
Frame Relay Analysis and Emulation



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>

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- Multilink Frame Relay Emulation (CLI)

FrameRelay Analysis and Emulation over T1 E1

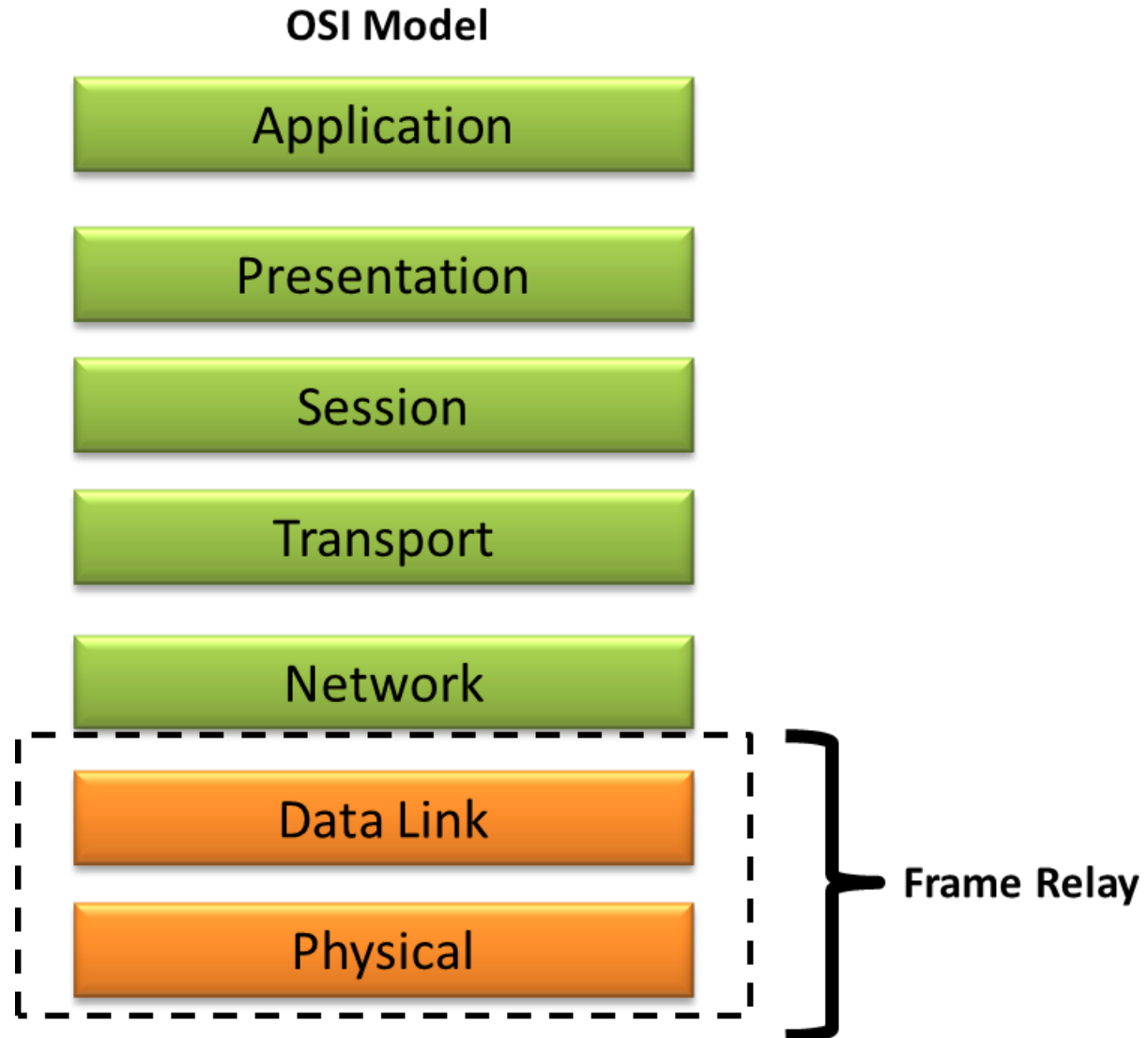
Why use Frame Relay?

- Reduced Overhead –
 - Much faster
 - Lower delays
 - Requires reliable links
- Outband signaling
- Good for bursty and variable traffic
- Cost effective multiplexed communications interface
- Congestion control

Protocol Features

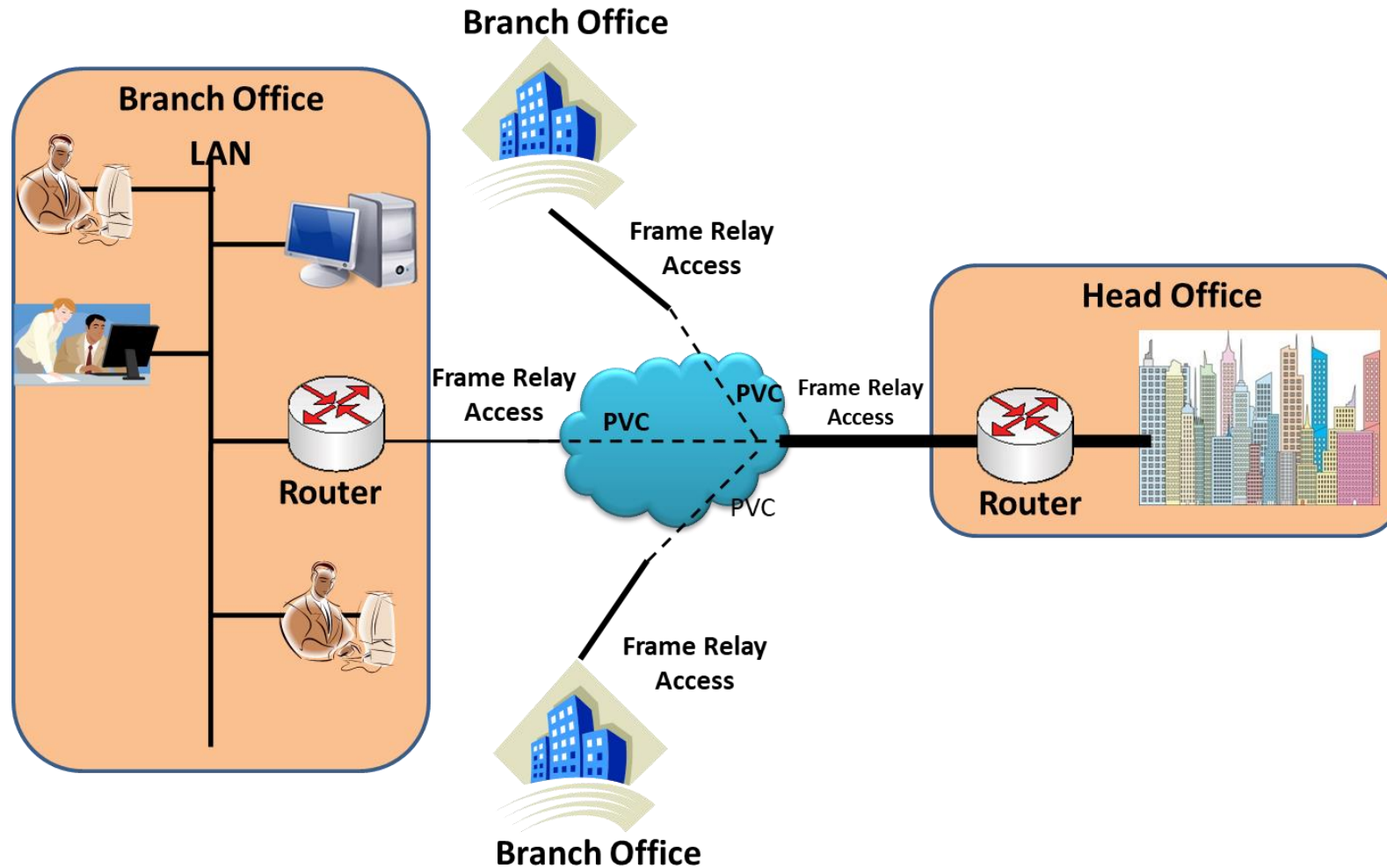
- Connection –oriented WAN technology based on packet (frame) switching
- Frames of variable length (up to 4096 bytes, typically 1600 bytes)
- High data rates at user-network interfaces (2Mbps, ultimately up to 45 Mbps)
- Bandwidth on demand
- No flow control mechanisms (nearly)
- No error control (but FCS) or retransmission mechanisms
- All protocol functions implemented at 2nd level (data link) of OSI model
- No standards for physical interface: can be X.21, V.35, G.703, G.704
- Option to create multiple aggregate column groups and prioritize the groups as per the requirement to display the summary results efficiently
- Allows the user to create search/filter criteria automatically from the current screen selection

Frame Relay in OSI Layer



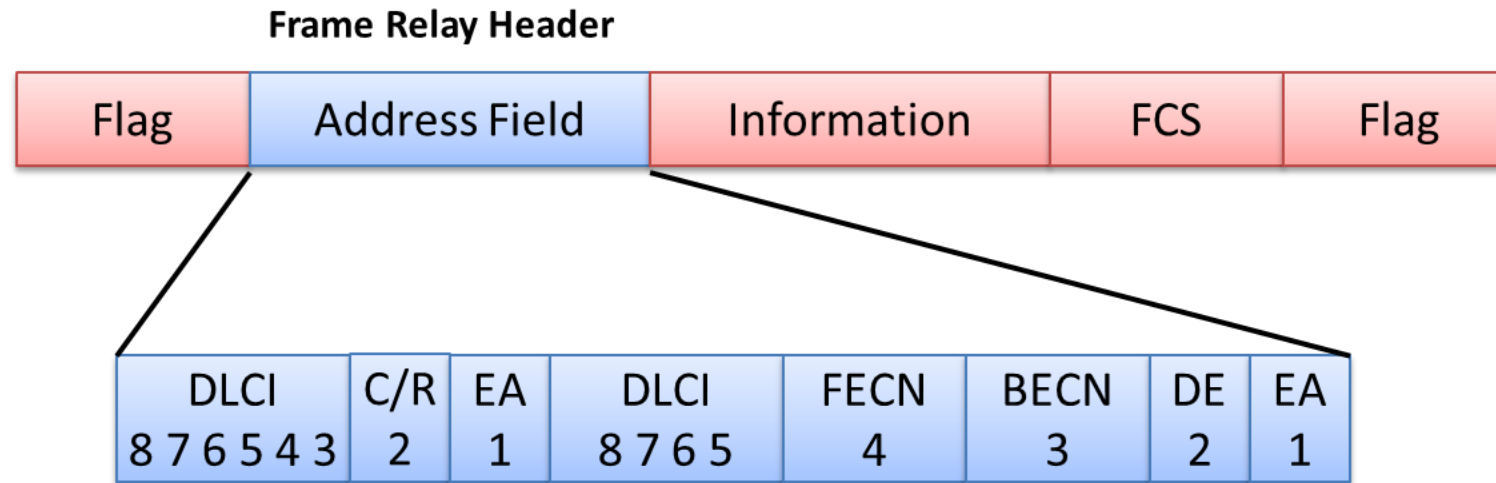
Frame Relay Network

- Data Terminal Equipment (DTE) – User device and the logical frame relay end-system
- Data Communication Equipment (DCE) – Comprises of modems and packet switches



Frame Relay Structure

- Frame Relay structure is based on the LAPD protocol
- Frame Relay header consists of DLCI, C/R, EA, FECN, BECN, and DE



Frame Relay Header Structure

DLCI – Datalink Connection Identifier

C/R – Command/Response

EA – Extended Address field

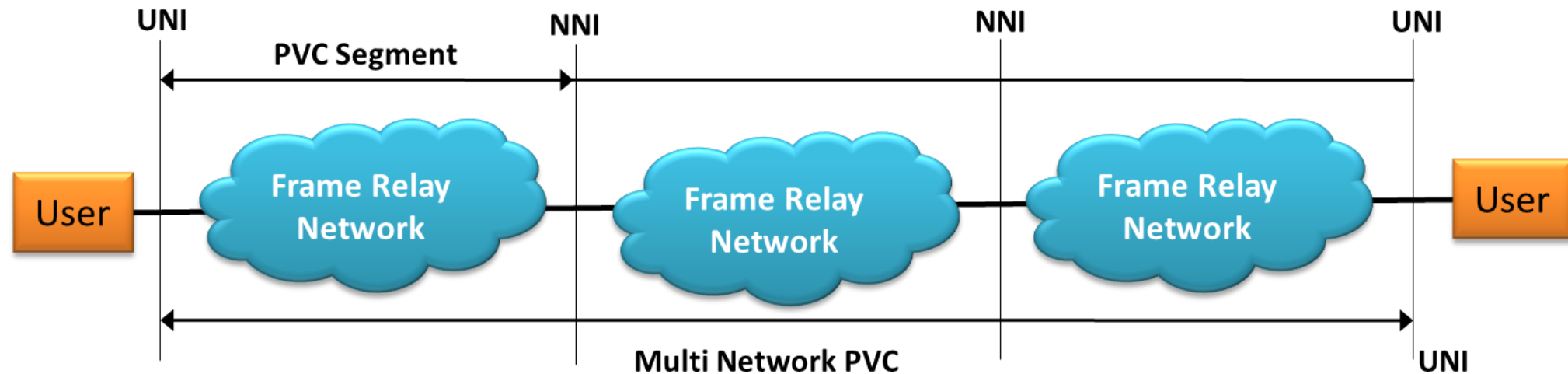
FECN – Forward Explicit Congestion Notification

BECN – Backward Explicit Congestion Notification

DE – Discard Eligibility

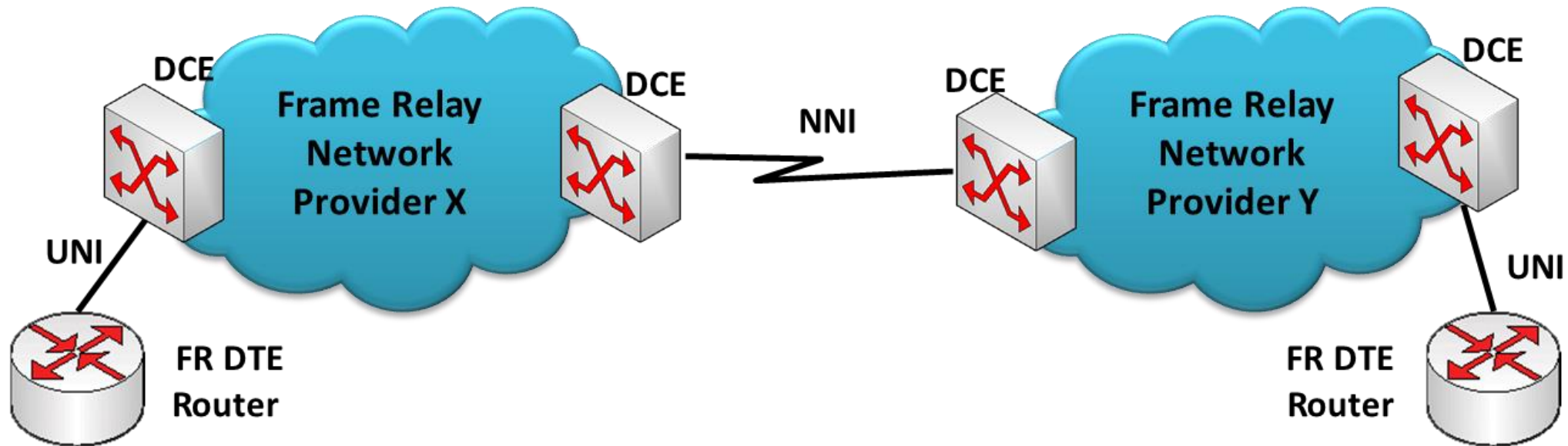
Frame Relay Interface Types

- User-to-Network Interface (UNI)
 - The DTE and DCE interfaces act as fragmentation and reassembly peers; UNI (DTE-DCE) fragmentation is used in order to allow real-time and data frames to share the same UNI interface between a DTE and the Frame Relay Network
- Network-to-Network Interface (NNI)
 - NNI connects different Frame Relay networks together
 - NNI interface standardizes DCE to DCE communication



