            |
| Temperature                                                                                     | Operating: 0 °C to 50 °C (32 °F to 122 °F)<br>Storing: -40 °C to 70 °C (-40 °F to 158 °F)                                            |
| Relative humidity                                                                               | 0 % to 93 %, non-condensing                                                                                                          |
| Maximum operation altitude                                                                      | 5000 m (16000 ft)                                                                                                                    |
| Pollution degree                                                                                | 3                                                                                                                                    |
| Measurement category                                                                            | Not rated for measurement categories II, III, or IV                                                                                  |

# **B** *Glossary*

## **Acronym List**

|         |           |
|---------|-----------|
| 10B_ERR | 10B_Error |
| ?       | Help      |

### **A**

|      |                                |
|------|--------------------------------|
| AC   | Alternating Current            |
| ACH  | Associated Channel Header      |
| ACT  | Activity                       |
| AIS  | Alarm Indication Signal        |
| AMI  | Alternate Mark Inversion       |
| APS  | Automatic Protection Switching |
| ATM  | Asynchronous Transfer Mode     |
| AU-n | Administrative Unit-n          |
| AUI  | Attachment Unit Interface      |

### **B**

|      |                                   |
|------|-----------------------------------|
| B8ZS | Bipolar with 8 zero substitution  |
| BB   | Buffer to Buffer                  |
| BBE  | Background Block Error            |
| BBER | Background Block Error Ratio      |
| BDI  | Backward Defect Indication        |
| BDP  | Bandwidth Delay Product           |
| BEI  | Backward Error Indication         |
| BER  | Bit Error Rate                    |
| BERT | Bit Error Rate Test               |
| BIAE | Backward Incoming Alignment Error |

## Glossary

### Acronym List

---

|       |                                         |
|-------|-----------------------------------------|
| BIP   | Bit-Interleaved Parity                  |
| bit/s | Bit per second                          |
| BSD   | Backward Signal Degrade                 |
| BSF   | Backward Signal Fail                    |
| BTS   | Base Station (Base Transceiver Station) |

## C

|       |                                    |
|-------|------------------------------------|
| C     | Current                            |
| C-DCI | Client - Defect Clear Indication   |
| C-FDI | Client - Forward Defect Indication |
| C-LOS | Client - Loss Of Signal            |
| C-RDI | Client - Remote Defect Indication  |
| C&M   | Control & Management               |
| CAGE  | Commerce And Government Entities   |
| CBR   | Constant Bit Rate                  |
| CBS   | Committed Burst Size               |
| CC    | Continuity Check                   |
| CCM   | Continuity Check Message           |
| CE    | Congestion Encountered             |
| CD    | Connectivity Defect                |
| CDF   | Client Data Frames                 |
| CE    | European Conformity                |
| cHEC  | core Header Error Check            |
| CID   | Channel Identifier                 |
| CIR   | Committed Information Rate         |
| CLK   | Clock                              |
| CMF   | Client Management Frames           |
| CORR  | Correctable                        |

|        |                                   |
|--------|-----------------------------------|
| COS    | Class Of Service                  |
| CPRI   | Common Public Radio Interface     |
| CRC    | Cyclic Redundancy Check           |
| CRC-4  | Cyclic Redundancy Check on 4 bits |
| CRITIC | Critical                          |
| CSF    | Client Signal Fail                |
| CSV    | Comma Separated Value             |
| CV     | Code Violation                    |
| CW     | Code Word                         |

## D

|      |                                        |
|------|----------------------------------------|
| DA   | Destination MAC Address                |
| DAPI | Destination Access Point Identifier    |
| DAS  | Distributed Antenna Systems            |
| dBm  | Decibel - milliwatts                   |
| DCC  | Data Communications Channel            |
| DCI  | Defect Clear Indication                |
| DM   | Degraded Minutes                       |
| DMM  | Delay Measurement Message              |
| DMR  | Delay Measurement Reply                |
| DS0  | Digital Signal-level 0 (64 Kbit/s)     |
| DS1  | Digital Signal-level 1 (1.544 Mbit/s)  |
| DS3  | Digital Signal-level 3 (44.736 Mbit/s) |
| DSn  | Digital Signal-level n                 |
| DST  | Destination                            |
| DTE  | Data Terminal Equipment                |
| DUS  | Don't Use for Synchronization          |
| DUT  | Device Under Test                      |

## Glossary

### Acronym List

---

#### E

|         |                                                                      |
|---------|----------------------------------------------------------------------|
| E0      | European standard for digital transmission-level 0 (64 Kbit/s).      |
| E1      | European standard for digital transmission-level 1 (2.048 Mbit/s).   |
| E2      | European standard for digital transmission-level 2 (8.448 Mbit/s).   |
| E3      | European standard for digital transmission-level 3 (34.368 Mbit/s).  |
| E4      | European standard for digital transmission-level 4 (139.264 Mbit/s). |
| EB      | Errored Block                                                        |
| EBS     | Excess Burst Size                                                    |
| EC      | Error Count                                                          |
| ECN     | Explicit Congestion Notification                                     |
| ECT     | ECN Capable Transport                                                |
| EEC     | Ethernet Equipment Clock                                             |
| EFS     | Error Free Second                                                    |
| eHEC    | extension Header Error Check                                         |
| EIR     | Excess Information Rate                                              |
| EoOTN   | Ethernet over OTN                                                    |
| ERDI    | Enhanced RDI                                                         |
| ES      | Errored Second                                                       |
| ESMC    | Ethernet Synchronization Message Channel                             |
| ESF     | Extended Superframe                                                  |
| ESR     | Errored Second Ratio                                                 |
| EUI     | EXFO Universal Interfaces                                            |
| EXI     | Extension Header Identifier                                          |
| EXM     | Extension Header Mismatch                                            |
| EXT CLK | External Clock                                                       |

## F

|       |                                   |
|-------|-----------------------------------|
| FAS   | Frame Alignment Signal            |
| FC    | Fibre Channel                     |
| FCC   | Federal Communications Commission |
| FCS   | Frame Check Sequence              |
| FCC   | Federal Communications Commission |
| FD    | Frame Delay                       |
| FDI   | Forward Defect Indication         |
| FEC   | Forward Error Correction          |
| FLOGI | Fabric Login                      |
| FLR   | Frame Loss Ratio                  |
| fps   | Frame Per Second                  |
| FSD   | Forward Signal Degrade            |
| FSF   | Forward Signal Fail               |

## G

|         |                                  |
|---------|----------------------------------|
| GAL     | Generic Associated Channel Label |
| GE      | Gigabit Ethernet                 |
| Gbit/s  | Gigabit per second               |
| GCC     | General Communication Channel    |
| GFP     | Generic Framing Procedure        |
| GFP-F   | GFP - Framed                     |
| GFP-T   | GFP - Transparent                |
| GHz     | Giga Hertz                       |
| GM      | Grand Master                     |
| GMP     | Generic Mapping Procedure        |
| GMP OOS | GMP Out of Synchronization       |

## Glossary

### Acronym List

---

|     |                          |
|-----|--------------------------|
| GUA | Global IPv6 Address      |
| GUI | Graphical User Interface |

## H

|             |                                      |
|-------------|--------------------------------------|
| H           | History                              |
| HDB3        | High Density Bipolar 3 Code          |
| HDLC        | High-level Data Link Control         |
| HDMI        | High Definition Multimedia Interface |
| HDTV        | High Definition Television           |
| Hi-BER      | High-Bit Error Ratio                 |
| Hi-BER1027B | High-Bit Error Ratio 1027 Blocks     |
| HP-         | High Order Path -                    |
| Hz          | Hertz                                |

## I

|      |                                                 |
|------|-------------------------------------------------|
| IAE  | Incoming Alignment Error                        |
| IAIS | Incoming Alarm Indication Signal                |
| ID   | Identification                                  |
| IEC  | International Electrotechnical Commission       |
| IEC  | Incoming Error Count                            |
| IEEE | Institute of Electrical & Electronics Engineers |
| IFDV | Inter-Frame Delay Variation                     |
| IN   | Input                                           |
| IP   | Internet Protocol                               |
| IPDV | Inter Packet Delay Variation                    |
| IPTV | Internet Protocol Television                    |
| IPG  | Interframe Gap                                  |

|         |                                                                   |
|---------|-------------------------------------------------------------------|
| IPv4    | Internet Protocol version 4                                       |
| IPv6    | Internet Protocol version 6                                       |
| IQ Data | In-Phase and Quadrature modulation data (digital baseband signal) |
| ISDN    | Integrated Services Digital Network                               |
| ISM     | In-Service Monitoring                                             |

## J

|    |                       |
|----|-----------------------|
| JC | Justification Control |
|----|-----------------------|

## L

|     |                                |
|-----|--------------------------------|
| -L  | Line                           |
| L1  | CPRI Layer 1                   |
| L2  | CPRI Layer 2                   |
| LAN | Local Area Network             |
| LBM | Loopback Message               |
| LBR | Loopback Reply                 |
| LCD | Loss of Code-Group Delineation |
| LCK | Locked                         |
| LED | Light-Emitting Diode           |
| LER | Label Edge Router              |
| lb  | Pound                          |
| LBO | Line Build Out                 |
| LFD | Loss of Frame Delineation      |
| LLA | Link-Local IPv6 Address        |
| LLC | Logical Link Control           |
| LLM | Loss Measurement Message       |
| LMR | Loss Measurement Reply         |

## Glossary

### Acronym List

---

|            |                                                               |
|------------|---------------------------------------------------------------|
| LOA        | Loss Of Alignment                                             |
| LOAML      | Loss of Alignment Marker Lock                                 |
| LOAML1027B | Loss of Alignment Marker Lock 1027 Blocks                     |
| LOBL       | Loss of Block Lock                                            |
| LOBL1027B  | Loss of Block Lock 1027 Blocks                                |
| LOC        | Loss Of Clock                                                 |
| LOCS CSF   | Loss of Client Signal - Client Signal Fail                    |
| LOCCS CSF  | Loss of Client Character Synchronization - Client Signal Fail |
| LOF        | Loss Of Frame                                                 |
| LOFLOM     | Loss of Frame Loss Of Multiframe                              |
| LOM        | Loss Of Multiframe                                            |
| LOPPS-L    | Loss Of Pulse Per Second - Local                              |
| LOPPS-R    | Loss Of Pulse Per Second - Remote                             |
| LOP        | Loss Of Pointer                                               |
| LOR        | Loss Of Recovery                                              |
| LOS        | Loss Of Signal                                                |
| LSB        | Least-Significant Bit                                         |
| LSP        | Label Switch Path                                             |
| LSR        | Label Switching Router                                        |
| LSS        | Loss of Sequence Synchronization                              |
| LTC        | Loss of Tandem Connection                                     |
| LTM        | Link Trace Message                                            |
| LTR        | Link Trace Reply                                              |

