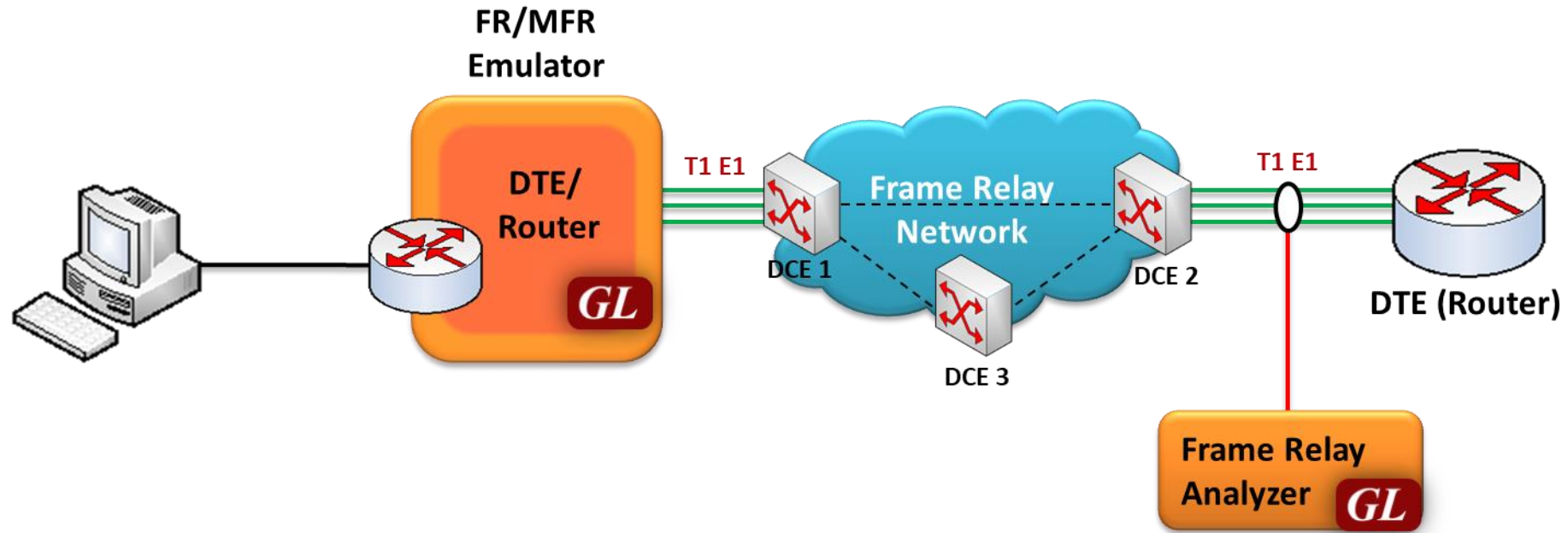

Multi-Link Frame Relay Emulator (MFR)

(FR and MFR Simulation)



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MFR Emulator Working Principle



- Multi-Link Frame Relay Emulation (MFR) software based on client-server architecture over GL's field proven T1 E1 hardware platforms
- The software acts as a Frame Relay (FR)-MFR Data Terminal Equipment (DTE)/Router and generates traffic in compliance with frame relay fragmentation & reassembly models i.e., UNI (DTE-DCE) NNI (DCE peers) & end-to-end fragmentation over multiple virtual circuits

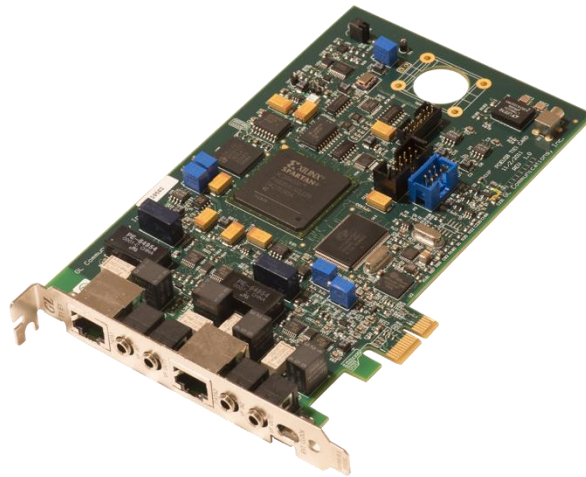
Hardware Platforms



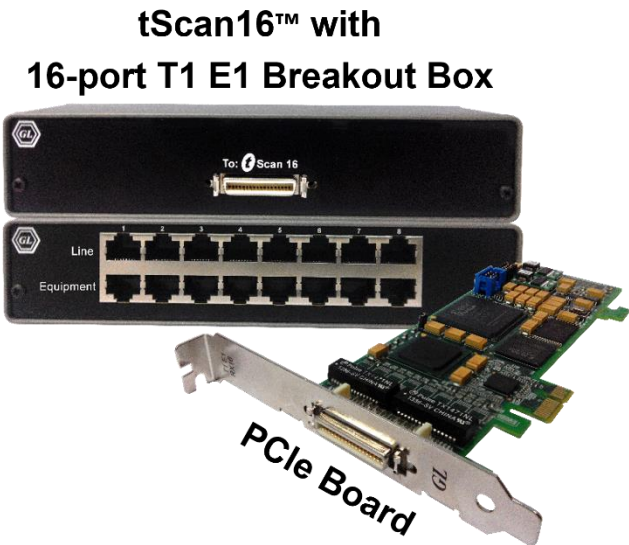
tProbe™ - Portable USB based T1 E1 VF FXO FXS and Serial Datacom Analyzer