Fragmentation

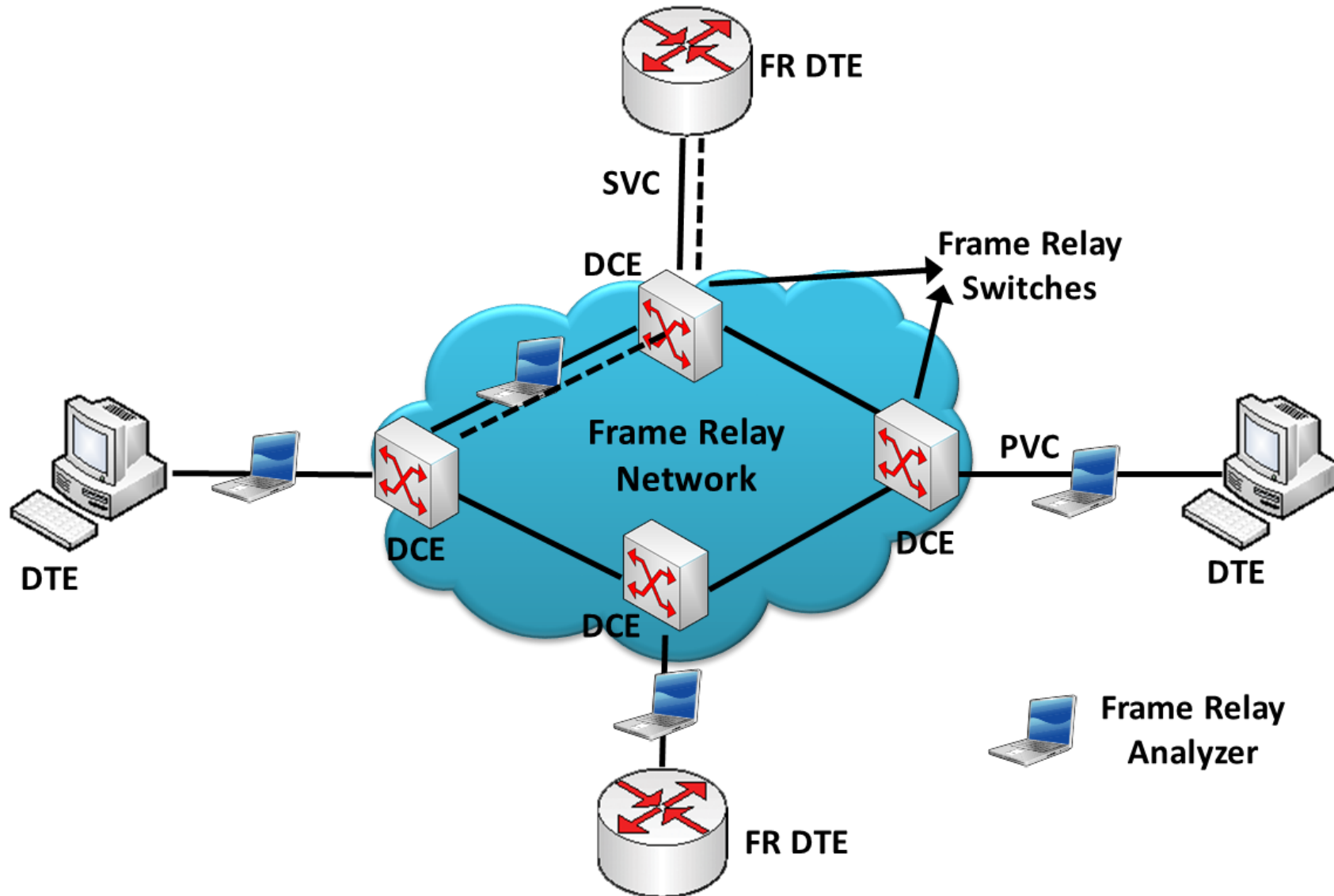
- Fragmentation allows to fragment long data frames into a sequence of shorter frames that are then reassembled into the original frame by the receiving peer DTE or DCE
- FRF.12 supports three fragmentation applications:
 - Locally across a Frame Relay UNI interface between the DTE/DCE peers
 - Locally across a Frame Relay NNI interface between DCE peers
 - End-to-End between two Frame Relay DTEs interconnected by one or more Frame Relay networks



Advantages

- Multiple virtual circuits can exist simultaneously across a given transmission line since virtual circuits consume bandwidth only when they transport data
- Each device can use more of the bandwidth as necessary, and thus operate at higher speeds
- Discard erroneous frames and eliminate time-consuming error-handling processing

GL's Frame Relay Analyzer



Supported Platforms



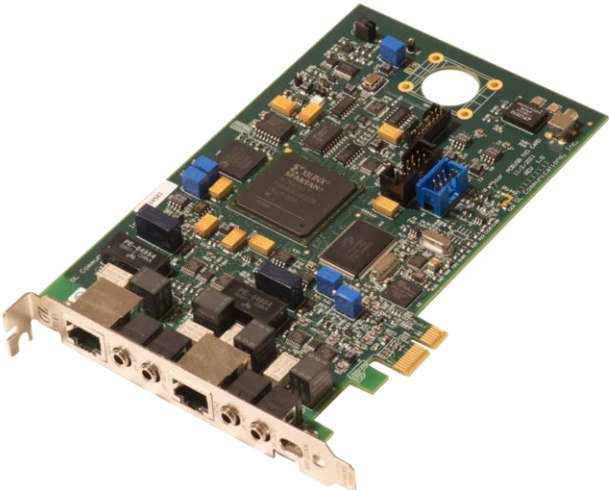
Front Panel

Back Panel

**tProbe™ - Portable USB based T1 E1 VF
FXO FXS and Serial Datacom Analyzer**

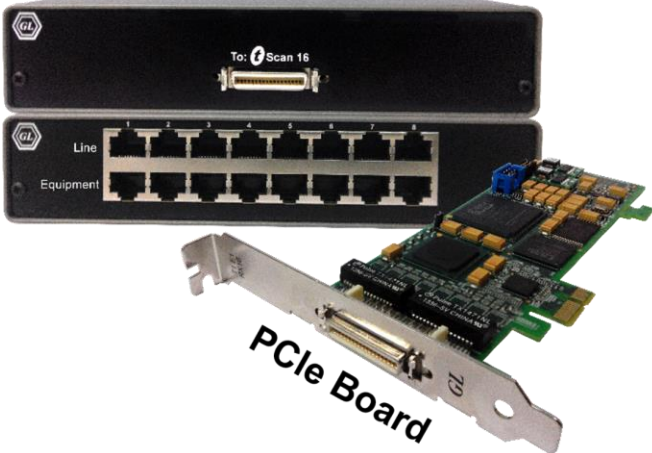


Quad / Octal T1 E1 PCIe Card



Dual T1 E1 Express (PCIe) Board

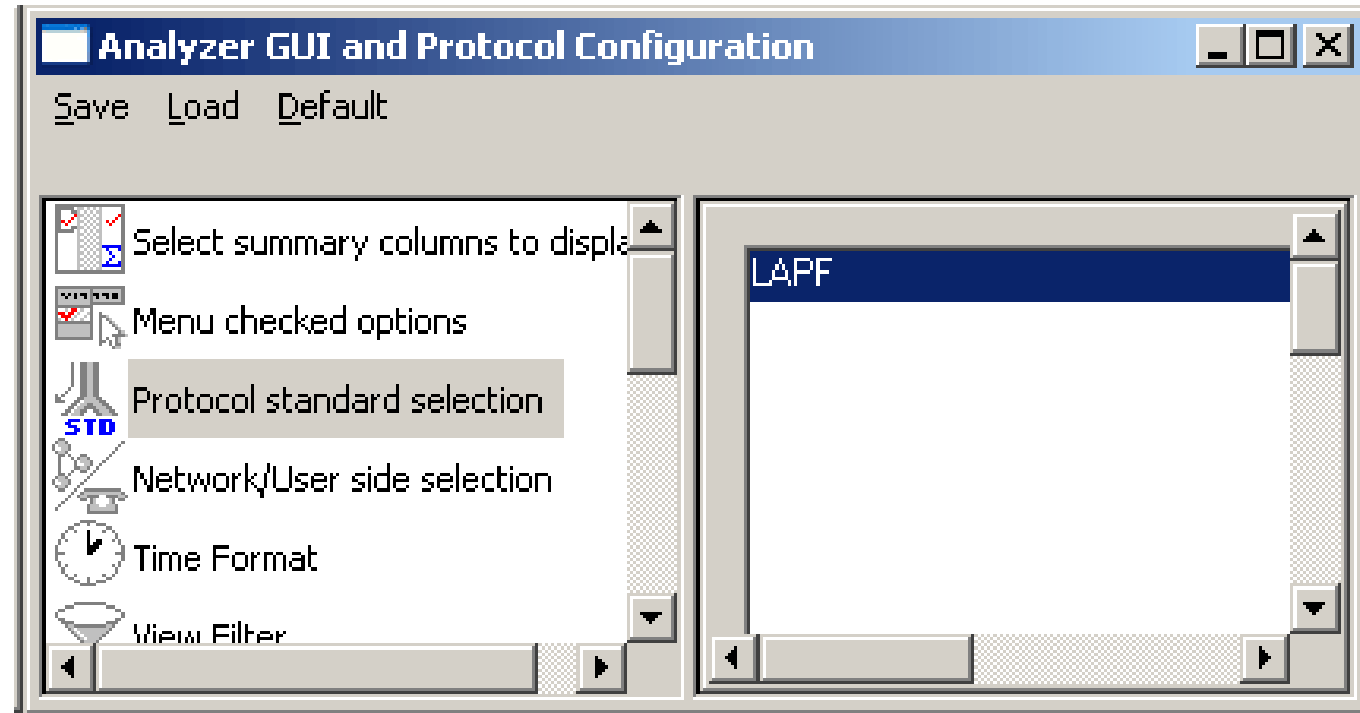
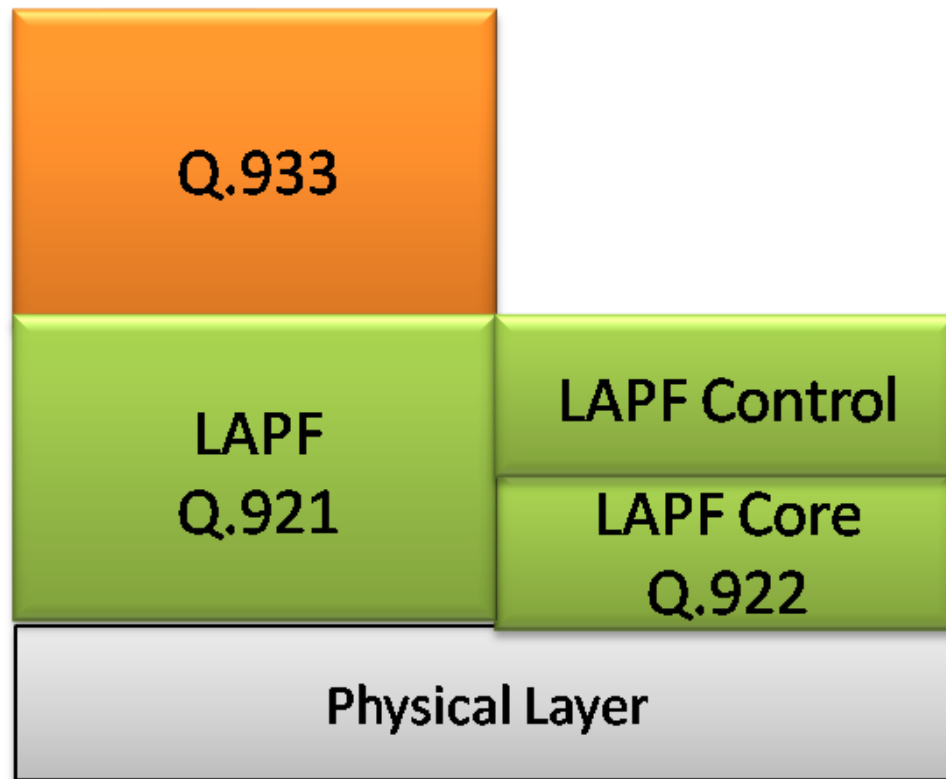
**tScan16™ with
16-port T1 E1 Breakout Box**



PCIe Board

Supported Protocols

- **LAPF** – Enhanced version of LAPD (Q.921) and decodes Layer 2 as Link Access Procedure/Protocol (LAPF) as defined in the ITU Q.922



Frame Relay Analysis

Frame Relay Protocol Analysis LAPF 64-bit

File View Capture Statistics Database Call Detail Records Configure Help

0 GoTo

| Dev | TSlot | SubCh | Frame# | TIME (Relative) | Len | Error | NLPID Multiprotocol Encapsulation | Sequence Number FRF 12.1 Fragment | Destination IP Address IP | Source IP Address IP |
|-----|-------|-------|--------|-----------------|-----|-------|--------------------------------------|--------------------------------------|------------------------------|-------------------------|
| ✓ 2 | 1-31 | | 0 | 00:00:00.000000 | 76 | | SNAP | | 74.125.135.100 | 192.168.1.56 |
| ✓ 2 | 1-31 | | 1 | 00:00:00.000000 | 74 | | SNAP | | 74.125.135.100 | 192.168.1.56 |
| ✓ 2 | 1-31 | | 2 | 00:00:00.000713 | 76 | | SNAP | | 74.125.128.103 | 192.168.1.56 |
| ✓ 2 | 1-31 | | 3 | 00:00:00.000713 | 74 | | SNAP | | 74.125.128.103 | 192.168.1.56 |
| ✓ 2 | 1-31 | | 4 | 00:00:00.055750 | 76 | | SNAP | | 192.168.1.56 | 74.125.135.100 |

Card2 TimeSlots=1-31 Frame=0 at 00:00:00.000000 OK Len=76 *** Right click to SHOW/HIDE layers

HDLC Frame Data + FCS

===== LAPF Layer =====

0000 Control bit = ..0..... (0)
0000 Ending Fragment = .1..... Yes
0000 Beginning Fragment = 1..... Yes
0000 Sequence Number = 291 (...0001. 00100011)
0002 EA =0 (0)

Hex Dump of the Frame Data

| Device # | Frame Count(Device #) |
|----------|-----------------------|
| 2 | 52 |
| total 2 | 52 |

C:\Program Files\GL Communications Inc\U: 52 Frames

Summary view

Detail view

Hex dump view

Statistics view

Different Views

- Summary View: This pane displays the columns that contain Card Number, Timeslots, Frame Number, Time, Frame Error Status, Command/Response, Length, Error, C/R, SAPI, CTL, P/F, FUNC, and more in a tabular format
- Detail View: This pane displays in detail about a frame in order to analyze and decode by selecting it in the summary view
- Hex Dump View: This pane displays the frame information in HEX and ASCII format
- Statistics View: This pane displays the Statistics that are calculated based on the protocol fields

Real-time Analysis

Bundle 1

Add Bundle Delete Bundle

Add Link Delete Link

Card 1

Timeslot Selection

TS

1 2 3 4 5 6 7 8 9 10 11 12

All TS Clear TS

Data Transmission Rate

Single Channel

☒ 64 kbps ☐ 56 kbps

Hyper-Channel

☐ Nx64 kbps

Subchannels 8-56 kbps

DS0 bits

☐ 8 ☐ 16 ☐ 24 ☐ 32 ☐ 40 ☐ 48 ☐ 56

1 2 3 4 5

All None

Card and Timeslot Selection

Card Selection

Cards

1 2

Timeslot Selection

TS

1 2 3 4 5 6 7 8 9 10 11 12

All TS Clear TS

Data Transmission Rate

Single Channel

☒ 64 kbps ☐ 56 kbps

Hyper-Channel

☐ Nx64 kbps ☐ Nx56 Kbps (bits 1-7) ☐ Nx56 Kbps (Bits 2-8)