## M

|    |                         |
|----|-------------------------|
| m  | Minute                  |
| m  | Meter                   |
| MA | Maintenance Association |

|        |                                                                |
|--------|----------------------------------------------------------------|
| MAC    | Media Access Control                                           |
| MAID   | Maintenance Association Identification                         |
| Mbit/s | Megabit per second                                             |
| MD     | Maintenance Domain                                             |
| MDI    | Media Dependant Interface (straight through Ethernet cable)    |
| MDIO   | Management Data Input/Output                                   |
| MDIX   | Media Dependant Interface Crossover (crossover Ethernet cable) |
| ME     | Maintenance Entity                                             |
| MEG    | ME Group                                                       |
| MEG ID | MEG Identification                                             |
| MEP    | MEG End Point                                                  |
| MFAS   | Multiframe Alignment Signal                                    |
| MHz    | Megahertz                                                      |
| MNO    | Mobile Network Operator                                        |
| MIP    | MEG Intermediate Point                                         |
| MPD    | Mean Path Delay                                                |
| MPLS   | Multiprotocol Label Switching                                  |
| MS     | Multiplex Section                                              |
| MSA    | Multisource Agreement                                          |
| MSB    | Most-Significant Bit                                           |
| MSEQV  | Marker Sequence Violation                                      |
| MSIM   | Multiplex Structure Identifier Mismatch                        |
| MTU    | Maximum Transfer Unit                                          |

## N

|      |                                    |
|------|------------------------------------|
| NATO | North Atlantic Treaty Organization |
| nAUI | CAUI or XLAUI                      |
| NDF  | New Data Flag                      |

## Glossary

### Acronym List

---

|     |                                    |
|-----|------------------------------------|
| NE  | Network Element                    |
| NID | Network Interface Device           |
| NJO | Negative Justification Opportunity |
| nm  | Nanometer                          |

## O

|       |                                                  |
|-------|--------------------------------------------------|
| OAM   | Operation, Administration, and Maintenance       |
| OBSAI | Open Base Station Architecture Initiative        |
| OC-   | Optical Carrier-                                 |
| OCI   | Open Connection Indication                       |
| ODI   | Outgoing Defect Indication                       |
| ODU   | Optical Data Unit                                |
| OEI   | Outgoing Error Indication                        |
| OH    | Overhead                                         |
| OOF   | Out-Of-Frame                                     |
| OOM   | Out-Of-Multiframe                                |
| OOR   | Out-Of-Recovery                                  |
| OOS   | Generic Mapping Procedure Out Of Synchronization |
| OOS   | Out-Of-Sequence                                  |
| OOSM  | Out-Of-Service Monitoring                        |
| OPU   | Optical Payload Unit                             |
| ORI   | Open Radio equipment Interface                   |
| OTN   | Optical Transport Network                        |
| OTU   | Optical Transport Unit                           |
| OUI   | Organizationally Unique Identifier               |
| OUT   | OUTput                                           |

**P**

|            |                                         |
|------------|-----------------------------------------|
| -P         | Path                                    |
| PC         | Personal Computer                       |
| PCD        | Path Connectivity Defect                |
| PCS        | Physical Coding Sublayer                |
| PD         | Payload Defect                          |
| PDI        | Payload Defect Indication               |
| PDU        | Protocol Data Unit                      |
| PE         | Provider Edge                           |
| pFCS       | payload Frame Check Sequence            |
| PFI        | Payload Frame Check Sequence Identifier |
| PHY        | Physical Layer Device                   |
| PLI        | Payload Length Indicator                |
| PLM        | Payload Label Mismatch                  |
| PLOGI      | Port Login                              |
| PM         | Performance Monitoring                  |
| PNO        | Provisionable by the Network Operator   |
| POS        | Position Field                          |
| POSV       | Position Field Violation                |
| PPD        | Path Payload Defect                     |
| ppm or PPM | parts per million                       |
| PRBS       | Pseudo Random Bit Sequence              |
| PRS        | Primary Reference Source/Clock          |
| PRC        | Primary Reference Source/Clock          |
| PSD        | Path Server Defect                      |
| PSI        | Payload Structure Identifier            |
| PTI        | Payload Type Identifier                 |
| PTP        | Precision Time Protocol                 |

## Glossary

### Acronym List

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|            |                           |
|------------|---------------------------|
| Ptr. Incr. | Pointer Increment         |
| Ptr. Decr. | Pointer Decrement         |
| PTSF       | Packet Timing Signal Fail |
| PW         | Pseudo-Wire               |

## Q

|      |                                  |
|------|----------------------------------|
| QL   | Quality Level                    |
| QoS  | Quality of Service               |
| QSFP | Quad Small Form Factor Pluggable |

## R

|       |                                  |
|-------|----------------------------------|
| R-LOF | Remote - Loss Of Frame           |
| R-LOS | Remote - Loss Of Signal          |
| RAI   | Remote Alarm Indication          |
| RDI   | Reverse Defect Indication        |
| RDI   | Remote Defect Indication         |
| RE    | Radio Equipment                  |
| REC   | Radio Equipment Control          |
| REI   | Remote Error Indicator           |
| RES   | Reserved                         |
| RFI   | Remote Failure Indication        |
| RMA   | Return Merchandise Authorization |
| RRH   | Remote Radio Head                |
| RS-   | Regenerator Section              |
| RTD   | Round Trip Delay                 |
| RTT   | Round Trip Time                  |
| RX    | Receive                          |

**S**

|       |                                        |
|-------|----------------------------------------|
| s     | second                                 |
| -S    | Section                                |
| S-OAM | Service - OAM                          |
| SA    | Source MAC Address                     |
| SAPI  | Source Access Point Identifier         |
| SB    | Superblock                             |
| SD    | Server Defect                          |
| SDH   | Synchronous Digital Hierarchy          |
| SDI   | Service Access Point Defect Indication |
| SDT   | Service Disruption Time                |
| SDTV  | Standard Digital Television            |
| SEF   | Severely Errored Framing               |
| SEP   | Severely Errored Period                |
| SEQV  | Sequence Violation                     |
| SES   | Severely Errored Second                |
| SESR  | Severely Errored Second Ratio          |
| SF    | Superframe                             |
| SFP   | Small Form Factor Pluggable            |
| SI    | International System                   |
| SLA   | Service-Level Agreement                |
| SLM   | Synthetic Loss Message                 |
| SLR   | Synthetic Loss Reply                   |
| SM    | Section Monitoring                     |
| SMA   | Sub-Miniature A Connector              |
| SMC   | SONET Minimum Clock Traceable          |
| SNAP  | Sub Network Access Point               |
| SOF   | Start Of Frame                         |

## Glossary

### Acronym List

---

|       |                                     |
|-------|-------------------------------------|
| SONET | Synchronous Transport Signal        |
| SP    | Service Provider                    |
| SPE   | Synchronous Payload Envelope        |
| SRC   | Source                              |
| SSM   | Synchronization Status Messaging    |
| ST1   | Stratum 1 Traceable                 |
| ST2   | Stratum 2 Traceable                 |
| ST3   | Stratum 3 Traceable                 |
| ST3E  | Stratum 3E Traceable                |
| STM   | Synchronous Transport Module        |
| STS   | Synchronous Transport Signal        |
| STU   | Synchronized - Traceability Unknown |
| SYMB  | Symbol                              |

## T

|      |                              |
|------|------------------------------|
| TC   | Traffic Class                |
| TCM  | Tandem Connection Monitoring |
| TCP  | Transport Control Protocol   |
| tHEC | type Header Error Check      |
| TIM  | Trace Identifier Mismatch    |
| TLV  | Type, Length, and Value      |
| TNC  | Transit Node Clock Traceable |
| TOS  | Type Of Service              |
| TST  | Test PDU                     |
| TTI  | Trail Trace Identifier       |
| TTL  | Time To Live                 |
| TU   | Tributary Unit               |

|     |                      |
|-----|----------------------|
| TUG | Tributary Unit Group |
| TX  | Transmit             |

## U

|         |                          |
|---------|--------------------------|
| UAS     | Unavailable Second       |
| UE      | end-User Equipment       |
| UDP     | User Data Protocol       |
| UNCORR  | Uncorrectable            |
| UNEQ    | Unequipped               |
| UPI     | User Payload Identifier  |
| UPM     | User Payload Mismatch    |
| $\mu$ s | microsecond              |
| USA     | United States of America |
| UTP     | Unshielded Twisted Pairs |

## V

|      |                              |
|------|------------------------------|
| V    | VT                           |
| VC   | Virtual Container            |
| VIOL | Violation                    |
| VLAN | Virtual Local Area Network   |
| VoIP | Voice over Internet Protocol |
| VT   | Virtual Tributary            |
| VTG  | VT Group                     |

**Glossary**

*Acronym List*

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W

|     |                        |
|-----|------------------------|
| WAN | Wide Area Network      |
| WIS | WAN Interface Sublayer |
| WWN | World Wide Name        |

## 10G Ethernet Client

The OTN Overclocked technology provides the capability to transparently transport 10G base-R Ethernet signals into OPU2 as specified in ITU-T. Two optical rates are provided:

- 11.0957 Gbits/s, +/- 100 ppm, designated OTU2e
- 11.0491 Gbits/s, +/- 100 ppm, designated OTU1e

The OTU2e uses the mapping scheme of CBR10G into OPU2 as defined in G.709. The client signal, 10GE LAN and the OPU fixed stuff bytes are accommodated into an OPU-like signal designated OPU2e. This signal is then wrapped in an ODU2e and then in an OTU2e signal.

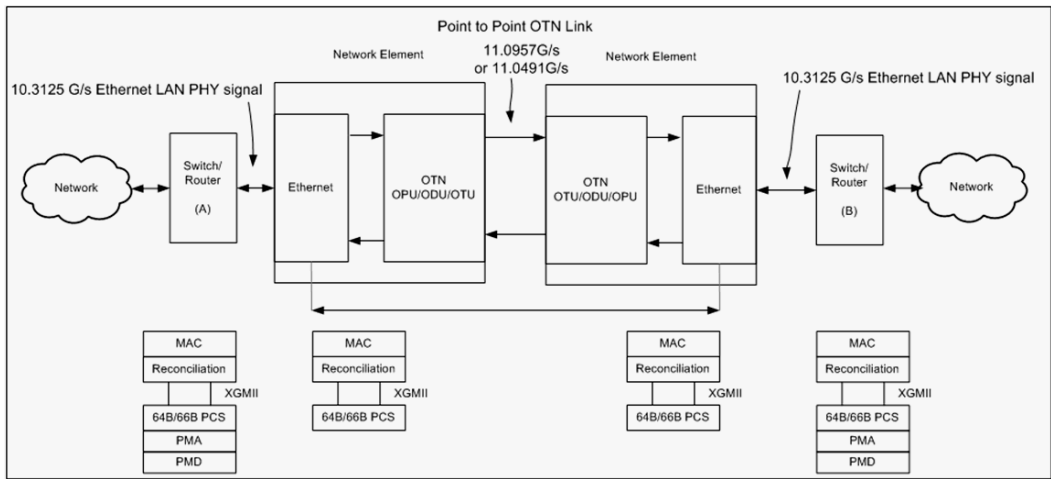
The OTU1e uses the mapping scheme of CBR2G5 into OPU1 as defined in G.709. The client signal, 10GE LAN is accommodated into an OPU-like signal designated OPU1e (note that the fixed stuff bytes are not left free) this is why the 10GE signal can be transported at a lower rate than OTU2e. This signal is then wrapped in an ODU1e and then in an OTU1e signal.

