



eCPRI Testing Modular Test Platforms

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1.0 About This User Manual

This user manual is suitable for novice, intermediate, and experienced users and is intended to help you successfully use the features and capabilities of the various modules for test platforms. It is assumed that you have basic computer experience and skills, and are familiar with IP and telecommunication concepts, terminology, and safety.

Every effort was made to ensure that the information contained in this manual is accurate. However, information is subject to change without notice. We accept no responsibility for any errors or omissions. In case of discrepancy, the web version takes precedence over any printed literature.

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2.0 eCPRI Testing for 10G/25G/25G with RS-FEC

eCPRI is designed to comply with the more stringent requirements brought on by 5G standards for fronthaul solutions based on CPRI/OBSAI. These include:

- Increase bandwidth
- Bandwidth scalability and flexibility
- Low latency
- Flexibility in functional split options between Remote Unit (RU) and Centralized Unit (CU)

Note: eCPRI testing availability depends on the test platform and module. Options and features described in this manual may not be available on all software versions and platforms. Refer to the latest specification sheet on www.veexinc.com for a breakdown of available test modes for each platform and module.

Test Interfaces for eCPRI

- 10G
- 25G
- 25G with RS-FEC Support

Framed Traffic

Layer 2 or Layer 4 traffic

Test Frame Header: Protocol Rev. 1, Configurable C field, Configurable message

Packet Capture and Decode

- Line rate packet capture
- Full frame capture or truncated
- Layer 2, Layer 4, Message Type

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3.0 Safety Information



Safety precautions should be observed during all phases of operation of this instrument. The instrument has been designed to ensure safe operation however please observe all safety markings and instructions. Do not operate the instrument in the presence of flammable gases or fumes or any other combustible environment. VeEX Inc. assumes no liability for the customer's failure to comply with safety precautions and requirements.

Optical Connectors

The test sets display a laser warning icon when the laser source is active to alert the user about a potentially dangerous situation. It is recommended to:

1. Deactivate the laser before connecting or disconnecting optical cables or patchcords.
2. Never look directly into an optical patchcord or an optical connector interface (SFP+) while the laser is enabled. Even though optical transceivers are typically fitted with Class 1 lasers, which are considered eye safe, optical radiation for an extended period can cause irreparable damage to the eyes.
3. Never use a fiber microscope to check the optical connectors when the laser source is active.

Safe Module Handling

While replacing test modules, all work on the open panel must be performed only by suitably qualified personnel who is familiar with the dangers both to people and to the instrument itself.

- Modules are not hot swappable. The platform must be turned off and unplugged from VAC mains when removing or inserting test modules.
- For safety and EMC (Electromagnetic Compatibility), empty module slots must be properly covered with blank panel covers.
- Prevent foreign objects from entering the unit, before, during and after module exchange or re-configuration process. They could create short circuits or damage internal fans.
- Always store test modules by themselves in individual ESD protected packaging (with no loose elements, like screws or tools).

Lithium-ion Battery Precautions

Lithium-ion (Li-ion) battery packs are compact and offer high capacity and autonomy, which make them ideal for demanding applications, like providing long lasting power to portable test equipment. For safety reasons, due to their high energy concentration, these batteries packs and products containing them must be used, charged, handled, and stored properly, according to the manufacturer's recommendations.

Li-ion battery packs contain individual Li-ion cells as well as battery monitoring and protection circuitry, sealed in its plastic container that shall not be disassembled or serviced.

The test set unit's battery pack is also fitted with a safety connector to prevent accidental short circuits and reverse polarity.

- Always charge the unit's battery pack inside the test platform battery bay using the AC/DC adapter supplied by VeEX.
- Do not charge or use the battery pack if any mechanical damage is suspected (shock, impact, puncture, crack, etc).
- Do not continue charging the battery if it does not recharge within the expected charging time
- Storage: For long term storage, the battery pack should be stored at 20°C/68°F (room temperature), charged to about 30 to 50% of its capacity. Spare battery packs should be charged and used at least once a year to prevent over-discharge (rotate them regularly).
- It is recommended to charge and use battery packs at least every three months. Battery packs shall not go without recharging (reconditioning) for more than six months.
- After extended storage, battery packs may reach a deep discharge state or enter into sleep mode. For safety reasons, Li-ion

batteries in deep discharge state may limit the initial charging current (pre-recharge) before starting their regular fast charging cycle. The pre-charging state may take several hours.

- Air transportation of Li-ion batteries is regulated by United Nations' International Air Transportation Association (IATA) Dangerous Goods Regulations and by country-specific regulations. Please check local regulations and with common carriers before shipping Li-ion battery packs or products containing relatively large Li-ion battery packs.

Electrical Connectors

Telephone lines may carry dangerous voltages. Always connect the electrical test ports to known test interfaces which carry low level signals.

ESD: Electrostatic Discharge Sensitive Equipment

Test modules could be affected by electrostatic discharge. To minimize the risk of damage when replacing or handling test modules, make sure to follow proper ESD procedures and dissipate any electrostatic charge from your body and tools and the use proper grounding gear.



- Perform all work at a workplace that is protected against electrostatic build-up and discharging.
- Never touch any exposed contacts, printed circuit boards or electronic components.
- Always store test modules in ESD protected packaging.
- Wear ESD protection and grounding gear when:
 - Inserting, extracting, or handling test modules.
 - Inserting or removing SFPs, XFPs, QSFPs, or CFPs from the platform.
 - Connecting or disconnecting cables from modules or platform.

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4.0 Basic Operations

For more information about Basic Operations, Home menu, Launching Test Applications etc., see the test unit's *Platform User Manual* on www.veexinc.com.

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5.0 Utilities

For more information on Utilities and Tools available, see the test unit's *Platform User Manual* on www.veexinc.com.

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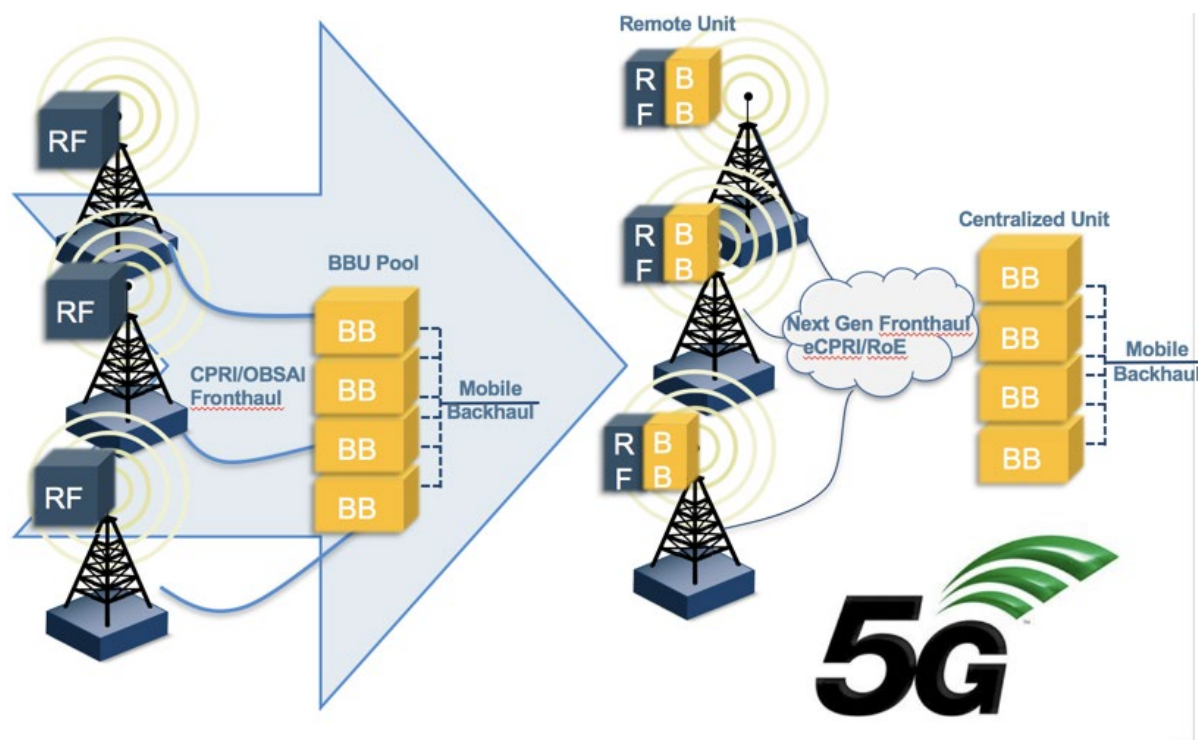
6.0 eCPRI

6.1 eCPRI Testing Overview

The Common Public Radio Interface (CPRI) forum introduced a new more stringent Ethernet packet based fronthaul interface, **eCPRI**, due to limitations for 5G deployments based on traditional CPRI or OBSAI.

To ensure that 5G network's strict requirements are met in the fronthaul, the eCPRI Transport Network requirement document establishes classes of service for data and C&M traffic. With full line rate eCPRI traffic generation capabilities and high accuracy one-way latency measurements, the eCPRI test application provides the tools necessary to ensure that the eCPRI transport network is ready for 5G deployments.

CPRI Mobile Fronthaul Evolution

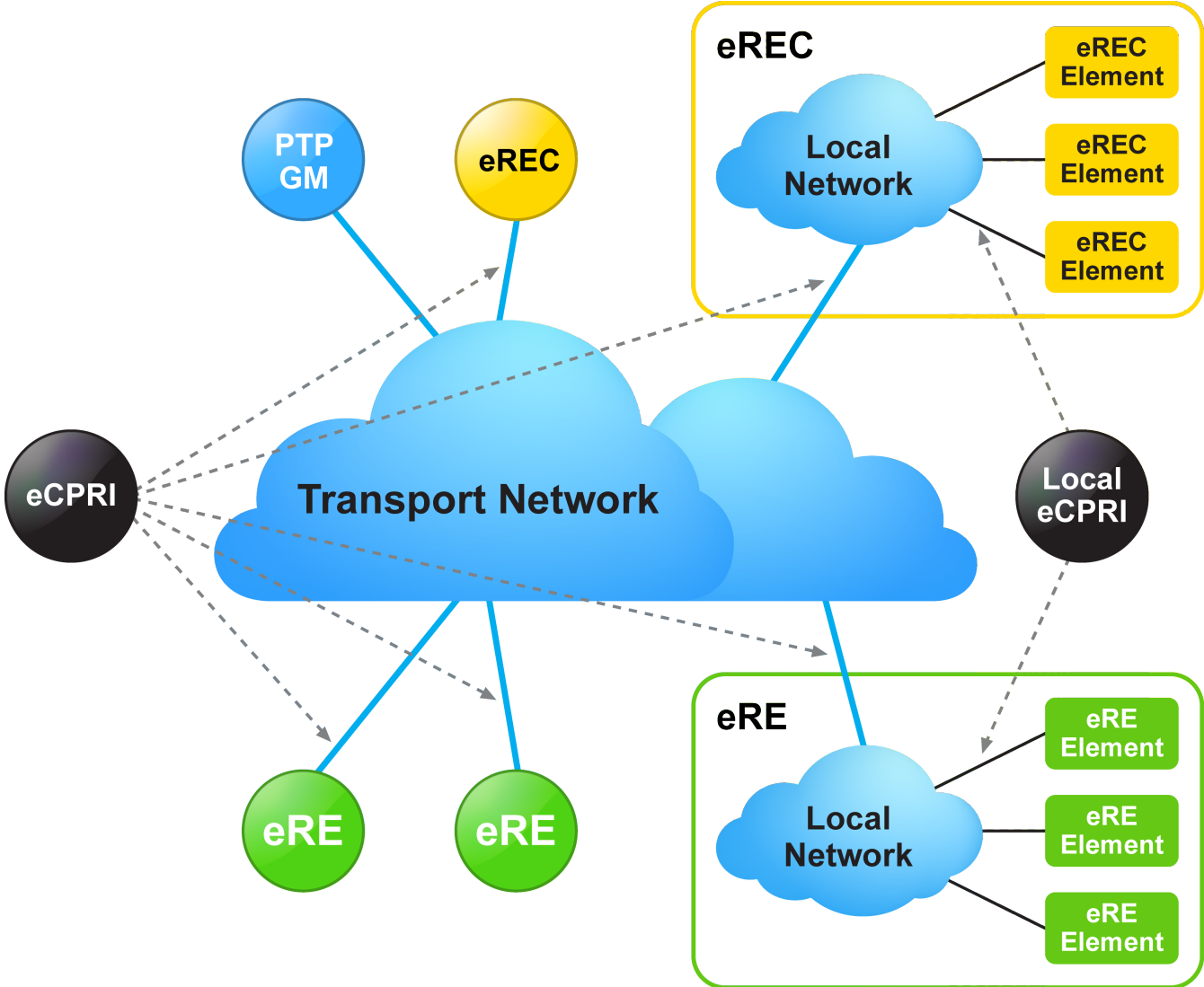


This protocol has been developed by Ericsson AB, Huawei Technologies Co. Ltd, NEC Corporation, Alcatel Lucent and Nokia Siemens. The standard is public and can be downloaded from <http://www.cpri.info>.