Subchannels 8-56 kbps

DS0 bits

☐ 8 ☐ 16 ☐ 24 ☐ 32 ☐ 40 ☐ 48 ☐ 56

1 2 3 4 5 6 7 8

All None

CRC CRC16

OK

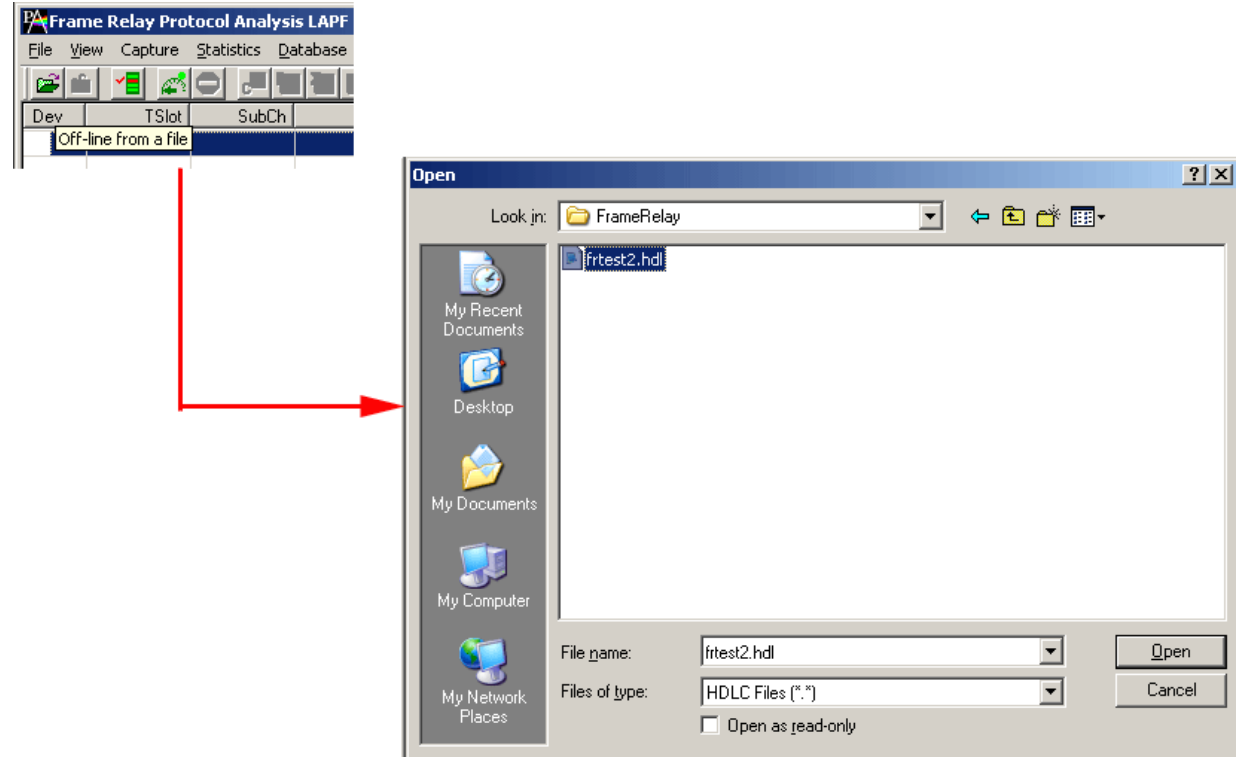
Selected Links TS 1:1..31

Real-time Analysis

- Streams can be captured on the selected time slots (contiguous or non-contiguous), sub-channels (fractional DS0 to DS1) or full bandwidth
- Frames may also be contained in either one, $n \times 64$ kbps, or $n \times 56$ kbps data channels
- Capture frames based on Frame Relay options such as fragments and maximum differential delay
- Frames may also be captured based on their FCS (16 bits, 32 bits, none), bit inversion, octet bit reversion, user/network side options
- Recorded trace file can then be analyzed offline, exported to ASCII file, or printed

Offline Analysis

- Off-line analysis is equivalent to capturing a file in pre-defined timeslots
- Captured frames or only the filtered frames can be exported to *.HDL file for the further off-line analysis
- Trace file for offline analysis can be loaded either through analyzer GUI or through simple command-line arguments



Offline Analysis using CLI

Off-line Frame Relay Protocol Analysis LAPF

File View Capture Statistics Database Call Detail Records Configure Help

0 GoTo

| Dev | TS... | Su... | Frame# | TIME (Relative) | Len | Error | DLCI | DE | BECN | FECN | C |
|-----|-------|-------|--------|-----------------|-----|-------|------|----|------|------|---|
| ✓ 1 | 2 | | 0 | 00:00:00.000000 | 40 | | 256 | 0 | 0 | 0 | L |
| ✓ 1 | 2 | | 1 | 00:00:00.000817 | 10 | | 256 | 0 | 0 | 0 | L |
| ✓ 1 | 2 | | 2 | 00:00:00.314571 | 10 | | 256 | 0 | 0 | 0 | L |

Card1 T HDLC Fr
====
EA
C/R
DLCI

Hex Dump
+-----
40 01 03 08 02 06 02 05 04 03 80 90 C3 18 03 A9 @ II Å ©
83 86 6C 08 80 35 35 35 36 30 30 30 70 08 80 36 III 15556000p 16
37 30 34 37 38 34 C0 70 704784Ap

Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

D:\>cd D:\Program Files\Gl Communications Inc\Fram Relay Analyzer

D:\Program Files\Gl Communications Inc\Fram Relay Analyzer>Frelprot framerelay\frtest2.hdl

D:\Program Files\Gl Communications Inc\Fram Relay Analyzer>_

| Call ID | Call Status | Calling Num | Called Num | Call Start Date & Time | Call Duration |
|---------|-------------|-------------|------------|----------------------------|-----------------|
| 0 | completed | 5556000 | 6704784 | 1601-01-01 00:00:00.000001 | 00:01:47.374180 |

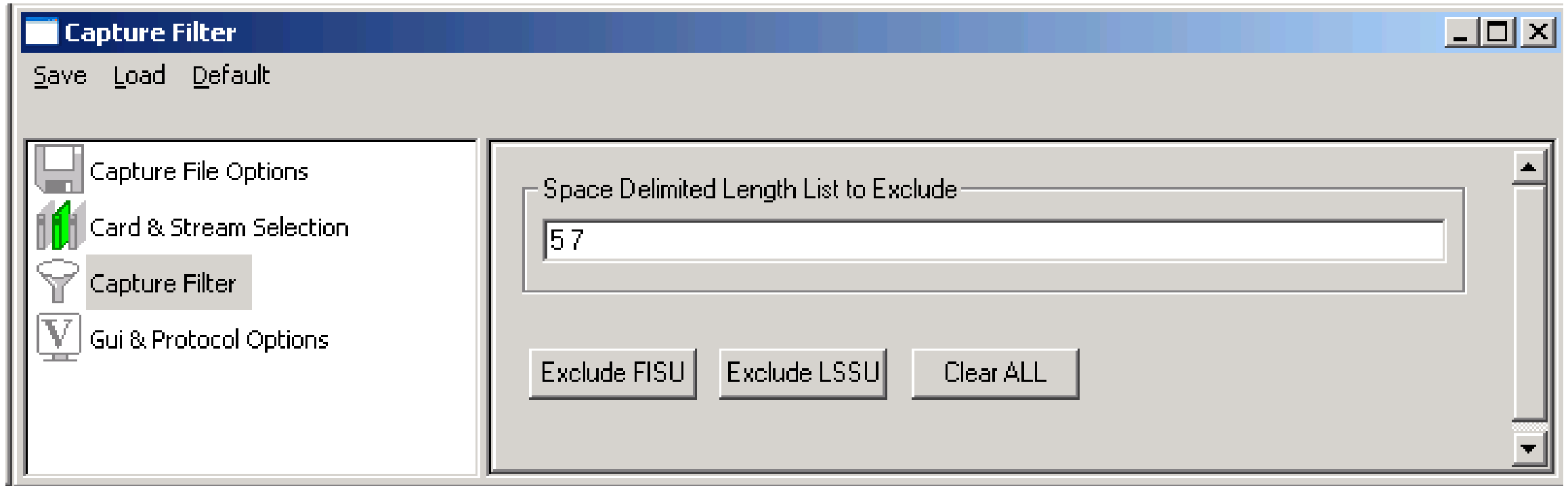
C:\Documents and Settings\root 4 Frames

Other Features

- Call trace defining important call specific parameters such as call ID, status (active or completed), duration, calling number, called number, release complete cause etc. are displayed
- Filter Frames (Real-time): Isolate certain specific frames from all frames in real-time as well as offline
- Filter Frames (Offline): The frames can be filtered after completion of capture based on BECN, FECN, DLCI, DE, NLPID, IP source and destination address, TCP & UDP source and destination port.
- Search features helps users to search for a particular frame based on specific search criteria
- Capability to export summary view details to comma separated values (CSV) format for subsequent import into a database or spreadsheet
- Capability to export detail decode information to an ASCII file

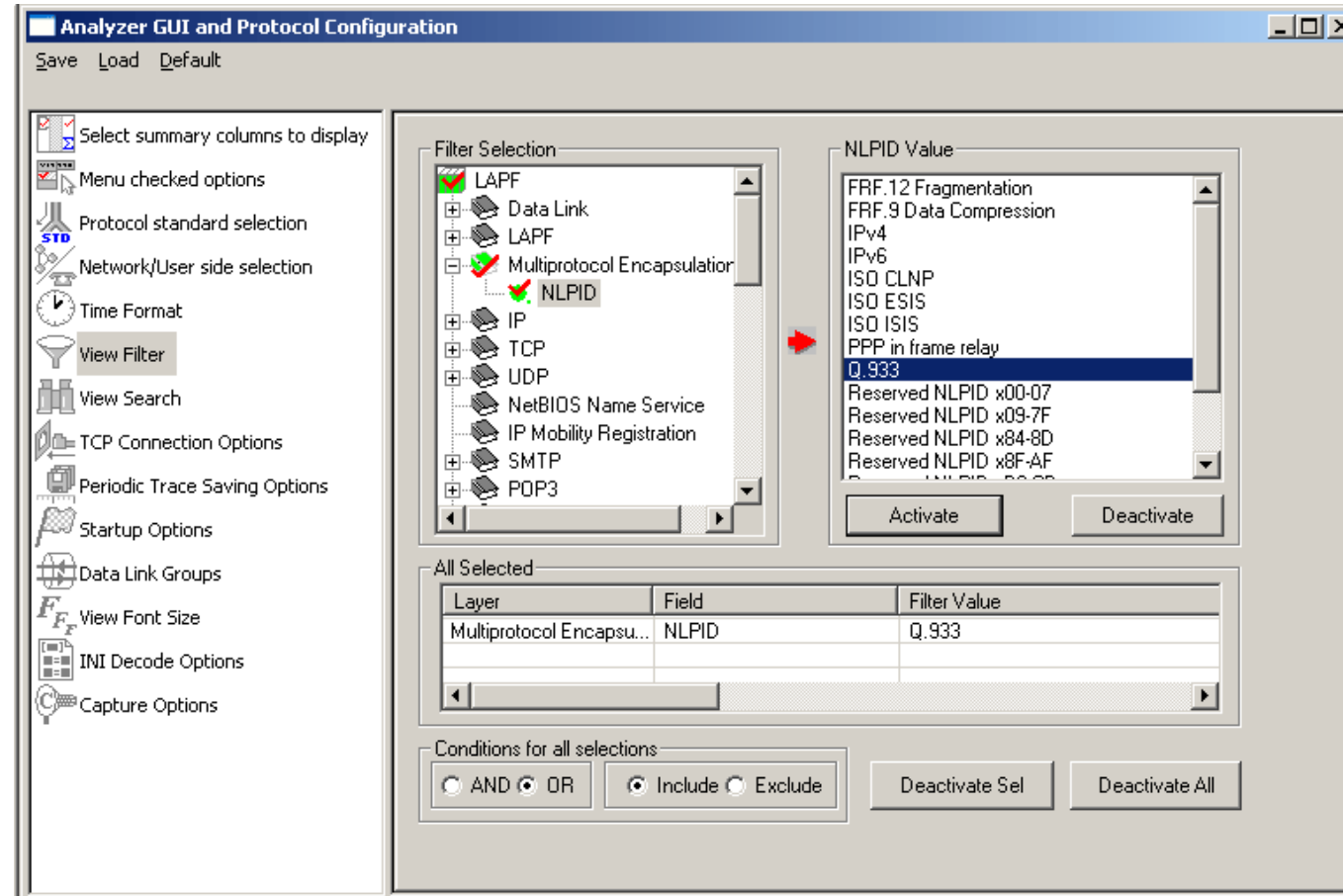
Filter Frames (Real-time)

- Isolate certain specific frames from all frames in real-time as well as offline
- Real-time Filter applies to the frames being captured and is based on the frame length



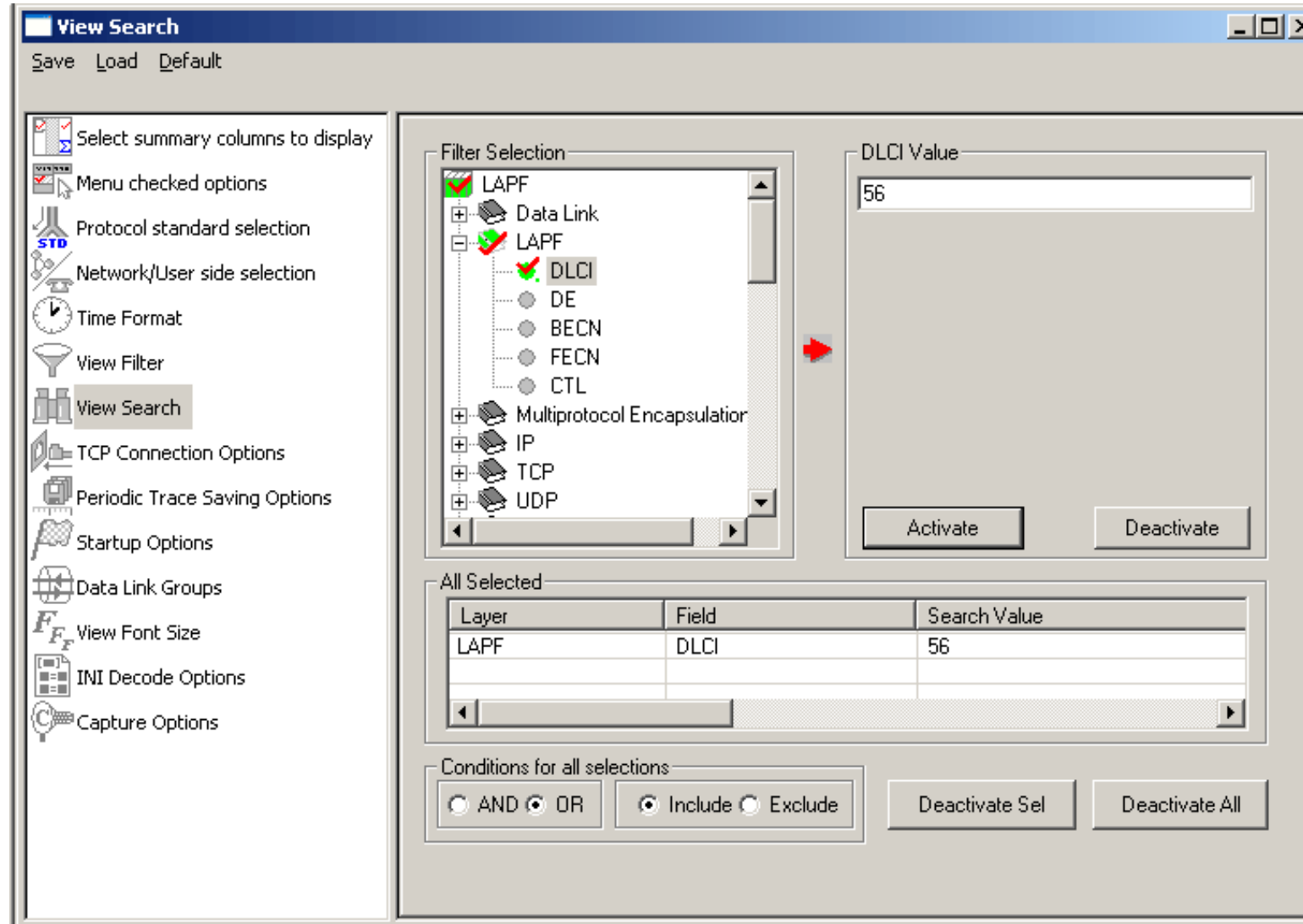
Filter Frames (Offline)

- Isolates required frames from all frames in real-time, as well as offline
- The frames can be filtered after completion of capture based on BECN, FECN, DLCI, DE, NLPID, IP source and destination address, TCP & UDP source and destination



Search Frames

- Search features helps users to search for a particular frame based on specific search criteria



Filtering Criteria From Screen Selection

- Allows the user to create filter criteria automatically from the current screen selection

Frame Relay Protocol Analysis LAPF 64-bit

| Dev | TSlot | SubCh | Frame# | TIME (Relative) | Len | Error | NLPID | Sequence Number | Source IP A |
|-----|-------|-------|--------|-----------------|-----|-------|-------|-----------------|--------------|
| ✓ 2 | 1-31 | | 0 | 00:00:00.000000 | 76 | | SNAP | | 192.168.1.56 |
| ✓ 2 | 1-31 | | 1 | 00:00:00.000000 | 74 | | SNAP | | 192.168.1.56 |
| ✓ 2 | 1-31 | | 2 | 00:00:00.000713 | 76 | | SNAP | | |
| ✓ 2 | 1-31 | | 3 | 00:00:00.000713 | 74 | | SNAP | | |
| ✓ 2 | 1-31 | | 4 | 00:00:00.055750 | 76 | | SNAP | | |
| ✓ 2 | 1-31 | | 5 | 00:00:00.055750 | 74 | | SNAP | | |

Use Ctrl, Shift for Extended Selection

Multiprotocol Encapsulation::NLPID
IP::Destination IP Address
IP::Source IP Address
TCP::Destination Port
TCP::Source Port

