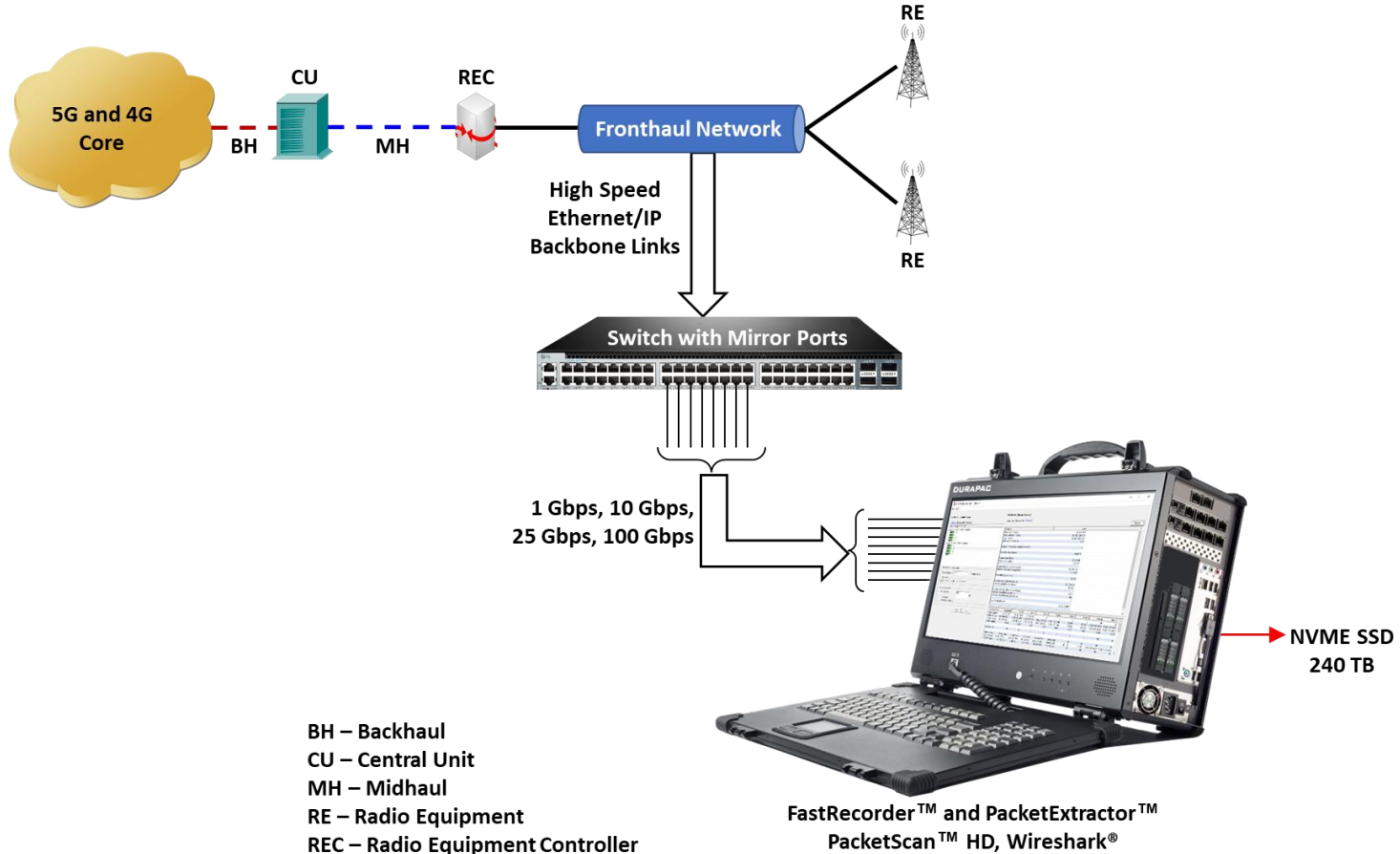

eCPRI Protocol Analysis



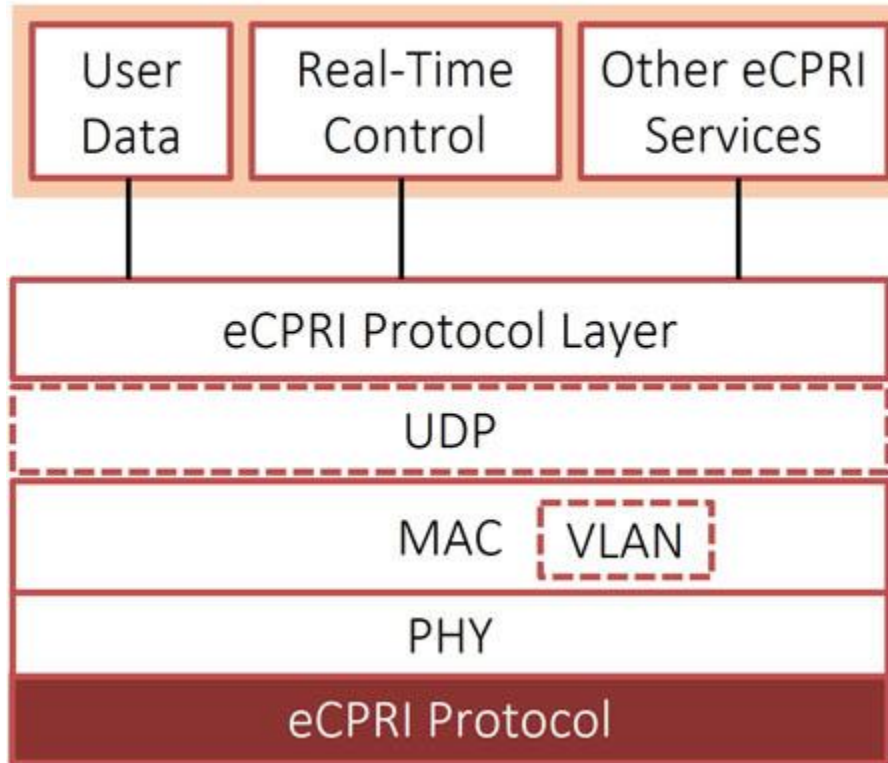
818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878
Phone: (301) 670-4784 Fax: (301) 670-9187 Email: info@gl.com
Website: <https://www.gl.com>

