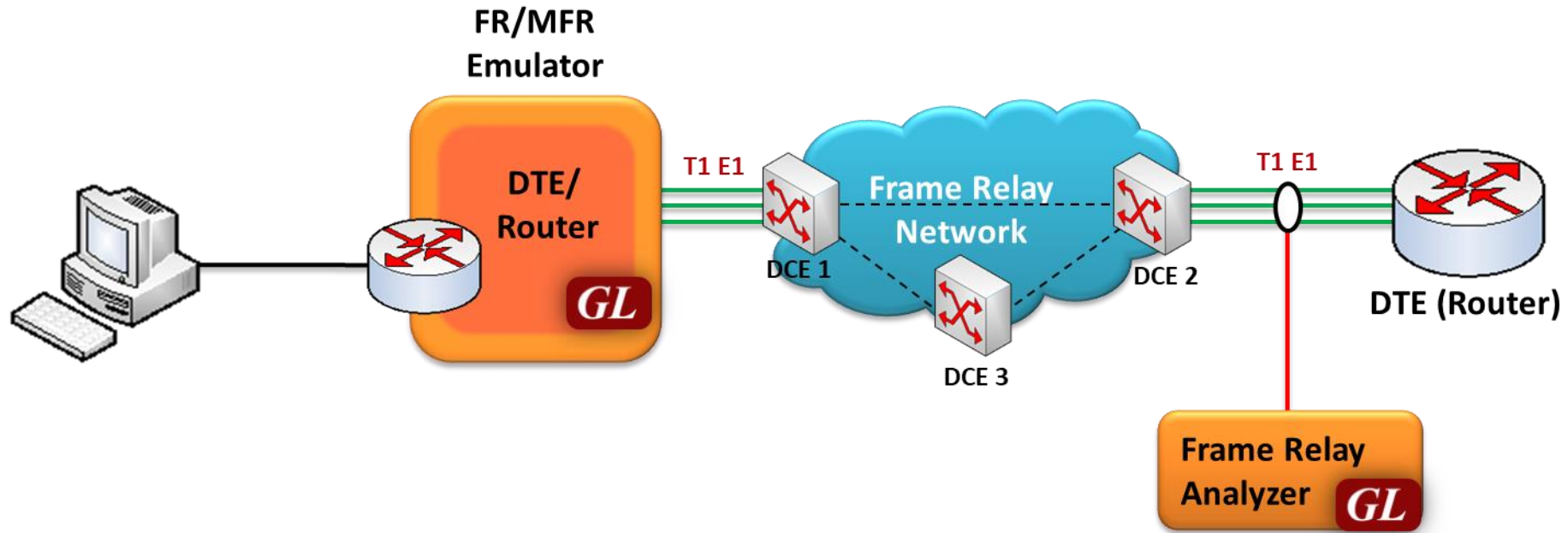

Multi-Link Frame Relay Emulator (MFR)