OK Select All Cancel

Analyzer GUI and Protocol Configuration

Save Load Default

Select summary columns to di...
Menu checked options
Protocol standard selection
Network/User side selection
Time Format
View Filter
View Search
TCP Connection Options
Periodic Trace Saving Options
Startup Options
Data Link Groups
View Font Size
INI Decode Options
Define Summary Columns
Aggregate Summary Columns
Capture Options

Filter Selection

- ✓ LAPF
 - Data Link
 - LAPF
 - ✓ Multiprotocol Encapsulation
 - Q.933 Layer 3
 - SNAP
 - MAC
 - ARP
 - PPP over frame relay
 - Link Control Protocol RFC1
 - FRF 12.1 Fragment
 - ✓ IP

Value Selection

Activate Deactivate

All Selected

| Layer | Field | Filter Value |
|--------------------------|------------------------|----------------|
| Multiprotocol Encapsu... | NLPID | SNAP |
| IP | Destination IP Address | 74.125.135.100 |

Conditions for all selections

AND OR Include Exclude

Deactivate Sel Deactivate All

Search Criteria From Screen Selection

- Allows the user to create search criteria automatically from the current screen selection

The screenshot shows the 'Frame Relay Protocol Analysis LAPF 64-bit' interface. The packet list table is as follows:

| Dev | TSlot | SubCh | Frame# | TIME (Relative) | Len | Error | NLPID | Sequence Number | Source IP Address |
|-----|-------|-------|--------|-----------------|-----|-------|-------|-----------------|-------------------|
| ✓ 2 | 1-31 | | 0 | 00:00:00.000000 | 76 | | SNAP | | 192.168.1.56 |
| ✓ 2 | 1-31 | | 1 | 00:00:00.000000 | 74 | | SNAP | | |
| ✓ 2 | 1-31 | | 2 | 00:00:00.000713 | 76 | | SNAP | | |
| ✓ 2 | 1-31 | | 3 | 00:00:00.000713 | 74 | | SNAP | | |
| ✓ 2 | 1-31 | | 4 | 00:00:00.055750 | 76 | | SNAP | | |
| ✓ 2 | 1-31 | | 5 | 00:00:00.055750 | 74 | | SNAP | | |

A context menu is open over the first packet, with options: 'Search Selected Value', 'Set Search Criteria as Sel Values', and 'Set Filter Criteria as Sel Values'. A red arrow points from the 'Set Search Criteria as Sel Values' option to a dialog box titled 'Use Ctrl, Shift for Extended Selection'. The dialog box contains a list of search criteria: 'Multiprotocol Encapsulation::NLPID', 'IP::Destination IP Address', 'IP::Source IP Address', 'TCP::Destination Port', and 'TCP::Source Port'. The 'IP::Source IP Address' option is selected. The dialog has 'OK', 'Select All', and 'Cancel' buttons.

The 'Analyzer GUI and Protocol Configuration' window is shown. The 'Filter Selection' pane on the left lists various protocols, with 'IP' selected. The 'Value Selection' pane on the right is empty. Below these panes is a table titled 'All Selected' with the following data:

| Layer | Field | Search Value |
|--------------------------|-------------------|--------------|
| Multiprotocol Encapsu... | NLPID | SNAP |
| IP | Source IP Address | 192.168.1.56 |

At the bottom of the window, there are 'Conditions for all selections' with radio buttons for 'AND' and 'OR', and checkboxes for 'Include' and 'Exclude'. There are also 'Deactivate Sel' and 'Deactivate All' buttons.

Statistics

- Numerous statistics can be obtained to study the performance and trend in the network

The screenshot shows a 'Statistics' window with the following components:

- Field Names:** A tree view showing network layers and protocols. 'Layers' is expanded, showing 'Physical Link' and 'LAPF'. 'LAPF' is further expanded, showing 'C/R' (selected), 'Ctl', 'D/C', 'DE', 'DLCI', 'EA', 'FECN', 'Modifier Function', 'N(R)', 'N(S)', 'P/F', and 'Supervisory Function'. Other layers include 'Multiprotocol Encapsulation', 'IP', and 'TCP'.
- C/R:** A section for configuring the C/R field. It includes a 'Use Type (single selection)' dropdown with 'Total', 'Key', and 'Field'. Below it is a 'Statistic Type(s) (calculated, multiple selection)' list with 'Frame Count', 'Frame Percent', 'Byte Count', and 'Byte Percent'. A 'Value Set' section contains two radio buttons: 'Cumulative' (selected) and 'Separate'. Below these are 'Add/Mod' and 'Remove' buttons.
- Selected Statistic Information:** A table with the following data:

| Layer | Field Name | Use Type | Statistic Type |
|--------------|------------|----------|----------------|
| Physical ... | Device # | Total | |
| LAPF | C/R | Total | Frame Count |

Saving a File

- Captured trace files can be controlled by saving the trace using different conventions such as –
 - Trace files with user-defined prefixes
 - Trace file with date-time prefixes
 - Slider control to indicate the total number of files, file size, frame count, or time limit

Periodic Trace Saving Options
Save Load Default

Select summary columns to display
Menu checked options
Protocol standard selection
Network/User side selection
Time Format
View Filter
View Search
TCP Connection Options
Periodic Trace Saving Options
Startup Options
Data Link Groups
View Font Size
INI Decode Options
Capture Options

Using View Filter
☒ All Frames (no filtering)
☐ Filtered Only (use view filter)

Save Directory
C:\

Save File Names
☒ Sequential File Names
file name prefix: [] number of digits: 123 file name suffix: .HDL
☐ Date/Time Formatted Names
file name prefix: %Y%M%D_%H%i file name suffix: .HDL
file name suffix: file name suffix

Create a New File After the Specified Limit Has Been Reached
☒ File Size Limit e.g. 1048576 or 1024K or 1M Limit Value: 1000000
☐ Frame Count Limit e.g. 1048576 or 1024K or 1M
☐ Time Limit e.g. 24:00 (HH:MM)

Restrict or Recycle After N Files Options
2147483647 ☒ Keep N Latest Files ☐ Stop After N Files ☐ Unrestricted

Define Summary Columns

- Add or remove any protocol fields through Define Summary Column option

Selection of Summary Column

Output display in analyzer

The image shows two windows from a network analyzer. The top window, 'Define Summary Columns', has a left sidebar with various options. The 'Define Summary Columns' option is highlighted with a red box. A red arrow points from this box to the text 'Output display in analyzer'. The main area of this window shows 'Defined Protocol Summary Fields for LAPF' with a list of fields and checkboxes. The 'EA' checkbox is checked and highlighted with a red box. A red arrow points from this box to the text 'Selection of Summary Column'. The bottom window, 'Frame Relay Protocol Analysis LAPF', displays a table of protocol data. The 'EA' column is highlighted with a red box. A red arrow points from this box to the text 'Output display in analyzer'. Below the table, there is a section for 'Card2 TimeSlots=1-31 Frame=0 at 13:52:45.690524 OK Len=182' and a 'Hex Dump of the Frame Data'.

| Dev | TSlot | SubCh | Frame# | TIME | Len | Error | DLCI | EA | DE | BECN | FECN | CTL | Sequence Number |
|-----|-------|-------|--------|------------|-----|-------|------|----|----|------|------|----------|-----------------|
| 2 | 1-31 | | 0 | 00:00... | 182 | | 3 | 1 | 0 | 1 | 1 | Infor... | |
| 2 | 1-31 | | 1 | 25:22:1... | 410 | | 3 | 1 | 0 | 1 | 1 | Infor... | |
| 2 | 1-31 | | 2 | 00:00... | 244 | | 3 | 1 | 0 | 1 | 1 | Infor... | |
| 2 | 1-31 | | 3 | 00:00... | 76 | | 3 | 1 | 0 | 1 | 1 | Infor... | |
| 2 | 1-31 | | 4 | 00:00... | 76 | | 3 | 1 | 0 | 1 | 1 | Infor... | |
| 2 | 1-31 | | 5 | 00:00... | 76 | | 3 | 1 | 0 | 1 | 1 | Infor... | |
| 2 | 1-31 | | 6 | 00:00... | 76 | | 3 | 1 | 0 | 1 | 1 | Infor... | |
| 2 | 1-31 | | 7 | 00:00... | 76 | | 3 | 1 | 0 | 1 | 1 | Infor... | |

Card2 TimeSlots=1-31 Frame=0 at 13:52:45.690524 OK Len=182

HDLCL Frame Data + FCS

***** LAPF Layer *****

Control bit = .1..... (1)

Ending Fragment = .1..... Yes

Beginning Fragment = 1..... Yes

Sequence Number = 3843 (...1111. 00000011)

EA =0 (0)

C/R =0. Command(User), Response(Network)

DLCI = 3 (000000... 0011....)

Hex Dump of the Frame Data

```
FF 03 00 3D C0 00 0C 3C 00 21 45 00 00 AA F9 89  y =A < IE a0
40 00 3F 06 C9 3C CA AE 9C 22 48 25 C9 91 06 B8  @ ? E<E@HxE
E8 9F 00 44 EE F3 4C 96 B9 52 80 18 00 D7 08 84  e! DióL!R! x!
00 00 01 01 08 0A 02 73 1B B2 02 53 6A 22 03 00  s Sj
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

Off-line Viewing [C:\Program Files\GL Communications Ir\11 938 Frames

Aggregate Group Column

- The user can create multiple aggregate column groups and prioritize the groups as per the requirement to display the summary results efficiently

The image shows two overlapping windows from a network analysis tool. The top window is the 'Aggregate Summary Columns' dialog, which allows users to define custom summary columns. It includes a list of available columns on the left and a table for defining aggregate groups. The bottom window is the 'Frame Relay Protocol Analysis LAPF 64-bit' packet analyzer, displaying a list of captured frames with columns for Time Slot, SubChannel, Frame Number, Time, Length, and various protocol fields. A red box highlights the 'Group~0' column in the packet list, which corresponds to the aggregate group defined in the dialog above.

Aggregate Summary Columns Dialog:

| Name | Display Format | Summary Columns | Separator |
|---------|-------------------|--|-----------|
| Group~0 | Concat | NLPID_Multiprotocol Encapsulation Destination IP Address_IP | & |
| Group~1 | <Col_Alias> Value | POP3 Message_POP3 | |
| Group~2 | Overlay | Destination Port_TCP | |

Frame Relay Protocol Analysis LAPF 64-bit Packet List:

| TSlot | SubCh | Frame# | TIME (Relative) | Len | Group~0 | Error | NLPID Multiprotocol Encapsulation | Sequence Number FRF 12.1 Fragment | Source IP Address IP | Destination IP A IP |
|-------|-------|--------|-----------------|-----|-----------------------|-------|--------------------------------------|--------------------------------------|-------------------------|------------------------|
| 1-31 | | 0 | 00:00:00.000000 | 76 | SNAP & 74.125.135.100 | | SNAP | | 192.168.1.56 | 74.125.135.100 |
| 1-31 | | 1 | 00:00:00.000000 | 74 | SNAP & 74.125.135.100 | | SNAP | | 192.168.1.56 | 74.125.135.100 |
| 1-31 | | 2 | 00:00:00.000713 | 76 | SNAP & 74.125.128.103 | | SNAP | | 192.168.1.56 | 74.125.128.103 |
| 1-31 | | 3 | 00:00:00.000713 | 74 | SNAP & 74.125.128.103 | | SNAP | | 192.168.1.56 | 74.125.128.103 |
| 1-31 | | 4 | 00:00:00.055750 | 76 | SNAP & 192.168.1.56 | | SNAP | | 74.125.135.100 | 192.168.1.56 |
| 1-31 | | 5 | 00:00:00.055750 | 74 | SNAP & 192.168.1.56 | | SNAP | | 74.125.135.100 | 192.168.1.56 |
| 1-31 | | 6 | 00:00:00.056463 | 68 | SNAP & 74.125.135.100 | | SNAP | | 192.168.1.56 | 74.125.135.100 |
| 1-31 | | 7 | 00:00:00.056463 | 66 | SNAP & 74.125.135.100 | | SNAP | | 192.168.1.56 | 74.125.135.100 |
| 1-31 | | 8 | 00:00:00.057141 | 76 | SNAP & 74.125.128.103 | | SNAP | | 192.168.1.56 | 74.125.128.103 |
| 1-31 | | 9 | 00:00:00.057141 | 74 | SNAP & 74.125.128.103 | | SNAP | | 192.168.1.56 | 74.125.128.103 |
| 1-31 | | 10 | 00:00:00.088036 | 76 | SNAP & 192.168.1.56 | | SNAP | | 74.125.128.103 | 192.168.1.56 |
| 1-31 | | 11 | 00:00:00.088036 | 74 | SNAP & 192.168.1.56 | | SNAP | | 74.125.128.103 | 192.168.1.56 |

Packet Details (Frame 0):