Network Architecture



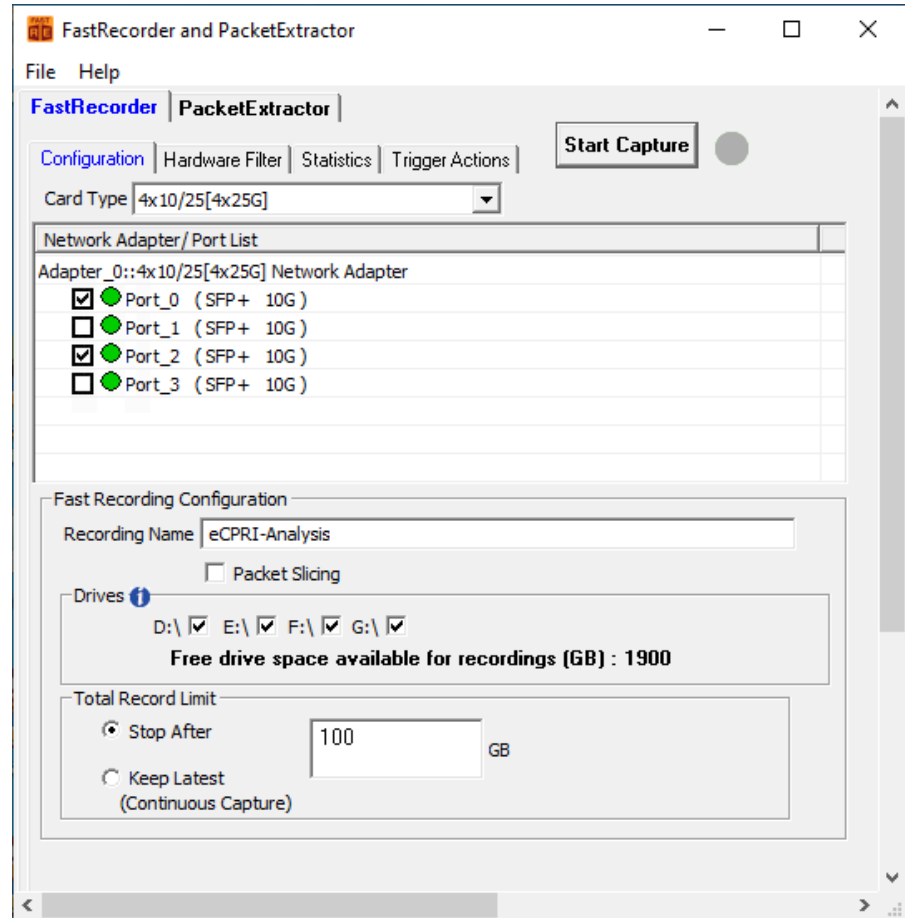
eCPRI Protocol Stack

eCPRI Services



Monitoring eCPRI on FastRecorder™ Application

- FastRecorder™ and PacketExtractor™ analyzer supports **eCPRI** analysis feature to monitor **eCPRI** traffic for packet impairments such as Missed Packets, Out of Order, Duplicate Packets, One-Way Delay etc.



Configuring Hardware Filter for eCPRI Analysis

The screenshot displays the 'FastRecorder and PacketExtractor' application interface. The 'Hardware Filter' tab is active, and the 'Add Filter' dialog box is open. The dialog shows a tree view of filter categories, with 'eCPRI' selected. The 'Value (Decimal Value)' field is set to '0,1,2,3'. The 'Predefined Values' list includes 'IQ Data', 'Bit Sequence', 'Real time control data', and 'Generic Data transfer'. A red box highlights the 'Add Filter' button at the bottom right of the dialog. A red arrow points from the 'Add' button in the 'Filters' list to the 'Add Filter' dialog.

FastRecorder and PacketExtractor

File Help

FastRecorder | PacketExtractor

Configuration Hardware Filter Statistics Trigger Actions Start Capture

Filter Type Advanced

Filters

- eCPRI
- Filter - 2
- Filter - 3
- Filter - 4
- Filter - 5
- Filter - 6
- Filter - 7
- Filter - 8
- Filter - 9
- Filter - 10

Add

Add Filter

Field ID Pr

CFI

- VLAN ID
- VLAN1
 - Tag Protocol ID
 - User Priority
 - CFI
 - VLAN ID
- VLAN2
 - Tag Protocol ID
 - User Priority
 - CFI
 - VLAN ID
- eCPRI
 - eCPRI Message Type
- IP(IPv4/IPv6)
 - TunnelType
 - IP Address
- IPv4
 - Protocol Type
 - Header Length
 - Differentiated Service
 - DS_ECN
 - DS_CodePoint
 - Total Length
 - IP DatagramID
 - Fragmentation Offset
 - Flag_DontFragment
 - Flags_MoreFragments