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6.2 Interface Specifications

eCPRI System Architecture Example*
 (*eCPRI Interface Specifications ver 1.1)

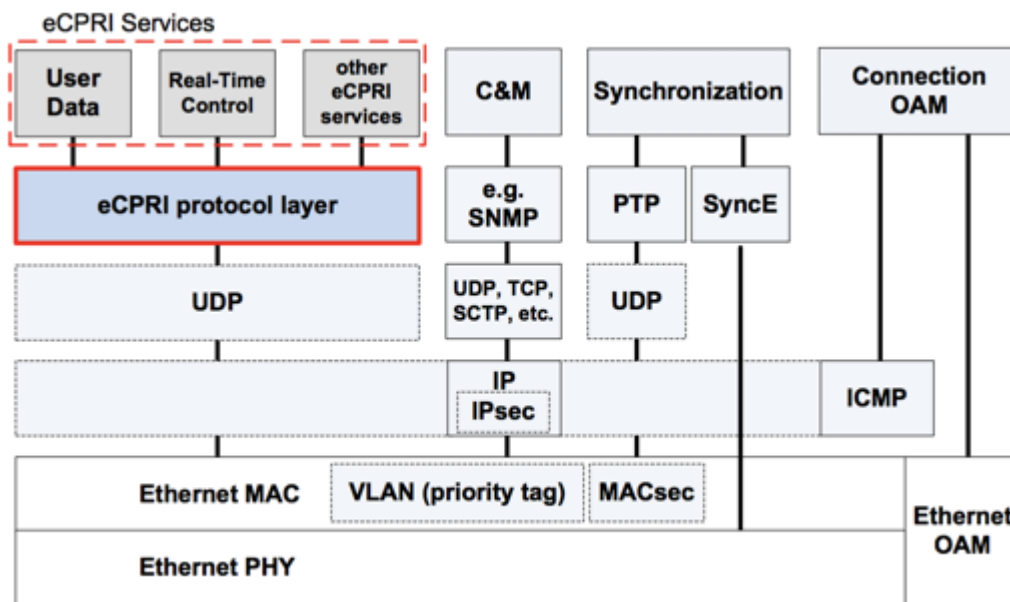


- CPRI Specification was written with the goal to be generic enough to support scalable rates, physical access medium type, and air interface technologies.
- eCPRI relies on existing standards for Ethernet/IP networking, synchronization, and security.

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6.2.1 Protocol Stack

eCPRI Protocol Stack* (*eCPRI Interface Specifications ver 1.2)



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6.2.2 eCPRI Key Features

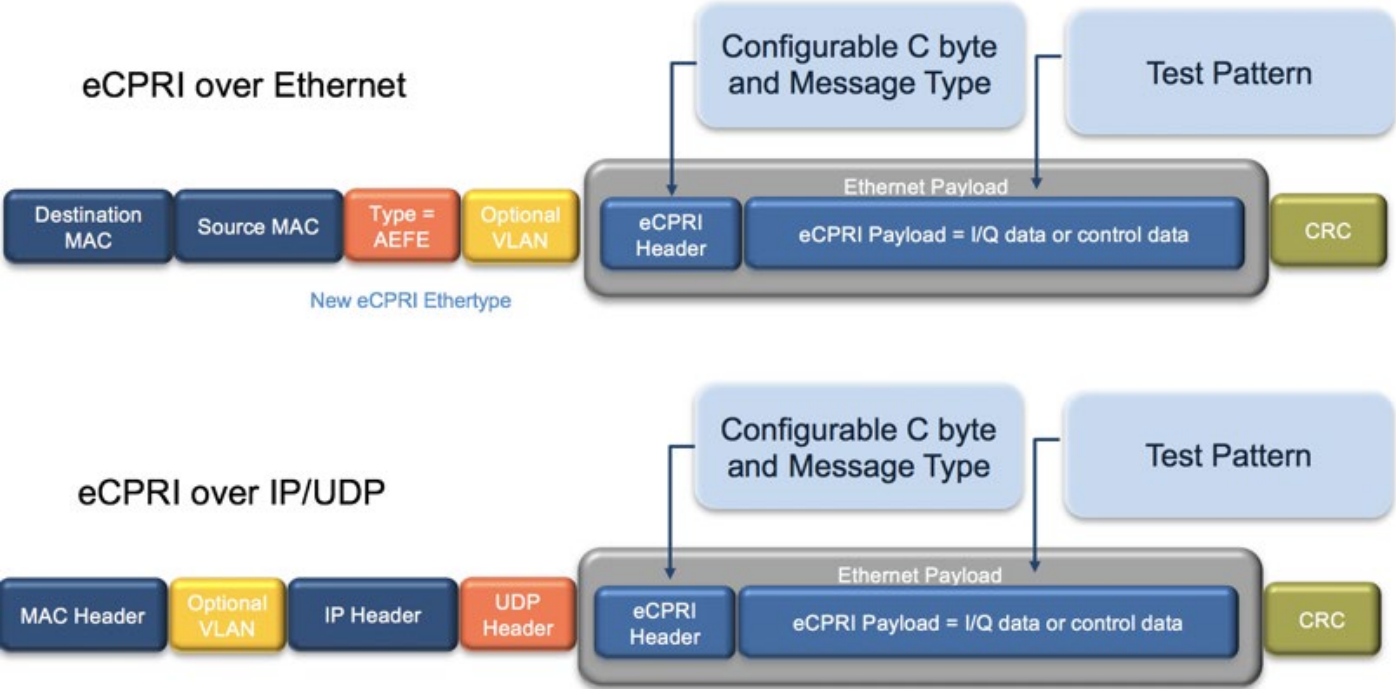
Key features of eCPRI include:

- 25G/10G eCPRI (Protocol ver.1)
- Ethernet Type: AE-FE (eCPRI)
- Configurable C field and message type
- Dual-port testing capabilities
- RS-FEC support
- Multi-stream testing up to 32 independent streams
 - Each stream can be set with independent frame size, bandwidth, traffic profile, and QoS levels
- Throughput testing at Layer 2 and Layer 4
- Frame sizes from 64 to 1518 bytes and jumbo frames up to 16000 bytes (Layer 2 only)
- Configurable Source and Destination MAC
- Fully configurable IPv4 or IPv6 header
 - UDP Header configurable Source and Destination ports
- Q in Q (VLAN stacking up to 3 VLAN tags with configurable priority and type)
- MPLS up to 3 labels with configurable Label/S/CoS and TTL
- Test Patterns:
 - PRBS pattern: 231-1, 223-1, 215-1, 211-1
 - PRBS normal and inverted patterns
 - All 0s, All 1s, and User Defined
- High accuracy One-Way-Delay latency measurement
- Line rate packet capture

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6.2.3 eCPRI Data Framing

eCPRI Data Framing

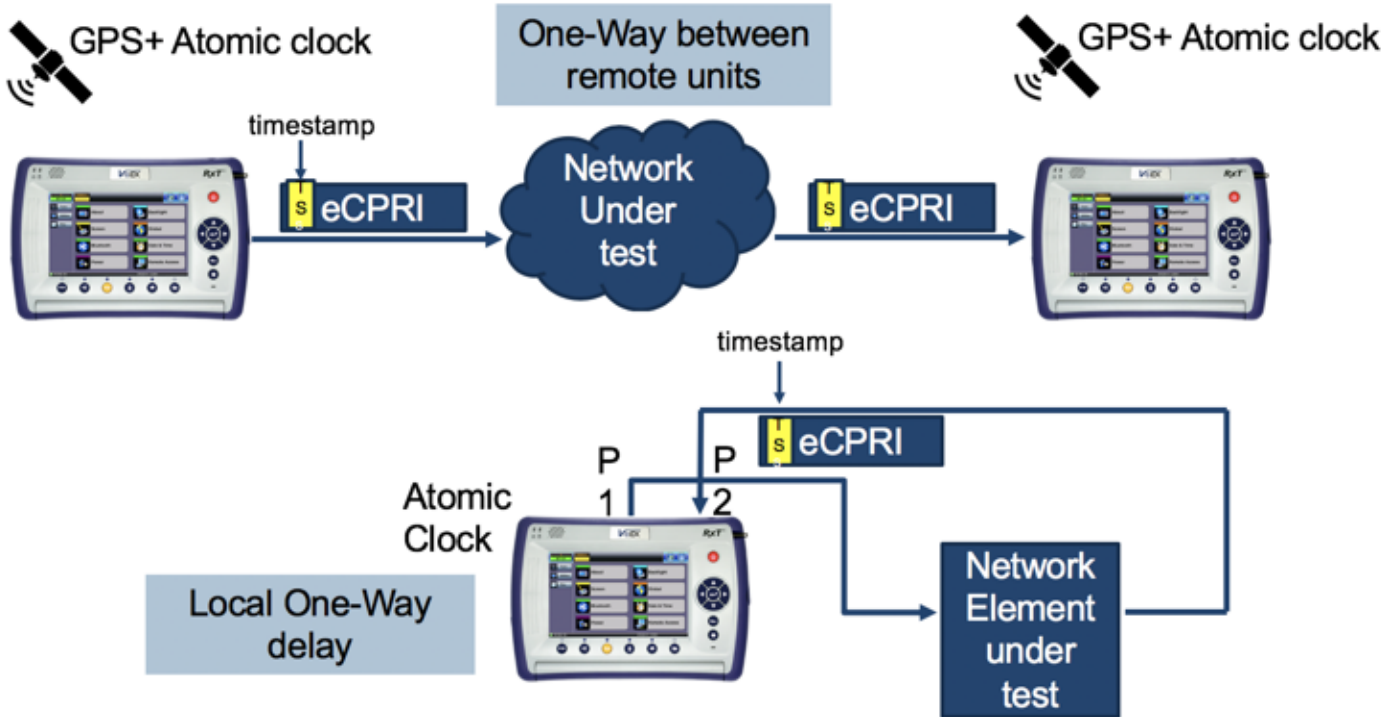


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6.2.4 eCPRI One Way Latency Measurement

The diagram below shows how eCPRI works with RXT-6000e and RXT-6200 test modules.

eCPRI One Way Latency Measurement

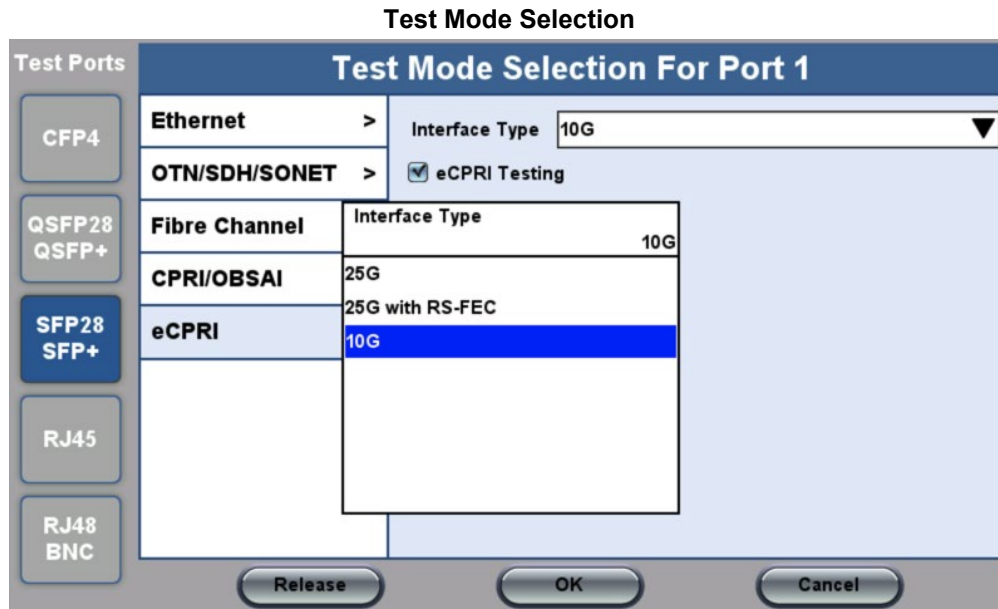


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6.3 eCPRI Setup

Test mode, test port(s), and network settings are required prior to performing any measurements or applications.