```
Card2 TimeSlots=1-31 Frame=0 at 00:00:00.000000 OK Len=76
HDLC Frame Data + FCS
----- LAPF Layer -----
0000 Control bit          = ..0.... (0)
0000 Ending Fragment     = .1.... Yes
0000 Beginning Fragment  = 1..... Yes
0000 Sequence Number     = 291 (...0001. 00100011)
0002 EA                  = .....0 (0)
0002 C/R                 = .....0. Command(User). Response(Network)
0002 DLCI                = 13 (000000... 1101....)
0003 EA                  = .....1 (1)
0003 DE                  = .....0. (0)
0003 BECN                = .....0.. (0)
0003 FFCN                = .....0 (0)
```

Data Link Group

- Data link groups that help in defining the direction of the calls in each network and form logical groups comprised of unidirectional (either 'Forward' or 'Backward') data links

Data Link Group Specification

Card

Timeslot

Subch

01

02

03

04

05

06

07

08

09

10

11

12

13

14

15

16

17

18

19

20

00

01

02

03

04

05

06

07

08

09

10

11

12

13

14

15

16

17

18

19

0

1

2

3

4

5

6

7

Data Link Group Name

East

☒ Forward Link Direction

Add

Odd Cards

Even Cards

All Cards

None

| Card | TS | Sc | Dir | Data Link Group Name |
|------|----|----|-----|----------------------|
| 1 | 0 | 0 | --> | West |
| 2 | 1 | 1 | <-- | West |
| 3 | 2 | 0 | --> | West |
| 4 | 3 | 1 | <-- | West |
| 5 | 0 | 0 | --> | East |
| 6 | 1 | 1 | <-- | East |
| 7 | 2 | 0 | <-- | East |
| 8 | 3 | 1 | --> | East |
| | | | | |
| | | | | |
| | | | | |

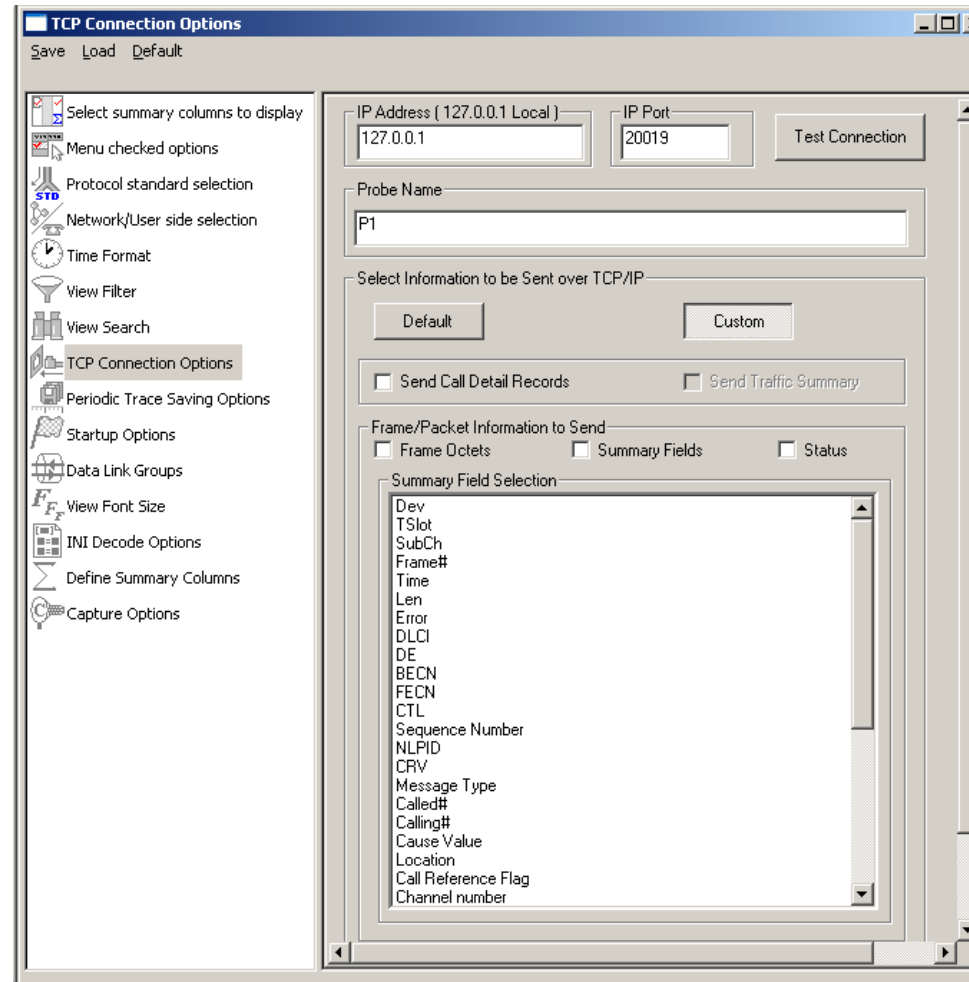
Delete Sel

Delete All

Default

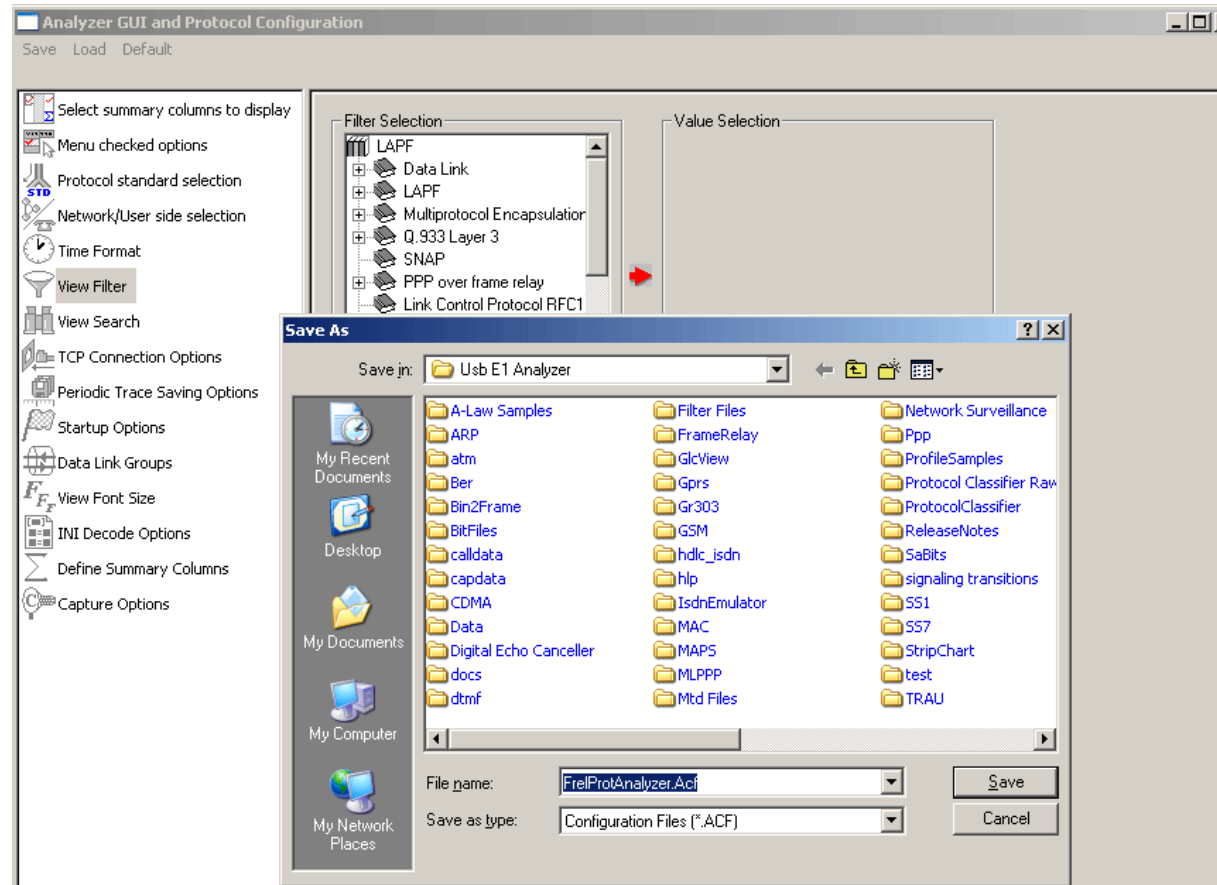
TCP Connection Options

- Used for Network Surveillance and Monitoring
- Designed to send protocol summary information and binary frame data via TCP- IP connection to a Database Loader to load data into a database



Save/Load All Configuration Settings

- Protocol Configuration window provides a consolidated interface for all the settings required in the analyzer such as protocol selection, filter criteria, search criteria, and so on
- Configuration settings can be saved to a file, loaded from a configuration file, or user may just revert to the default values using the default option



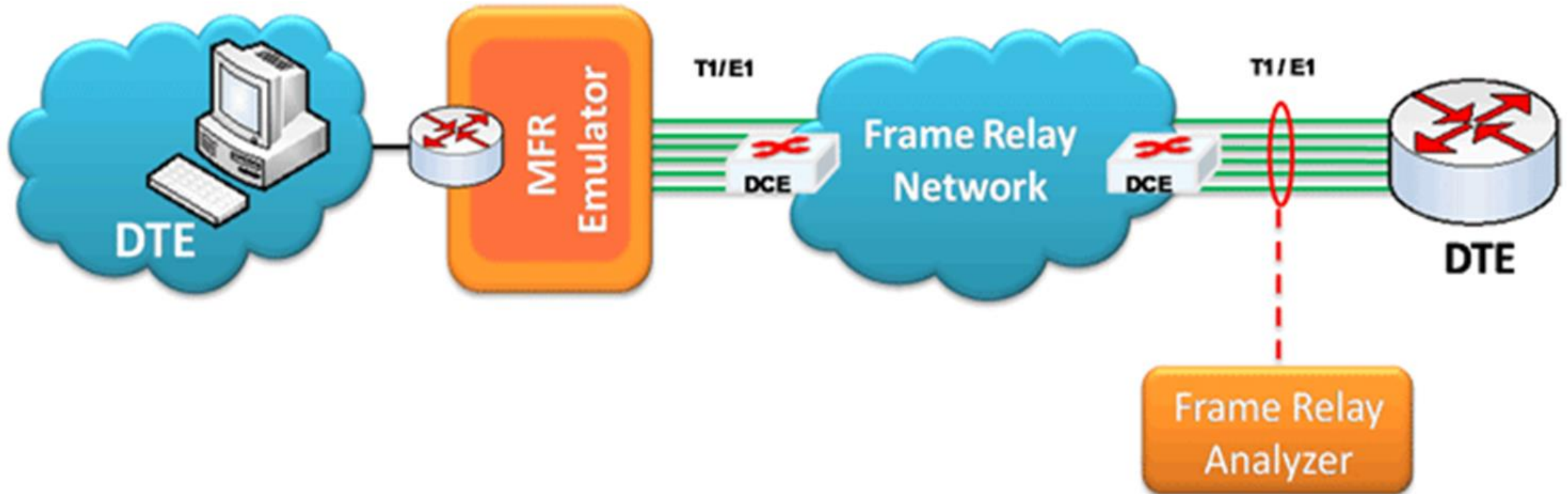
Applications

- Can be used as independent standalone units as "probes" integrated in a network surveillance systems
- Triggering, collecting, and filtering for unique subscriber information and relaying such information to a back-end processor
- Collecting Call Detail Records (CDR) information for billing
- Numerous statistics can be obtained to study the performance and trend in the network

Multi-Link Frame Relay Emulation using Client-Server

MFR Emulator

- GUI based WCS client, which simulates Multi-Link Frame Relay Emulation
- Capable of generating and receiving MFR/FR traffic (with or without impairments)
- Traffic source can be sequence number, HDL files (containing packets/frames), flat binary file, user-defined frames (ASCII HEX file), and Ethernet data



FR Simulation

MFR Emulator - FR Simulation - Untitled

File Action Simulation Help

Server Connection Status ●

Link View Action VC Statistics Tx/Rx Verification

| Link Name | Action | Status |
|-----------|--------|--------|
| #1:1..10 | Open | Down |
| #1:11..20 | Open | Down |
| #1:21..30 | Open | Down |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Add Delete Open Close

Link Config Impairments Statistics HDLC Statistics

☐ Fragmentation

Fragment Size

☐ Flags between Hdlc frames


☐ UNI NNI Fragmentation

☐ End to End Fragmentation

MFR Simulation

MFR Emulator - MFR Simulation - Untitled

File Action Simulation Help

Server Connection Status 

| Bundles | Status |
|---------|----------|
| 1 | DOWN |
| 2 | No Links |

Link View Action VC Statistics Tx/Rx Verification Bundle Config & Statistics

| Link Name | Action | Status |
|-----------|--------|--------|
| #1:1..5 | Open | Down |
| #1:11..15 | Open | Down |
| #1:6..10 | Open | Down |

Add Delete Open Close

Link Config Impairments Statistics HDLC Statistics

☐ Fragmentation

Fragment Size

☐ Flags between Hdlc frames

☐ UNI NNI Fragmentation

☐ End to End Fragmentation

Bundle ID

Add Delete

Open Close

Supported Standards

- FRF12 – This supports Frame Relay Fragmentation Implementation Agreement

Features

- Performs MFR as well as FR simulation on up to 16 T1 E1 lines; Group FR links to create a MFR bundle with each bundle/link configured with multiple virtual channels for traffic Tx/Rx
- FR links can be created on Full or Fractional Timeslots
- Supports hyper channels with discontinuous (sparse) timeslots
- Dynamically add/remove (open/close) of Frame Relay links without loss in data
- Multiple MFR Bundles/FR links can be created
- Generate and verify end to end traffic on each Virtual Channel
- User configurable FR/MFR packet and fragment size, bandwidth using flags, and maximum link differential delay
- Payload traffic generation and verification using Sequence number, pre-captured HDL files (containing packets/frames), Flat Binary file, and User defined frame (ASCII HEX file) for each Virtual Channel independently

Features

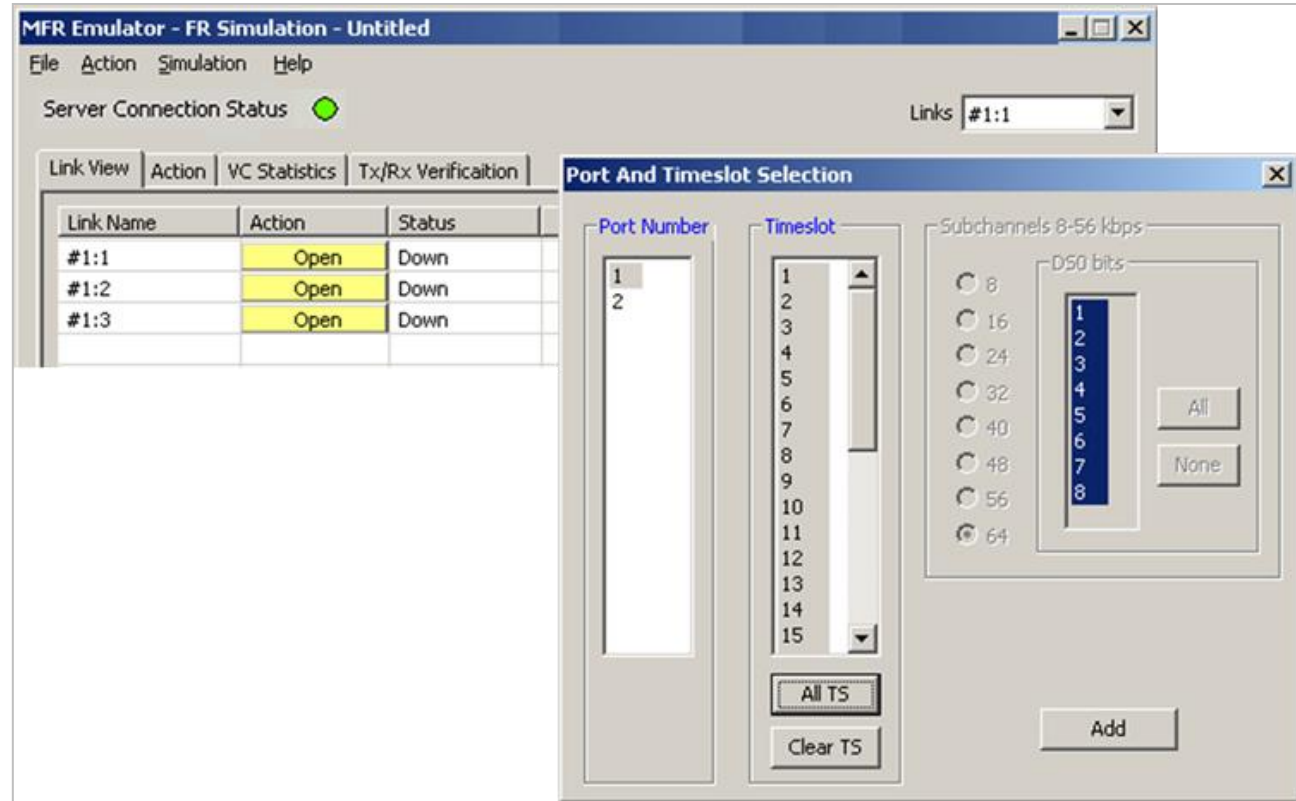
- Supports both Interface (UNI and NNI) and End-to-End fragmentation
- Transmit and receive Ethernet traffic over T1 E1 links by operating either in bridge or router mode
- Supports various Byte level, Frame level , CRC error, and Frame error impairments at link level
- Supports various Byte level and Frame level impairments at Fragment/Packet level for each Virtual Channel
- Provides detailed statistics for each bundle and virtual channels associated with a bundle
- Provides end to end traffic verification statistics
- Ideal solution for automated testing using command line scripts

FR Simulation

Adding Links

- Supports up to 16 T1 E1 links
- Timeslot of 64 Kbps or a Hyper Channels of n*64 Kbps or sub channels can also be used
- Supports hyper channels with continuous or discontinuous timeslots
- Each link is independent and can be configured with the selected 'Link Config' options

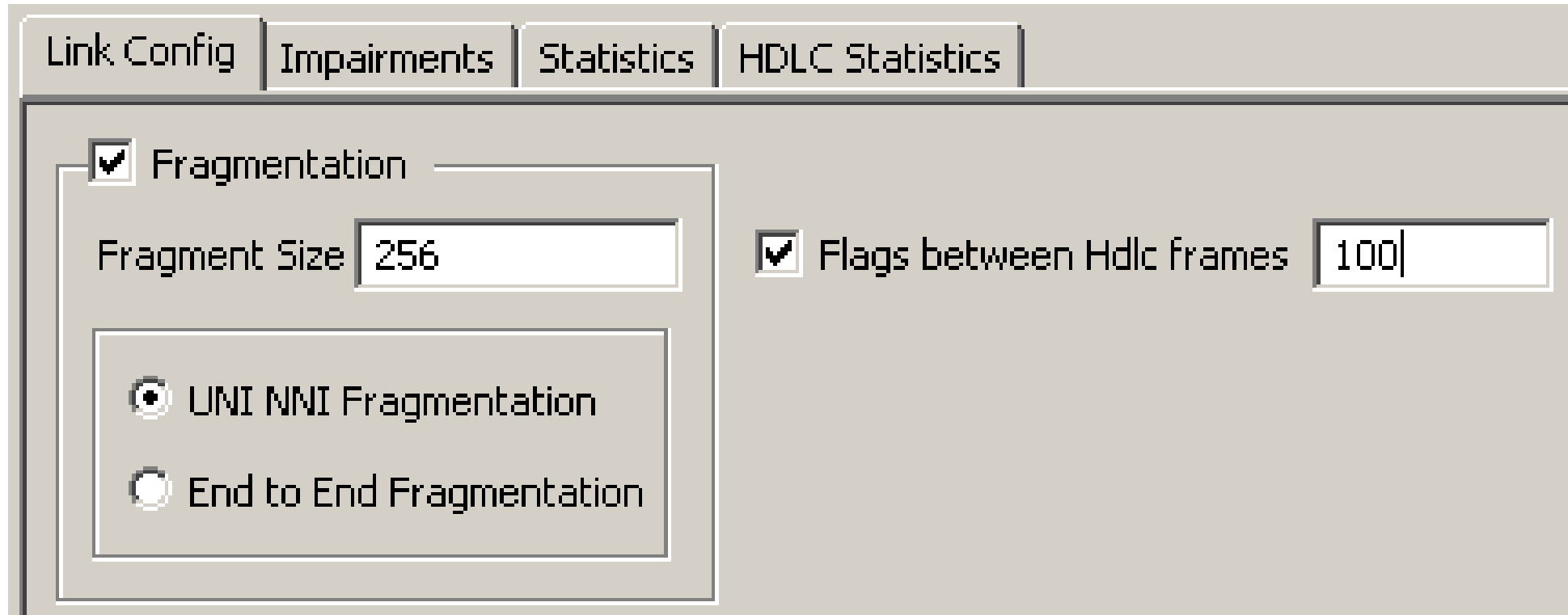
Added Links



Link Configuration

Link configuration is an optional feature, and the following values are negotiated when enabled

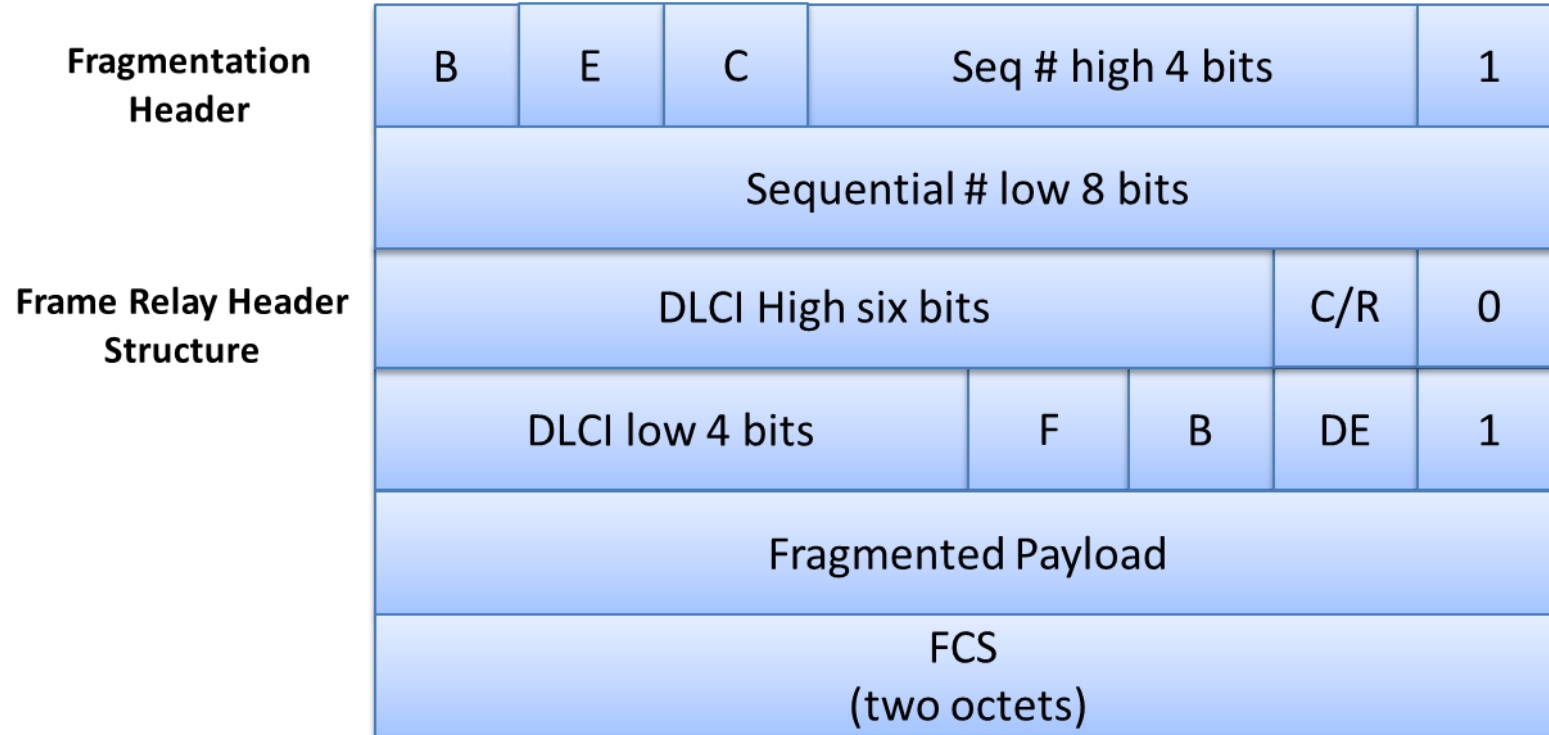
- Fragmentation Size: By default, the fragment size is 256. User can specify Fragment Size as required
- UNI NNI Fragmentation
- End to End Fragmentation
- Flags between Hdlc frames: This defines the number of flags to be inserted between HDLC frames the default value is 100