eCPRI

Over MAC

Over UDP

Value (Decimal Value)

0,1,2,3

Examples :

Ex1: 0

Ex2: 0,4

Predefined Values

- IQ Data**
- Bit Sequence**
- Real time control data**
- Generic Data transfer**
- Remote Memory Access
- One way delay measurement
- Remote reset
- Event Indication
- Reserved
- Vendor Specific

Add Filter

Clear All Filters

Invoking eCPRI Application

The screenshot displays the 'FastRecorder and PacketExtractor' application window. The 'PacketExtractor' tab is active, showing recording details for a record named 'eCPRI-Analysis'. The recording started on 2022-12-19 at 04:07:36 and ended at 04:08:29, with a duration of 00:00:53 and a size of 0.188 MB. A 'PreExtraction Filter' is configured with a duration limit of 00:00:53. The 'Operation' dropdown menu is set to 'eCPRI Analysis', which is highlighted with a red box and an arrow pointing to the 'eCPRI Analysis - Sequence Analysis' window.

Recording Information

- Record Name: **eCPRI-Analysis**
- Record Start Time: **2022-12-19 04:07:36**
- Record End Time: **2022-12-19 04:08:29**
- Record Duration: **00:00:53**
- Record Size: **0.188 MB**

PreExtraction Filter

Start Time: 04:07:36 End Time: 04:08:29

Limit Criteria

- All
- Duration (Limit Value: 00:00:53 HH:MM:SS)
- Extracted Size
- Extracted Packet Count

Operation: **eCPRI Analysis**

eCPRI Analysis - Sequence Analysis

Links: 192.168.1.55:64000<—>192.168.1.57:64000

Message Type	Total Packets	Missed Packets	Out Of Order Packets	Duplicate Packets
IQ Data	0	0	0	0
Bit Sequence	40	2	6	19
Data Transfer	36	2	7	15
Total	76	4	13	34

Total Processed Packets = 200 Total eCPRI Packets = 200

Shortcut Icons of eCPRI Message Statistics

eCPRI application provides the following message statistics.