6.3.1 Test Port Selection



This menu is accessed via the Test Port button located at the top left hand side of the screen.

To select the eCPRI test:

1. Click the **SFP28/SFP+** Test Port, and then select the **eCPRI** test mode.
2. Select the test interface type (10G, 25G, or 25G with RS-FEC), and then click **OK**.

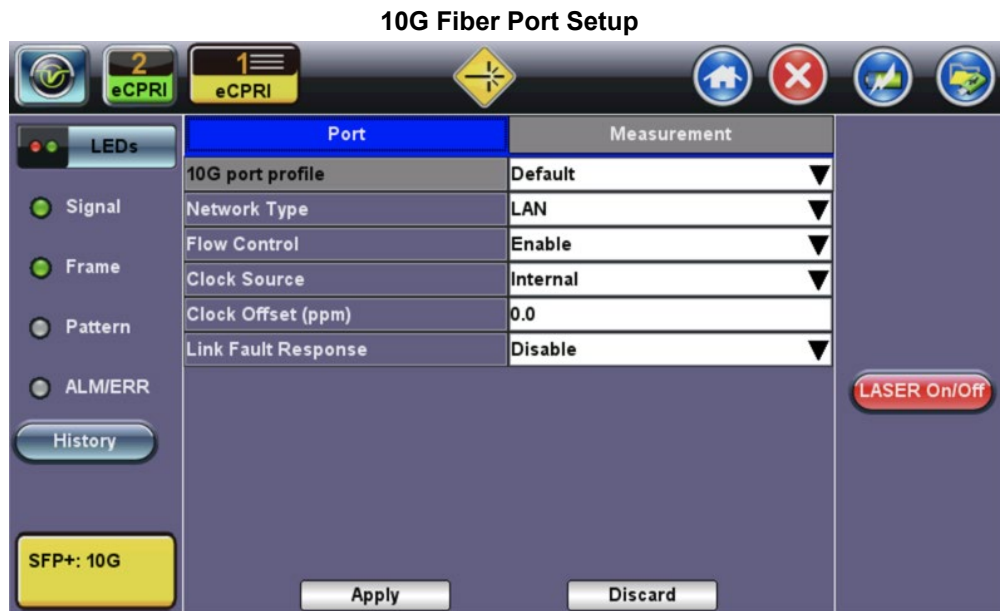
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6.3.2 Port Setup

Configure the Test Ports and/or Test Interfaces using the Setup menu on the Home page. The available configuration settings depend on the interface selected.

Select the operation mode and the interfaces that will be used to carry out tests. Once the operating mode and interfaces are selected, the the auto-negotiation, speed, duplex, and flow control settings for each port (where applicable) can be configured.

The figure below shows a 10G Port Setup.



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Port Setup

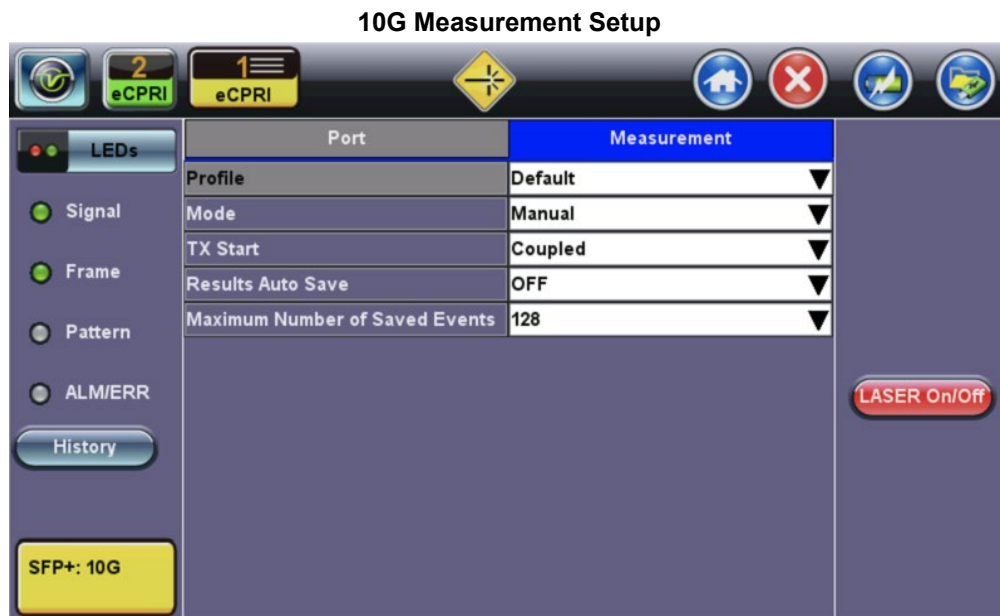
- **Port Profile:** Lock, Delete, Save, Save as..., Default, Last configuration
- **Network Type:** LAN
- **Flow Control:** Enable/Disable
 - When flow control is enabled, the test set will respond to pause frames received by the link partner by adjusting the transmit rate.
 - When flow control is disabled, the test set ignores all incoming pause frames from the link partner and continues transmitting at the configured transmit rate.
- **Clock Source:**

Note: For one-way delay measurements between remote test units, the clock source should be set to 1PPS external, GPS 1PPS or Atomic 1PPS.

 - **Internal:** The internal clock has an accuracy of +/- 3.5ppm conforming to G.812 recommendations.
 - **External:** 2Mbps, 2MHz, 1.5Mbps, 1.5MHz, 10MHz, 1PPS
 - **RxCLK:** The clock is derived from the received signal and the jitter of the incoming signal is suppressed.
 - **GPS 1PPS:** The optional built-in GPS provides a (raw) 1PPS timing signal (clock) and is aligned to the standard second.
 - **Atomic 1PPS:** The optional built-in Atomic Clock provides a stable 1PPS timing signal.
- **Clock Offset (ppm):** The clock for the transmitter is derived from the internal clock generator. Frequency offset: +/- 150 ppm with 0.1 ppm resolution.
- **Link Fault Response:** Enable/Disable

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6.3.3 Measurement Settings



The measurement and event log settings are configured in this screen.

- **Profile:** Last configuration, Delete, Save, Save as..., Default.
- **Mode:** Manual, timed, or auto mode are available.
 - **Manual mode:** Starts and stops the measurements manually.
 - **Timed mode:** Defines the duration of the test; after the test is started, the test will run for the configured duration and stop automatically.
- **TX Start:** Separated or Coupled. Configure how the measurements are started by separating or coupling the transmitter and receiver.
 - **Separated:** Independent control (Start/Stop) of the transmitter is enabled. At the start of the test only the receiver is turned on; the transmitter must be turned on manually.
 - **Coupled:** Transmitter and receiver are turned on at the same time, and the measurements start at the same time at the start of the test.
- **Results Auto Save:** ON/OFF. When ON is selected, results are saved automatically.
- **Maximum Number of Saved Events:** 128, 256, 512, 1024. Maximum number of error and alarm events recorded during a test.

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6.3.4 eCPRI Tests

After setting up test ports and configuring the measurements, tests are available from the **Throughput** and **Packet Capture** options on the **Home** page.

Note: Actual screens may differ depending on the installed module.



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6.4 Throughput Testing

6.4.1 Setup

To access Throughput testing features, tap **Throughput** from the **Home** menu.

Overview:

This application is very useful in verifying the transport of traffic with different prioritization settings across a network link. The test helps verify that the network can handle high priority traffic and low priority traffic accordingly.

The Throughput application performs the following measurements:

- Throughput performance
- Frame Loss analysis
- Delay analysis
- Frame/Packet arrival analysis
- Received Traffic Type analysis
- Received Traffic Frame Size analysis.

On the transmit side, the Throughput application currently allows up to 32 streams with its MAC and IP address, VLAN tags (up to 3), bandwidth/rate, frame size, and L2 and/or L4 quality of service (QoS) parameters. On the receiver end, the traffic is analyzed on a per stream basis as well as a global or aggregate measurement.

eCPRI Throughput testing at Layer 2 and 4 is supported. Throughput can be configured to use either stress patterns or user defined test patterns to simulate various conditions. The test layer, frame header, traffic profile, error injection, and control settings of the far-end device (if applicable) must be configured prior to testing.

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6.4.1.1 Frame Header Settings

The following parameters must be configured prior to performing a Throughput test:

- **Layer 2:**
 - Test pattern is encapsulated into a valid Ethernet frame with SOF, Preamble, and CRC field
 - A default or user configured Media Access Control (MAC) address is added to the frame
- **Layer 4:**
 - A default or user configured Media Access Control (MAC) address is added to the frame.
 - A default or user configured IP address is added to the frame.

Header Settings

Throughput Header Settings: Layer 2

The screenshot displays the 'Throughput Header Settings: Layer 2' interface. The 'Setup' tab is active, showing the following configuration:

Header	Traffic	General	Summary
Profile		Last configuration	
Stream #	1 of 1	Prev	Next
Test Layer		Layer 2	
Frame Type		Ethernet II(DIX)	
VLAN		1 tag	

Below the configuration table, a 3D bar chart represents the frame structure: MAC (blue), VLAN 1 (green), eCPRI (green), Data (grey), and CRC (red). The interface also includes a 'Start' button, a 'LASER On/Off' button, and a 'PCAP Start' button. The 'SFP+: 10G' indicator is visible at the bottom left.

Throughput Header Settings: Layer 4

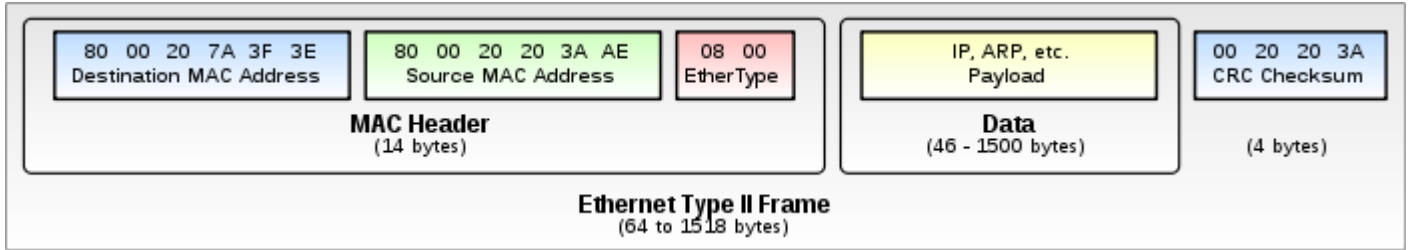
The screenshot displays the 'Throughput Header Settings: Layer 4' interface. The 'Setup' tab is active, showing the following configuration:

Header	Traffic	General	Summary
Profile		Last configuration	
Stream #	1 of 1	Prev	Next
Test Layer		Layer 4	
VLAN		1 tag	
MPLS		1 tag	
PROTOCOL		UDP	

Below the configuration table, a 3D bar chart represents the frame structure: MAC (blue), VLAN 1 (green), MPLS (green), IP (yellow), UDP (red), eCPRI (green), Data (grey), and CRC (red). The interface also includes a 'Start' button, a 'LASER On/Off' button, and a 'PCAP Start' button. The 'SFP+: 10G' indicator is visible at the bottom left.

- **Profile:** Load a previously configured test profile or create a new profile from existing settings.
- **Stream #:** Number of stream for which to configure the profile. Use the **Prev** and **Next** buttons to change streams.
Note: Use the General tab to configure the total number of streams. See [General Throughput Settings \(Global Configuration\)](#) for more details.
- **Test Layer:** Select layer to perform the test. Layer 2 or 4.
- **Frame Type:** (**Layer 2 only**) Ethernet II (DIX); named after DEC, Intel, and Xerox, this is the most common frame type today.
- **VLAN:** Off, 1 tag, 2 tags, 3 tags (VLAN stacking is an option for Q-in-Q applications)
- **MPLS (Layer 4 only):** Off, 1 tag, 2 tags, 3 tags
- **Protocol (Layer 4 only):** UDP
- **eCPRI, DATA, and CRC** are selected automatically for Layers 2 and 4. **IP** is selected automatically for Layer 4 only.