Quad / Octal T1 E1 PCIe Card



Dual T1 E1 Express (PCIe) Board

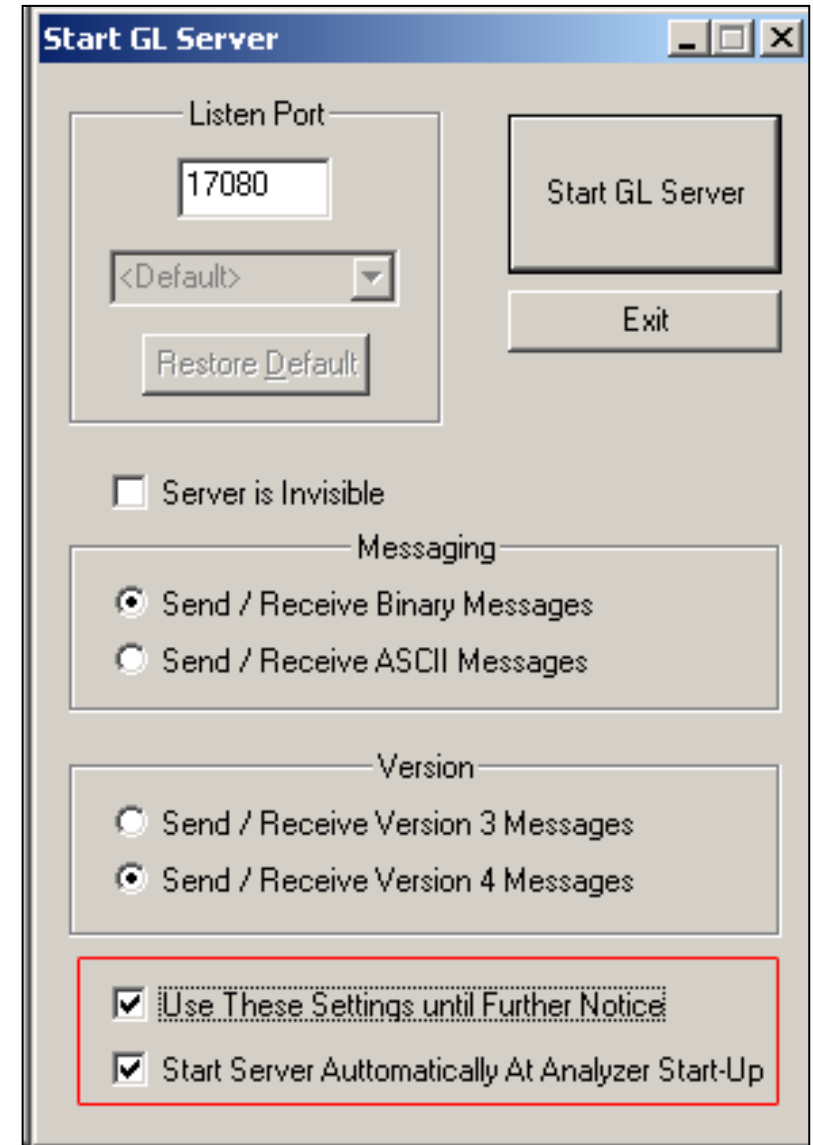


tScan16™ with 16-port T1 E1 Breakout Box

PCIe Board

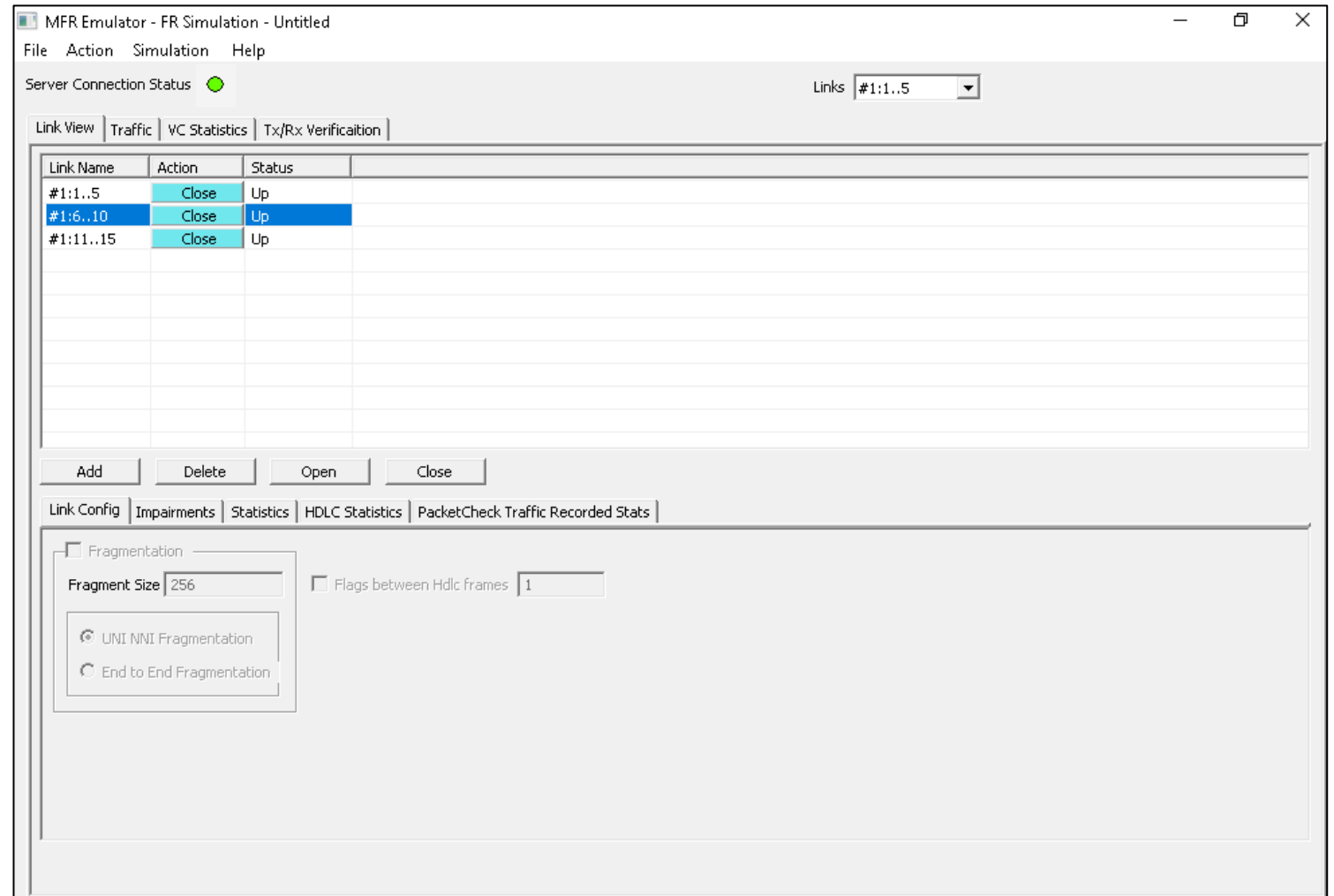
Connecting to the Server

- **Listen Port:** This is the TCP/IP port on which the server should listen for incoming connection requests from clients. By default, the Listen port for T1 card is set as **17080** and for E1, it is set as **17090**
- **Send / Receive Binary Messages:** Indicates that the server is to communicate with clients using binary messages
- **Send / Receive ASCII Messages:** Indicates that the server is to communicate with clients using ASCII (text-based) messages
- **Send / Receive Version 3 Messages:** Indicates that the server is to communicate with clients using version 3 messages
- **Send / Receive Version 4 Messages:** Indicates that the server is to communicate with clients using version 4 messages