- Sequence Analysis
- One-Way Delay Measurement
- Event Indication
- Remote Reset
- Remote Memory Access

Sequence Analysis

One Way Delay

Event Indication

Remote Reset

Remote Memory Access

Help

Message Type	Total Packets	Missed Packets
IQ Data	21	1
Bit Sequence	20	6
Data Transfer	18	8
Total	59	15

Sequence Analysis

- Analyzes the packet sequences of eCPRI Message types such as IQ Data, Bit Sequence, and Data Transfer, and generates packet statistics based on PCID, SEQID, and Data samples
- The analysis results are displayed in separate tabs, including **Message Statistics**, **Events**, and **All Links Statistics**

IQ Data

Bit Sequence

Data Transfer

Message Type	Total Packets	Missed Packets	Out Of Order Packets	Duplicate Packets
IQ Data	21	1	1	2
Bit Sequence	20	6	2	3
Data Transfer	18	8	1	3
Total	59	15	4	8

Total Processed Packets = 59 Total eCPRI Packets = 59

Events

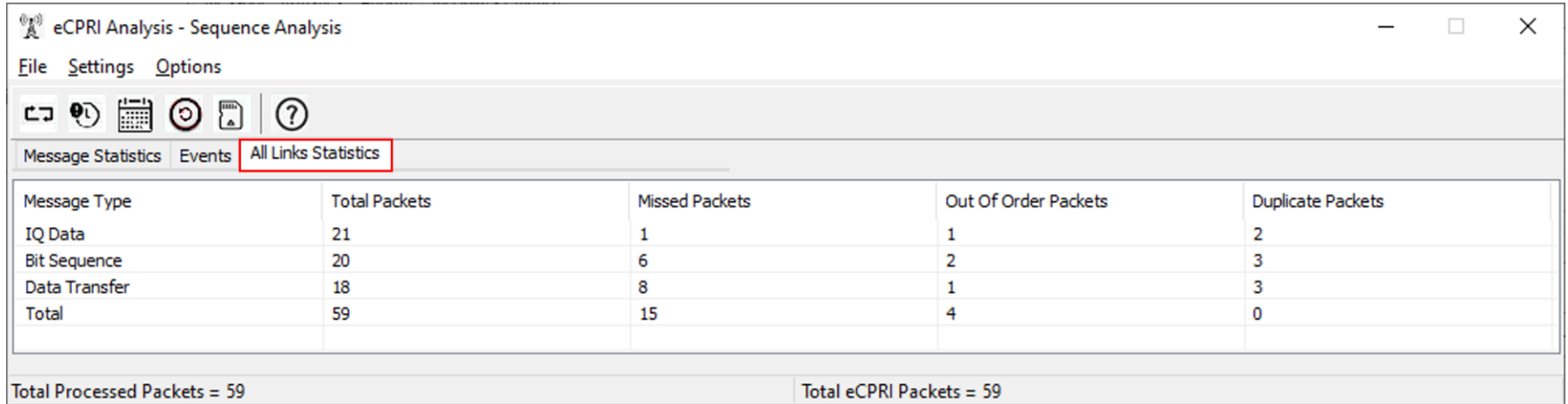
- The **Events** tab displays Packet Statistics like
 - Missed Packets (Provides the range if more than one packet is missed),
 - Duplicate Packets
 - Out of Order Packets Sequence Number for each PCID at the time of occurrence for IQ, Bit Sequence, and Data Transfer respectively

The screenshot shows the 'eCPRI Analysis - Sequence Analysis' application window. The 'Events' tab is selected and highlighted with a red box. The interface includes a menu bar (File, Settings, Options), a toolbar with various icons, and a 'Links' dropdown menu set to '192.168.1.55:64000<-->192.168.1.57:64000'. Below the toolbar, there are tabs for 'Message Statistics', 'Events', and 'All Links Statistics'. Under 'Events', there are sub-tabs for 'IQ Data', 'Bit Sequence', and 'Data Transfer'. A 'PCID Filter' input field with 'Apply' and 'Clear' buttons is present. The main area contains a table with the following data:

PCID	Timestamp	Missed Packets	Out Of Order Packets	Duplicate Packets
35444	2022-06-09 14:07:20.12397800039	33627		
35444	2022-06-09 14:07:20.12397800047	33636		
35444	2022-06-09 14:07:20.12397800056			33645
35444	2022-06-09 14:07:20.12397800057			33645
35444	2022-06-09 14:07:20.12397800058		33636	

At the bottom of the window, it displays 'Total Processed Packets = 59' and 'Total eCPRI Packets = 59'.

All Links Statistics



The screenshot shows the 'eCPRI Analysis - Sequence Analysis' application window. The 'All Links Statistics' tab is selected and highlighted with a red box. The main content area displays a table with the following data:

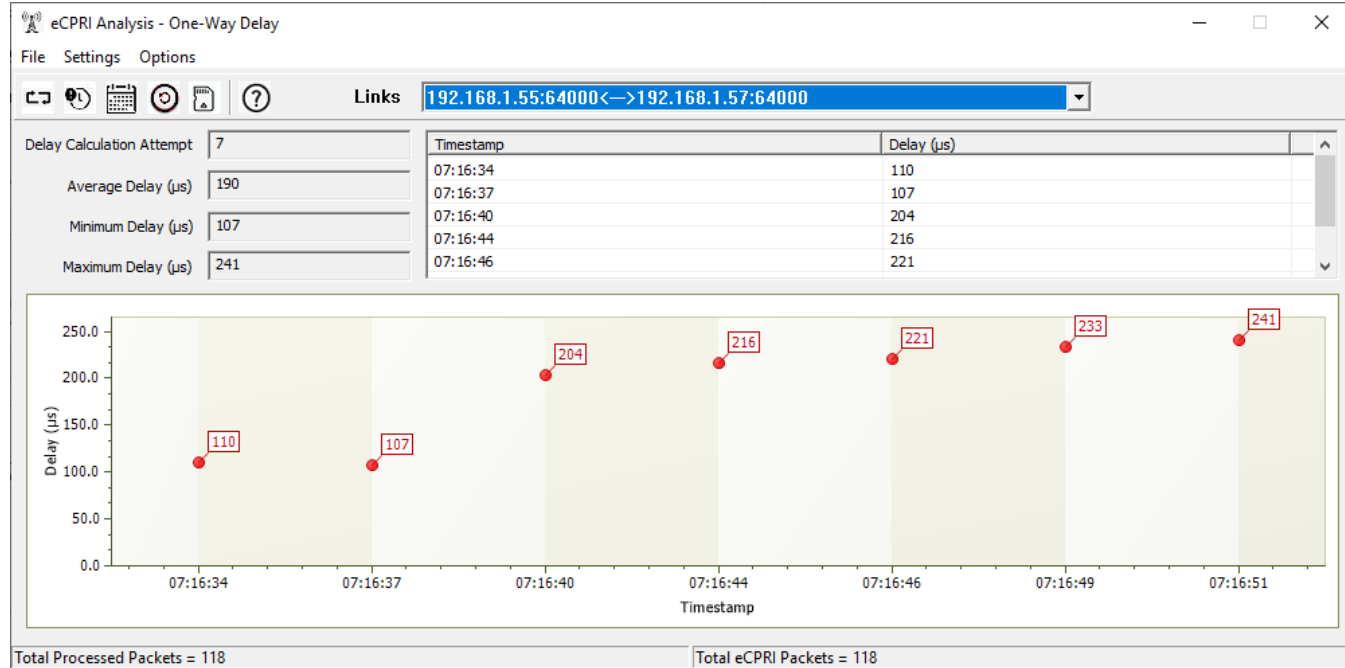
Message Type	Total Packets	Missed Packets	Out Of Order Packets	Duplicate Packets
IQ Data	21	1	1	2
Bit Sequence	20	6	2	3
Data Transfer	18	8	1	3
Total	59	15	4	0

At the bottom of the window, there are two summary statistics: 'Total Processed Packets = 59' and 'Total eCPRI Packets = 59'.