The most common Ethernet Frame format, Type II



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MAC, VLAN, MPLS, IP, UDP, eCPRI, DATA, and RX Filter Test Pattern Configurations:

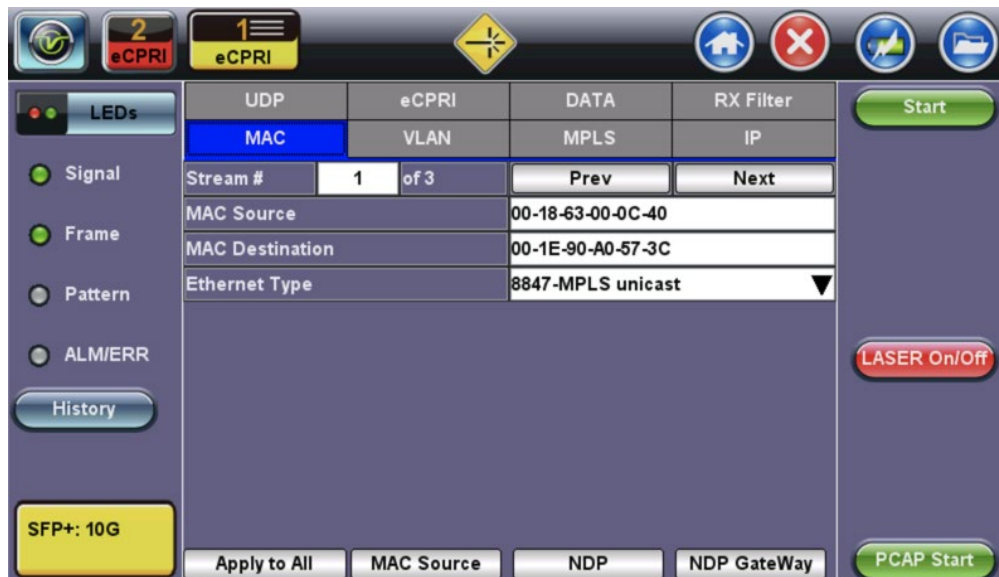
To configure the MAC addresses, IP addresses, VLAN tag(s), and test pattern, tap on the frame image displayed on the screen. This brings up the configuration screens for all the header fields.

Tap the **Apply** button at the bottom to save your selections to the current stream or **Apply to All** to save your selections to all streams.

- **MAC Header Tab:**

- **MAC Source:** Use the default source address of the test set or configure a new or different address. Tap the **Mac Source** button at the bottom to populate the fields with default test port settings. *For Layer 4 (IPv6) only:* Tap the **NDP Gateway** and **NDP** buttons at the bottom to locate MAC addresses on the local network for the network address designated in the gateway.
- **MAC Destination:** Configure the destination MAC address of the far-end partner test set.
- **Ethernet Type:**
 - **Layer 2:** AE-FE (fixed)
 - **Layer 4:** Set to 0800-IP (fixed), or select 8847-MPLS unicast or 8848-MPLS multicast if MPLS tagging is enabled.

Throughput Setup - MAC Layer 4

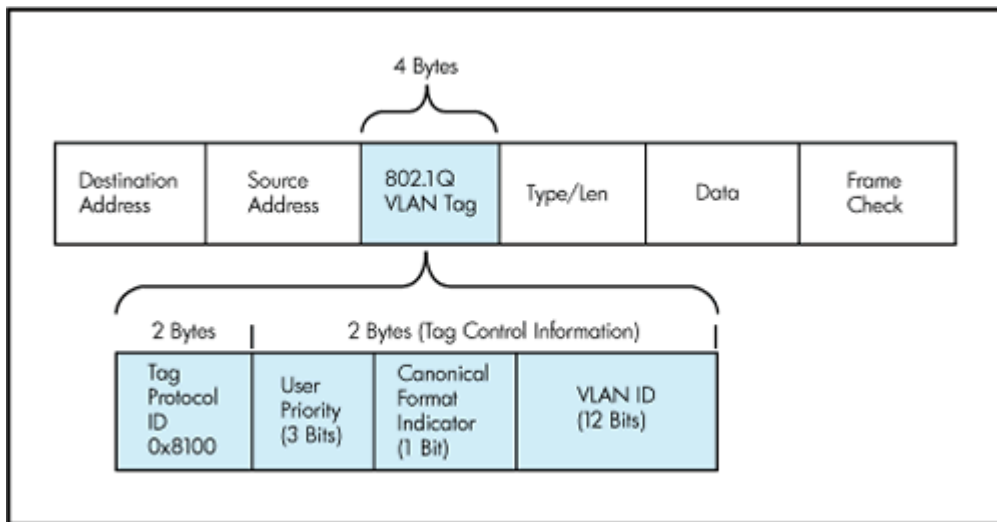


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- **VLAN Tab:**

- **VLAN ID:** Configurable in the range 1 to 4094.
 - Identifies the VLAN; used by standard 802.1Q.
 - It has 12 bits which allows the identification of 4096 (2^{12}) VLANs.
 - Of the 4096 possible VLANs, a VLAN of 0 is used to identify priority frames and value 4095 (FFF) is reserved.
 - Maximum possible VLAN configurations are therefore set to 4094.
- **VLAN Priority:** Configurable in the range 0 to 6
 - Set by the Priority Code Point (PCP), a 3-bit field referring to the IEEE 802.1p priority.
 - Indicates the frame priority level from 0 (lowest) to 7 (highest); used to prioritize different classes of traffic (voice, video, data, etc.).
- **Type:** The following selections are possible:
 - 8100 (IEEE 802.1Q tagged frame)
 - 88a8 (IEEE 802.1ad Provider Bridging)
 - User Defined
- **Drop Eligible:** If enabled, a drop eligibility flag will be set.

IEEE 802.1Q VLAN Tag in an Ethernet Frame



Throughput Setup - VLAN Tag configuration (Layer 4)

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- **MPLS Tab (Layer 4 only):**

- **MPLS label:** Configurable in the range 16 through 1,048,575 (labels 0 to 15 are reserved).
Note: Composed of 20 bits which allows for the creation of over one million labels.
- **CoS:** Configurable in the range 0 to 6.
Note: This field is three bits in length and maps directly to IP Precedence TOS bits to provide Class of Service (COS).
- **S-bit:** Configurable 0 or 1.
Note: The S field is one bit in length and is used for stacking labels. This is important as it is used to indicate the last label in the label stack.
- **TTL:** Configurable in the range 0 to 255. The default setting is 128 hops.
Note: Used to decrement the time-to-live counter.

Throughput Setup - MPLS configuration (Layer 4)



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- **IP Tab:** Configures the destination IP address, source address and header fields.

- **IPv4**
 - **IP Type:** IPv4, IPv6
 - **Source and Destination IP Address:** The source address is fixed to the IP address from the IP setup menu.
 - **Subnet:** Subnet mask
 - **Gateway:** Address of the network gateway
 - **IP TOS (for Quality of Service testing):** Legacy TOS or DSCP
 - **Legacy TOS :** The first three bits of the IP TOS field can be edited:
 - **Precedence:**
 - 000 - Routine
 - 001 - Priority
 - 010 - Immediate
 - 011 - Flash
 - 100 - Flash Override
 - 101 - Critical
 - 110 - Internetwork Control
 - 111 - Network Control
 - **TOS Values:**
 - 1000 - Minimize Delay
 - 0100 - Maximize Throughput
 - 0010 - Maximize Reliability
 - 001 - Minimize Monetary Cost
 - 0000 - Normal Service
 - **DSCP (Differentiated Services Code Point):** The first six bits of the IP TOS can be edited to provide

more granular service classification.

- **Time To Live (TTL):** Configurable in the range 0 to 255. Indicates how many hops have been traversed. It will be decremented by 1 each time it crosses a hop.
- **Do Not Fragment Flag:** Fragment offset byte configurable in the range 0 to 65.528.
Note: The fragment offset field, measured in units of eight-byte blocks, is 13 bits long and specifies the offset of a particular fragment relative to the beginning of the original unfragmented IP datagram.
- **Protocol:** UDP (0x11), TCP (0x06), User Defined.

Throughput Setup - IP Address Settings Layer 4 (IPv4 Legacy TOS)

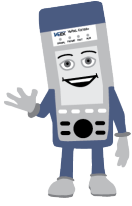
UDP	eCPRI	DATA	RX Filter
MAC	VLAN	MPLS	IP
Stream #	1 of 3	Prev	Next
IP Type	IPv4		
Source IP Address	192.168.0.10		
Destination IP Address	192.168.2.200		
Subnet	255.255.255.0		
Gateway	192.168.0.1		
IP TOS	DSCP		
DSCP	011001	ECT	0
		CE	0
TTL	128		
Do Not Fragment Flag	0		
Protocol	UDP - 0x11		
Apply to All	Apply	Ping	ARP

o IPv6

- **IP Type:** IPv6
- **Source and Destination IP Address:** 128-bit fields. The source address is fixed to the IP address from the IP setup menu.
- **Traffic Class:** 8-bit level used to designate priority handling of packets.
- **Flow Label:** 20-bit label used to identify packets for special handling.
- **Next Header:** 8-bit field to identify the type of header that immediately follows.
- **Hop Limit:** 8-bit field to designate the maximum number of hops from source to destination. Packet is discarded once number is decremented to zero.

Throughput Setup - IP Address Settings Layer 4 (IPv6)

UDP	eCPRI	DATA	RX Filter
MAC	VLAN	MPLS	IP
Stream #	1 of 3	Prev	Next
IP Type	IPv6		
Source IP Address	2001:d11:c0a8:a:218:63ff:fe00:2		
Destination IP Address	5555:11:c0a8:a::8552		
Traffic Class	0		
Flow Label	0		
Next Header	17		
Hop Limit	0		
Apply to All			



Multiple Streams - MAC/IP Address Setup

If all of the streams are going to the same far-end unit, then the MAC/IP destination addresses must be the same on all of the streams.

If any of the traffic streams are going to more than one far-end unit then ensure the correct MAC/IP destination addresses are configured for the respective streams.

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- **UDP Header Tab:**

- **Source Port:** 16-bit fields used to identify the transmitter's and receiver's ports. Field has limit of 65,535.

Throughput Setup - UDP Settings Layer 4

MAC	VLAN	MPLS	IP
UDP	eCPRI	DATA	RX Filter
Stream #	1 of 3	Prev	Next
Source Port	0		
Destination Port	0		

Start

LASER On/Off

PCAP Start

Apply to All

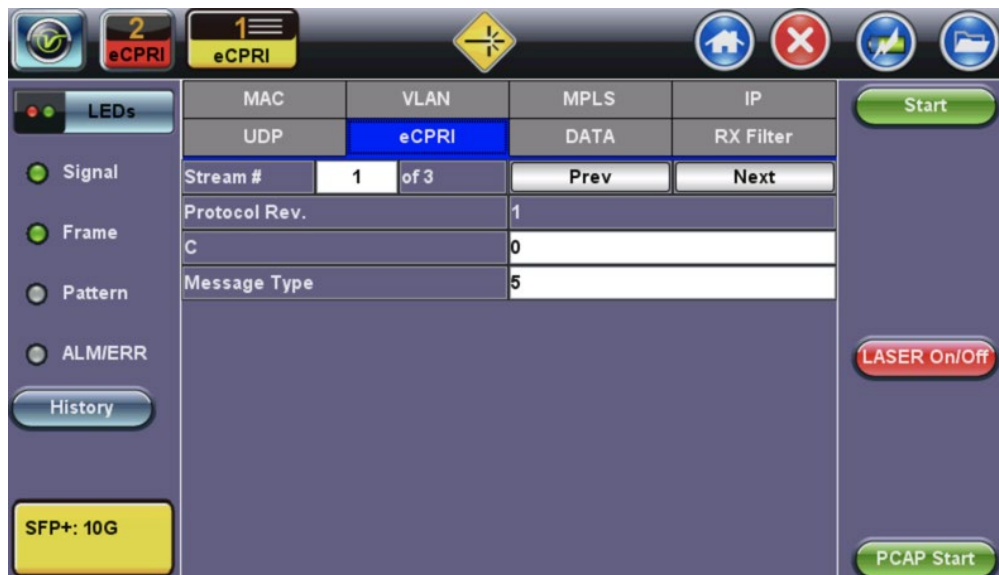
SFP+: 10G

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- **eCPRI Header Tab:**

- **Protocol Rev.:** eCPRI Interface Specification version used (version 1 is default).
- **C:**
 - 0 = indicates last message
 - 1 = indicates another eCPRI message follows
- **Message Type:** The following types of messages are allowable in eCPRI specifications ver. 1. The default is set to 5 for One-way latency measurements.
 - 0 = IQ Data
 - 1 = Bit Sequence
 - 2 = Real-Time Control Data
 - 3 = Generic Data Transfer
 - 4 = Remote Memory Access
 - 5 = One-way Delay Measurement
 - 6 = Remote Reset
 - 7 = Event Indication
 - 8 - 63 = Reserved
 - 64 - 255 = Custom