The image shows a 'Link Configuration' dialog box with four tabs: 'Link Config', 'Impairments', 'Statistics', and 'HDLC Statistics'. The 'Link Config' tab is active. Inside the tab, there is a 'Fragmentation' section with a checked checkbox. Below this, there is a 'Fragment Size' text box containing the value '256'. To the right of this, there is a 'Flags between Hdlc frames' text box containing the value '100', also with a checked checkbox. Below the 'Fragment Size' text box, there is a group box containing two radio buttons: 'UNI NNI Fragmentation' (which is selected) and 'End to End Fragmentation'.

UNI NNI Fragmentation

- UNI NNI Fragmentation: In UNI and NNI fragmentation, the frame starts with the fragmentation header, followed by the Frame Relay header



DLCI – Datalink Connection Identifier
C/R – Command/Response
DE – Discard Eligibility

B – Beginning Fragment Bit
E – Ending Fragment Bit
C – Control Bit

End to End Fragmentation

- End to End Fragmentation: End-to-End fragmentation is used between peer DTEs and is restricted to use on PVCs only. The Network Layer Protocol ID (NLPID) will be set to 0xB1

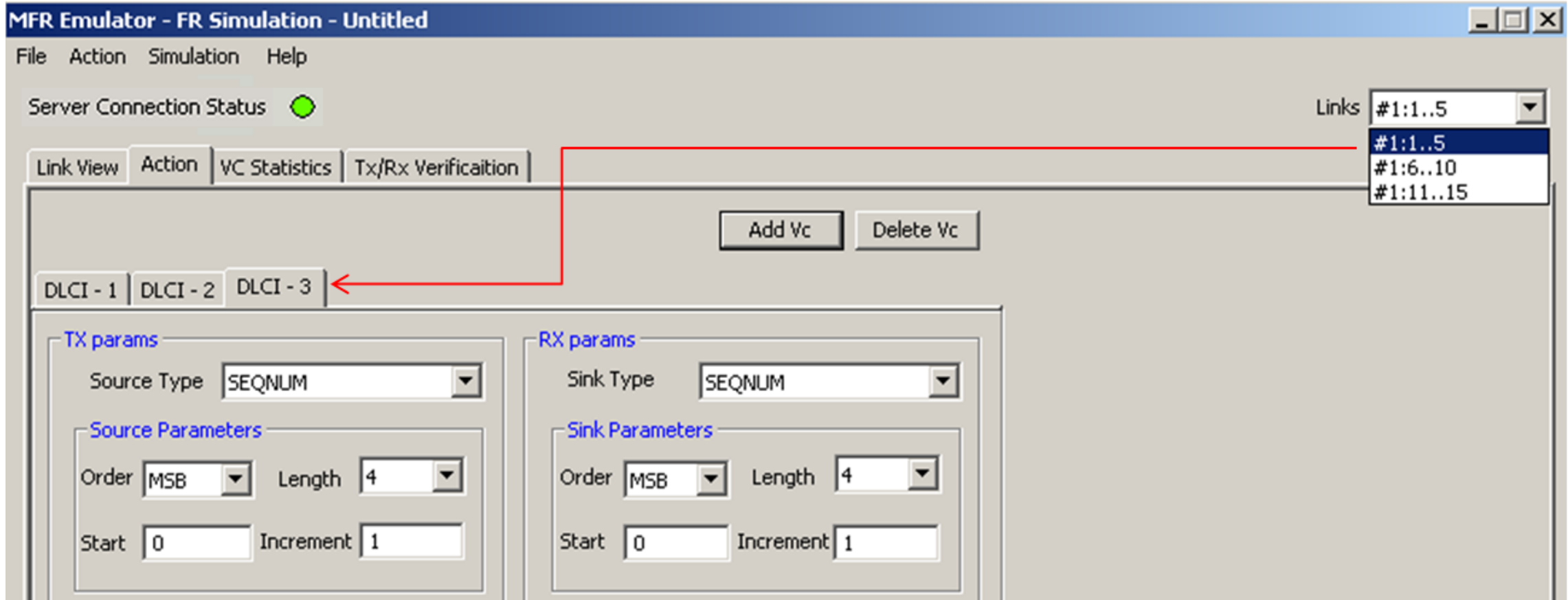
| | | | | | | | | | |
|------------------------------|----------------------|-------------------------|---|---|-------------------|---|-----|---|--|
| Frame Relay Header Structure | DLCI High six bits | | | | | | C/R | 0 | |
| | DLCI High 4 bits | | | | F | B | DE | 1 | |
| | UI (0X03) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | |
| | NLPD (0XB1) | 1 | 0 | 1 | 1 | 0 | 0 | 0 | |
| | Fragmentation Header | B | E | C | Seq # high 4 bits | | | 0 | |
| | | Sequential # low 8 bits | | | | | | | |
| | | Fragmented Payload | | | | | | | |
| | FCS (two octets) | | | | | | | | |

DLCI – Datalink Connection Identifier
C/R – Command/Response
DE – Discard Eligibility

B – Beginning Fragment Bit
E – Ending Fragment Bit
C – Control Bit

Adding VC in FR Simulation

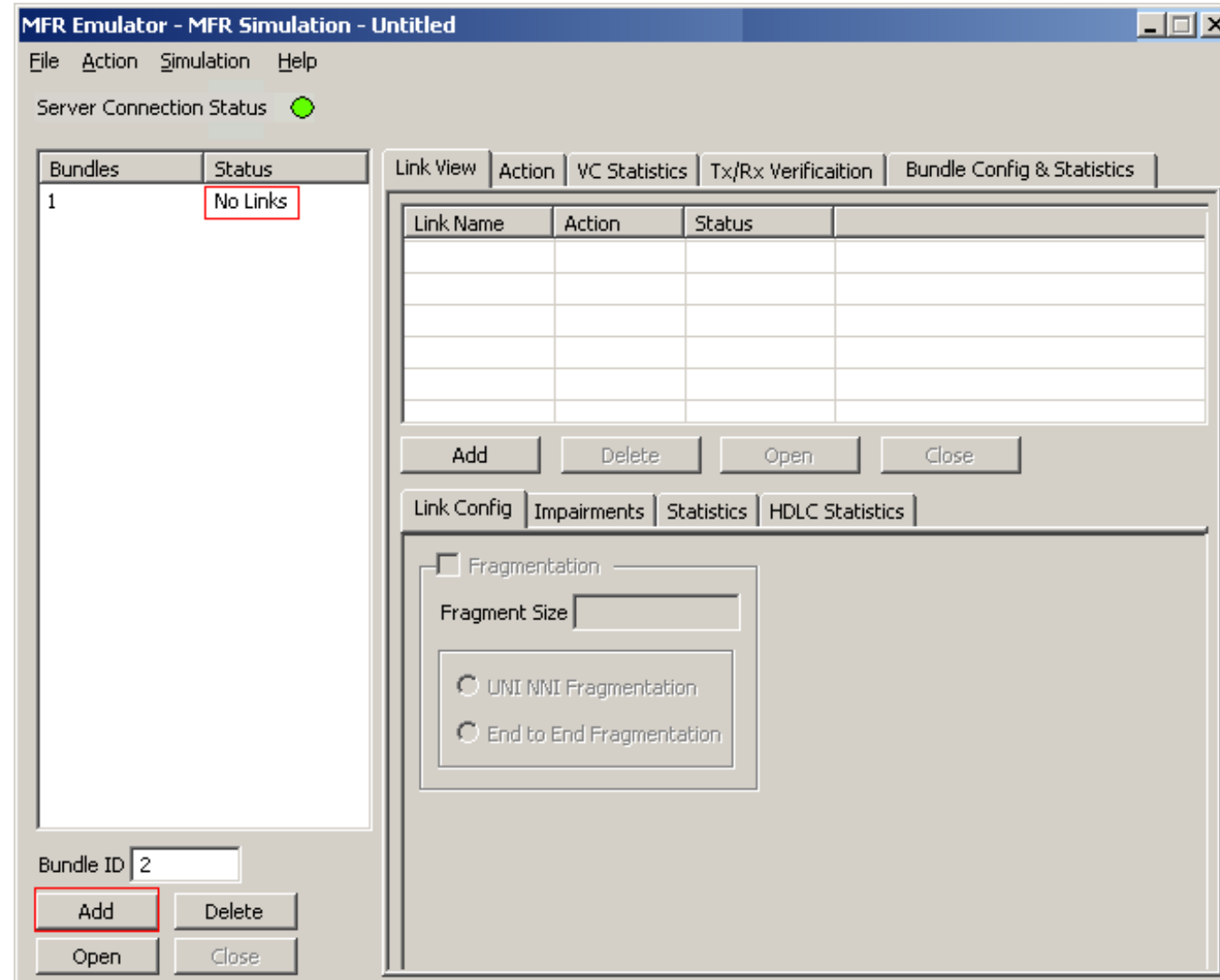
- In FR simulation virtual channels are added on the selected link



MFR Simulation

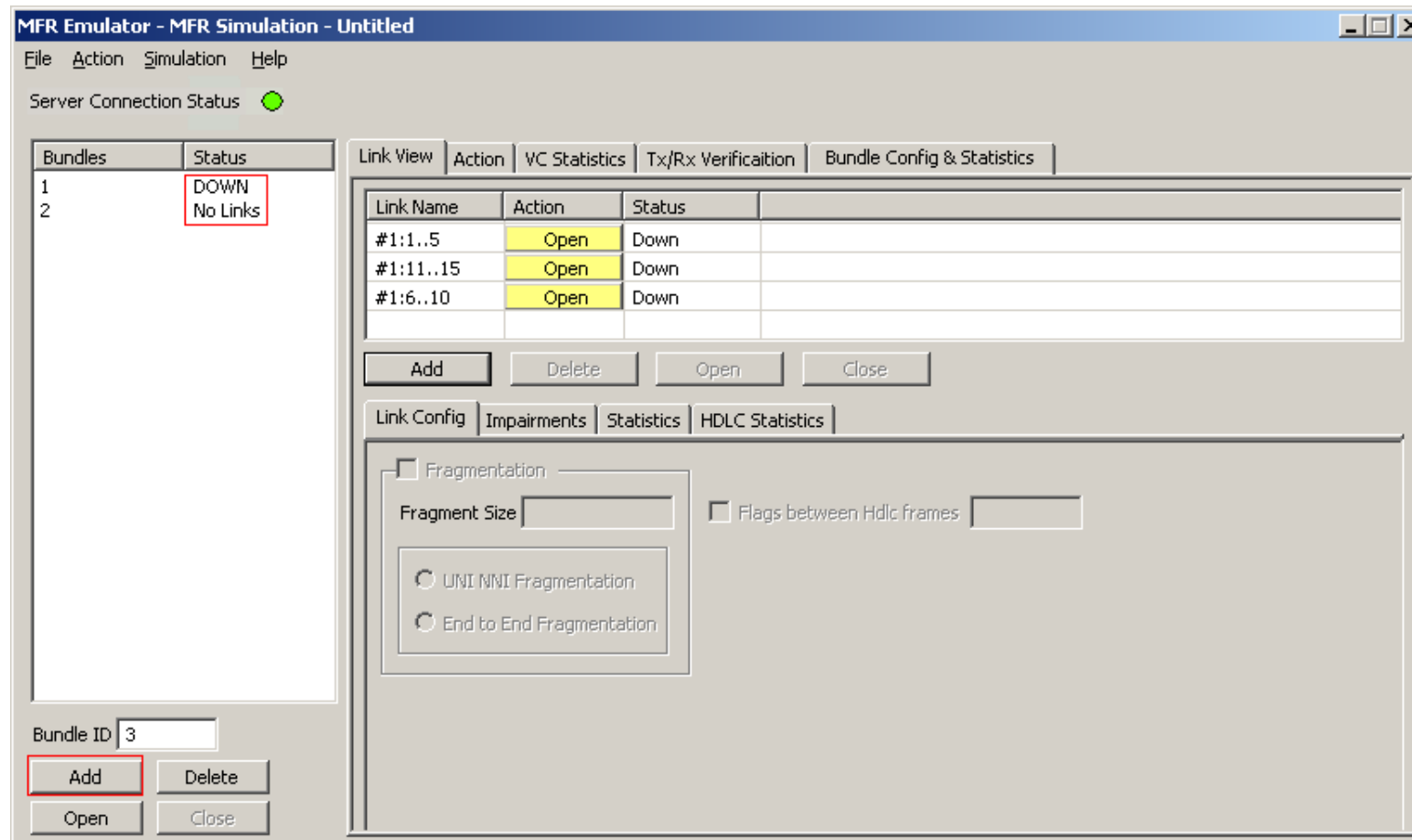
Adding a Bundle

- User can add a bundle by Clicking on Add button in the bundle pane, number of links constitute a bundle




Adding links to form an MFR bundle

- Various links (of any bandwidth varying from 64Kbps to n*64Kpbs or sub channels) can be added to form the MFR bundle
- MFR bundles multiple link-layer channels into a single network-layer channel



Bundle Config and Statistics

- Bundle Statistics will show statistics of transmitted frames, received frames, transmitted octets, and received octets for a selected bundle

Server Connection Status 

| Bundles | Status |
|---------|--------|
| 1 | UP |
| 2 | UP |

Link View | Action | VC Statistics | Tx/Rx Verification | Bundle Config & Statistics

Bundle Statistics

Number of Frames transmitted

Number of Frames Received

Number of Octets transmitted

Number of Octets received

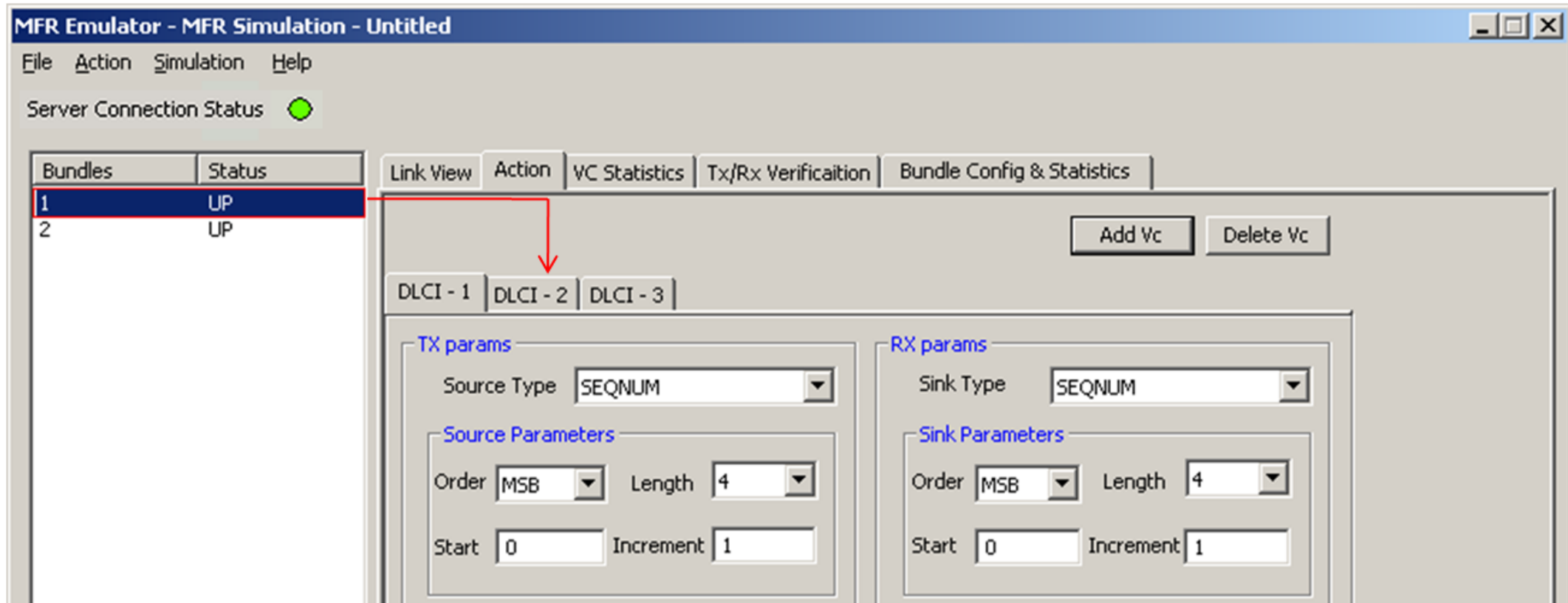
Bundle Config

Fragment Size

Max Differential Delay

Adding VC in MFR Simulation

- In MFR Simulation virtual channels are added on the selected bundle



Tx and Rx Parameters

- Tx parameters are used to generate the FR traffic and Rx parameters are used as reference to verify the received frames. The results of the verification are displayed in Tx/Rx Verification tab

The image shows a software interface for configuring transmission (Tx) and reception (Rx) parameters. It consists of two side-by-side panels, 'TX params' and 'RX params'.

TX params:

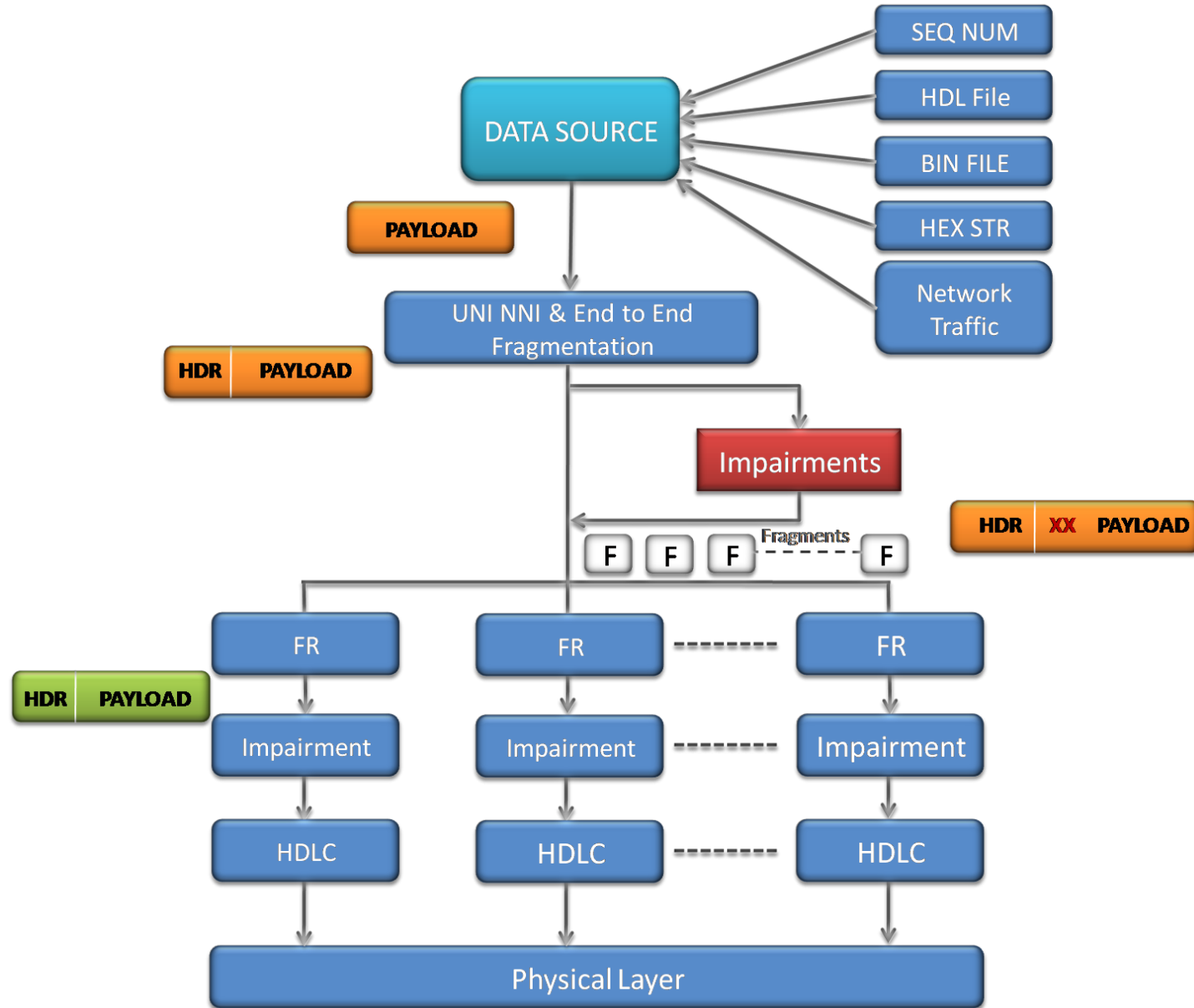
- Source Type:** A dropdown menu with 'SEQNUM' selected. A red box highlights the dropdown and its open list: SEQNUM, HDLFILE, BINFILE, HEXSTR, NETWORK TRAFFIC.
- Source Param:** A sub-section containing:
 - Order:** A dropdown menu with 'MSB' selected.
 - Start:** A text box with '0'.
 - Increment:** A text box with '1'.
- Prefix Header:** A checkbox that is unchecked.
- Duration Spec:** A section with three radio buttons:
 - Continuous transmission:** Selected.
 - Limited frames:** 1000.
 - EOF:** Unselected.
- Payload Len:** A text box with '1500'.

RX params:

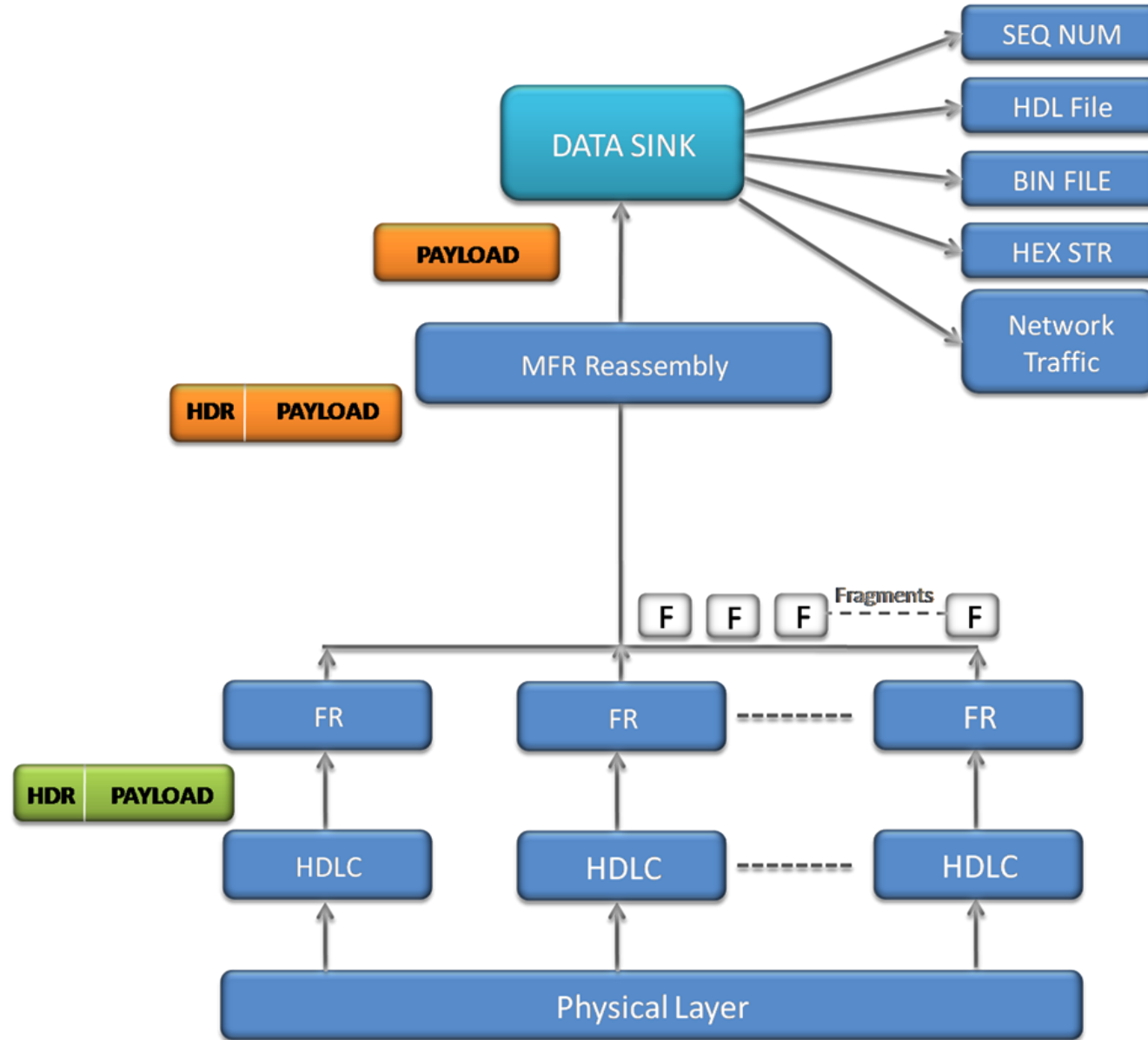
- Sink Type:** A dropdown menu with 'SEQNUM' selected. A red box highlights the dropdown and its open list: SEQNUM, HDLFILE, BINFILE, HEXSTR, NETWORK TRAFFIC.
- Sink Parameter:** A sub-section containing:
 - Order:** A dropdown menu with 'MSB' selected.
 - Start:** A text box with '0'.
 - Increment:** A text box with '1'.
- Prefix Header:** A checkbox that is unchecked.
- Duration Spec:** A section with three radio buttons:
 - Continuous Reception:** Selected.
 - Limited frames:** 1000.
 - EOF:** Unselected.
- Payload Len:** A text box with '1500'.

At the bottom of the interface, there are five buttons: 'Start Tx', 'Impairments', 'Start Rx', 'Start All Tx', and 'Start All Rx'.

Transmit Function

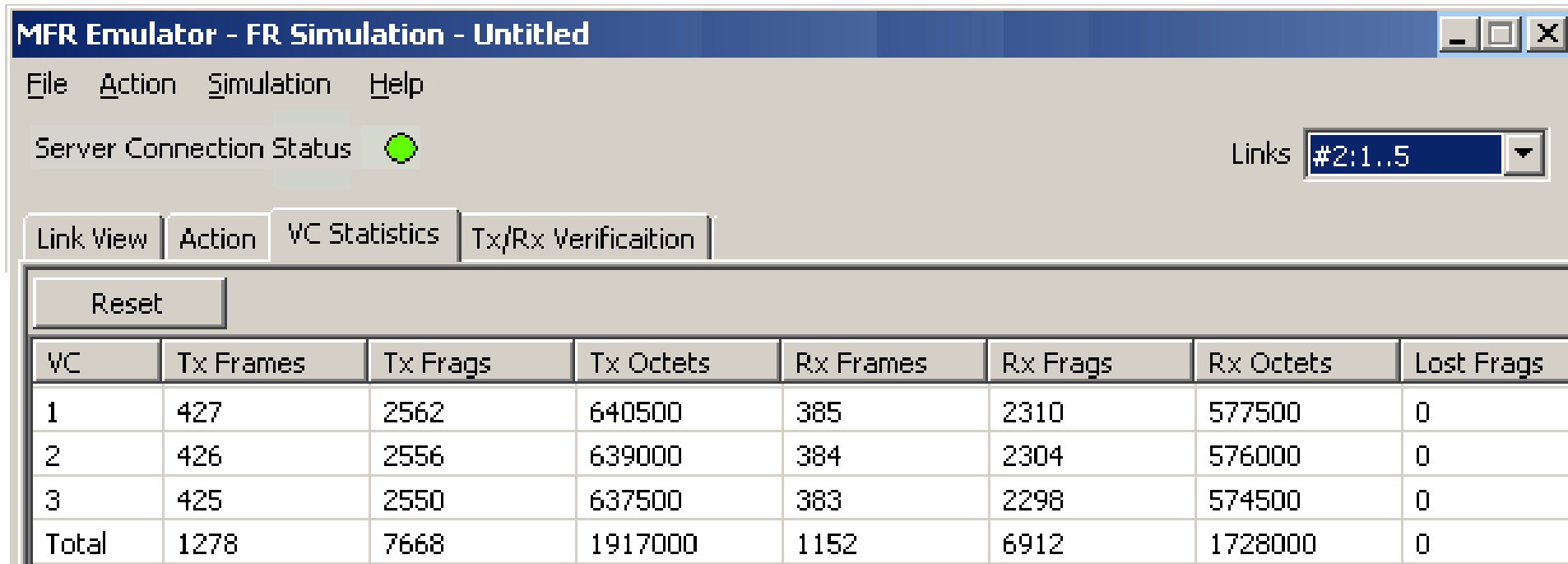


Receive Function



VC Statistics

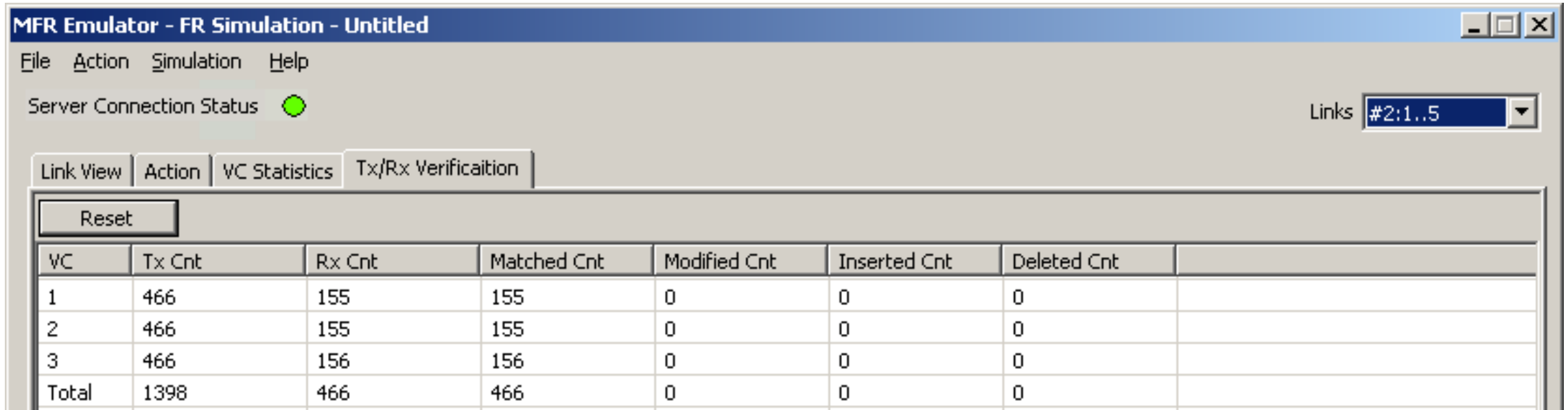
- The Statistics for each of the added VCs are available in VC Statistics tab
- The statistics include number of Transmitted and received frames, Fragments, Octets, and Lost fragments



| VC | Tx Frames | Tx Frags | Tx Octets | Rx Frames | Rx Frags | Rx Octets | Lost Frags |
|-------|-----------|----------|-----------|-----------|----------|-----------|------------|
| 1 | 427 | 2562 | 640500 | 385 | 2310 | 577500 | 0 |
| 2 | 426 | 2556 | 639000 | 384 | 2304 | 576000 | 0 |
| 3 | 425 | 2550 | 637500 | 383 | 2298 | 574500 | 0 |
| Total | 1278 | 7668 | 1917000 | 1152 | 6912 | 1728000 | 0 |

Tx/Rx Verification

- The results of the verification for each of the added VCs are available in Tx/Rx Verification
- The statistics include number of frames Transmitted, Received, Matched, Modified, Inserted and Deleted



| VC | Tx Cnt | Rx Cnt | Matched Cnt | Modified Cnt | Inserted Cnt | Deleted Cnt |
|-------|--------|--------|-------------|--------------|--------------|-------------|
| 1 | 466 | 155 | 155 | 0 | 0 | 0 |
| 2 | 466 | 155 | 155 | 0 | 0 | 0 |
| 3 | 466 | 156 | 156 | 0 | 0 | 0 |
| Total | 1398 | 466 | 466 | 0 | 0 | 0 |

Impairments

- Supports various Byte level, Frame level , CRC error, and Frame error impairments at link level
- Supports various Byte level and Frame level impairments at Fragment/Packet level for each Virtual Channel
- Impairments that affect an entire frame:
 - Delete Frame
 - Insert Frame
 - CRC error
 - Frame error
 - Duplicate Frame
- Impairments that modify a byte or few bytes in a frame at specified offset :
 - Insert Bytes
 - Delete Bytes
 - Bitwise ANDing octets
 - Bitwise Oring octets
 - Bitwise XORing octets