(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

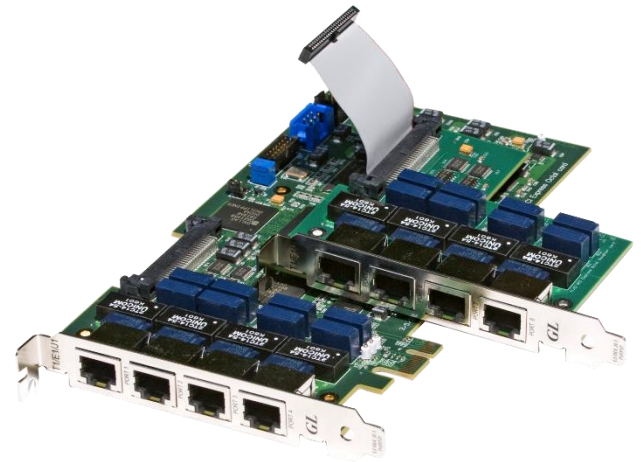
Hardware Platforms



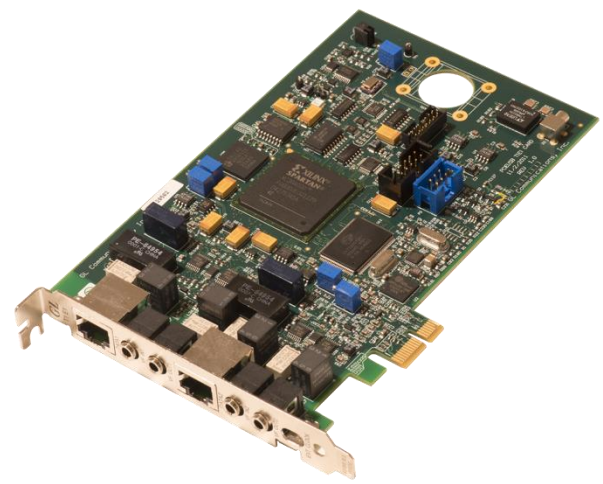
Back Panel

Front Panel

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

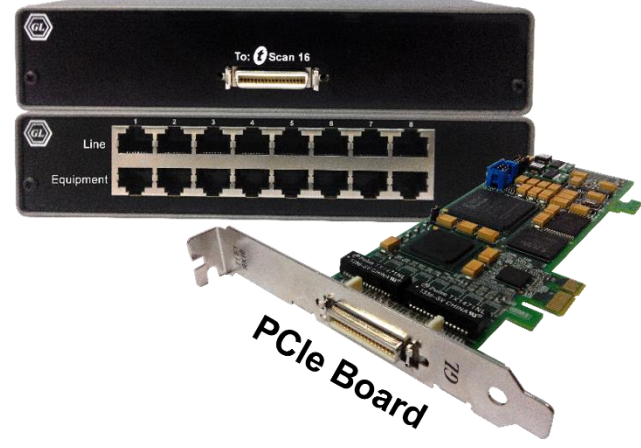


Quad / Octal T1 E1 PCIe Card



Dual T1 E1 Express (PCIe) Board

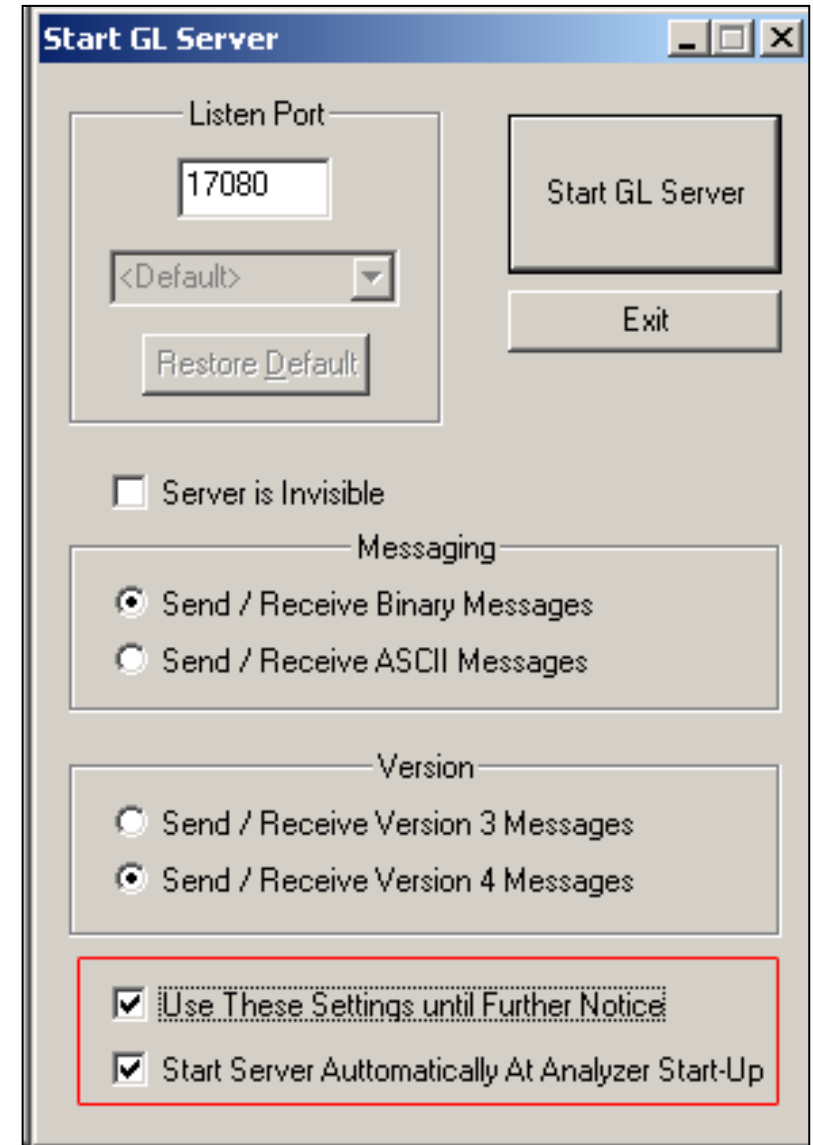
tScan16™ with 16-port T1 E1 Breakout Box