- Displays sequence analysis for all available eCPRI links. This tab shows the aggregation of IQ Data, Bit Sequence, Data Transfer, Total Packets, Missed Packets, Out of Order Packets, and Duplicate Packets for each message type across all links

One-Way Delay Measurement

- Displays the number of delay attempts, the average delay, and the minimum and maximum delay in microseconds
- The delay values are plotted on a Point graph, which calculates the values at different intervals. The same values are also added to a table for each link



Event Indication

- Indicates events that occurred between two eCPRI nodes
- An event in Event Indication can contain one or more faults (raises/ceases) or notifications related to user data processing
- The **Faults** and **Notifications** are displayed in separate tabs in this dialog

eCPRI Analysis - Event Indication

File Settings Options

Links 192.168.1.55:64000<-->192.168.1.57:64000

Faults Notifications

Total 14 Raises 11 Ceases 3

Element ID	#Faults	Raise	Cease
65535	14	11	3

General Userplane HW Fault
General Userplane SW Fault
General Userplane HW Fault
General Userplane HW Fault
General Userplane SW Fault
General Userplane HW Fault

Total Processed Packets = 20 Total eCPRI Packets = 20

Fault Indication

eCPRI Analysis - Event Indication

File Settings Options

Links 192.168.1.55:64000<-->192.168.1.57:64000

Faults Notifications

Total 14 Raises 11 Ceases 3

Element ID	#Faults	Raise	Cease
65535	14	11	3

General Userplane HW Fault
General Userplane SW Fault
General Userplane HW Fault
General Userplane HW Fault
General Userplane SW Fault
General Userplane HW Fault

Total Processed Packets = 20 Total eCPRI Packets = 20

- Displays the total number of faults, as well as the number of raises and ceases. Additionally, the tab shows these statistics for each element represented by the Element ID in a tabular column
- The **Faults** tab also displays any hardware, software, or vendor-specific faults for the selected Element ID

Notifications

- The **Notification** tab shows the total number of notifications, as well as notifications for each Element ID displayed in a tabular column
- In addition, the **Notification** tab displays User Plane Data issues for the selected Element ID, such as Data arriving too late, Data Buffer Overflow, Data Buffer Underflow, and Data arriving too early

The screenshot shows the 'eCPRI Analysis - Event Indication' application window. The 'Notifications' tab is selected and highlighted with a red box. The 'Links' dropdown menu is set to '192.168.1.55:64000<-->192.168.1.57:64000'. Below the tabs, the 'Total' count is 9. A table displays the notification data for Element ID 65535, which has 9 notifications. Below the table, a list of notification messages is shown, including 'Userplane data arrived too early', 'Userplane data received too late', 'Userplane data buffer underflow', and 'Unknown message type received'. The status bar at the bottom indicates 'Total Processed Packets = 20' and 'Total eCPRI Packets = 20'.