- **Use these settings Until Further Notice:** This option to use the current configuration settings as default settings at analyzer startup
- **Start Server Automatically At analyzer Startup:** It will start the WCS server at analyzer startup by default



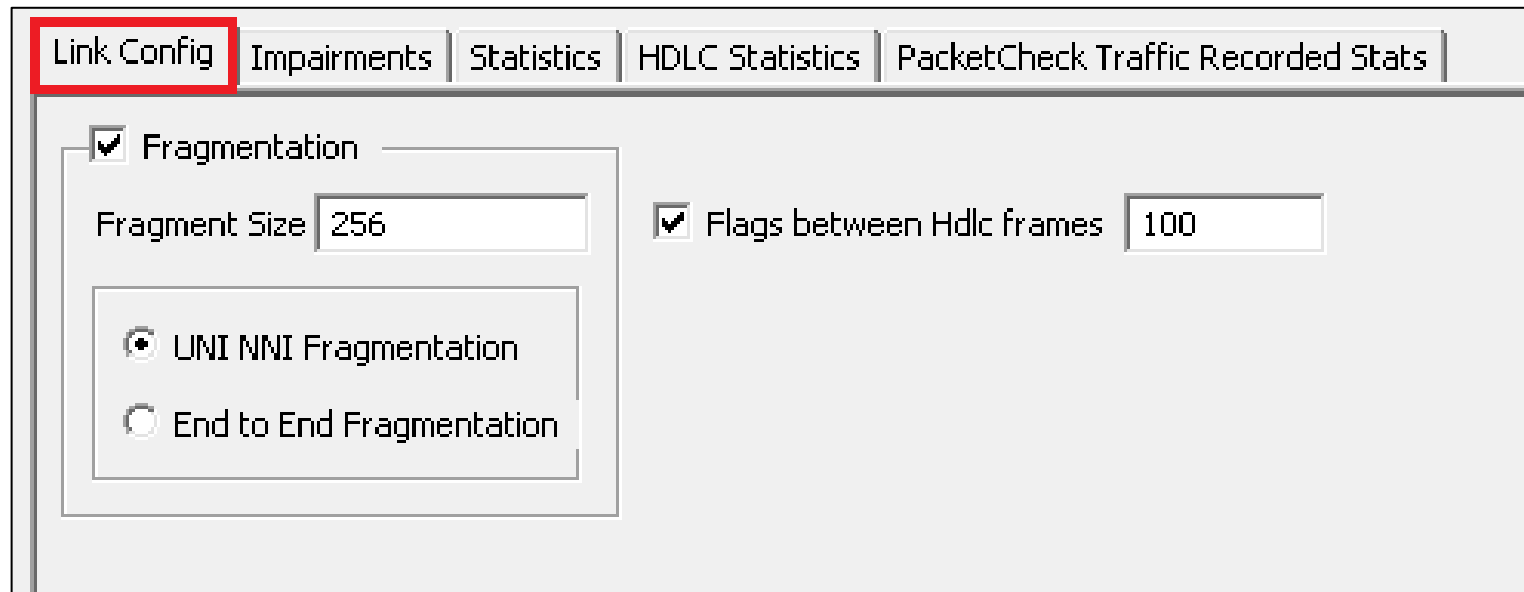
Simulating Frame Relay Links

- Various links (of any bandwidth varying from 64Kbps to n*64Kpbs or sub channels) can be added in FR Simulation
- Two or more than two timeslots can be grouped to constitute a Hyper-channel



Link Configuration

- Provides Frame Fragmentation configuration adhering to FRF.12 standard for traffic generation on selected FR links
- Supports two types of fragmentation: UNI NNI Fragmentation and End-to-End Fragmentation on a FR link
- Allows to configure the bandwidth using flags



The screenshot displays the 'Link Configuration' interface with the following settings:

- Link Config** (highlighted in red)
- Impairments** | **Statistics** | **HDLC Statistics** | **PacketCheck Traffic Recorded Stats**
- Fragmentation**
- Fragment Size:
- Flags between Hdlc frames**
- UNI NNI Fragmentation**
- End to End Fragmentation**

Simulating MFR Bundle

- Allows to create a virtual interface referred as 'bundle' interface
- An MFR bundle can consist of multiple physical links of the same type or physical links of different types
- Data sent through this channel will be distributed among all the links
- It is used to derive larger bandwidth pipe by aggregating smaller bandwidth pipes e.g. from multiple T1s or E1s

The screenshot displays the 'MFR Emulator - MFR Simulation - Untitled' window. At the top, there is a menu bar with 'File', 'Action', 'Simulation', and 'Help'. Below the menu bar, a 'Server Connection Status' indicator shows a green dot. The main interface is divided into several sections:

- MFR Bundles Table:** A table with two columns: 'MFR Bundles' and 'Status'. It contains one entry: '1' with status 'UP'.
- Link View Table:** A table with columns 'Link Name', 'Action', and 'Status'. It lists three links:

Link Name	Action	Status
#1:1..10	Close	Up
#1:11..20	Close	Up
#1:21..30	Close	Up
- Bundle ID Input:** A text box labeled 'Bundle ID' containing the value '2', with 'Add', 'Delete', 'Open', and 'Close' buttons below it.
- Link Config Panel:** A panel with tabs for 'Link Config', 'Impairments', 'Statistics', and 'HDLC Statistics'. It includes:
 - A 'Fragmentation' checkbox (unchecked).
 - A 'Fragment Size' input field with the value '256'.
 - A 'Flags between Hdlc frames' checkbox (unchecked) with an input field containing '100'.
 - Two radio button options: 'UNI NNI Fragmentation' (selected) and 'End to End Fragmentation'.

Impairments

- Enable the user to intentionally introduce errors in data transmission.
- Impairments can be applied at different levels, i.e.
 - Impair all packets sent over a Physical Link
 - Impair frames on a particular Virtual Channel [VC may be on a physical link or on the MFR bundle]
 - Impair frames on a particular Aggregated Virtual Channel
 - Impair all packets on the MFR bundle

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

Link Config **Impairments** Statistics HDLC Statistics PacketCheck Traffic Recorded Stats

Enable

Impairment Type: DELETE FRAME

Options

Frame count: 1

Byte Offset: 1

Skip Before Impair: 1

Impairment Duration

Repeat 1

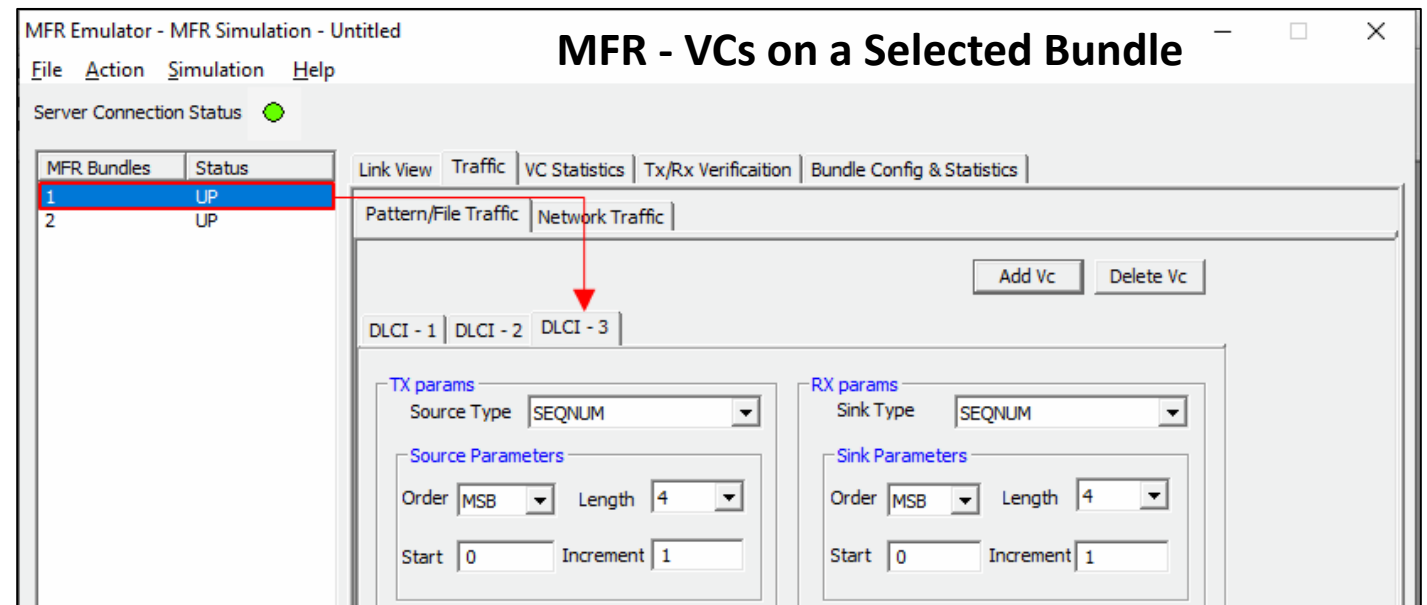
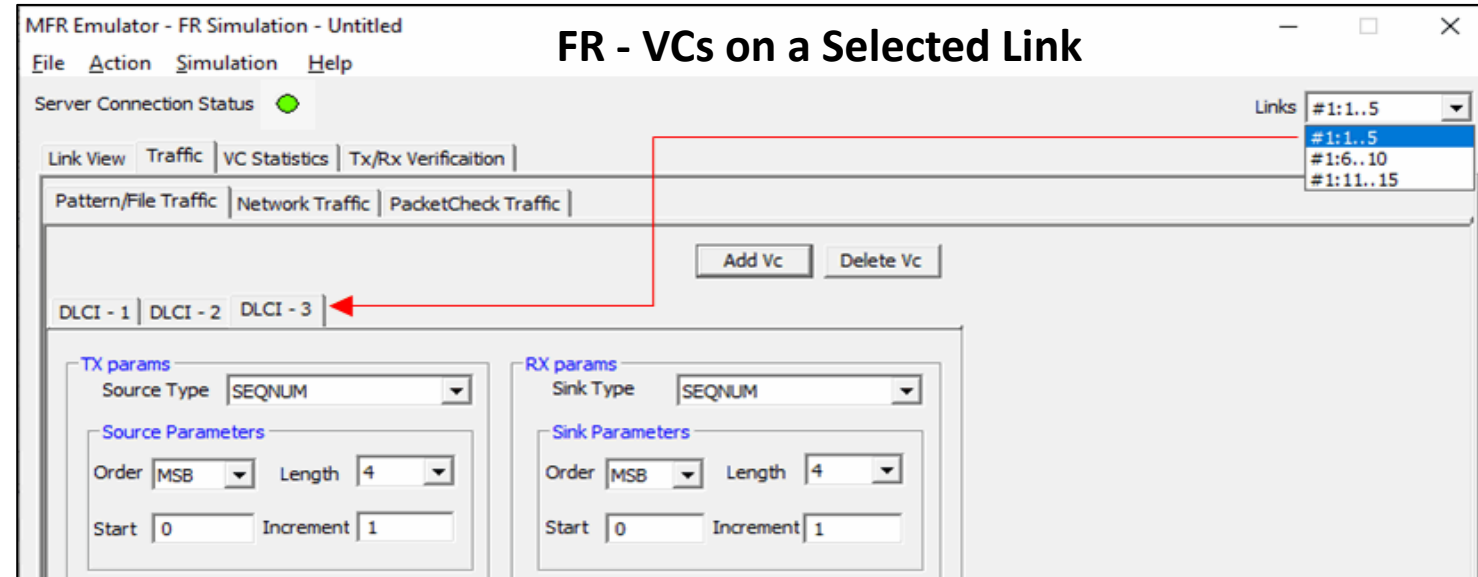
Continuous