PCIe Board

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

The screenshot shows the MFR Emulator - FR Simulation - Untitled window. The window title is "MFR Emulator - FR Simulation - Untitled". The menu bar includes "File", "Action", "Simulation", and "Help". The "Server Connection Status" is indicated by a green dot. The "Links" dropdown menu is set to "#1:1..5". The "Link View" tab is selected, showing a table with the following data:

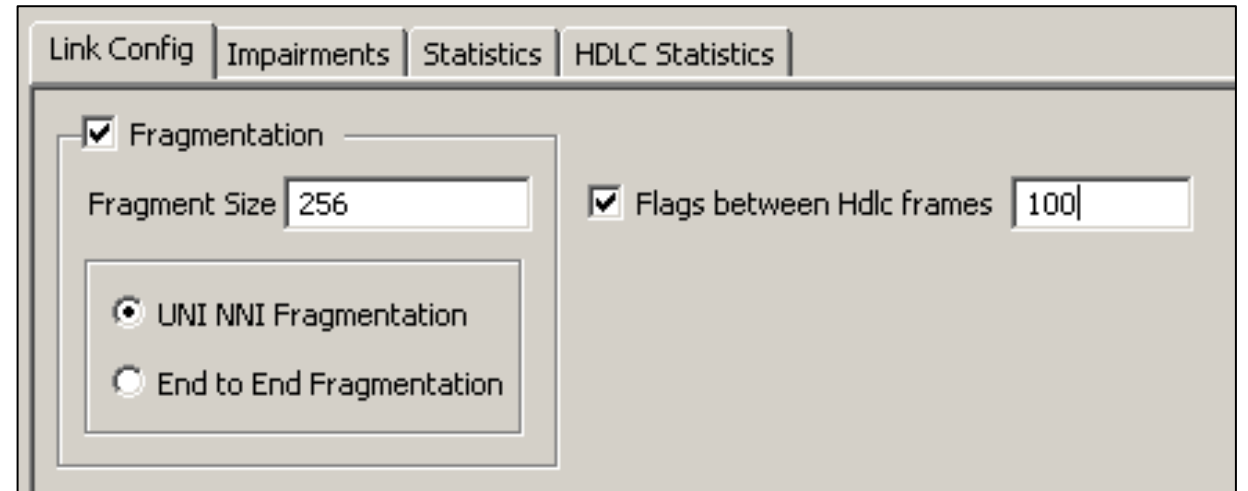
Link Name	Action	Status
#1:1..5	Close	Up
#1:6..10	Close	Up
#1:11..15	Close	Up

Below the table are buttons for "Add", "Delete", "Open", and "Close". The "Link Config" tab is selected, showing the following configuration options:

- Fragmentation
- Fragment Size: 256
- Flags between HdLC frames: 100
- UNI NNI Fragmentation
- End to End Fragmentation

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 a configuration window with four tabs: "Link Config", "Impairments", "Statistics", and "HDLC Statistics". The "Link Config" tab is active. It features a "Fragmentation" section with a checked checkbox. Below this, there is a "Fragment Size" input field containing the value "256". To the right, there is a "Flags between Hdlc frames" input field containing the value "100". A sub-section contains two radio buttons: "UNI NNI Fragmentation" (which is selected) and "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. The interface includes a menu bar (File, Action, Simulation, Help) and a 'Server Connection Status' indicator (green dot). A table on the left lists MFR Bundles:

MFR Bundles	Status
1	UP

Below this table are 'Add', 'Delete', 'Open', and 'Close' buttons. A 'Bundle ID' input field contains the value '2'. The main area features several tabs: 'Link View', 'Traffic', 'VC Statistics', 'Tx/Rx Verification', and 'Bundle Config & Statistics'. The 'Link View' tab is active, showing a table of links:

Link Name	Action	Status
#1:1..10	Close	Up
#1:11..20	Close	Up
#1:21..30	Close	Up

Below the link table are 'Add', 'Delete', 'Open', and 'Close' buttons. Further down, there are tabs for 'Link Config', 'Impairments', 'Statistics', and 'HDLC Statistics'. The 'Link Config' tab is active, showing options for 'Fragmentation' (unchecked), 'Fragment Size' (256), 'Flags between Hdlc frames' (100, unchecked), and radio buttons for '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