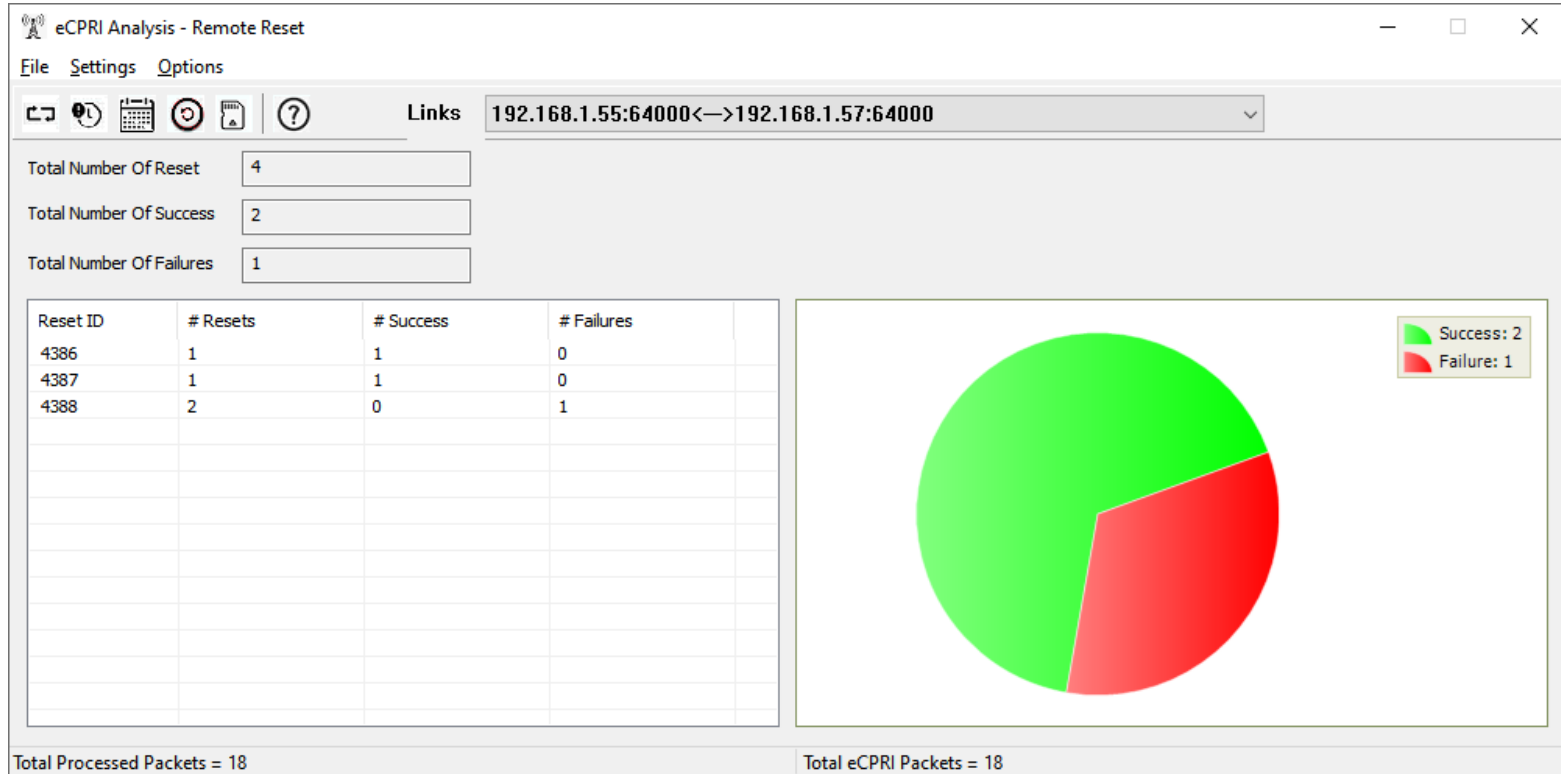
Element ID	Notifications
65535	9

Userplane data arrived too early
Userplane data received too late
Userplane data buffer underflow
Userplane data received too late
Unknown message type received
Userplane data buffer underflow

Total Processed Packets = 20 Total eCPRI Packets = 20

Remote Reset

- Displays statistics for each Reset ID, including the total number of successful and failed resets, as well as the total number of resets with successful and failed outcomes. The statistics are shown both in a PIE graph and in a tabular column



Remote Memory Access

- Displays statistics for each Element ID, as well as the total number of successful and failed read and write operations
- The statistics include the total Read Count, Read Success, Read Failure, Write Count, Write Success, and Write Failure for each Element ID, as well as the total statistics for all the elements

The screenshot shows the 'eCPRI Analysis - Remote Memory Access' application window. The title bar includes standard window controls. Below the title bar is a menu bar with 'File', 'Settings', and 'Options'. A toolbar contains several icons for navigation and help. The 'Links' section shows a dropdown menu with the selected link '192.168.1.55:64000<-->192.168.1.57:64000'. Below this, there are two columns of summary statistics: 'Read' and 'Write'. The 'Read' statistics are: Total 4, Success 2, Failure 2. The 'Write' statistics are: Total 7, Success 5, Failure 2. At the bottom, a table displays detailed statistics for each Element ID. The table has 7 columns: Element ID, Read Count, Read Success, Read Failure, Write Count, Write Success, and Write Failure. The data rows are as follows:

Element ID	Read Count	Read Success	Read Failure	Write Count	Write Success	Write Failure
8755	1	0	1	0	0	0
8756	1	1	0	0	0	0
8757	0	0	0	1	1	0
8758	0	0	0	1	0	1
8759	0	0	0	1	1	0
8760	1	1	0	0	0	0
8761	0	0	0	1	1	0
8762	0	0	0	1	1	0
8763	0	0	0	1	1	0
8764	1	0	1	0	0	0
8765	0	0	0	1	0	1

At the bottom of the window, there are two status bars: 'Total Processed Packets = 19' on the left and 'Total eCPRI Packets = 19' on the right.