Activate

Delay: 250 msec Apply Sync All Links

Pattern/File Traffic

- The source of the traffic is either a file or a repetitive pattern as defined by the user
- Traffic type can be used for end-to-end testing of the link
- The verification process will provide results such as how many frames are received and out of which how many have been matched successfully with configured pattern, similarly, how many frames modified etc.
- BERT test can also be conducted using various pre-defined patterns or a user defined pattern file



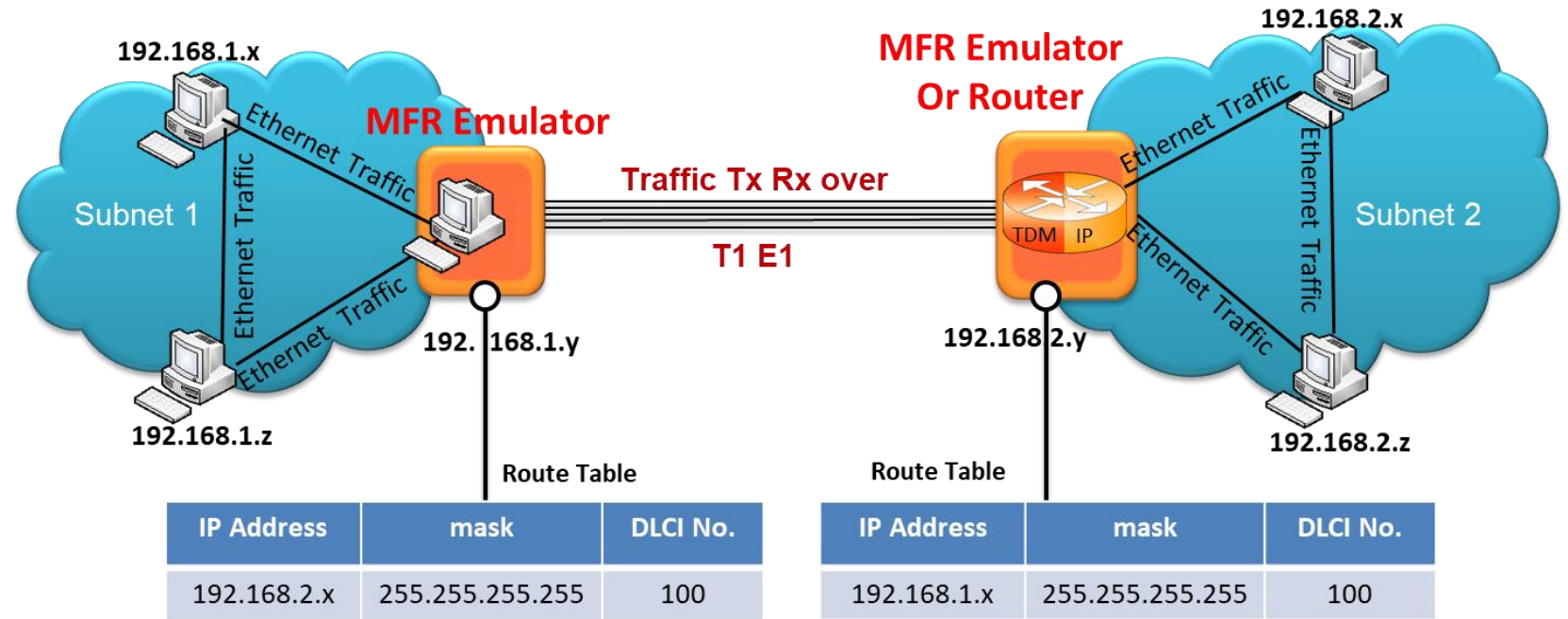
TxRx Verification

Link View Traffic VC Statistics Tx/Rx Verification Bundle Config & Statistics							
Reset							
VC	Tx Cnt	Rx Cnt	Matched Cnt	Modified Cnt	Inserted Cnt	Deleted Cnt	Bert Status
1	1592	1395	1286	2	0	2	N/A
2	1590	1395	1286	5	0	5	N/A
3	1590	1394	1284	3	0	3	N/A
Total	4772	4184	3856	10	0	10	