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

The screenshot shows the 'MFR Emulator - FR Simulation - Untitled' window. The title bar includes 'FR - VCs on a Selected Link'. The interface has a menu bar (File, Action, Simulation, Help) and a 'Server Connection Status' indicator (green dot). Below the menu bar are tabs for 'Link View', 'Traffic', 'VC Statistics', and 'Tx/Rx Verification'. Under the 'Traffic' tab, there are sub-tabs for 'Pattern/File Traffic', 'Network Traffic', and 'PacketCheck Traffic'. A 'Links' dropdown menu is set to '#1:1..5', with a list showing '#1:1..5', '#1:6..10', and '#1:11..15'. Below this are 'Add Vc' and 'Delete Vc' buttons. A red arrow points from the 'Add Vc' button to the 'DLCI - 3' tab. The 'DLCI - 1 | DLCI - 2 | DLCI - 3' tabs are visible. The 'TX params' section includes 'Source Type' (SEQNUM), 'Order' (MSB), 'Length' (4), 'Start' (0), and 'Increment' (1). The 'RX params' section includes 'Sink Type' (SEQNUM), 'Order' (MSB), 'Length' (4), 'Start' (0), and 'Increment' (1).

The screenshot shows the 'MFR Emulator - MFR Simulation - Untitled' window. The title bar includes 'MFR - VCs on a Selected Bundle'. The interface has a menu bar (File, Action, Simulation, Help) and a 'Server Connection Status' indicator (green dot). Below the menu bar are tabs for 'Link View', 'Traffic', 'VC Statistics', 'Tx/Rx Verification', and 'Bundle Config & Statistics'. Under the 'Traffic' tab, there are sub-tabs for 'Pattern/File Traffic' and 'Network Traffic'. A table on the left shows 'MFR Bundles' and 'Status':

MFR Bundles	Status
1	UP
2	UP

A red arrow points from the '1' in the table to the 'DLCI - 3' tab. Below the table are 'Add Vc' and 'Delete Vc' buttons. The 'DLCI - 1 | DLCI - 2 | DLCI - 3' tabs are visible. The 'TX params' section includes 'Source Type' (SEQNUM), 'Order' (MSB), 'Length' (4), 'Start' (0), and 'Increment' (1). The 'RX params' section includes 'Sink Type' (SEQNUM), 'Order' (MSB), 'Length' (4), 'Start' (0), and 'Increment' (1).