The transparent transport of the 10G base-R means that the full 10G Ethernet data rate i.e. 10.3125 Gbit/s is transported over OTN. This means that the following information is transported:

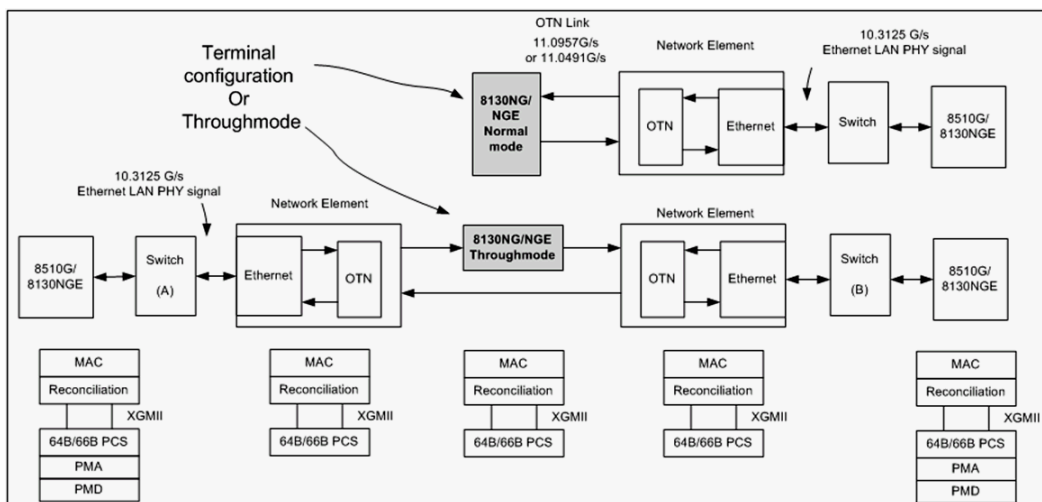
- PCS 64B/66B coded information
- IPG (inter-frame filler), MAC FCS, Preamble and SFD (start of frame delimiter) and Ordered Sets (Remote Fault indication)

The OTN clocking is derived from the Ethernet client signal which is +/- 100 ppm, this is outside the clock tolerance allocated by the G.709 standard which translates in unspecified jitter performance thus limiting the application to Point to Point data path.

The following figure presents a typical network application.



The following figure presents a typical test application.



The Ethernet layer provides the equivalent functionality of the BERT Framed Layer 2 Test application supported on EXFO's Datacom product family with the particularity that there is no Ethernet Physical port as such. The Ethernet frame has its Ethertype field set to 0x88B7.

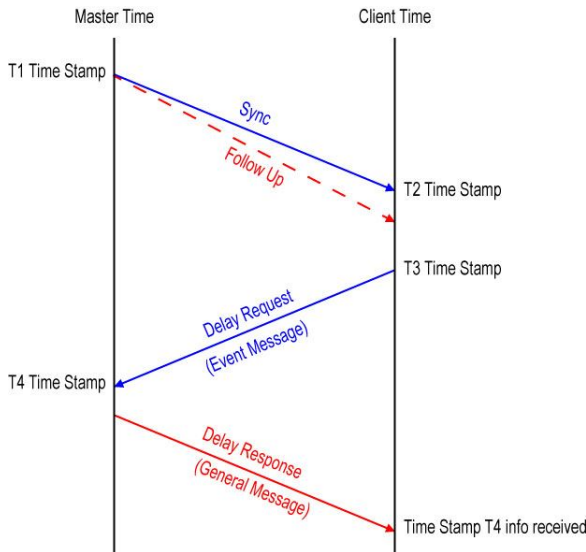
## 1588 PTP

The goal of the IEEE 1588 Precision Time Protocol (PTP) is to provide Network Synchronization using a packet based distribution mechanism.

Depending on the system application the Network Synchronization may require phase and frequency synchronization. 1588 PTP has the capability to deliver both by allowing a Client clock to track a Master clock in phase (time of day) and in frequency.

The protocol is based on exchange of time stamps between the Master clock and the Client clock. Two methods have been defined in the 1588 PTP standard:

- **Delay Request-Response** mechanism uses message Sync, Delay Request, Delay Response, and Follow Up (if required).



- **Peer Delay** mechanism uses message Pdelay Request, Pdelay Response, and if required Pdelay Response Follow Up. This mechanism is restricted to topologies where each peer-to-peer port communicates PTP messages with, at most, one other such port. Peer Delay is not supported by the Telecom Profile.

In order to minimize traffic on the network, PTP can operate in different modes:

- **Two-way** operation uses Sync/Follow Up, Delay Request, and Delay Response messages.
- **One-way** operation uses only the Sync/Follow Up messages. This mode of operation is used to synchronize a Client clock in frequency only. The Master clock and Client clock phases are not aligned.
- **Two-step** clock mode uses the optional Follow Up message to carry the T1 time stamp.
- **One-step** clock mode uses the Sync message to carry the T1 time stamp; no Follow Up message is transmitted by the Master clock, therefore less traffic on the network.

Client clock synchronization is achieved with a 2-part process:

- Part 1: Path delay measurement using bidirectional messages  
$$\text{Mean path delay measurement (MPD)} = ((T2-T1) + (T4-T3)) / 2$$
- Part 2: Clock phase offset correction  
$$\text{Offset} = (T2-T1) - \text{MPD}$$

The offset information is used by the Client clock to adjust the frequency of its oscillator in order to keep the phase offset close to zero.

The 1588 PTP supports the following Master/Client communication; however **Unicast** is used for the Telocom Profile.

- **Multicast:** A Master clock sends its Sync/Follow Up and Delay Response in a multicast mode. A Client can collect information from many Master clocks and select the Master clock that is best suited for its application.
- **Unicast:** A dedicated communication link is established between the Master and the Client clock. This mode of operation requires a negotiation which is initiated by the Client clock.

The 1588 PTP messages can be mapped on the following protocols; however UDP IPv4 is used for the Telecom Profile.

- UDP/IPv4
- UDP/IPv6
- Ethernet

## 1588 PTP Profiles

The purpose of a PTP profile is to allow organizations to specify particular selections of attribute values and optional features of PTP that, when using the same transport protocol, inter-work and achieve a performance that meets the requirements of a given application. The following describes the Telecom Profile.

The Telecom Profile G.8265.1 is designed for frequency synchronization in Telecom network applications. The main attributes of this profile are:

- Unicast communication with the Grand Master
- UDP/IPv4 network layer

With the Telecom Profile, the Client Clock initiates the communication to the Master Clock by making a request for service that consists of sending Signaling messages containing a REQUEST UNICAST TRANSMISSION TLV to the IP address of the Master Clock.

If the Master Clock has sufficient capacity to handle the Client Clock request, it responds with a signaling message containing a GRANT UNICAST TRANSMISSION TLV.

The REQUEST UNICAST TRANSMISSION TLV contains several parameters:

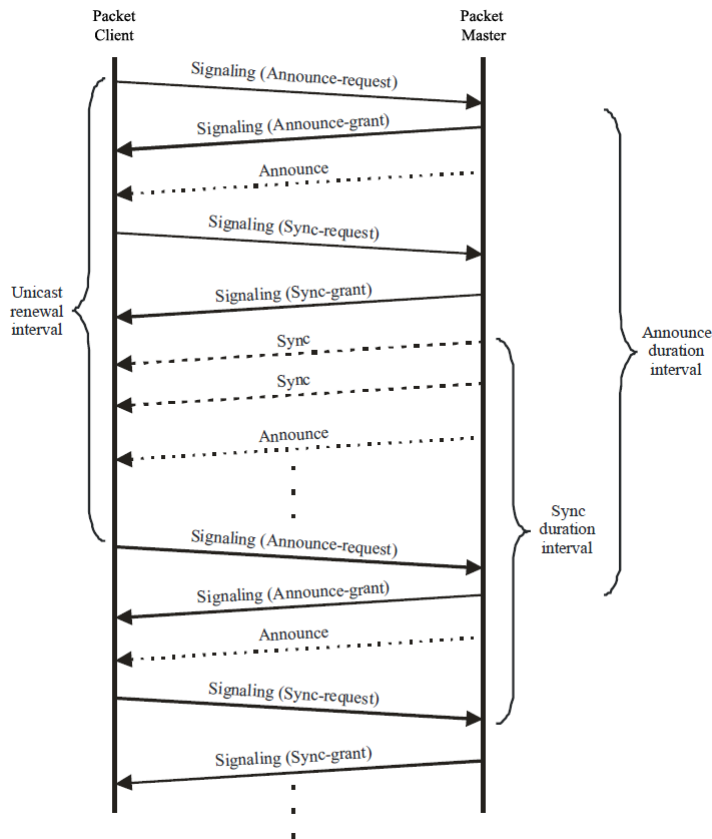
- **messageType** is the type of service being requested: Announce, Sync, or Delay Response.
- **durationField** is the duration of the requested service: 300 seconds by default and configurable from 60 to 1000 seconds.
- **logInterMessagePeriod**: transmission rate of the requested messages.

If the Master Clock denies the request, e.g. because it has no remaining capacity, it will send back a GRANT UNICAST TRANSMISSION TLV with the durationField set to zero.

In the event of being denied service by a Master Clock, or receiving no response to the service request, a Client Clock should wait a minimum of one second before issuing a new Unicast request to that Master Clock.

As Unicast service is only granted for a limited time, the Client Clock must re-request service periodically, before the expiration of the current grant. The Client Clock should reissue the request sufficiently far in advance of the expiration to allow the request to be repeated at least twice if no grant is received. This parameter is called Unicast renewal interval.

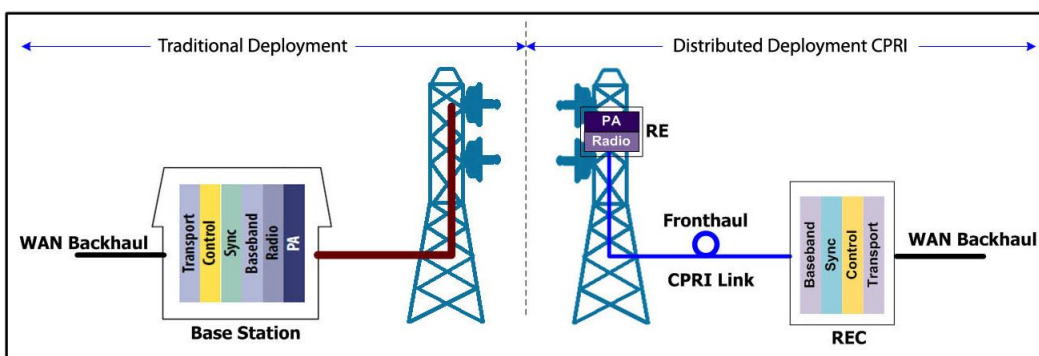
The following diagram shows the sequence of message exchange between a Client Clock and a Master Clock. First, the Client request Unicast Announce message service. When this is granted and the first Announce message is received, the Client can check the QL value conveyed in the clockClass field of the message. From there the Client Clock can request service for Sync and Delay Request messages. Service requests are reissued at the end of the Announce duration interval to ensure continuity of service.



## CPRI

### Overview

Traditional mobile installations are bulky (use thick coaxial cables) and require a lot of power to operate (there is a huge power loss in the coaxial cabling which often requires the use of Tower Mounted Amplifiers) as outlined in the following figure.



Pressures on the Mobile Network Operators (MNO) to reduce their capital, operational cost, and increase coverage are at the heart of a revolution in the mobile network. To address the situation, a concept of decomposition of the radio base station has been developed where the radio basic functions and its ability to transmit and receive radio modulated signals are separated. In such a distributed environment a protocol is required to maintain synchronization and management capabilities as well as transporting the user traffic between the simplified base station and its Remote Radio Head (RRH).