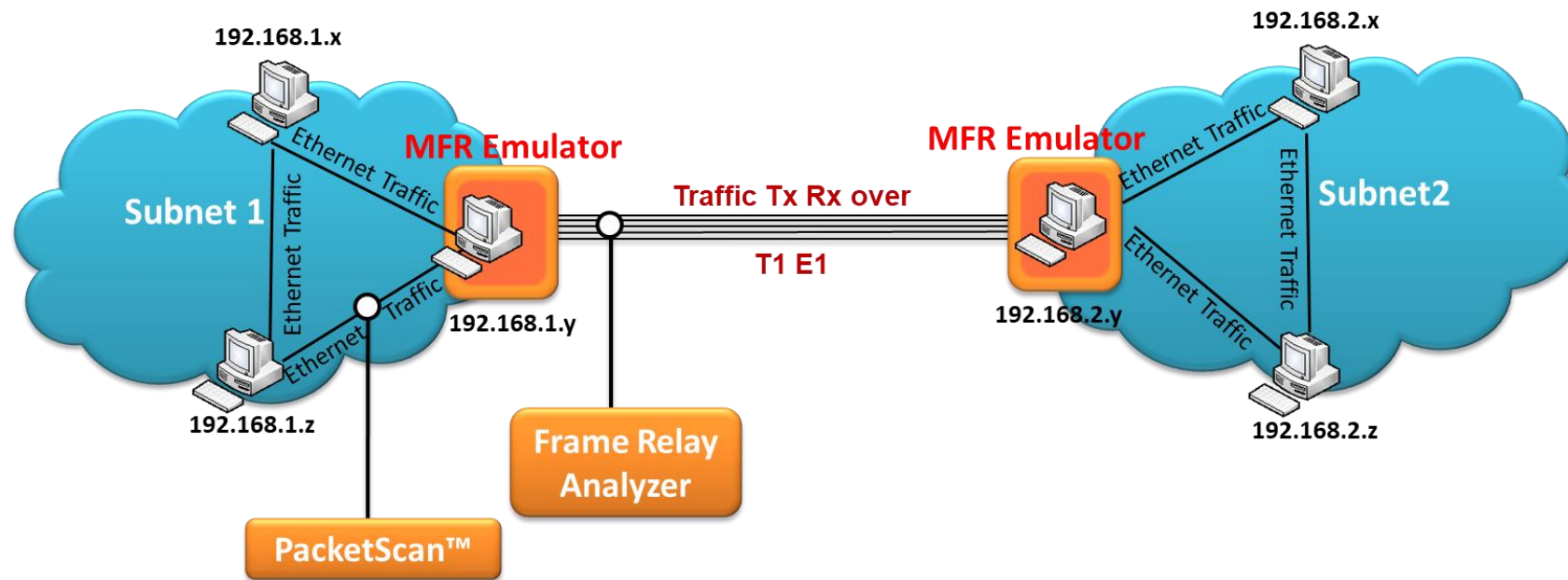
- The results of the verification for each of the added VCs are available in Tx/Rx Verification
- The statistics include:
 - The number of VCs created
 - The number of frames transmitted successfully
 - The number of frames received successfully
 - If a received frame is verified successfully, then it will be included in "Matched" Frame Count
 - If a received frame does not match, it will be included in the "Modified" Frame Count
 - If the frame is lost then it will be included in "Deleted" Frame Count
 - If extra frames have been received which were not expected then they will be included in Inserted Frame Count

Network Traffic - MFR Emulator as a Router

- Allows user to setup routing table by configuring IP Address and Mask
- Once configured, the emulator forwards the IP packets which match routing criteria over MFR links
- Emulator responds to all ARP requests whose IP addresses present in routing table
- The image shows two networks, **Subnet1** and **Subnet2**, connected through T1 E1 lines using MFR Emulator that is configured to work as router