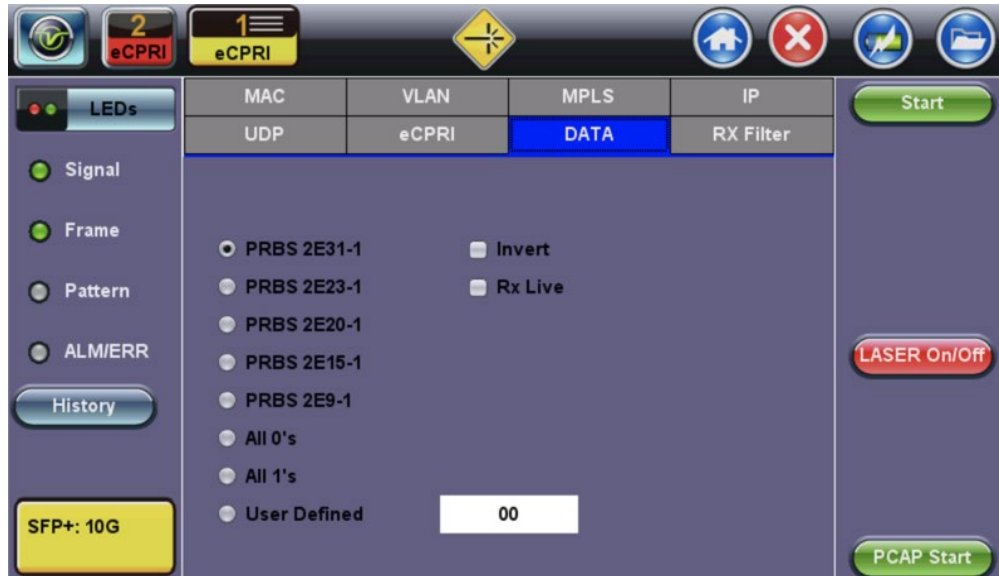
Throughput Setup - eCPRI Settings Layer 4



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- **Data Tab:** Select a test pattern that will be encapsulated in the Ethernet frame payload (for framed mode). For both Layer 2 and 4 the following pattern is available:
 - **PRBS:**
 - 2E31 -1 (147 483 647-bit pattern used for special measurement tasks, [e.g., delay measurements at higher bit rates])
 - 2²³ -1 (8 388 607 bit pattern primarily intended for error and jitter measurements at bit rates of 34 368 and 139 264 kbps)
 - 2¹⁵ -1 (32 767 bit pattern primarily intended for error and jitter measurements at bit rates of 1544, 2048, 6312, 8448, 32 064 and 44 736 kbps)
 - **All 0's:** Set to all zeros
 - **All 1's:** Set to all ones
 - **User Defined:** 2 bit field
 - **Invert:** Normal or inverted
 - **Rx Live:** Select checkbox to check that receiver is active and ready to receive data.

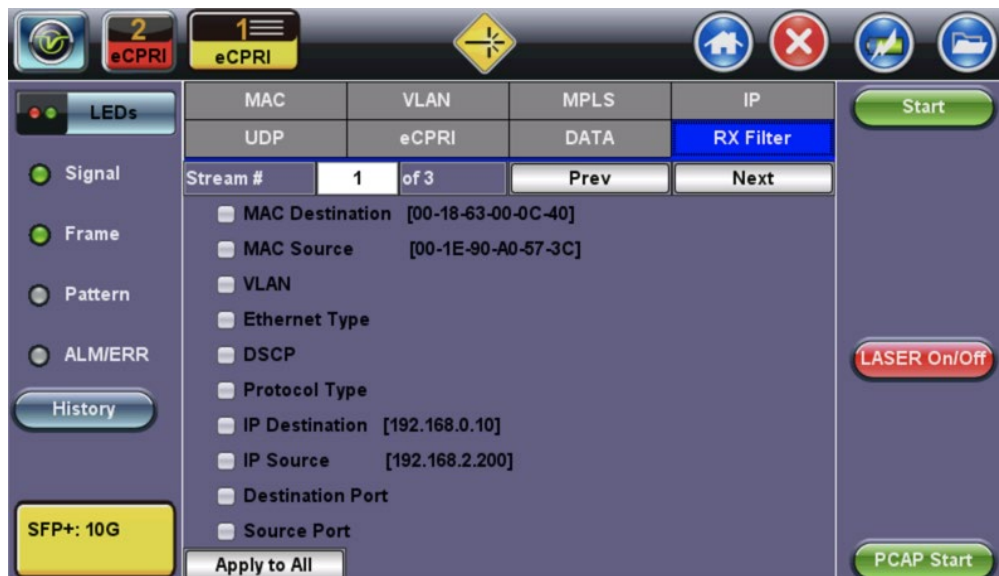
Throughput Setup - DATA Settings Layer 4



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- **RX Filter Tab:** Filters incoming streams. When checked, the incoming traffic flows that do not match these criterion will not be considered for test results.
 - **MAC Destination**
 - **MAC Source**
 - **VLAN**
 - **Ethernet Type**
 - **DSCP (Layer 4 only)**
 - **Protocol Type (Layer 4 only)**
 - **IP Destination (Layer 4 only)**
 - **IP Source (Layer 4 only)**
 - **Destination Port (Layer 4 only)**
 - **Source Port (Layer 4 only)**
 - **VLAN Eligible (Layer 4 only)**

Throughput Setup - RX Filter Header Setup Settings Layer 4



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6.4.1.2 Traffic Settings (Per Stream Configuration)

Use the Traffic tab to configure the traffic profile per stream, including frame size selection, traffic type, and transmit rate.

- **Stream #:** Select a stream number to configure.
- **Traffic Flow:**
 - Multiple Streams: Constant
 - Single Stream: Constant, Ramp, Burst, or Single Burst
- **Frame Size (Type):** Fixed
- **Frame Size (bytes):** If a fixed frame size is chosen, this option is enabled to enter the frame size. Frame sizes can be from 64 bytes to 1518 bytes, in addition to jumbo frames up to 9k bytes.
- **Constant Bandwidth:** Configure the transmit rate for the stream. The parameters depend on the Traffic Flow selected.
 - Constant Traffic Flow: Constant Bandwidth
 - Ramp: Start BW, Stop BW, Step BW, Ramp Time, Repetitions
 - Burst: Burst 1 Bandwidth, Burst 1 Time, Burst 2 Bandwidth, Burst 2 Times
 - Single Burst: Single Burst Bandwidth

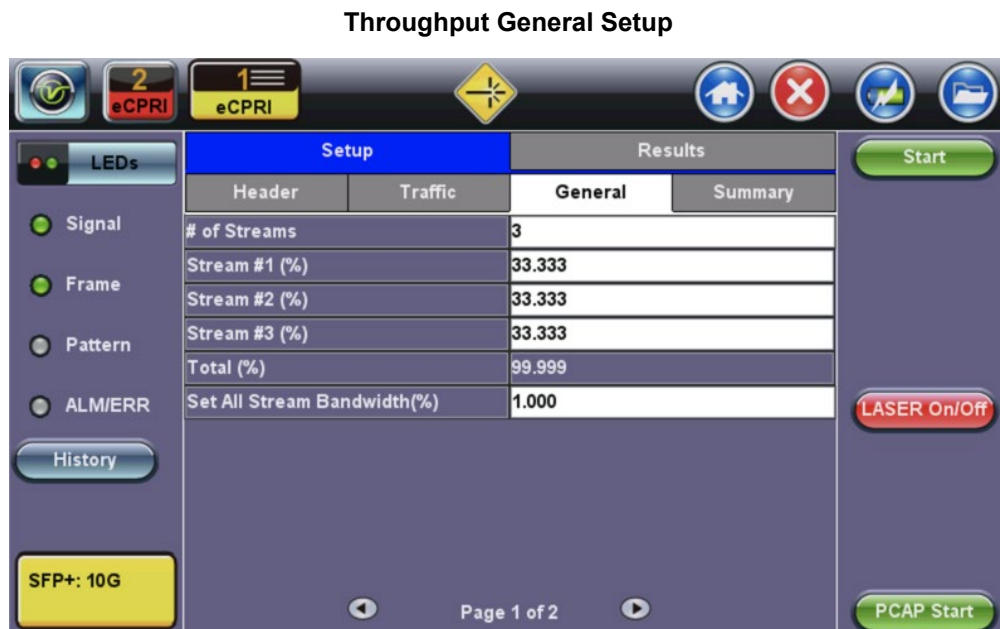
Note: The bandwidth allocation per stream is already configured in the **General Settings** tab, but can be modified in this screen as well.

Throughput Traffic Settings

Setup		Results	
Header		General	Summary
Stream #	1 of 3	Prev	Next
Traffic Flow	Constant		
Frame Size Type	Fixed		
Frame Size (bytes)	130	Apply to All	
Constant Bandwidth	33.333	%	

6.4.1.3 General Throughput Settings (Global Configuration)

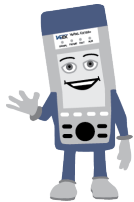
- **# of Streams:** Up to 32 streams.
- **Stream #:** Allocated Bandwidth per Stream: The total bandwidth for all streams cannot exceed 100%.
- **Total (%):** Sum of all stream rates in %.



Page 2 features One Way Delay measurement and Service Disruption Test (SDT) measurement settings.

- **Delay Measurement Mode:** Enable/disable the round trip delay measurement. It should only be enabled when running the test to a remote loopback.
- **RTD Unit Auto Scale:** ON/OFF
- **Histogram:** Enable / Disable
- **Sampling Period:** 1sec, 10secs, 30secs, 1min, 10min, 30min, 1hr. Defines how often the RTD (round trip delay) measurement is evaluated against the RTD threshold.
- **Threshold (Max RTD allowed):** Input the value in us, ms or sec. Defines the maximum allowed round trip delay value. If the RTD value exceeds the threshold, an event is logged with corresponding time stamp.
- **Save Histogram:** Enable/Disable
- **SDT Measurement:** Enable/Disable. The Service Disruption Test is triggered based on user established thresholds.
 - **SDT Violation Threshold (us):** Triggers an SDT Violation event in the event log. This is helpful for historical purposes during any given test. If the measured SDT is equivalent or greater than the configured threshold an SDT Violation event is counted.
 - **SDT Measurement Trigger (>us):** Any inter-frame gap that is equivalent or greater than the configured threshold will trigger the SDT measurement. This is useful if a known threshold is expected from a given network under test. For example, if the known switchover time is 50ms, the trigger can be set to a value slightly below 50ms to assure that the SDT is measured.

Throughput General Setup - One Way Delay Service



Multiple Streams

All streams are configured for the same test layer - if Layer 2 is selected, all streams will be Layer 2 traffic.

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6.4.1.4 Error/Alarm Injection Settings (Per Stream Configuration)

Error injection and Alarm Injection can be performed during testing by tapping the **Setup Injection** button. The type of errors and error injection are configured in the Error Injection tab. Once the test is running, error injection can be performed by pressing the **Error Inj** button on the right side of the screen.

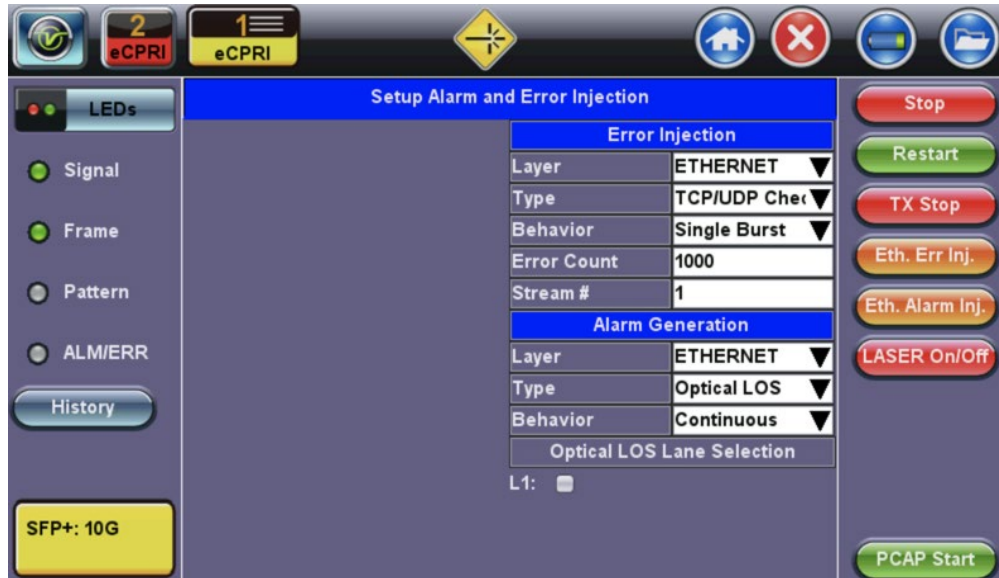
Error Injection Settings

- **Layer:** ETHERNET
- **Type:** Type of error: CRC, TCP/UDP Checksum, Pause, OOS, Missing Sequence, or Dup. Sequence. When Pause is selected, the unit will transmit a pause frame when the **Error Inj.** button is pressed.
- **Behavior:** How the errors will be injected: Single, Single Burst, or Rate.
- **Pause Quanta:** Field appears when **Type** is set to Pause. The Pause time duration is configurable in units of 512 bit time. At Gigabit Ethernet speed, this is equivalent to 512 ns. For example, if pause time is set to 1000, the pause duration will be set to 1000x512 ns.
- **Error Count:** Field appears when **Behavior** is set to Single Burst.
- **Error Rate:** Field appears when **Behavior** is set to Rate.
- **Stream #:** The stream to configure.