- Differential link delay insertion during transmission

Link Level Impairments

- Different kinds of impairments are available, namely:
- Impairments that affect an entire FR frame -
 - DELETE FRAME
 - INSERT FRAME
 - CRC
 - FRAME
 - DUPLICATE FRAME

DELETE FRAME
INSERT FRAME
DELETE BYTES
INSERT BYTES
DUPLICATE FRAME
CRC
FRAME
AND
OR
XOR

Link Config | Impairments | Statistics | HDLC Statistics

☒ Enable

Impairment Type: DELETE FRAME

Options

Frame count: 1

Byte Offset: 1

Skip Before Impair: 1

Impairment Duration

☐ Repeat 1

☒ Continuous

Activate

Delay

250 msec

Apply

Sync All Links

Link Level Impairments

Original Frame

| | | | | | | | |
|----|----|----|----|----|----|----|----|
| 00 | 11 | 00 | 00 | 00 | 00 | 00 | 00 |
| 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |

Original Frame

| | | | | | | | |
|----|----|----|----|----|----|----|----|
| 00 | 11 | AB | 01 | DE | 87 | 46 | 31 |
| 68 | AB | 01 | DE | 87 | 46 | 31 | 68 |
| AB | 01 | DE | 87 | 46 | 31 | 68 | AB |
| 01 | DE | 87 | 46 | 31 | 68 | AB | 01 |
| DE | 87 | 46 | 31 | 68 | AB | 01 | DE |
| 87 | 46 | 31 | 68 | AB | 01 | DE | 87 |

Impairment : INS ABCD, OFF 10

| | | | | | | | |
|----|----|----|----|----|----|----|----|
| 00 | 11 | 00 | 00 | 00 | 01 | 00 | 00 |
| 00 | 01 | AB | CD | 00 | 00 | 00 | 01 |
| 00 | 00 | 00 | 01 | 00 | 00 | 00 | 01 |
| 00 | 00 | 00 | 01 | 00 | 00 | 00 | 01 |
| 00 | 00 | 00 | 01 | 00 | 00 | 00 | 01 |
| 00 | 00 | 00 | 01 | 00 | 00 | 00 | 01 |
| 00 | 00 | | | | | | |

Impairment : DEL 6, OFF 10

| | | | | | | | |
|----|----|----|----|----|----|----|----|
| 00 | 11 | AB | 01 | DE | 87 | 46 | 31 |
| 68 | AB | AB | 01 | DE | 87 | 46 | 31 |
| 68 | AB | 01 | DE | 87 | 46 | 31 | 68 |
| AB | 01 | DE | 87 | 46 | 31 | 68 | AB |
| 01 | DE | 87 | 46 | 31 | 68 | AB | 01 |
| DE | 87 | | | | | | |

Link Level Impairments


Original Frame

| | | | | | | | |
|----|----|----|----|----|----|----|----|
| 00 | 11 | AB | 01 | DE | 87 | 46 | 31 |
| 68 | AB | 01 | DE | 87 | 46 | 31 | 68 |
| AB | 01 | DE | 87 | 46 | 31 | 68 | AB |
| 01 | DE | 87 | 46 | 31 | 68 | AB | 01 |
| DE | 87 | 46 | 31 | 68 | AB | 01 | DE |
| 87 | 46 | 31 | 68 | AB | 01 | DE | 87 |

Impairment : AND 0x00, OFF 10

| | | | | | | | |
|----|----|----|----|----|----|----|----|
| 00 | 11 | AB | 01 | DE | 87 | 46 | 31 |
| 68 | AB | 00 | DE | 87 | 46 | 31 | 68 |
| AB | 01 | DE | 87 | 46 | 31 | 68 | AB |
| 01 | DE | 87 | 46 | 31 | 68 | AB | 01 |
| DE | 87 | 46 | 31 | 68 | AB | 01 | DE |
| 87 | 46 | 31 | 68 | AB | 01 | DE | 87 |

Link Level Impairments Verification

Server Connection Status 

Links #2:1..31

Link View | Action | VC Statistics | Tx/Rx Verificaiton

Reset

| VC | Tx Cnt | Rx Cnt | Matched Cnt | Modified Cnt | Inserted Cnt | Deleted Cnt | |
|-------|--------|--------|-------------|--------------|--------------|-------------|--|
| 1 | 1000 | 1000 | 667 | 0 | 333 | 0 | |
| Total | 1000 | 1000 | 667 | 0 | 333 | 0 | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

VC Impairments

- Impairments in Action layer can be applied for individual VCs

The screenshot shows a software interface for configuring Virtual Circuit (VC) impairments. At the top, there are tabs for 'Link View', 'Action', 'VC Statistics', and 'Tx/Rx Verification', with 'Action' currently selected. To the right of the tabs are 'Add Vc' and 'Delete Vc' buttons. Below the tabs, a label 'DLCI - 1' is visible. The main area is divided into two columns: 'TX params' on the left and 'RX params' on the right. Each column contains a 'Source Type' or 'Sink Type' dropdown menu set to 'SEQNUM'. Underneath, there are 'Source Parameters' or 'Sink Parameters' sections with 'Order' (MSB) and 'Length' (4) dropdowns, and 'Start' (0) and 'Increment' (1) input fields. A 'Prefix Header' checkbox is present in both sections. Below these is a 'Duration Spec' section with three radio button options: 'Continuous transmission' or 'Continuous Reception' (selected), 'Limited frames' (with a value of 1000), and 'EOF'. At the bottom of each column is a 'Payload Len' input field set to 1500. At the very bottom of the interface are four buttons: 'Start Tx', 'Impairments' (highlighted with a red rectangle), 'Start Rx', 'Start All Tx', and 'Start All Rx'.

VC Impairments Verification

MFR Emulator - MFR Simulation - Untitled

File Action Simulation Help

Server Connection Status ●

| MFR Bundles | Status |
|-------------|--------|
| 1 | UP |
| 2 | UP |

Bundle ID

Add Delete

Open Close

Link View Action VC Statistics Tx/Rx Verification Bundle Config & Statistics

Reset

| VC | Tx Cnt | Rx Cnt | Matched Cnt | Modified Cnt | Inserted Cnt | Deleted Cnt |
|-------|--------|--------|-------------|--------------|--------------|-------------|
| 1 | 0 | 12927 | 12927 | 0 | 0 | 10 |
| Total | 0 | 12927 | 12927 | 0 | 0 | 10 |

MFR Emulator - MFR Simulation - Untitled

File Action Simulation Help

Server Connection Status ●

| MFR Bundles | Status |
|-------------|--------|
| 1 | UP |
| 2 | UP |

Bundle ID

Add Delete

Open Close

Link View Action VC Statistics Tx/Rx Verification Bundle Config & Statistics

Reset

| VC | Tx Frames | Tx Frags | Tx Octets | Rx Frames | Rx Frags | Rx Octets | Lost Frags |
|-------|-----------|----------|-----------|-----------|----------|-----------|------------|
| 1 | 0 | 0 | 0 | 63779 | 382674 | 95668500 | 30 |
| Total | 0 | 0 | 0 | 63779 | 382674 | 95668500 | 30 |

Link Statistics

- Provides important statistics information for the selected link, such as
- Number of frames transmitted
- Received frames
- Number of Octets Transmitted
- Number of Octets Received

| Link Config | Impairments | Statistics | HDLC Statistics |
|------------------------------|-------------|------------|-----------------|
| Number of Frames Transmitted | | 893 | Reset |
| Number of Frames Received | | 967 | |
| Number of Octets Transmitted | | 1343072 | |
| Number of Octets Received | | 1454368 | |

Hdlc Statistics

- The following error statistics are shown in Hdlc tab –
- Tx Under/Over Runs
- Rx Under/Over Runs
- Number of FR packets with bad FCS
- Number of packets with Frame Error

| | | | |
|--------------------|-----------------------------------|--------------------------------------|-----------------|
| Link Config | Impairments | Statistics | HDLC Statistics |
| Tx Under/Over Runs | <input type="text" value="0"/> | <input type="button" value="Reset"/> | |
| Rx Under/Over Runs | <input type="text" value="0"/> | | |
| CRC Error Frames | <input type="text" value="3000"/> | | |
| Frame Error Frames | <input type="text" value="0"/> | | |

Client-Server MFR Emulation

- Sample script for Transmission & Reception of MFR Frames

FrameRelay_E1.gls - GLClient