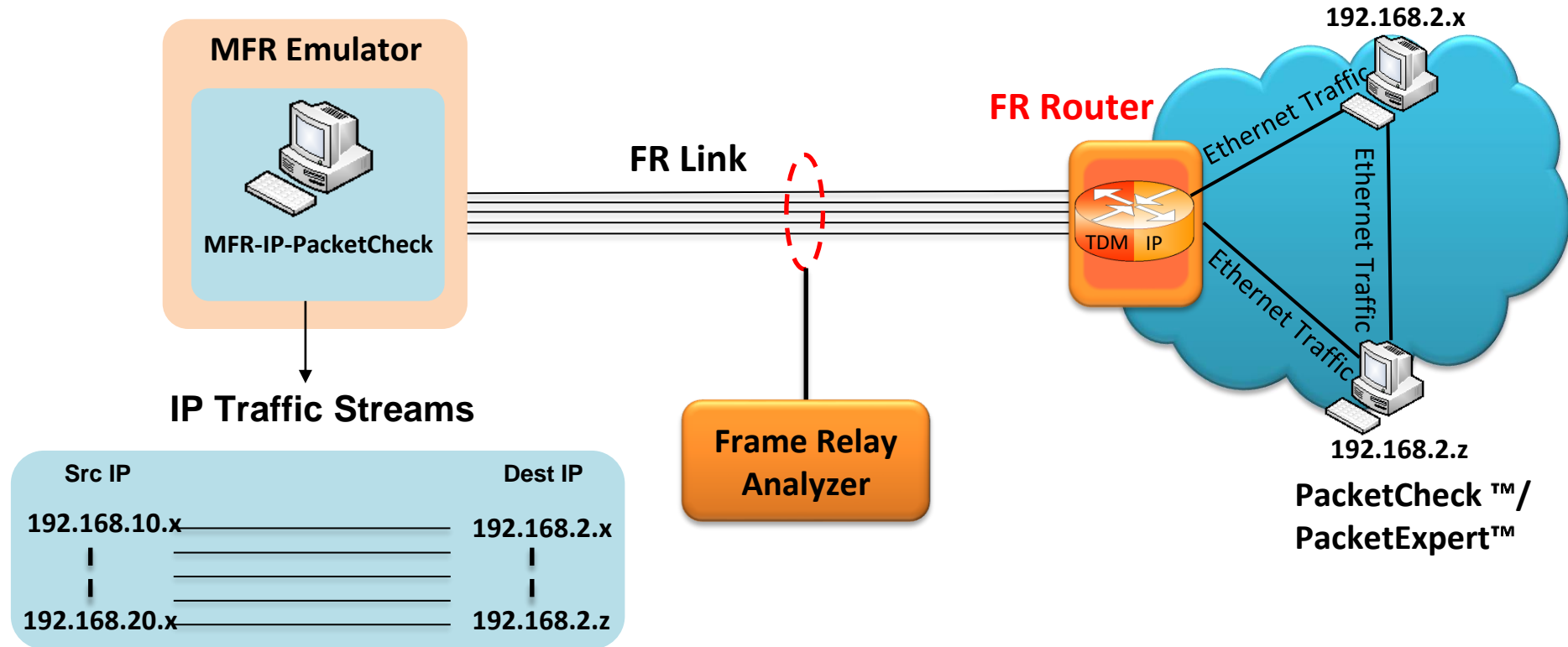


Network Traffic - MFR Emulator as a Bridge



- When the MFR Emulator is configured to act as bridge between two networks, all ARP and traffic received from the network is encapsulated as bridged IP and streamed over T1 E1 links
- The Emulator on another network removes bridging header, converts to Ethernet and streams to the destination

PacketCheck™ Traffic



- Allows IP traffic generation and reception over FR links
- Multiple IP traffic streams can be generated and processed over multiple VCs created within the FR links
- VCs can be configured to encapsulate the IP packets with desired custom headers to emulate various protocols
- MFR-IP-PacketCheck traffic is used to generate and receive IP packet streams to and from a FR router
- FR Router shall be tested for routing the received packets to the proper destination

PacketCheck™ Traffic Configuration

- Supports Layer 2, Layer 3 and Layer 4 Bert packets to send out via Route table
- Allows to create multiple Routes and multiple VCs on the FR links
- Each Route will have its own route criteria and an assigned VC
- Packets that pass through the defined criteria of a route, will be transmitted on the VC assigned to that route

The screenshot shows the MFR Emulator interface for configuring traffic. The 'Traffic' tab is selected, and the 'Route Configuration' table is visible. The table lists several routes with their respective parameters.

Dest IP Mask	IP Type	Src Port	Dest Port	Packet Mode	Tx Prefix Header	Tx Skip Bytes	Rx Prefix Header	Rx Skip Bytes	DLCI	Link Name	Bandwidth(%)
0.0.0.0	17	8901	7890	Custom	03CC	14	54bef737bc79788cb5d729b60800	2			10
0.0.0.0	17	7890	8901	Custom	03CC	14	788cb5d729b654bef737bc790800	2			10
255.255.255.255	17	8901	7890	Custom	03CC	14	54bef737bc7a788cb5d729b60800	2			10
255.255.255.255	17	7890	8901	Custom	03CC	14	788cb5d729b654bef737bc7a0800	2			10
255.255.255.255	17	0	0	Custom	03CC	14	1cfd0875f9951cfd0875f9940800	2			10
255.255.255.255	17	0	0	Custom	03CC	14	1cfd0875f9941cfd0875f9950800	2			10

Buttons at the bottom include: Load PacketCheck Config, Add Route, Delete Route, Record to File, Start Recording, Start Traffic, and MFR-IP-PacketCheck.

PacketCheck™ Traffic Recorder

- Frames that do not match any configured parameters in the Route table, as well as errored frames, will be recorded
- Recorded traffic can be saved in HDL file formats, which can then be conveniently analyzed using Wireshark® or the PacketScan applications