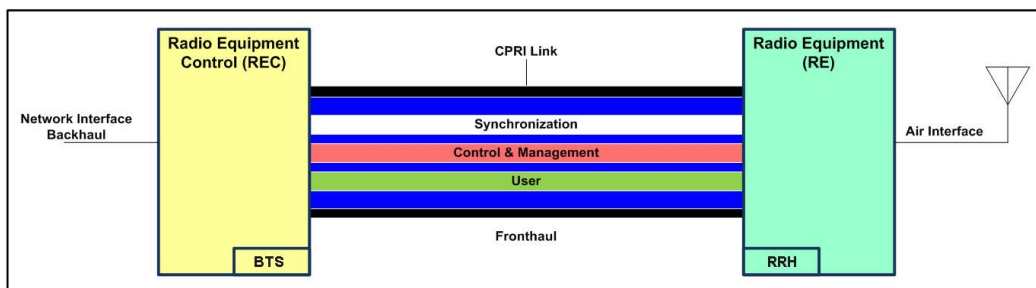
This protocol called Common Public Radio Interface (CPRI) separates a traditional radio base station configuration into two separate elements: Radio Equipment Control (REC) and the Radio Equipment (RE). The REC processes the baseband radio digital information and performs the control of the Radio Equipment. The RE converts the digital radio information into radio frequency signals transported over the air interface (antenna). The REC and RE are interconnected by a point-to-point link. This link carries the CPRI protocol and is known in the industry as the fronthaul as opposed to the backhaul that is the WAN bringing the network traffic to the base station.

The CPRI link can be extended over several kilometers as it uses fiber optics, in fact it can be deployed up to 40 km although most field installations at the moment of this writing are below 10 km.

The CPRI standard covers the physical and data link layers only. This specific focus provides additional development freedom to the various vendors to implement proprietary functions at upper layers.

## Functional Description

As mentioned earlier, CPRI remotely locates the RE from the REC. This means that the RE must be controlled, managed and synchronized from the REC in addition to transporting the User information (Voice and user application data) and all that on the same digital link. As such, CPRI is composed of 3 communication flows multiplexed into a single serial signal transmitted in the same optical fiber as illustrated in the following figure.

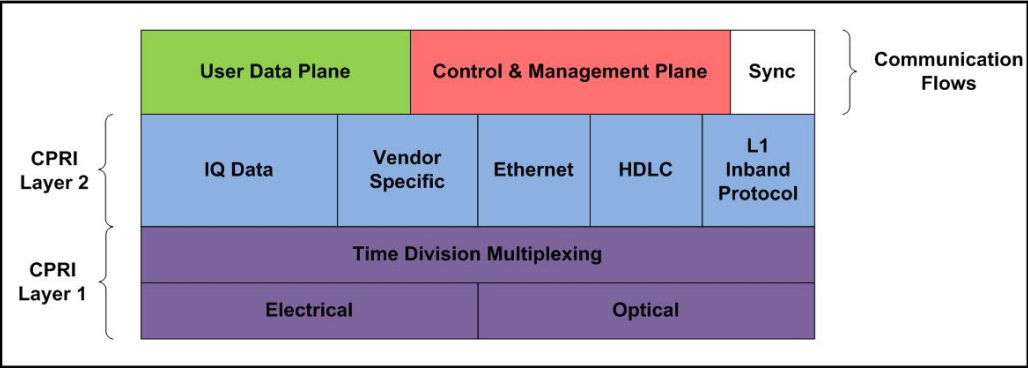


An electrical link is also available from CPRI but it is typically used for base station shelf interconnection. Since a state machine drives the link parameters (rates, protocol, and C&M channel) alignment, a BTS (defined as Master in the standard) and RRH (defined as Slave in the standard) interfaces are defined where the Master initiates the negotiation procedure necessary to achieve this alignment.

- **Synchronization:** Provides precise frequency and frame timing alignment from BTS to RRH to ensure accurate frequency and timing of the RF signal transmission and reception on the Air Interface. In essence, it provides the reference frequency for the RE.
- **Control & Management (C&M):** Management of the link between the REC and RE as well as control over radio functions such as alarms and power.
- **User:** Also known as IQ Data, represents the voice and data information that is exchanged by end-User Equipment (UE)

CPRI Model

The CPRI Model revolves around the 3 communication flows described above. CPRI defines only the Layer 1 and Layer 2 associated to these communication flows as outlined in the following figure.



The User Data Plane contains mostly voice/data traffic in the form of IQ Data samples. IQ Data digitally encodes the change in amplitude/phase of a user device modulated signal sampled at the RE antenna.

The Control & Management Plane maintains the CPRI link itself and provides the facility to manage the operation of the RE radio functions. It is done through the L1 Inband Protocol which provides a bit oriented channel defined to support link specific alarms (R-LOS, R-LOF, ...). Also, the Ethernet/HDLC channel offer two OAM&P channel alternatives which are respectively high and low bandwidth with rates configurable based on the CPRI line interface rate. These carry proprietary information between the REC and RE. Some Vendor Specific overhead is also available.

Finally, the Synchronization flow ensures frequency stability and offers the overhead necessary for frame alignment between the REC and RE to ensure hitless channel or frequency hopping. All these flows are time division multiplexed onto one optical fiber for CPRI field deployments such as Distributed Antenna Systems (DAS).

Physical Interface

CPRI offers 8 options in terms of interface rates. Rates below 10G uses 8B/10B line coding as per CPRI V6.0 while rates above 10G use 64B/66B coding. Depending on the rates used, scrambling is optional. Depending on the CPRI signal structure (Framed or Unframed) the scrambling is either manually configured or negotiated.

| Option | Rate                        | Line Coding | Protocol Version (Scrambling)                                                 |
|--------|-----------------------------|-------------|-------------------------------------------------------------------------------|
| 1      | 614.4 Mbit/s <sup>a</sup>   | 8B/10B      | Version 1: No scrambling                                                      |
| 2      | 1.2288 Gbit/s               |             |                                                                               |
| 3      | 2.4576 Gbit/s               |             |                                                                               |
| 4      | 3.0720 Gbit/s               |             |                                                                               |
| 5      | 4.9152 Gbit/s               |             | Version 1: No scrambling<br>Version 2: Scrambling<br>(Scrambling is optional) |
| 6      | 6.1444 Gbit/s               |             |                                                                               |
| 7      | 9.8304 Gbit/s               |             |                                                                               |
| 8      | 10.1376 Gbit/s <sup>a</sup> | 64B/66B     | Version 2: Scrambling                                                         |

- a. Not supported as presently not used in the field.

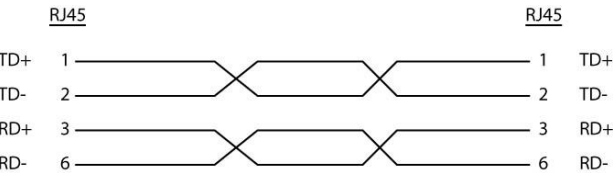
Ethernet Cables

Minimum Category 3 cable is required for 10Base-T connection while Category 5 cable is required for 100Base-TX and 1000Base-T connections.

Maximum cable length (between two nodes) for 10Base-T, 100Base-TX, or 1000Base-T connection is 328 feet (100 meters).

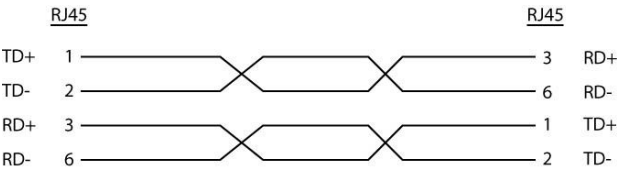
➤ Straight Through Cable (10/100 Mbit/s)

An Unshielded Twisted Pair (UTP) straight through cable is required to connect a 10Base-T/100Base-TX NetBlazer port to a layer 1 or 2 device (ex: HUB, switch).

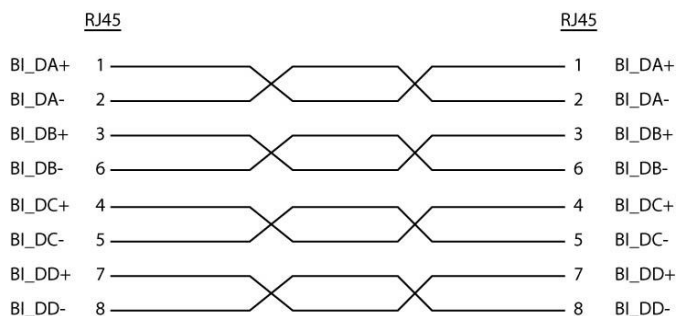


➤ Crossover Cable (10/100 Mbit/s)

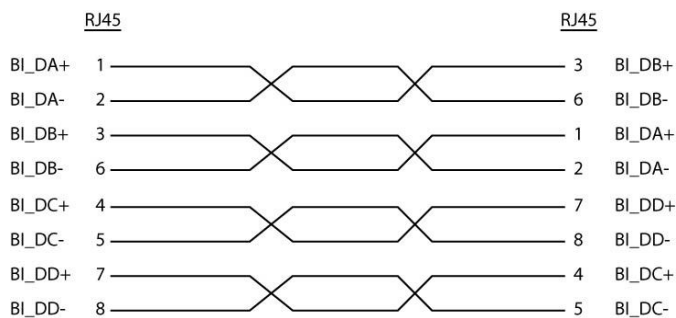
An Unshielded Twisted Pair (UTP) crossover cable is required to connect the 10Base-T/100Base-TX NetBlazer port to a layer 3 device (ex: router).



➤ **Straight Through Cable (1000 Mbit/s)**



➤ **Crossover Cable (1000 Mbit/s)**



## **G.709 Optical Transport Network (OTN)**

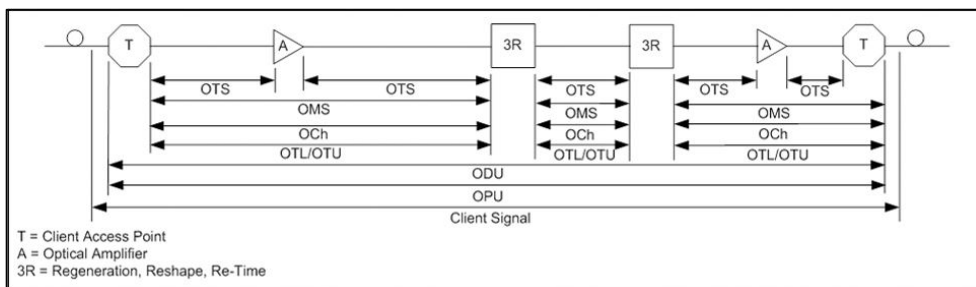
### **Overview**

The optical transport network (OTN) combines the benefits of SONET/SDH technology with the bandwidth expansion capabilities offered by dense wavelength-division multiplexing (DWDM) technology.

The OTN consists of the following layers:

- Optical Transport Section (OTS)
- Optical Multiplex Section (OMS)
- Optical Channel (OCh)
- Optical channel Transport Lane (OTL)
- Optical Transport Unit (OTU)
- Optical Data Unit (ODU)
- Optical Channel Payload Unit (OPU)

Each of these layers and their functions are distributed along the network and activated when they reach their termination points, which are illustrated in the following figure.



OTN Layer Termination Points

The termination of the OTS, OMS and OCh layers is performed at the optical level of the OTN. It is at the termination of the OTU layer that further functionality can be added. This layer is the digital layer—also known as the “digital wrapper”—and offers specific overhead to manage the OTN’s digital functions. The OTU also introduces a new dimension to optical networking by adding forward error correction (FEC) to the network elements, allowing operators to limit the number of required regenerators used in the network which, in turn, lowers its cost.