Alarm Injection Settings

- **Layer:** ETHERNET
- **Type:** Type of alarm: Local Fault, Remote Fault, or Optical LOS. **Alarm Inj.** Button is pressed.
- **Behavior:** How the alarms will be injected: Continuous or Single Burst
- **Optical LOS Lane Selection:** Checkbox appears when **Type** is set to Optical LOS.

Throughput Error/Alarm Injection Setup



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6.4.1.5 Summary

The summary screen lists the MAC source, MAC destination and VLAN information of each stream. Tap the appropriate box of each tab to reconfigure the source, destination, or VLAN information.

Throughput Summary MAC List - Level 4



Throughput Summary IP List - Level 4

Setup | Results

Header | Traffic | General | Summary

Port List | Mpls List | Gateway List

MAC List | IP List | VLAN List

# of Streams	Source IP	Destination IP	Subnet Mask
Stream #1	192.168.0.10	192.168.2.200	255.255.255.0
Stream #2	::	::	::
Stream #3	::	::	::

Start

SFP+: 10G

Src. to Dest. | Dest. to Src. | Swap

Page 1 of 1

PCAP Start

LASER On/Off

Throughput Summary VLAN List - Level 4

Setup | Results

Header | Traffic | General | Summary

Port List | Mpls List | Gateway List

MAC List | IP List | VLAN List

# of Streams	ID	Priority	Type
vlan #1 of stream 1	12	3	8100
vlan #2 of stream 1	12	3	88a8
vlan #3 of stream 1	12	3	88a8
vlan #1 of stream 2	135	3	8100
vlan #2 of stream 2	12	3	88a8
vlan #3 of stream 2	12	3	88a8

Start

SFP+: 10G

Page 1 of 2

PCAP Start

LASER On/Off

Throughput Summary MPLS List - Level 4

Setup | Results

Header | Traffic | General | Summary

MAC List | IP List | VLAN List

Port List | Mpls List | Gateway List

Background	Label	S	Cos	TTL
mpls #1 of stream 1	0	0	0	128
mpls #2 of stream 1	0	0	0	128
mpls #3 of stream 1	0	1	0	128
mpls #1 of stream 2	0	0	0	128
mpls #2 of stream 2	0	0	0	128
mpls #3 of stream 2	0	1	0	128

Start

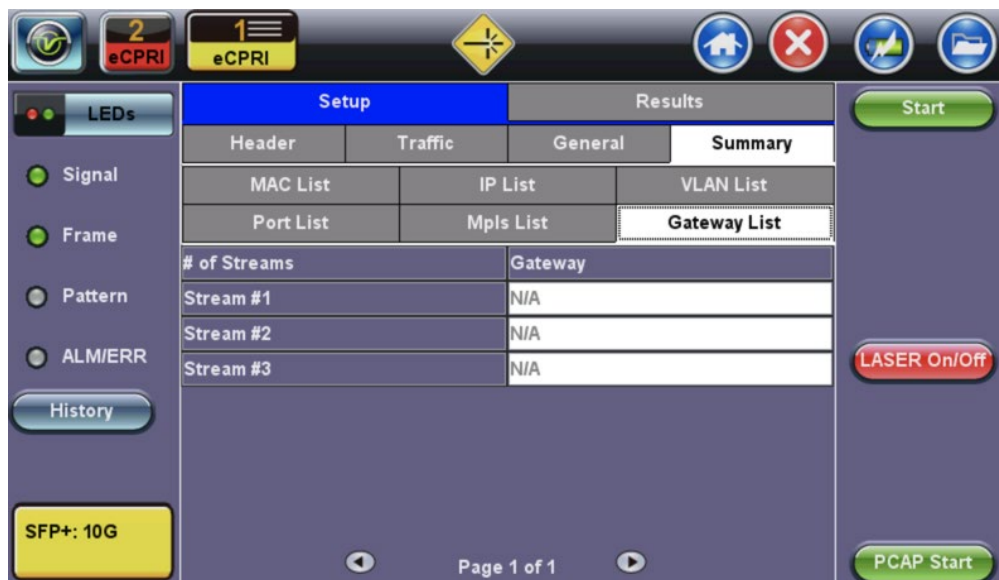
SFP+: 10G

Page 1 of 2

PCAP Start

LASER On/Off

Throughput Summary Gateway List - Level 4



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6.4.1.6 Starting/Stopping a Throughput (Multiple Streams) Test

Once all configurations have been made, tap the **Start** button on the right section of the screen to start the measurements.

Note: If testing on the fiber ports, make sure the LASER is turned On before starting the test.

- **End-to-End Testing**
 - Connect the test set to another unit that supports eCPRI testing.
 - After configuring test settings on both units, start the tests.

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6.4.2 Throughput Results

When the test is first started, the screen changes to the Global/Aggregate results screen automatically.

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6.4.2.1 Global/Aggregate Results

The Global results pages display measurements for all traffic streams as well as non test traffic.

The **Global Stream Summary** screen displays:

- Stream number (#)
- Transmit and Receiver rate (bps)
- Events (errors/alarms) associated with the stream

Throughput Results - Global Stream Summary

Global		Per Stream					
Stream Summary	Aggregate	Signal	Errors	Alarms	Events	Traffic	Delay
Stream	TX (bps)	RX (bps)	Last Event				
1	3.333G	0.000K	No Event				
2	3.333G	0.000K	No Event				
3	3.333G	0.000K	No Event				
TOTAL		10.000G	0.000K				

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The **Aggregate** screen displays these parameters:

- **Line Rate** (bps): This value is always fixed since it depends on the maximum capacity of the link under test, hence the test interface that is configured.
- **Utilization**: % of Line Rate. For example, if we transmit 100Mbps on a 1Gbps interface then the utilization value is 10% (or 100Mbps) of the total link capacity (or Line Rate).
- **Utilization (bps)**
- **Framed Rate**: $(\text{Payload} + \text{MAC/IP Header} + \text{VLAN Tag} + \text{Type/Length} + \text{CRC}) / (\text{Payload} + \text{Total Overhead}) * \text{Line Rate} \%$ (in Mbps).
- **Data Rate**: $\text{Payload} / (\text{Payload} + \text{Total Overhead}) * \text{Line Rate} \%$.
- **Total # of frames, bad frames, and pause frames.**

Throughput Results - Global Aggregate

Global		Per Stream					
Stream Summary	Aggregate	Signal	Errors	Alarms	Events	Traffic	Delay
ST:2018-10-4 14:20:51		ET:00:22:12					
	TX	RX					
Line Rate (bps)	10.000G	10.000G					
Utilization (%)	100.00%	0.00%					
Utilization (bps)	10.00G	0.00K					
Framed Rate (bps)	8.869G	0.000K					
Data Rate (bps)	3.783G	0.000K					
Total Frames	9410356654	0					
Bad Frames	0	0					
Pause Frames	0	0					

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The **Global Signal** screen (fiber ports only) displays the optical level measured by the CFP2 or QSFP+ transceiver.

Throughput Results - Global Signal Page 1

The screenshot shows the 'Global Signal' page for 'Rx' (Receiver) optical power. The interface includes a top navigation bar with 'Setup' and 'Results' tabs, and a left sidebar with various monitoring options. The main content area displays a table for 'Rx Optical Power[dBm]' and a signal level indicator.

Rx Optical Power[dBm]				LOS	SAT
	Cur.	Min.	Max.	-30	+3
TOTAL	-2.62	-2.63	-2.58		

Additional interface elements include a 'History' button, 'SFP+: 10G' indicator, and a right sidebar with control buttons like 'Stop', 'Restart', 'TX Stop', 'Eth. Err Inj.', 'Eth. Alarm Inj.', 'LASER On/Off', 'Setup Injection', and 'PCAP Start'. The page is labeled 'Page 1 of 4'.

Throughput Results - Global Signal Page 2

The screenshot shows the 'Global Signal' page for 'Tx' (Transmitter) optical power. The interface is similar to Page 1, but the main content area displays a table for 'Tx Optical Power[dBm]' and a signal level indicator.

Tx Optical Power[dBm]				LOS	SAT
	Cur.	Min.	Max.	-30	+3
TOTAL	-1.74	-1.94	-1.60		

Additional interface elements include a 'History' button, 'SFP+: 10G' indicator, and a right sidebar with control buttons like 'Stop', 'Restart', 'TX Stop', 'Eth. Err Inj.', 'Eth. Alarm Inj.', 'LASER On/Off', 'Setup Injection', and 'PCAP Start'. The page is labeled 'Page 2 of 4'.

Throughput Results - Global Signal Page 3

Throughput Results - Global Signal Page 4

SFP Optical Module Information	
Vendor	FINISAR CORP.
Part Number	FTLX1471D3BCV
Serial Number	AVB1669
Identifier	[03h] SFP/SFP+/SFP28
Bit Rate (Gbps)	10.3
Wavelength (nm)	1310.0
Temperature	36.1 C
Voltage	3362 mV
Tranceiver Compliance (Hex)	00

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The **Global Errors** screen displays the Current and Total error count of all streams:

- Sync Header Error
- Block Type Error
- **FCS/CRC**: Number of received frames with an invalid Frame Check Sequence (FCS)
- **IP Checksum**: Invalid IP Frame Check sequence
- **TCP/UDP Checksum** (Layer 4 only)
- **Jabber frames**: Number of received frames larger than 1518 bytes containing an invalid FCS
- **Runt frames**: Number of received frames smaller than 64 bytes containing an invalid FCS
- **Giant frames** (Advanced Monitoring - Pass Through Results only): Number of received frames larger than 1518 bytes

Throughput Results - Global Errors

Global		Per Stream					
Stream Summary	Aggregate	Signal	Errors	Alarms	Events	Traffic	Delay
		Current		Total			
FCS/CRC	0		0				
IP Checksum	0		0				
TCP/UDP Checksum	0		0				
Jabber Frames	0		0				
Runt Frames	0		0				

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The **Global Alarms** screen displays the Current and Total alarm count of all streams:

- **LOS (ms):** Loss of Signal
- **Link Down (ms)**
- **Service disruption** associated with loss of signal:
 - **Current:** Duration of the current service disruption
 - **Total:** Total accumulated duration of the service disruptions
 - **Min/Max:** Minimum and maximum duration of the service disruption events
 - **No. of Occurrences:** Counter of service disruption events
- **Local/Remote Fault**
- **SDT alarm measurements**

Throughput Results - Global Alarms

Global		Per Stream					
Stream Summary	Aggregate	Signal	Errors	Alarms	Events	Traffic	Delay
		Current		Total			
LOS (us)	0			0			
Link Down (us)	0			0			
Local Fault	0		Remote Fault	0			
Service Disruption (us)							
Current	N/A		Total	N/A			
Last				0			
Min/Max	0			0			
No. of Occurrences				0			
No. of SDT Violations				0			
IPG Trigger Events				0			
IPG Trigger Measurement(us)				0			

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The **Global Events** screen displays the **Time**, **Event Type**, **Number of Events**, and **Test Type**.