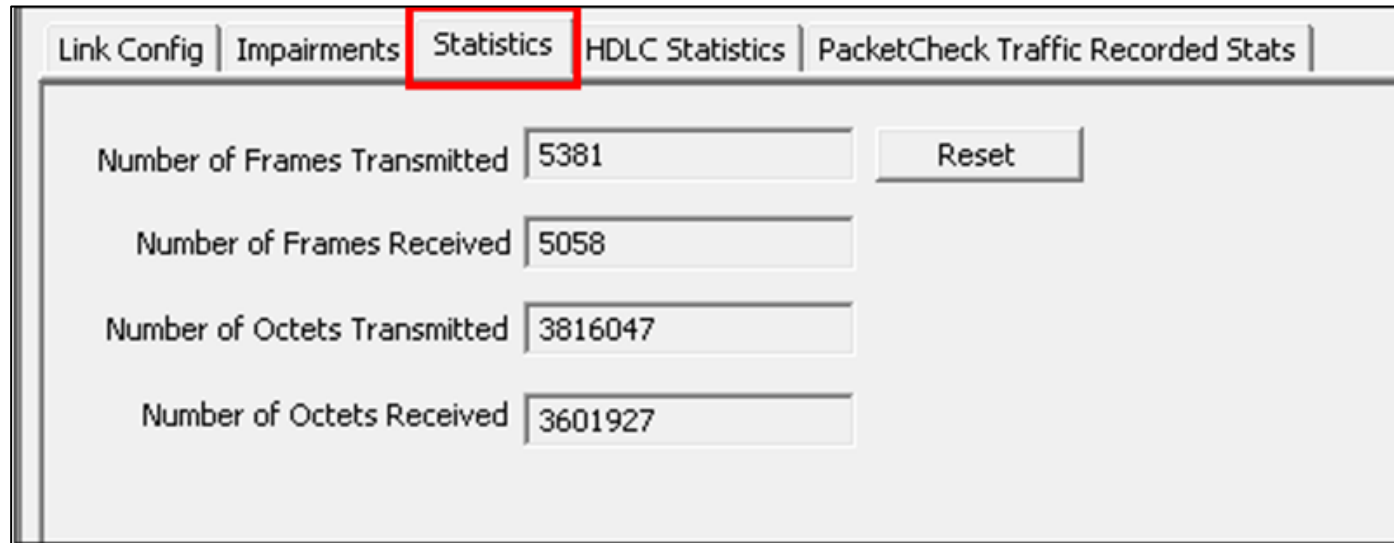
The screenshot displays the MFR Emulator - FR Simulation interface. The main window shows a 'Route Configuration' table with the following data:

Stream Id	Stream Name	Src MAC Address	Src MAC Mask	Dest MAC Address	Dest MAC Mask	ETH Type	Src IP Address	Src IP Mask	Dest IP Address	Dest IP Mask
1	Default	FF-FF-FF-FF-FF-FF	00-00-00-00-00-00	FF-FF-FF-FF-FF-FF	00-00-00-00-00-00	0000	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0

A 'Record to File' dialog box is open, showing options to record non-matched route packets. The 'Combined' radio button is selected, and the file path is set to 'C:\Users\Anirudh\Desktop\packetCheck-Files\MFR-Packetcheck\1...'. The 'Record to File' button in the main interface is highlighted with a red box.

Linked Statistics

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



The screenshot displays a web-based interface for link management. At the top, there are five tabs: 'Link Config', 'Impairments', 'Statistics', 'HDLC Statistics', and 'PacketCheck Traffic Recorded Stats'. The 'Statistics' tab is highlighted with a red border. Below the tabs, there are four rows of statistics, each with a text label and a corresponding input field containing a numerical value. A 'Reset' button is located to the right of the first row.

Statistic	Value
Number of Frames Transmitted	5381
Number of Frames Received	5058
Number of Octets Transmitted	3816047
Number of Octets Received	3601927

HDLC Statistics

- Errors that occur during transmission / reception like the Tx Under/Over Runs, Rx Under/Over Runs, number of FR packets with bad FCS, and number of packets with Frame Errors is recorded in the HDLC Statistics fields

Link Config	Impairments	Statistics	HDLC Statistics	PacketCheck Traffic Recorded Stats
Tx Under/Over Runs	0	<input type="button" value="Reset"/>		
Rx Under/Over Runs	0			
CRC Error Frames	3633			
Frame Error Frames	0			

PacketCheck™ Traffic Recorded Statistics

- Displays the recorded frame count, errored frame count for the selected links, and the total count for all configured links


The screenshot shows the MFR Emulator interface. The 'Link View' tab is active, displaying a table of links. The link '#2:1..31' is selected. Below the link table, the 'PacketCheck Traffic Recorded Stats' tab is active, showing a detailed table of traffic statistics for the selected link.

Link Name	Action	Status
#1:1..31	Close	Up
#2:1..31	Close	Up

Description	#2:1..31	Total
Frames Write to File	864	1705
< 64 Length Frames	20	39
64 Length Frames	2	3
65-127 Length Frames	62	124
128-255 Length Frames	128	231
256-511 Length Frames	134	261
512-1023 Length Frames	256	505
1024-1518 Length Frames	262	524
> 1518 Length Frames	0	18
FCS Errors	864	880
Other Error Frames	0	825

VC Statistics

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

Server Connection Status  Links

Link View Traffic **VC Statistics** Tx/Rx Verification

Reset

VC	Tx Frames	Tx Frags	Tx Octets	Rx Frames	Rx Frags	Rx Octets	Lost Frags
200	3346	0	5019000	3414	0	5121000	0
300	3345	0	230845	3415	0	235838	0
400	3345	0	5017500	3415	0	5122500	0
500	3344	0	5016000	3413	0	5119500	0
600	3344	0	5016000	3413	0	5119500	0
Total	16724	0	20299345	17070	0	20718338	0

MFR Simulation in Command Line Interface

```
FrameRelay_E1.gls - GLClient
File Edit View Connect Script Log User Help
[Icons]
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..31, Link Status=Active,
===== HDLC Stats =====, Tx Octets=9159516, Tx Frames=35502, Rx Octets=0, Rx Frames=0, Tx Over/Under
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, Lost Frags=0, Received count=0,
Matched count=0, Modified count=0, Inserted count=0, Deleted count=0
OK
//There should be fragmentation with B=1,E=0 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 FRAGSIZE 500";
//inform task 1 "CREATE VC TS #1:1..31 DLCI 1 FRAG FORMAT END TO END FRAGSIZE 500";
//inform task 1 "CREATE VC SC #1:1..31:1..8 DLCI 1 FRAG FORMAT END TO END FRAGSIZE 500";
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 Ver 4 B NUM
```

Thank you