FEC allows an increase in the optical link budget by providing a new method to correct errors, thereby reducing the impact of network noise and other optical phenomena experienced by the client signal traveling through the network.

The OTU also encapsulates two additional layers—the ODU and the OPU—which provide access to the payload (SONET, SDH, etc.). These layers are normally terminated at the same location.

## Glossary

### *G.709 Optical Transport Network (OTN)*

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The OTU, ODU (including the ODU tandem connection) and OPU layers can all be analyzed and monitored. As per ITU G.709, current test solutions offer these possibilities using the following line rates:

- OTU1 ( $255/238 \times 2.488\,320\text{ Gbit/s} \approx 2.666057143\text{ Gbit/s}$ ) also referred to as 2.7 Gbit/s
- OTU2 ( $255/237 \times 9.953280\text{ Gbit/s} \approx 10.709225316\text{ Gbit/s}$ ) also referred to as 10.7 Gbit/s
- OTU3 ( $255/236 \times 39.813120\text{ Gbit/s} \approx 43.018413559\text{ Gbit/s}$ ) also referred to as 43 Gbit/s
- OTU4 ( $255/227 \times 99.532\,800\text{ Gbit/s} \approx 111.809973568\text{ Gbit/s}$ ) also referred to as 112 Gbit/s.

The following non standard rates are also defined:

- OTU1e ( $255/238 \times 10.3125\text{ Gbit/s} \approx 11.0491071429\text{ Gbit/s}$ )
- OTU2e ( $255/237 \times 10.3125\text{ Gbit/s} \approx 11.0957278481\text{ Gbit/s}$ )
- OTU3e1 ( $255/236 \times 4 \times 10.3125\text{ Gbit/s} \approx 44.570974576\text{ Gbit/s}$ )
- OTU3e2 ( $243/217 \times 16 \times 2.488320\text{ Gbit/s} \approx 44.583355576\text{ Gbit/s}$ )

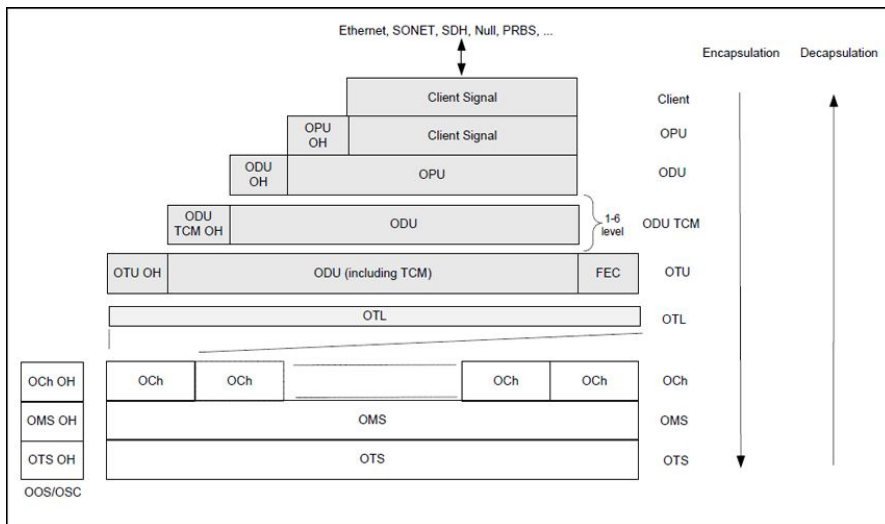
The following non standard rates are not covered by the ITU standard but they are the equivalent function associated to Fiber Channel rates:

- OTU1f ( $255/238 \times 10.51875\text{ Gbit/s} \approx 11.2700892857143\text{ Gbit/s}$ )
- OTU2f ( $255/237 \times 10.51875\text{ Gbit/s} \approx 11.3176424050633\text{ Gbit/s}$ )

Each line rate is adapted to service different client signals:

- OC-48/STM-16 is transported via OTU1
- OC-192/STM-64 is transported via OTU2
- OC-768/STM-256 is transported via OTU3
- Null Client (All 0s) is transported via OTU<sub>k</sub> ( $k = 1, 2, 1e, 2e, 1f, 2f, 3, 3e1, 3e2$ )
- PRBS31 is transported via OTU<sub>k</sub> ( $k = 1, 2, 1e, 2e, 1f, 2f, 3, 3e1, 3e2$ )

In order to map client signals via ITU G.709, they are encapsulated using the structure illustrated in the following figure.



**Basic OTN Transport Structure**

## Glossary

### *G.709 Optical Transport Network (OTN)*

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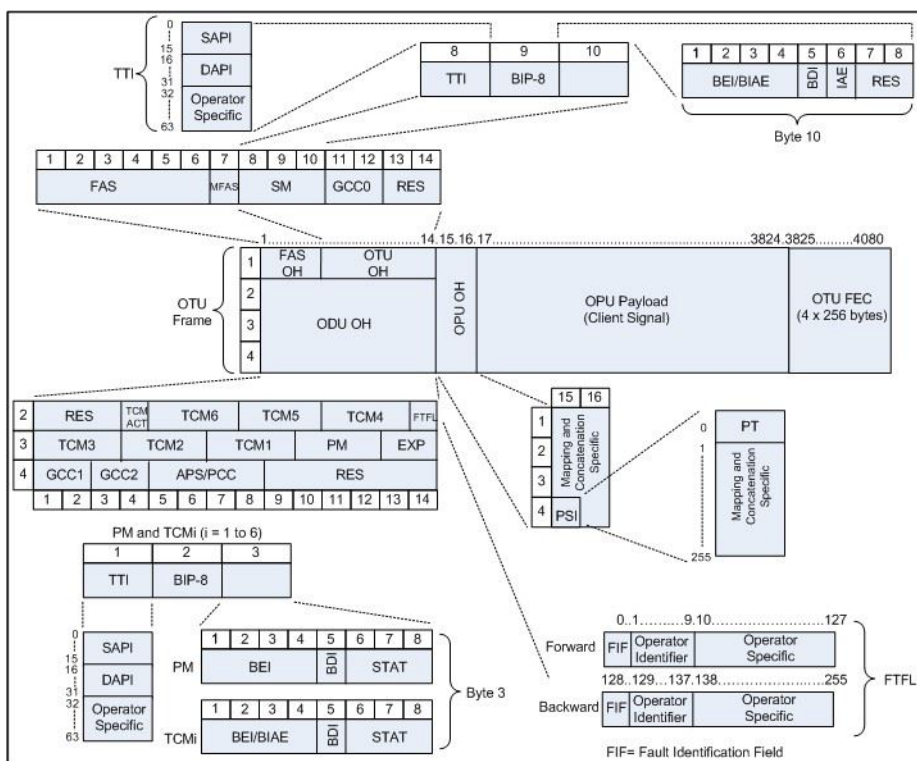
As depicted above, to create an OTU frame, a client signal rate is first adapted at the OPU layer. The adaptation consists of adjusting the client signal rate to the OPU rate. Its overhead contains information to support the adaptation of the client signal. Once adapted, the OPU is mapped into the ODU. The ODU maps the OPU and adds the overhead necessary to ensure end-to-end supervision and tandem connection monitoring (up to six levels). Finally, the ODU is mapped into an OTU, which provides framing as well as section monitoring and FEC.

Following the OTN structure presented in figure *Basic OTN Transport Structure* on page 611, OTUks ( $k = 1, 2, 3$ ) are transported using the OCh; each unit is assigned a specific wavelength of the ITU grid. Several channels can be mapped into the OMS and then transported via the OTS layer. The OCh, OMS and OTS layers each have their own overhead for management purposes at the optical level. The overhead of these optical layers is transported outside of the ITU grid in an out-of-band channel called the optical supervisory channel (OSC).

When the OTU frame structure is complete (OPU, ODU and OTU), ITU G.709 provides OAM&P functions that are supported by the overhead.

As shown in the figure below, the OTU frame is broken down into the following components:

- Framing
- OTL, OTU, ODU, OPU overhead
- OTU FEC



## OTU Frame Description

➤ Framing

The OTU framing is divided into two portions: FAS and MFAS.

The frame alignment signal (FAS) uses the first six bytes and, similarly to SONET/SDH, it is used to provide framing for the entire signal. In order to provide enough 1/0 transitions for synchronization, scrambling is used over the entire OTU frame, except for the FAS bytes.

The multiframe alignment signal (MFAS) byte is used to extend command and management functions over several frames. The MFAS counts from 0 to 255, providing a 256 multiframe structure.

➤ Overhead

Each portion of the OTU frame has its own specific overhead functions. They are displayed in figure *OTU Frame Description* on page 613, and are briefly described below. Further details can be found about these overhead fields in the ITU G.709 standard.

➤ Optical channel Transport Lane (OTL)

The Optical channel Transport Lane (OTL) is an adaptation layer whose purpose is to re-use the modules developed for Ethernet 40GBASE-R. These modules have a four-lane WDM interface to and from a transmit/receive pair of G.652 optical fibers, and connect to the host board via a 4-lane (OTL3.4) electrical interface.

The OTL layer is responsible for mapping the serial OTU signal onto a parallel path designated lanes. In the case of OTU3 the signal is distributed over 4 logical lanes.

➤ **Optical Transport Unit (OTU)**

The OTU overhead is comprised of the SM, GCC0 and RES bytes.

The section monitoring (SM) bytes are used for the trail trace identifier (TTI), parity (BIP-8) and the backward error indicator (BEI), or backward incoming alignment error (BIAE), backward defect indicator (BDI), and incoming alignment error (IAE). The TTI is distributed over the multiframe and is 64 bytes in length. It is repeated four times over the multiframe.

General communication channel 0 (GCC0) is a clear channel used for transmission of information between OTU termination points.

The reserved (RES) bytes are currently undefined in the standard.

➤ **Optical Data Unit (ODU)**

The ODU overhead is broken into several fields: RES, PM, TCMi, TCM ACT, FTFL, EXP, GCC1/GCC2 and APS/PCC.

The reserved (RES) bytes are undefined and are set aside for future applications.

The path monitoring (PM) field is similar to the SM field described above. It contains the TTI, BIP-8, BEI, BDI and Status (STAT) field.

There are six tandem connection monitoring (TCMi) fields, which contain the BEI/BIAE, BDI and STAT fields. The STAT field is used in the PM and TCMi fields to provide an indication of the presence or absence of maintenance signals.

The tandem connection monitoring activation/deactivation (TCM ACT) field is currently undefined in the standards.

The fault type and fault location reporting communication channel (FTFL) is a message spread over a 256-byte multiframe that provides the ability to send forward and backward path-level fault indications.

The experimental (EXP) field is a field that is not subject to standards and is available for network operator applications.

General communication channels 1 and 2 (GCC1/GCC2) fields are very similar to the GCC0 field except that each channel is available in the ODU.

The automatic protection switching and protection communication channel (APS/PCC) supports up to eight levels of nested APS/PCC signals, which are associated to a dedicated-connection monitoring level depending on the value of the multiframe.