Analysis of eCPRI Decodes in Offline PacketScan™ HD

Over UDP

```
Device0 Frame=6 at 2022-06-09 06:07:36.711206000 OK Len=112 *** Right d
Ethernet Frame Data
----- MAC Layer -----
0000 Destination Address = xFCAA149225C4
0006 Source Address      = x54BEF737CB9A
000C Length/Protocol Type = x86DD IPv6
----- IPv6 Layer -----
000E Protocol Version   = 0110.... (6)
000E Traffic Class      = 0 (...0000 0000....)
000F Flow Label         = 834513 (...1100 10111011 11010001)
0012 Payload Length     = 58 (x003A)
0014 Next Header        = 00010001 User Datagram Protocol (UDP)
0015 Hop Limit          = 64 (x40)
0016 Source Address     = fe80::64f2:5e84:f1db:502
0026 Destination Address = fe80::589e:b2d5:9074:2bec
----- UDP Layer -----
0036 Source Port        = 64000 (xFA00)
0038 Destination Port   = 64000 (xFA00)
003A Length (Header + Data) = 58 (x003A)
003C Checksum           = x7F76
----- eCPRI Layer -----
003E C                  = .....0 eCPRI message is the last one inside the eCPRI PDU
003E eCPRI Protocol Revision = 0001.... (1)
003F eCPRI Message Type   = 00000100 Remote Memory Access
0040 eCPRI Payload Size   = 28 (x001C)
0042 Remote Memory Access ID = 17 (x11)
0043 Req/Resp             = ....0010 Failure
0043 Read/Write           = 0010.... Write_No_Resp
0044 Element ID           = 8755 (x2233)
0046 Address              = x050403020100
004C Length               = 16 (x0010)
User Data                 = xFFEEDDCCBBAA99887766554433221100
```

Analysis of eCPRI Decodes in Offline PacketScan™ HD

Over MAC

```
Device0 Frame=0 at 2019-02-13 11:36:46.000000000 OK Len=64 *** Right
Ethernet Frame Data
----- MAC Layer -----
0000 Destination Address      = x008016000000
0006 Source Address          = x008016884EFF
000C Length/Protocol Type    = xAEFE eCPRI
----- eCPRI Layer -----
000E C                        = .....0 eCPRI message is the last one inside the eCPRI PDU
000E eCPRI Protocol Revision = 0001.... (1)
000F eCPRI Message Type      = 00000000 IQ Data
0010 eCPRI Payload Size      = 20 (x0014)
      eCPRI Payload          = x123487650F0E0D0C0B0A09080706050403020100
----- 0-RAN Fronthaul CUS Layer -----
      ecpriPcid              =
0012 BandSector_ID          = ..010010 (18)
0012 DU_Port_ID             = 00..... (0)
0013 RU_Port_ID             = ....0100 (4)
0013 CC_ID                   = 0011.... (3)
      ecpriSeqid             =
0014 Sequence ID            = 135 (x87)
0015 Subsequence ID         = .1100101 (101)
0015 E bit                   = 0..... More fragments follow
0016 FilterIndex             = ....1111 Reserved
0016 payloadVersion          = .000.... (0)
0016 dataDirection          = 0..... Uplink
0017 frameId                 = 14 (x0E)
0018 subframeId              = 0000.... (0)
0018 slotId                  = 52 (....1101 00.....)
0019 startSymbolId          = ..001100 (12)
001A sectionId               = 176 (00001011 0000....)
001B symInc                  = .....0.. use the current symbol number
001B rb                       = ....1... every other RB used
001B startPrbu               = 521 (.....10 00001001)
001D numPrbu                 = 8 (x08)
      udCompHdr              =
001E udCompMeth              = ....0111 Reserved
001E udIqWidth                = 0000.... I and Q are each 16 bit wide
      Dump                    = x050403020100
```

Thank you