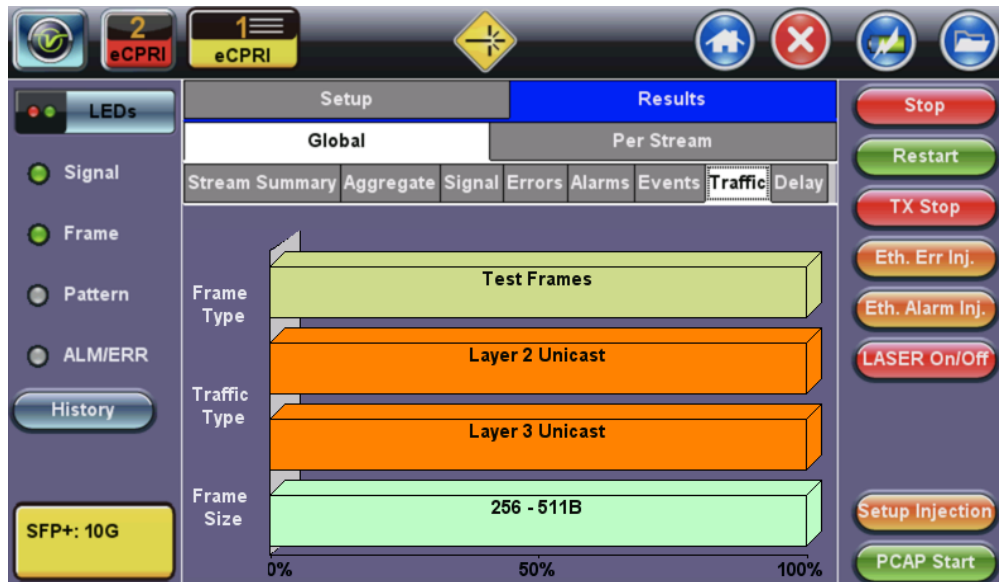
Throughput Results - Global Events



The **Global Traffic** screen displays:

- Frame Type of all streams
- Traffic Type of all streams
- Frame size of all streams

Throughput Results - Global Traffic



Tap on the bar graph for frame and traffic distribution statistics.

Frames tab: The following Frame distribution statistics are displayed in Count (#) and Percentage (%):

- Received (RX) frames: Total frame
- Total/Test frames
- VLAN tagged frames
- Q-in-Q VLAN stacked frames
- Non-test frames
- Transmitted (TX) frames: Total frame - Total # frames transmitted
- Pause frames: Total number of transmitted and received Ethernet pause flow-control frames

Throughput Results - Global Traffic Details

Frames	Traffic Type	Frame Size
RX Frames	#	%
Total	0	100
Test	0	0
VLAN	0	0
VLAN Stack	0	0
MPLS	0	0
MPLS Stack	0	0
Non-Test	0	0
TX Frames	#	
Total	9092076782	
Pause Frames	TX	RX
Total	0	0

Traffic Type tab: The following Traffic distribution statistics are displayed in Count (#) and Percentage (%):

- Layer 2/3 Unicast frames: Number of Unicast frames received without FCS errors.
- Layer 2/3 Broadcast frames: Number of Broadcast frames received without FCS errors. Broadcast frames have a MAC address equal to FF-FF-FF-FF-FF-FF.
- Layer 2/3 Multicast frames: Number of Multicast frames received without FCS errors.

Frame Size tab: The following Frame distribution statistics are displayed in Count (#) and Percentage (%):

- < 64 bytes frames
- 64-127 byte frames
- 128-255 byte frames
- 256-511 byte frames
- 512-1023 byte frames
- 1024-1279 byte frames
- 1280-1518 byte frames
- > 1518 byte frames - Jumbo frames

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The **Global Delay** tab: Delay measures the interpacket gap, start of the frame, and preamble duration. Frame arrival statistics are displayed in tabular format:

- **Frame Arrival Time**
 - Current, minimum, average, and maximum frame arrival time
- **Frame Delay Variation**
 - Average

Throughput Results - Global Delay

Stream Summary	Aggregate	Signal	Errors	Alarms	Events	Traffic	Delay
Frame Arrival Time							
Current	N/A	Average	N/A				
Minimum	N/A	Maximum	N/A				
Frame Delay Variation							
Average		N/A					

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6.4.2.2 Per Stream Results

The **Per Stream** tab displays the same type of statistics as seen in Global Results, but for each stream. For descriptions of the parameters in each tab, with the exception of **Rates**, please refer back to the corresponding section in [Global/Aggregate Results](#).

- **Summary:** Framed rate, data rate, # of bytes, total # of frames associated with each stream.
- **Errors:** Errors associated with each stream.
- Service Disruption Test results for each stream.
- **Events:** Events associated with each stream.
- **Traffic:** Traffic statistics associated with each stream.
- **Delay:** Delay associated with each stream. **Note:** *One Way Delay measurements are only available in the per-stream results screen.*
- **Rates:** Rate information associated with each stream.

Throughput Results - Per Stream Summary

Setup		Results			
Global		Per Stream			
Summary	Errors	SDT	Events	Traffic	Rates
VLAN ID: N/A	Stream #	1	of 3	Prev	Next
ST:2018-10-4 14:20:51	ET:00:37:33				
	TX	RX			
Utilization (%)	33.333%	0.000%			
Utilization (bps)	3.333G	0.000K			
Framed Rate (bps)	2.889G	0.000K			
Data Rate (bps)	888.880M	0.000K			
# of Bytes	813553792090	0			
Total Frames	6258106093	0			
Bad Frames	0	0			

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The **Per Stream Errors** screen displays the Current and Total error count of each stream.

- **Bit:** Indicates errors related to test pattern (Bit Error or LSS [Pattern Loss])
- **BER:** Bit Error Ratio
- **FCS/CRC:** Number of received frames with an invalid Frame Check Sequence (FCS)
- **IP Checksum:** Invalid IP Frame Check sequence
- **TCP/UDP Checksum** (Layer 4 only)
- **Jabber frames:** Number of received frames larger than 1518 bytes containing an invalid FCS
- **Runt frames:** Number of received frames smaller than 64 bytes containing an invalid FCS
- **Frame Loss:** Number of frames lost from receiver
- **Frame Loss %:** Percentage of total frames that were lost
- **OOS:** Out of Service errors
- **Duplicate Sequence**

Throughput Results - Per Stream Errors Page 1

Setup		Results			
Global		Per Stream			
Summary	Errors	SDT	Events	Traffic	Rates
VLAN ID: N/A	Stream #	1	of 3	Prev	Next
	Current	Total			
FCS/CRC	0	0			
IP Checksum	0	0			
TCP/UDP Checksum	0	0			
Jabber Frames	0	0			
Runt Frames	0	0			
Frame Loss	No Test Traffic	0			
Frame Loss %	No Test Traffic	0.00%			
OOS	No Test Traffic	0			
Dup. Sequence	No Test Traffic	0			

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Service Disruption Test

- **Total:** Total cumulative service disruption for the duration of the test.
- **Last:** Last SDT measured during the test.
- **Min/Max:** Minimum and maximum SDT measured during the test.
- **No. of Occurrences:** Number of service disruption events (SDTs).
- **No. of SDT Violations:** Number of instances the SDT threshold was met or exceeded.

Throughput Results - Per Stream SDT

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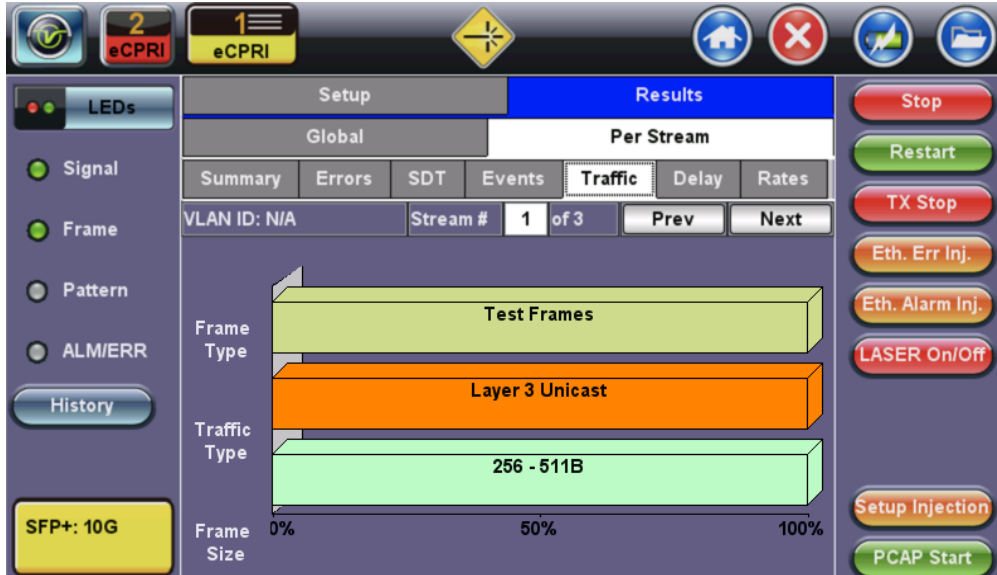
The **Per Stream Events** screen displays a Date and Time stamped record of bit errors, alarms and other anomalies pertaining to each stream.

Throughput Results - Per Stream Events

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The **Per Stream Traffic** screen displays the frame type and frame size distribution pertaining to each stream.

Throughput Results - Per Stream Traffic



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The **Per Stream Delay** screen displays the frame delay information pertaining to each stream.

The Histogram shows the sampling points for the delay.

Throughput Results - Per Stream Delay



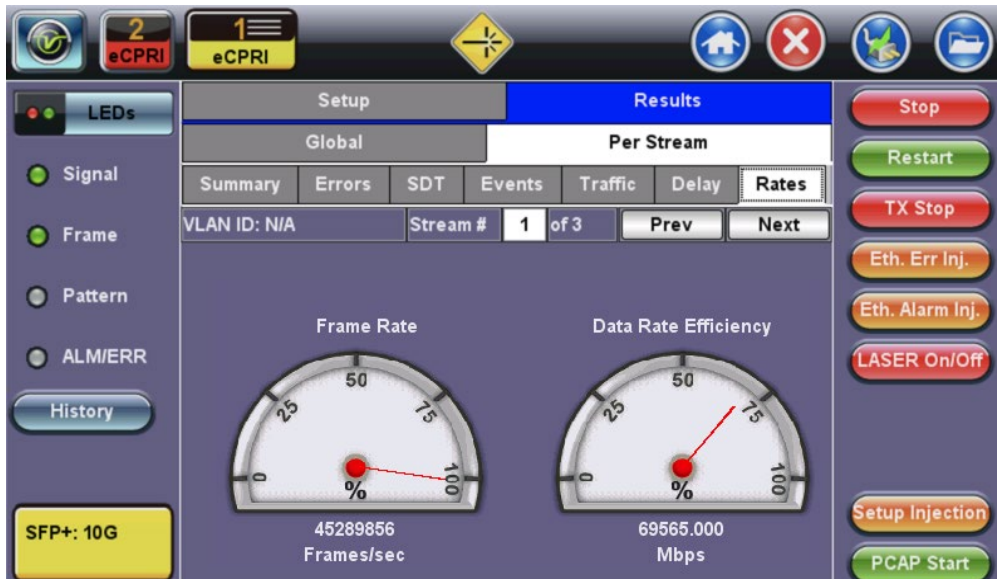
Throughput Results - Per Stream Delay - Histogram



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The **Per Stream Rates** screen displays the frame rate and data rate pertaining to each stream. Tap on either dial to see rate details.

Throughput Results - Per Stream Rates



Throughput Results - Per Stream Rate Details

Rate Details		
Frames/sec	TX	RX
Current	2777750	0
Minimum	2777750	0
Maximum	2777750	0
Average	2777750	0
Data Rate (Mb/s)	TX	RX
Current	888.880M	0.000K
Minimum	888.880M	0.000K
Maximum	888.880M	0.000K
Average	888.880M	0.000K

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6.4.3 Saving Throughput Results

After stopping the test, save the results by pressing the **Save** button on the platform's keypad.

A window will open giving the option of naming the results file. Enter the desired name for the file and tap apply. The results will be saved. For more information on retrieving saved test results, refer to test unit's platform manual for more information.