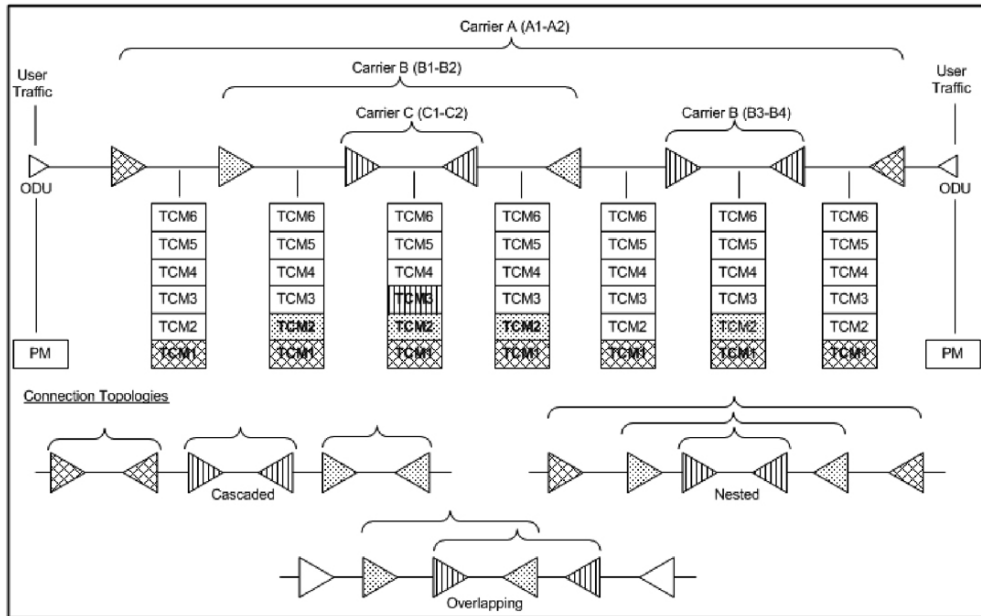
➤ **Optical Payload Unit (OPU)**

The primary overhead field associated to the OPU is the Payload Structure Identifier (PSI). This is a 256 bytes multi-frame where its first byte is defined as the Payload Type (PT). The remaining 255 bytes are currently reserved.

The other fields in the OPU overhead are dependent on the mapping and concatenation capabilities associated to the OPU. For an asynchronous mapping (the client signal and OPU clock are different) Justification Control (JC) bytes are available to compensate for clock rate differences, two methods are supported Asynchronous Mapping Procedure (AMP) and Generic Mapping Procedure (GMP). For a purely Bit-Synchronous Mapping Procedure (BMP) (client source and OPU clock are the same), the JC bytes become reserved (set to 0). Concatenation bytes are also available as described in ITU G.709.

### Tandem Connection Monitoring (TCM)

TCM enables the user and its signal carriers to monitor the quality of the traffic that is transported between segments or connections in the network. SONET/SDH allowed a single level of TCM to be configured, while ITU G.709 allows six levels of tandem connection monitoring to be configured. The assignment of monitored connections is currently a manual process that involves an understanding between the different parties. There are various types of monitored connection topologies: cascaded, nested and overlapping. Examples of these topologies are provided in the following figure.



Tandem Connection Monitoring

Each of the six TCMi fields in the ODU overhead is assigned to a monitored connection. There can be from zero to six connections that can be configured for each connection. In the figure *Tandem Connection Monitoring* on page 618, there are three different connections that are actually monitored. Carrier C, due to its location, can monitor three TCM levels as the ODU passes through its portion of the network.

In addition to monitoring maintenance signals, using the STAT field associated with each TCM level, the TCM connection also monitors the BIP-8 and BEI errors for each connection level. Maintenance signals are used to advertise upstream maintenance conditions affecting the traffic and errors provide an indication of the quality of service offered at each segment of the network, which provides a valuable tool for the user and carrier to isolate faulty sections of the network.

## Forward Error Correction (FEC)

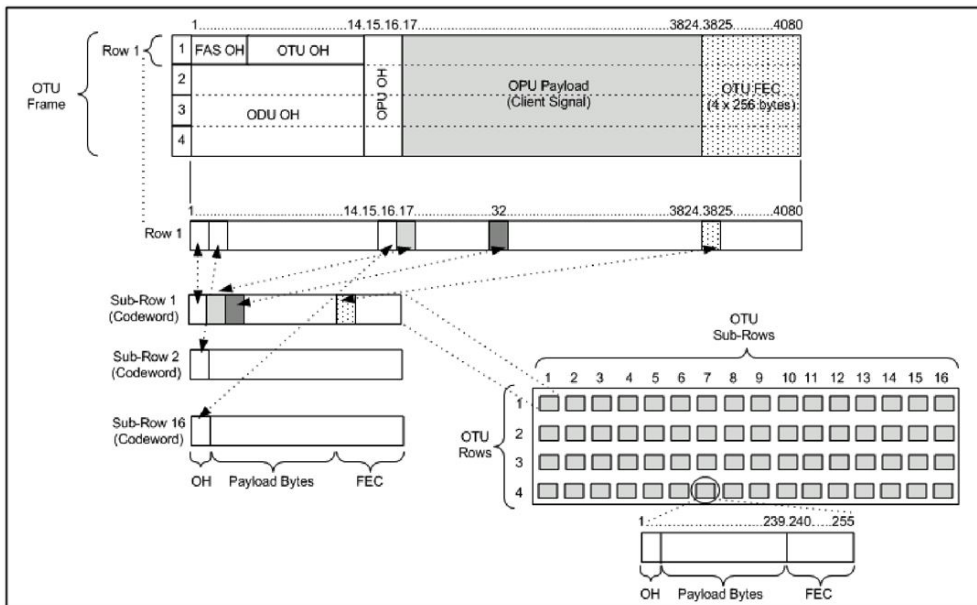
The ITU G.709 standard supports forward error correction (FEC) in the OTU frame and is the last part added to the frame before the frame is scrambled. FEC provides a method to significantly reduce the number of transmitted errors due to noise, as well as other optical phenomena that occur at high transmission speeds. This enables providers to support longer spans in between optical repeaters.

An OTU frame is divided into four rows. Each row is broken down into 16 sub-rows comprised of 255 bytes each, as shown in figure *Forward Error Correction* on page 620. A sub-row is composed of interleaved bytes. The interleave is executed so that the first sub-row contains the first overhead (OH) byte, the first payload byte and the first FEC byte, and so on for the remaining sub-rows of each row in the frame. The first FEC byte starts at position 240 for all sub-rows.

## Glossary

### *G.709 Optical Transport Network (OTN)*

The FEC uses a Reed-Solomon RS (255/239) coding technique. This means that 239 bytes are required to compute a 16-byte parity check. The FEC can correct up to eight (bytes) errors per sub-row (codeword) or detect up to 16 byte errors without correcting any. Combined with the byte interleave capability included in ITU G.709 implementation, the FEC is more resilient in regards to error burst, where up to 128 consecutive bytes can be corrected per OTU frame row.



Forward Error Correction

## ODU Multiplexing

The ODU multiplexer is a function that allows the multiplexing of ODU tributary signals into higher OTN signal rates. The G.709 standard supports 2 types of ODU multiplexer which can be classified as follows:

- Legacy architecture is based on multi-stage architecture to bring an ODUk client to a higher OTN interface rate. This multiplexer is identified by Payload Type 20 (PT 20).
- New architecture uses a single stage architecture to bring an ODUk client to any higher OTN interface rate. This method supports the ODUflex client signal. The multiplexer is identified by Payload Type 21 (PT 21).

**Note:** Refer to the OTN BERT on page 43 for the ODU multiplexing capabilities.

The multiplexing strategy is based on the concept of tributary slots, which is similar in concept to the SONET timeslot. The multiplexing of 4 ODU1 in one ODU2 is made by distributing the ODU1 structure in a repetitive sequence of 4 ODU2 Tributary slots, a similar strategy is used for ODU3 multiplexing where the repetitive sequence is made of 16 ODU3 tributary slots, refer to G.709 standard for detailed information.

## Glossary

### *G.709 Optical Transport Network (OTN)*

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The main attributes of the ODU multiplexer functionality are as follows:

- The Asynchronous Mapping Procedure (AMP) is used for multiplexing the tributary signals; this method uses a modified Justification Control mechanism which has 2 positive Justification Control bytes and one negative Justification Control byte.
- The new multiplex method also supports the Generic Mapping Procedure as the Justification Control mechanism is still using the OPU OH JC bytes.
- The Multiplex Structure Identifier (MSI) provides information that is specific to each type of multiplexer provided.
- Can handle multiplex signals with frequency offset of +/- 20 ppm on every layer for the legacy architecture while the new architecture (using GMP) can handle frequency offset of +/-100 ppm.

## ODUflex

ODUflex provides the capability to carry client payload of variable size with a container size of 1.244 Gbit/s granularity. An ODUflex (L) signal can be transported once multiplexed in an ODUk (H) signal, the multiplexer in this case handles tributary slots of 1.244 Gbit/s and has a Payload Type 21. The ODUflex function can be used to transport 2 signal categories mapped in ODTUk.ts using GMP:

➤ Ethernet in ODUflex over GFP-F signal

The Ethernet packets are mapped in GFP-F as specified in G.7041, the packets are processed as follows:

- The Start of Frame Delineation bytes are terminated
- Inter Frame Gaps bytes are terminated
- PCS coding is terminated
- GFP overhead bytes added

Since the PCS coding is terminated, it is not possible to transport the Ethernet Link status transparently but it is accommodated by the Forward Defect Indication (FDI) and Remote Defect Indication (RDI) alarms over GFP. The RDI is used to carry the Remote Fault alarm while the FDI is used to carry the Local Fault.

GFP-F provides rate adaptation between the incoming Ethernet signal and the outgoing OPUflex transport signal. This brings the fact that GMP is operated at a fixed Cm value close to the maximum server capacity.

➤ CBR over ODUflex signal

ODUflex can transport Constant Bit Rate signal (bulk filled Test pattern) as Client of the ODUflex CBR function. This CBR function needs a Pattern generator that can operate at a data rate specified by the user, the range of the available data rates is qualified by the Bandwidth management function.

**Glossary**

*G.709 Optical Transport Network (OTN)*

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**OTN Signal Rates**

| Rate                | Signal |
|---------------------|--------|
| 2.666057143 Gbit/s  | OTU1   |
| 10.709225316 Gbit/s | OTU2   |
| 11.0491 Gbit/s      | OTU1e  |
| 11.0957 Gbit/s      | OTU2e  |
| 11.2701 Gbit/s      | OTU1f  |
| 11.3176 Gbit/s      | OTU2f  |

## MPLS Labels

The MPLS labels are listed in the following table.

| Label           | Description        |
|-----------------|--------------------|
| 0               | IPv4 explicit null |
| 1               | Router alert       |
| 2               | IPv6 explicit null |
| 3               | Implicit null      |
| 14              | OAM alert          |
| 4 to 13, and 15 | Unassigned         |
| 16 to 1048575   | Label ID           |

## SONET/DSn/SDH/PDH

### SONET/DSn/SDH/PDH Nomenclature

The GUI will use the International or European nomenclature based on the SONET and SDH software options installed on the FTB-700G/800 Series.

| Software option | Nomenclature  |
|-----------------|---------------|
| SONET only      | International |
| SDH only        | European      |
| SONET and SDH   | International |