```

OK
inform task 3 "CREATE VC HC #1:1..31 DLCI 1 FRAG FORMAT END TO END FRAGSIZE 256";
OK
inform task 3 "Tx: HC #1:1..31 DLCI 1 CONT FIXLEN 1500 SEQNUM MSB4";
OK
inform task 3 "START TX HC #1:1..31 DLCI 1";
OK
query task 3;
Task 3:
Simulation=Frame Relay, Total FR Links=1, Active FR Links=1, Selected Link=1:1
===== HDLC Stats =====, Tx Octets=9159516, Tx Frames=35502, Rx Octets=0
Runs=0, Rx Over/Under Runs=0, CRC Error Count=0,
===== Virtual Channel Stats =====, Number of VC's on FR Link: '1:1..31'=1,
VC 1, DLCI=1, Tx Frames=5917, Tx Frags=35502, Rx Frames=0, Rx Frags=0, Los
Matched count=0, Modified count=0, Inserted count=0, Deleted count=0
OK

//There should be fragmentation with B=1,E=U for first fragment,
//B=0,E=0 for in between fragments and B=0, E=1 for last fragment.

run task "MFREmulatorE1:TxRx";
inform task 1 "SIMULATION FR";
inform task 1 "HC #1:1..31 FLAGS 100";
//inform task 1 "TS #1:1..31 FLAGS 100";
//inform task 1 "SC #1:1..31:1..8 FLAGS 100";
inform task 1 "ACTIVATE HC #1:1..31";
//inform task 1 "ACTIVATE TS #1:1..31";
//inform task 1 "ACTIVATE SC #1:1..31:1..8";
inform task 1 "CREATE VC HC #1:1..31 DLCI 1 FRAG FORMAT END TO END FRAGS
//inform task 1 "CREATE VC TS #1:1..31 DLCI 1 FRAG FORMAT END TO END FRAG
//inform task 1 "CREATE VC SC #1:1..31:1..8 DLCI 1 FRAG FORMAT END TO END F
inform task 1 "Tx: HC #1:1..31 DLCI 1 FRAMES 10 FIXLEN 1500 SEQNUM MSB4";
//inform task 1 "Tx: TS #1:1..31 DLCI 1 FRAMES 10 FIXLEN 1500 SEQNUM MSB4";
//inform task 1 "Tx: SC #1:1..31:1..8 DLCI 1 FRAMES 10 FIXLEN 1500 SEQNUM MSB4";
            
```

Ready

Frame Relay Protocol Analysis LAPF

| Dev | TS... | Su... | Frame# | TIME (Relative) | Len | DLCI | DE | BECN | FECN | CTL | NLPID | Sequenc... |
|-----|-------|-------|--------|------------------|-----|------|----|------|------|---------|------------------|------------|
| ✓ 2 | 1-31 | | 0 | -00:00:00.004403 | 264 | 1 | 0 | 0 | 0 | Unnu... | FRF.12 Fragme... | 0 |
| ✓ 2 | 1-31 | | 1 | -00:00:00.002935 | 264 | 1 | 0 | 0 | 0 | Unnu... | FRF.12 Fragme... | 1 |
| ✓ 2 | 1-31 | | 2 | -00:00:00.001467 | 264 | 1 | 0 | 0 | 0 | Unnu... | FRF.12 Fragme... | 2 |
| ✓ 2 | 1-31 | | 3 | 00:00:00.000000 | 264 | 1 | 0 | 0 | 0 | Unnu... | FRF.12 Fragme... | 3 |
| ✓ 2 | 1-31 | | 4 | 00:00:00.001467 | 264 | 1 | 0 | 0 | 0 | Unnu... | FRF.12 Fragme... | 4 |
| ✓ 2 | 1-31 | | 5 | 00:00:00.002935 | 228 | 1 | 0 | 0 | 0 | Unnu... | FRF.12 Fragme... | 5 |
| ✓ 2 | 1-31 | | 6 | 00:00:00.004258 | 264 | 1 | 0 | 0 | 0 | Unnu... | FRF.12 Fragme... | 6 |

Card2 TimeSlots=1-31 Frame=0 at -00:00:00.004403 OK Len=264

HDLC Frame Data + FCS

```

===== LAPF Layer =====
EA = .....0 (0)
C/R = .....0. Command(User), Response(Network)
DLCI = 1 (000000... 0001....)
EA = .....1 (1)
DE = .....0. (0)
BECN = .....0.. (0)
FECN = .....0... (0)
            
```

Hex Dump of the Frame Data

```

+-----+-----+-----+-----+-----+-----+
00 11 03 B1 80 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
            
```

Running. Utilization 21.39% C:\Temp.Hdl Captured 64186 frames

Features

- WCS Multi-Link Frame Relay is also available as a CLI application. Following functions are supported using simple commands:
- Activate/deactivate the individual bundle links in the MFR bundle
- Create/delete the virtual channels on the links
- Sends MFR frames with or without impairments
- Receives MFR frames
- Generates & receives traffic using source and sink types
 - Sequence numbers
 - Hex string frame
 - Binary flat files
 - HDL trace files (GL's proprietary file format)
- Various impairments can be applied on each individual FR links and virtual channels

Thank You