Throughput Results Save

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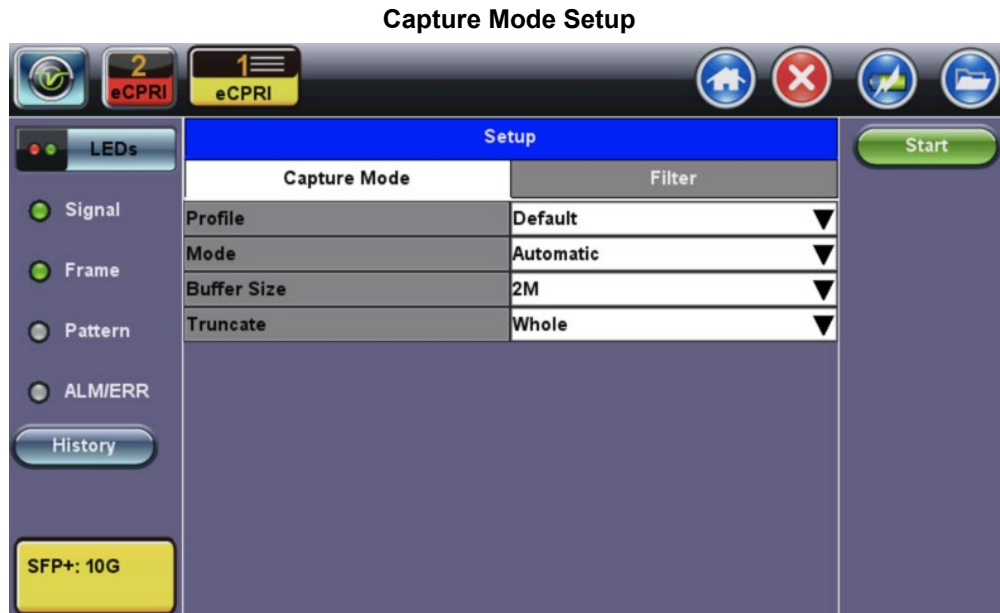
6.5 Packet Capture

6.5.1 Packet Capture Setup

The packet capture function can be used to capture packets to eCPRI test ports. The packet capture format is compatible with Wireshark and can be viewed on the unit or on a PC.

Configure the following **Capture Mode** parameters:

- **Profile:** Drop-down selections are Default, Delete, Save, Save As...
- **Mode:** Automatic. Packet capture is automatically started when pressing the **CAP ON** function key.
- **Buffer Size:** Defines the size of the storage allocated to packet capture.
- **Truncate:** Captures the whole frame or first number of bytes of that frame (64, 128, 192, 256).



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Select from the following Filter options:

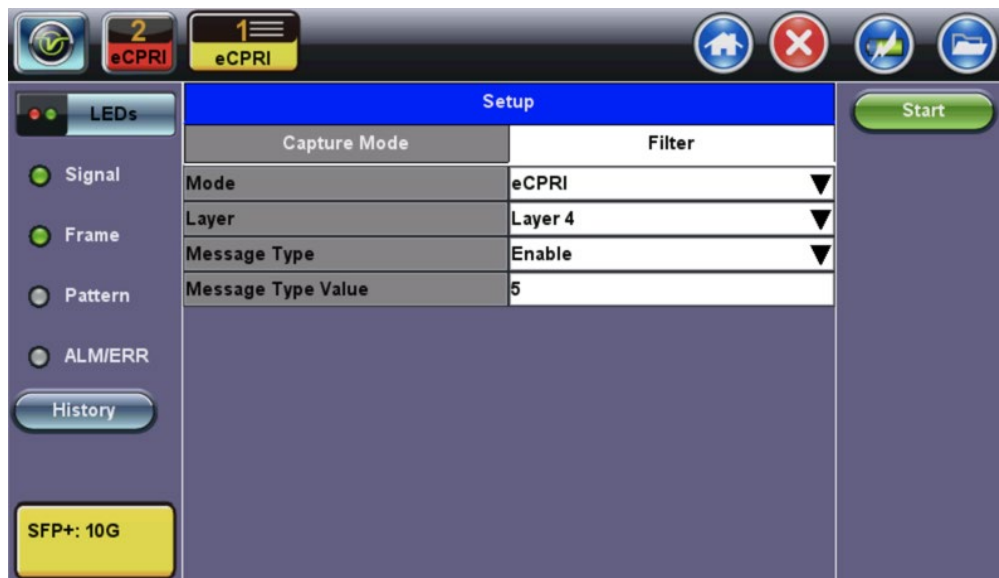
eCPRI Mode

- **Mode:** eCPRI. Only traffic frames matching the source and destination addresses are captured.
- **Layer:** Layer 2 or Layer 4
- **Message Type:** Enable or Disable
- **Message Type Value:** (Field appears when Message Type is set to Enable.) The default is set to 5 for One-way latency measurements.

The following types of messages are allowable in eCPRI specifications ver. 1.

- 0 = IQ Data
- 1 = Bit Sequence
- 2 = Real-Time Control Data
- 3 = Generic Data Transfer
- 4 = Remote Memory Access
- 5 = One-way Delay Measurement
- 6 = Remote Reset
- 7 = Event Indication
- 8 - 63 = Reserved
- 64 - 255 = Custom

Filter



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Tap the **Start** button to begin packet capture. A message appears showing the number of packets being captured.

Packet Capture In Progress

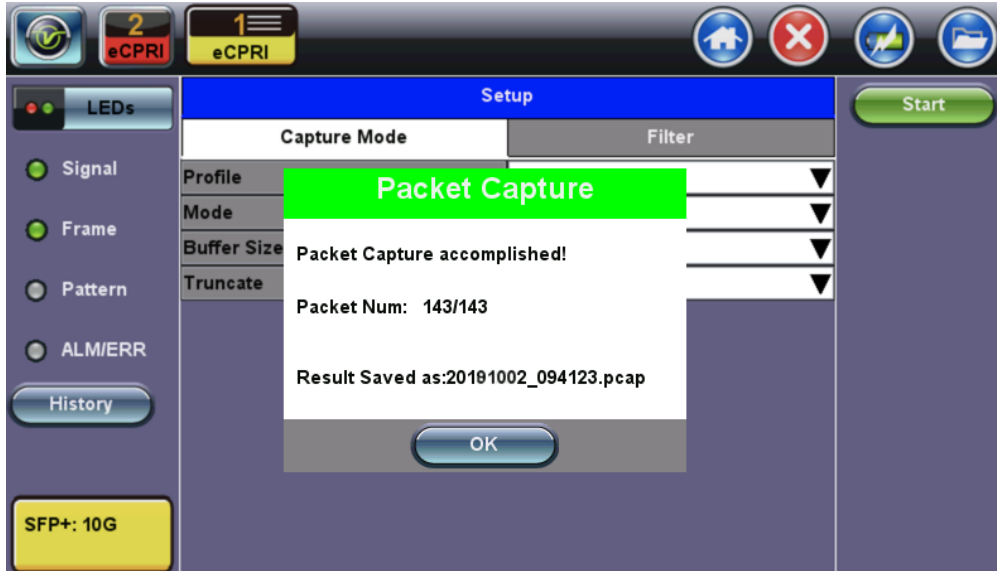


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6.5.2 Packet Capture Results

To finish packet capture and manage packet capture results, press **Stop**. A message appears showing the number of packets captured and the filename to which the results were saved on the test unit. Results are saved in PCAP format and are automatically named.

Packet Capture Save



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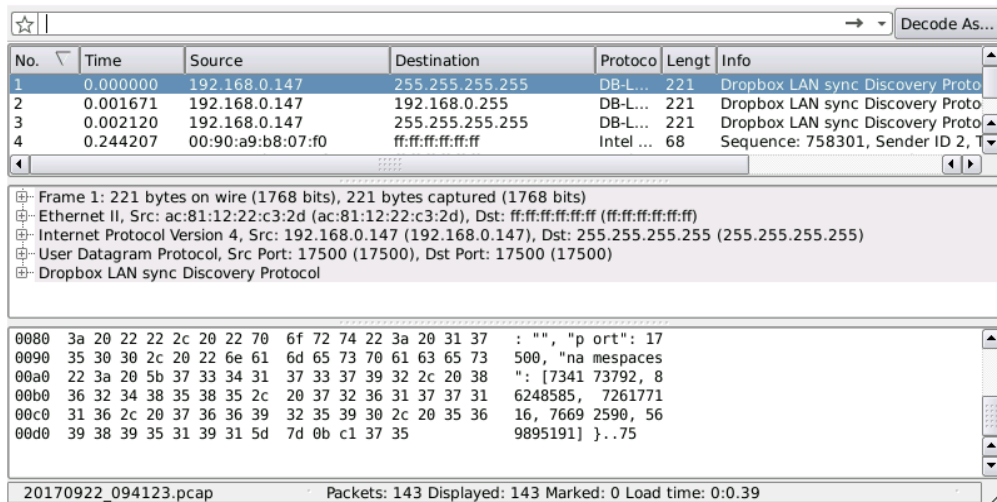
Viewing Packet Capture Results

When viewing results, Wire shark will launch and display the results.

The file is stored in the Files folder. It can be viewed on the test set or exported and analyzed on PC Wireshark. For more information on viewing and exporting files, see the RXT-1200 User Manual on www.veexinc.com.

The Packet Capture results screen is divided into three parts with all details of the capture. The size of each part can be manually adjusted.

Packet Capture Results on Wireshark



Top section:

- Time
- Source
- Destination
- Protocol
- Length
- Info

Middle and Lower Sections:

- Frame details
- Ethernet frame details

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7.0 Warranty and Software

Warranty Period: The warranty period for hardware, software and firmware is one (1) year from the date of shipment to the customer. The warranty period for battery pack, LCD, LCD touch panel, LCD protective cover, and accessories (including but not limited to patch cords, AC adaptor, SFP, USB adaptors, carrying case, carrying pouch) is limited to one (1) year.

Hardware Coverage: VeEX Inc. warrants hardware products against defects in materials and workmanship. During the warranty period, VeEX will, at its sole discretion, either

- Repair the products
- Replace hardware which proves to be defective

provided that the products that the customer elects to replace is returned to VeEX Inc. by the customer along with proof of purchase within thirty (30) days of the request by the customer, freight prepaid.

Software Coverage: VeEX Inc. warrants software and firmware materials against defects in materials and workmanship. During the warranty period, VeEX will, at its sole discretion, either

- Repair the products
- Replace the software and/or firmware which prove to be defective

provided that the products that the customer elects to replace is returned to VeEX Inc. by the customer along with proof of purchase within thirty (30) days of the request by the customer, freight prepaid.

Additionally, during the warranty period, VeEX Inc. will provide, without charge to the customer, all fixes, patches and enhancements to the purchased software, firmware and software options. VeEX Inc. does not warrant that all software or firmware defects will be corrected. New enhancements attached to a software option require the option to be purchased (at the time of order or the time of upgrade) in order to benefit from such enhancements.

Limitations: The warranty is only for the benefit of the customer and not for the benefit of any subsequent purchaser or licensee of any merchandise (hardware, software, firmware and/or accessories).

Revoking the warranty: VeEX Inc. does not guarantee or warrant that the operation of the hardware, software or firmware will be uninterrupted or error-free. The warranty will not apply in any of the following cases:

- Improper or inadequate maintenance by the customer
- Damage due to software installed by the customer on the unit without prior authorization (written) from VeEX Inc.
- Unauthorized alteration or misuse
- Damage occurred from operating the unit from outside of the environmental specifications for the product
- Improper installation by the customer

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8.0 Product Specifications



The most recent product specifications for test units can be found on the VeEX web site at www.veexinc.com.

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9.0 Certifications and Declarations



Declaration of Conformity



ROHS Statement

What is CE?

The CE marking is a mandatory European marking for certain product groups to indicate conformity with the essential health and safety requirements set out in European Directives. To permit the use of a CE mark on a product, proof that the item meets the relevant requirements must be documented.

Use of this logo implies that the unit conforms to requirements of European Union and European Free Trade Association (EFTA). EN61010-1

For a copy of the CE Declaration of Conformity relating to VeEX products, please contact VeEX customer service.

What is RoHS?

RoHS is the acronym for Restriction of Hazardous Substances. Also known as Directive 2002/95/EC, it originated in the European Union and restricts the use of specific hazardous materials found in electrical and electronic products. All applicable products imported into the EU market after **July 1, 2006** must pass RoHS compliance.

For more information about RoHS as it relates to VeEX Inc., go to the VeEX web site at www.veexinc.com/ROHS.

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10.0 About VeEX

VeEX Inc., an innovative, customer-focused communications test and measurement company, develops next generation test and monitoring solutions for telecommunication networks and services. With a blend of advanced technologies and vast technical expertise, VeEX's products diligently address all stages of network deployment, maintenance, field service turn-up, and integrate service verification features across DSL, Fiber Optics, CATV/DOCSIS, Mobile backhaul and fronthaul (CPRI/OBSAI), next generation Transport Network, Fibre Channel, Carrier & Metro Ethernet technologies, WLAN and Synchronization.

Visit us online at www.veexinc.com for latest updates and additional documentation.

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