### Signal Rates

| Rate           | SONET/DSn     | SDH/PDH        |              |
|----------------|---------------|----------------|--------------|
|                |               | International  | European     |
| 1.544 Mbit/s   | DS1           | -              | 1.5M         |
| 2.048 Mbit/s   | -             | E1             | 2M           |
| 8.448 Mbit/s   | -             | E2             | 8M           |
| 34.368 Mbit/s  | -             | E3             | 34M          |
| 44.736 Mbit/s  | DS3           | -              | 45M          |
| 51.84 Mbit/s   | STS-1e / OC-1 | STM-0e / STM-0 | 52M          |
| 139.264 Mbit/s | -             | E4             | 140M         |
| 155.52 Mbit/s  | STS-3e / OC-3 | STM-1e / STM-1 | 155M / STM-1 |
| 622.08 Mbit/s  | OC-12         | STM-4          | STM-4        |
| 2.48832 Gbit/s | OC-48         | STM-16         | STM-16       |
| 9.95328 Gbit/s | OC-192        | STM-64         | STM-64       |

## SONET/SDH High and Low Order Path Nomenclature

| Path Type  | SDH      | SONET    |
|------------|----------|----------|
| High Order | AU-3     | STS-1    |
|            | AU-4     | STS-3c   |
|            | AU-4-4c  | STS-12c  |
|            | AU-4-16c | STS-48c  |
|            | AU-4-64c | STS-192c |
| Low Order  | TUG-3    | -        |
|            | TUG-2    | VTG      |
|            | TU-11    | VT1.5    |
|            | TU-12    | VT2      |
|            | TU-3     | -        |

### SONET/SDH Alarms and Errors Nomenclature

| Layer                         | SONET    | SDH     |
|-------------------------------|----------|---------|
| Physical                      | BPV/CV   | CV      |
| Section / Regenerator Section | LOF-S    | RS-LOF  |
|                               | SEF      | RS-OOF  |
|                               | TIM-S    | RS-TIM  |
|                               | FAS-S    | RS-FAS  |
|                               | B1       | B1      |
| Line / Multiplex Section      | AIS-L    | MS-AIS  |
|                               | RDI-L    | MS-RDI  |
|                               | B2       | B2      |
|                               | REI-L    | MS-REI  |
| High Order Path               | AIS-P    | AU-AIS  |
|                               | LOP-P    | AU-LOP  |
|                               | H4-LOM   | H4-LOM  |
|                               | PDI-P    | -       |
|                               | RDI-P    | HP-RDI  |
|                               | ERDI-PCD | ERDI-CD |
|                               | ERDI-PPD | ERDI-PD |
|                               | ERDI-PSD | ERDI-SD |
|                               | PLM-P    | HP-PLM  |
|                               | UNEQ-P   | HP-UNEQ |
|                               | TIM-P    | HP-TIM  |
|                               | B3       | B3      |
|                               | REI-P    | HP-REI  |

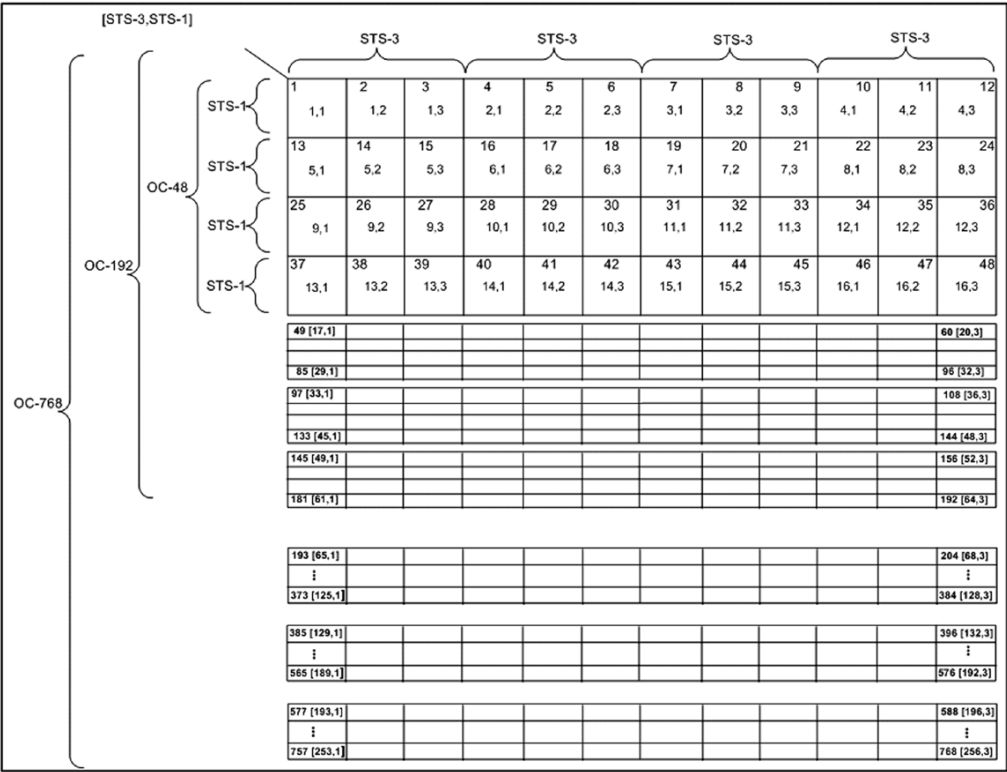
| Layer          | SONET    | SDH     |
|----------------|----------|---------|
| Low Order Path | AIS-V    | TU-AIS  |
|                | LOP-V    | TU-LOP  |
|                | RDI-V    | LP-RDI  |
|                | ERDI-VCD | ERDI-CD |
|                | ERDI-VPD | ERDI-PD |
|                | ERDI-VSD | ERDI-SD |
|                | RFI-V    | LP-RFI  |
|                | UNEQ-V   | LP-UNEQ |
|                | TIM-V    | LP-TIM  |
|                | PLM-V    | LP-PLM  |
|                | BIP-2    | BIP-2   |
|                | REI-V    | LP-REI  |

SONET Numbering Convention

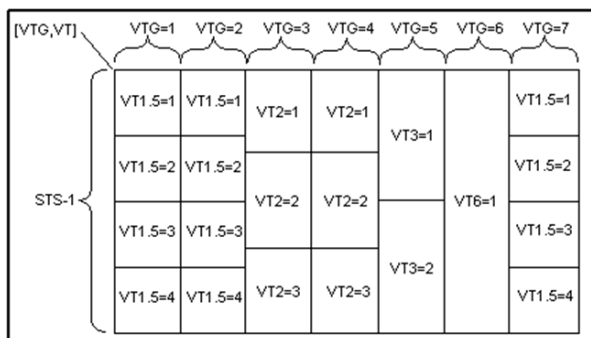
The FTB-700G/800 Series supports the Timeslot (default) and hierarchical two-level numbering conventions as per GR-253.

Hierarchical Notation:

The FTB-700G/800 Series supports numbering SONET high order path STS-1s and STS-3c using the two-level “STS-3#,STS-1#” convention in an OC-N. For example: STS-1 [2,3].



The FTB-700G/800 Series supports numbering SONET low order path using the two-level “VTGroup#,VT#” convention for numbering VTs within an STS-1. For example: VT1.5 [1,3], VT2 [3,2], VT6 [6,1].



The FTB-700G/800 Series supports numbering SONET high order path STS-nc within an OC-N using the two-level “STS-3#,STS-1#”. For example: STS-12c [5,1].

**Note:** For STS-1e the numbering is limited to the A value as only one STS-1 exists.

## SDH Numbering Convention

As per ITU G.707, the high order paths are defined using a 2 to 5 level convention E,D,C,B,A depending on the rate of the STM-n used.

- E: the AUG-64 are numbered 1 to 4
- D: the AUG-16 are numbered 1 to 4
- C: the AUG-4 are numbered 1 to 4
- B: the AUG-1 are numbered 1 to 4
- A: the AU-3 are numbered 1 to 3

So for the naming is as follows for each of the following rate:

- [E,D,C,B,A] for STM-256

## Glossary

SONET/DSn/SDH/PDH

- [D,C,B,A] for STM-64
- [C,B,A] for STM-16
- [B,A] for STM-4
- [0] for AU-4 in STM-1
- [A] for AU-3 in STM-1
- [A] for the AU-3 in STM-0e, A=0.

| B=1         |     |     |     | B=2 |     |     |     | B=3 |     |     |             |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------------|
| C=1         |     |     |     | C=2 |     |     |     | C=3 |     |     |             |
| C=2         |     |     |     | C=3 |     |     |     | C=4 |     |     |             |
| C=3         |     |     |     | C=4 |     |     |     |     |     |     |             |
| C=4         |     |     |     |     |     |     |     |     |     |     |             |
| D=1         |     |     |     |     |     |     |     |     |     |     |             |
| D=2         |     |     |     |     |     |     |     |     |     |     |             |
| D=3         |     |     |     |     |     |     |     |     |     |     |             |
| D=4         |     |     |     |     |     |     |     |     |     |     |             |
| E=1         |     |     |     |     |     |     |     |     |     |     |             |
| E=2         |     |     |     |     |     |     |     |     |     |     |             |
| E=3         |     |     |     |     |     |     |     |     |     |     |             |
| E=4         |     |     |     |     |     |     |     |     |     |     |             |
| 1           | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12          |
| A=1         | A=2 | A=3 | A=1 | A=2 | A=3 | A=1 | A=2 | A=3 | A=1 | A=2 | A=3         |
| 13          | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24          |
| A=1         | A=2 | A=3 | A=1 | A=2 | A=3 | A=1 | A=2 | A=3 | A=1 | A=2 | A=3         |
| 25          | 26  | 27  | 28  | 29  | 30  | 31  | 32  | 33  | 34  | 35  | 36          |
| A=1         | A=2 | A=3 | A=1 | A=2 | A=3 | A=1 | A=2 | A=3 | A=1 | A=2 | A=3         |
| 37          | 38  | 39  | 40  | 41  | 42  | 43  | 44  | 45  | 46  | 47  | 48          |
| A=1         | A=2 | A=3 | A=1 | A=2 | A=3 | A=1 | A=2 | A=3 | A=1 | A=2 | A=3         |
| [1,2,1,1,1] |     |     |     |     |     |     |     |     |     |     | [1,2,1,4,3] |
| [1,2,4,1,1] |     |     |     |     |     |     |     |     |     |     | [1,2,4,4,3] |
| [1,3,1,1,1] |     |     |     |     |     |     |     |     |     |     | [1,3,1,4,3] |
| [1,3,4,1,1] |     |     |     |     |     |     |     |     |     |     | [1,3,4,4,3] |
| [1,4,1,1,1] |     |     |     |     |     |     |     |     |     |     | [1,4,1,4,3] |
| [1,4,4,1,1] |     |     |     |     |     |     |     |     |     |     | [1,4,4,4,3] |
| [2,1,1,1,1] |     |     |     |     |     |     |     |     |     |     | [2,1,1,4,3] |
| ⋮           |     |     |     |     |     |     |     |     |     |     | ⋮           |
| [2,4,4,1,1] |     |     |     |     |     |     |     |     |     |     | [2,4,4,4,3] |
| [3,1,1,1,1] |     |     |     |     |     |     |     |     |     |     | [3,1,1,4,3] |
| ⋮           |     |     |     |     |     |     |     |     |     |     | ⋮           |
| [3,4,4,1,1] |     |     |     |     |     |     |     |     |     |     | [3,4,4,4,3] |
| [4,1,1,1,1] |     |     |     |     |     |     |     |     |     |     | [4,1,1,4,3] |
| ⋮           |     |     |     |     |     |     |     |     |     |     | ⋮           |
| [4,4,4,1,1] |     |     |     |     |     |     |     |     |     |     | [4,4,4,4,3] |

The low order paths are defined using a 2 or 3 level convention K,L,M depending on the rate of the AU-4 or AU-3 used to multiplex the low order signals.

- K: the TUG-3 are numbered 1 to 3
- L: the TUG-2 are numbered within the TUG-3 0 or from 1 to 7
- M: the TU-2, TU-12, TU-11 are numbered within the TUG-2 1, 1 to 3, 1 to 4 respectively

Examples for AU-4 (3 level convention)

TU-3: [K,0,0]

TU-2: [K,L,0]

TU-12:[K,L,M] where M = 1 to 3

TU-11:[K,L,M] where M = 1 to 4

Example for AU-3 (2 level convention)

TU-2: [L,0]

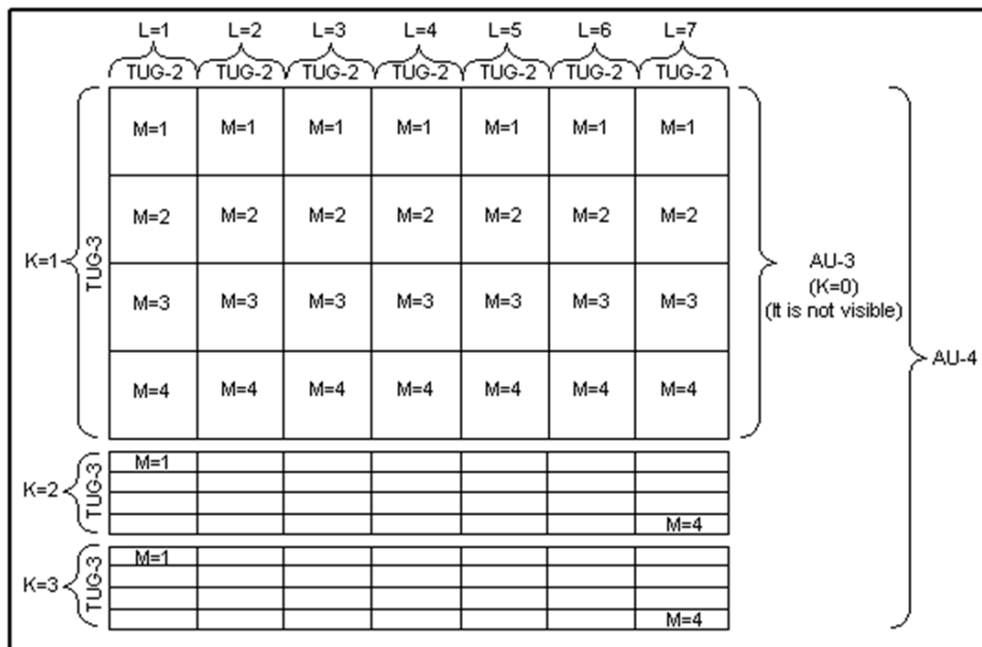
TU-12: [L,M] M is numbered 1 to 3

TU-11: [L,M] M is numbered 1 to 4

## Glossary

SONET/DSn/SDH/PDH

The GUI Grid indicates the TUG-2 [x] and TUG-3 [x] values.



## DSn/PDH Numbering Convention

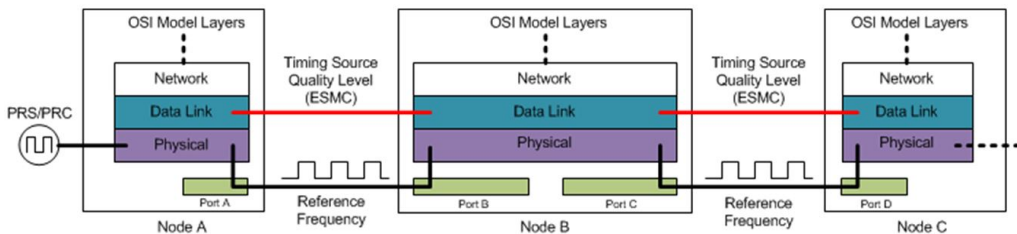
The DS1 numbering in DS3 shall be numbered with respect to the DS2 muxing [DS2,DS1]. For example a DS3 has 7 DS2 and a DS2 has 4 DS1, so an example would be for a DS1 number [3,2]. The DS3 shall have a single number to represent its position. That is [1] all the time whether it is used in an STS-1 or it is the DS3 electrical interface.

The PDH do not have special grouping of the E1, E2, E3 or E4. This means that the PDH has a single number. For example E1 number 2 shall be number [2].

The E1 in DS3 via G.747 numbering uses the naming [DS2,E1]. However in the grid the label shall adapt itself to DS2 [x] or 6.3M [x] (where x = 1 to 7) with respect to the interface standard used: European or International.

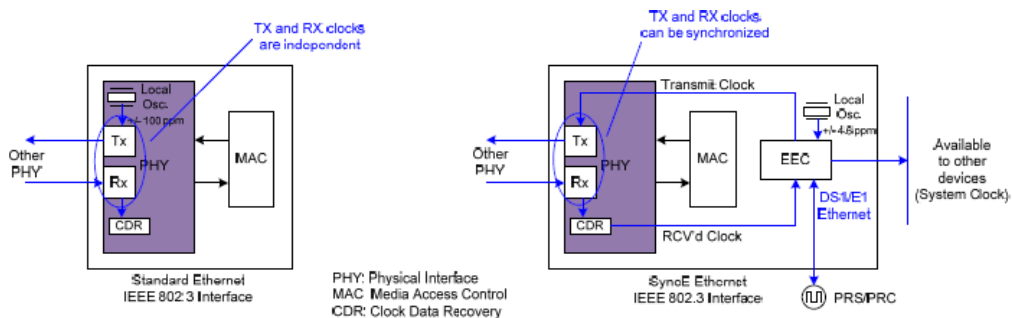
## SyncE

Synchronous Ethernet or SyncE enables a traceable network timing reference frequency to be distributed node-by-node across a chain of Ethernet devices (SyncE compliant devices only). The network timing reference is typically hierarchically traceable to a Primary Reference Source/Clock (PRS/PRC) in a unidirectional flow. Any node in the chain not compliant to SyncE automatically terminates the synchronization propagation but this does not impact the flow of traffic.



The Physical Layer carries the clock frequency and the Data Link layer carries the Quality Level (QL) associated to the transported frequency via Synchronization Status Messaging (SSM) embedded in the Ethernet Synchronization Message Channel (ESMC). The QL is transported via Information and Event PDUs typically transmitted at a rate of 1 frame per second but this rate can vary between 1 to 10 messages per second to respect the slow protocol rules. The Information PDU is used as heart-beat for the channel while one Event PDU is transmitted asynchronously to the Information PDU upon change of the QL value. Following this change, the Information PDU is also adjusted to match the new QL.

In order for an Ethernet interface to be considered Synchronous Ethernet compliant it needs to be upgraded as shown in the following diagram. In addition to supporting the ESMC channel, this upgrade consists in allowing the recovered clock from the CDR to be propagated to a function called the Ethernet Equipment Clock (EEC).



The EEC is present in a network element (NE) to determine which port should be used to distribute the frequency to other port(s) in the NE as well as what QL value to transmit over the ESMC to other network element in the network synchronization chain. The actual selection decision is based on the QL value received from the various port(s) in the NE. If none are valid the EEC is equipped with a better oscillator than a standard Ethernet interface to provide synchronization (Holdover mode). Typically the highest QL value is selected among the nominated sources within the network element.

Unicast/Multicast Addresses for Ethernet OAM

Unicast or multicast address can be used for most of S-OAM functions.

- Unicast addresses a unique destination address of the MEP.
- Multicast Class 1 addresses all MEPs in the MEG. The address value is 01-80-C2-00-00-3x, where x represents the MEG/MD Level.
- Multicast Class 2 addresses all MIPs and MEPs in the MEG. The address value is 01-80-C2-00-00-3y, where y represents the MEG/MD Level + 8.

The following table specifies which address type is used for each frame type.

| Frame Type | Unicast | Multicast |         | Frame Type | Unicast | Multicast |         |
|------------|---------|-----------|---------|------------|---------|-----------|---------|
|            |         | Class 1   | Class 2 |            |         | Class 1   | Class 2 |
| CCM        | X       | X         |         | LMM        | X       | X         |         |
| LBM        | X       | X         |         | LMR        | X       |           |         |
| LBR        | X       |           |         | SLM        | X       | X         |         |
| LTM        |         |           | X       | SLR        | X       |           |         |
| LTR        | X       |           |         | AIS        | X       | X         |         |
| TST        | X       | X         |         | CSF        | X       | X         |         |
| DMM        | X       | X         |         | LCK        | X       | X         |         |
| DMR        | X       |           |         |            |         |           |         |

VLAN ID and Priority

Special VID values (IEEE Std 802.1Q-1998)

| ID   | Description                                                                                                                                                                                                                                                            |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | The null VLAN ID. Indicates that the tag header contains only user priority information; no VLAN identifier is present in the frame. This VID value must not be configured as a PVID, configured in any Filtering Database entry, or used in any Management operation. |
| 1    | The default PVID value used for classifying frames on ingress through a Bridge Port. The PVID value can be changed on a per-Port basis.                                                                                                                                |
| 4095 | Reserved for implementation use. This VID value shall not be configured as a PVID, configured in any Filtering Database entry, used in any Management operation, or transmitted in a tag header.                                                                       |

VLAN Priority

|   |                    |   |                     |
|---|--------------------|---|---------------------|
| 0 | 000 - Low Priority | 4 | 100 - High Priority |
| 1 | 001 - Low Priority | 5 | 101 - High Priority |
| 2 | 010 - Low Priority | 6 | 110 - High Priority |
| 3 | 011 - Low Priority | 7 | 111 - High Priority |



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## 中国关于危害物质限制的规定

包含在本 EXFO 产品中的有毒有害物质或元素的名称及含量

| Part Name<br>部件名称                                         | Lead<br>铅<br>(Pb) | Mercury<br>汞<br>(Hg) | Cadmium<br>镉<br>(Cd) | Hexavalent Chromium<br>六价铬<br>(Cr(VI)) | Polybrominated biphenyls<br>多溴联苯<br>(PBB) | Polybrominated diphenyl ethers<br>多溴二苯醚<br>(PBDE) |
|-----------------------------------------------------------|-------------------|----------------------|----------------------|----------------------------------------|-------------------------------------------|---------------------------------------------------|
| Enclosure<br>外壳                                           | O                 | O                    | O                    | O                                      | O                                         | O                                                 |
| Electronic and electrical sub-assembly<br>电子和电气组件         | X                 | O                    | X                    | O                                      | X                                         | X                                                 |
| Optical sub-assembly <sup>a</sup><br>光学组件 <sup>a</sup>    | X                 | O                    | O                    | O                                      | O                                         | O                                                 |
| Mechanical sub-assembly <sup>a</sup><br>机械组件 <sup>a</sup> | O                 | O                    | O                    | O                                      | O                                         | O                                                 |

**Note:**

注:

This table is prepared in accordance with the provisions of SJ/T 11364.

本表依据 SJ/T 11364 的规定编制。

O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.

0: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 标准规定的限量要求以下。

X: indicates that said hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572. Due to the limitations in current technologies, parts with the “X” mark cannot eliminate hazardous substances.

X: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 标准规定的限量要求。

标记“X”的部件，皆因全球技术发展水平限制而无法实现有害物质的替代。

a. If applicable.

如果适用。

MARKING REQUIREMENTS  
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| This EXFO product<br>本 EXFO 产品 | 10                                                         |  |
| Battery <sup>a</sup><br>电池     | 5                                                          |  |

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