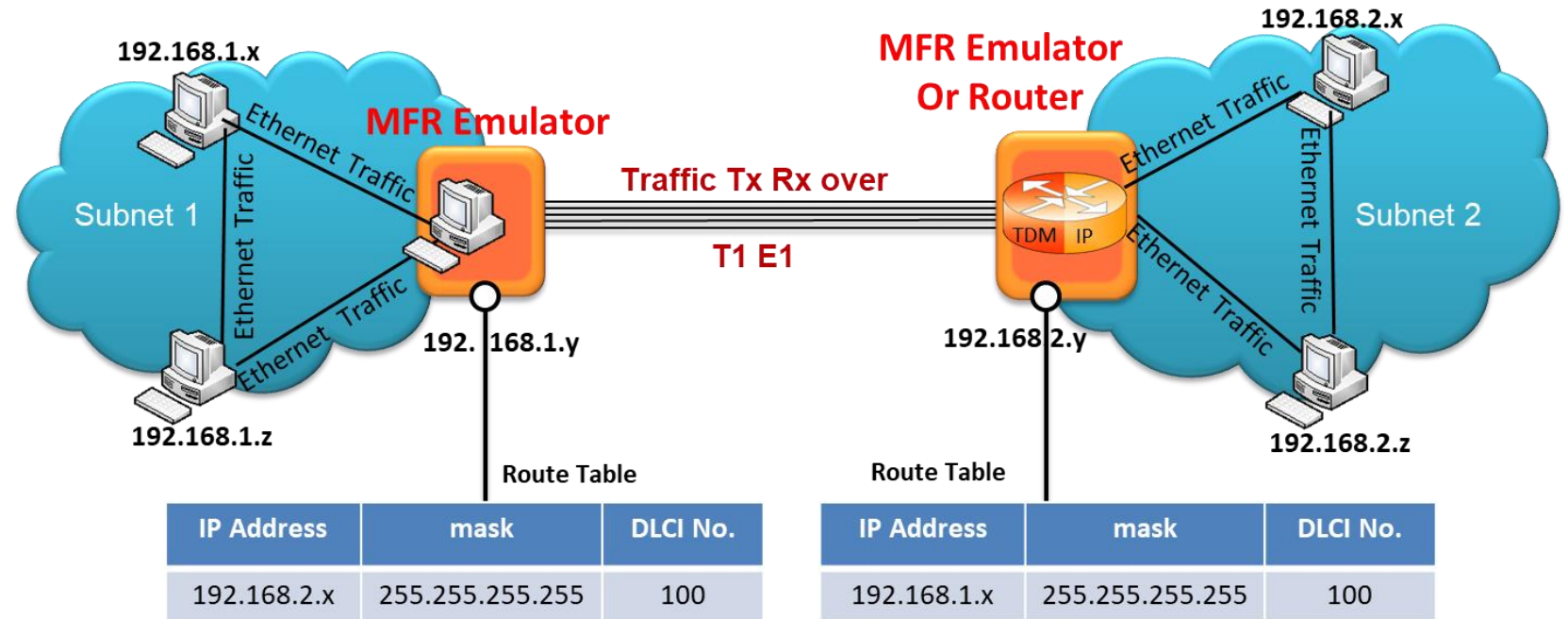
TxRx Verification

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	

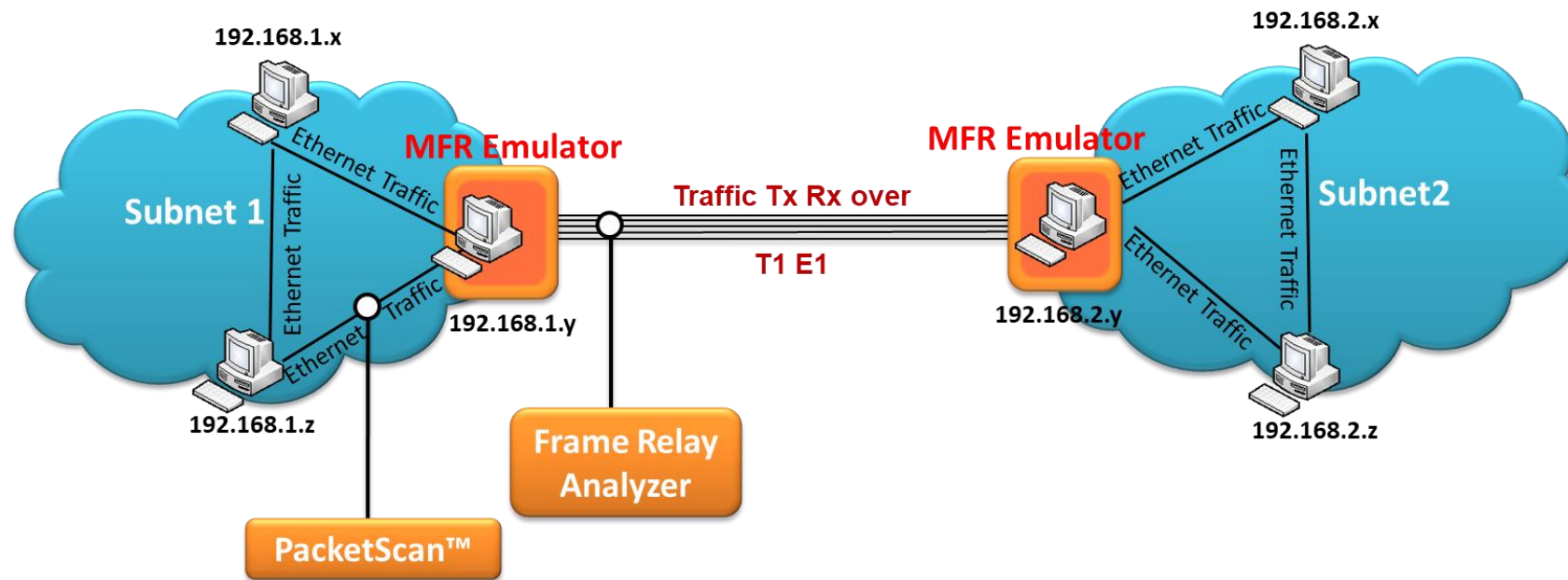
- The results of the verification for each of the added VCs are available in Tx/Rx Verification
- The statistics include:
 - The number of VCs created
 - The number of frames transmitted successfully
 - The number of frames received successfully
 - If a received frame is verified successfully, then it 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

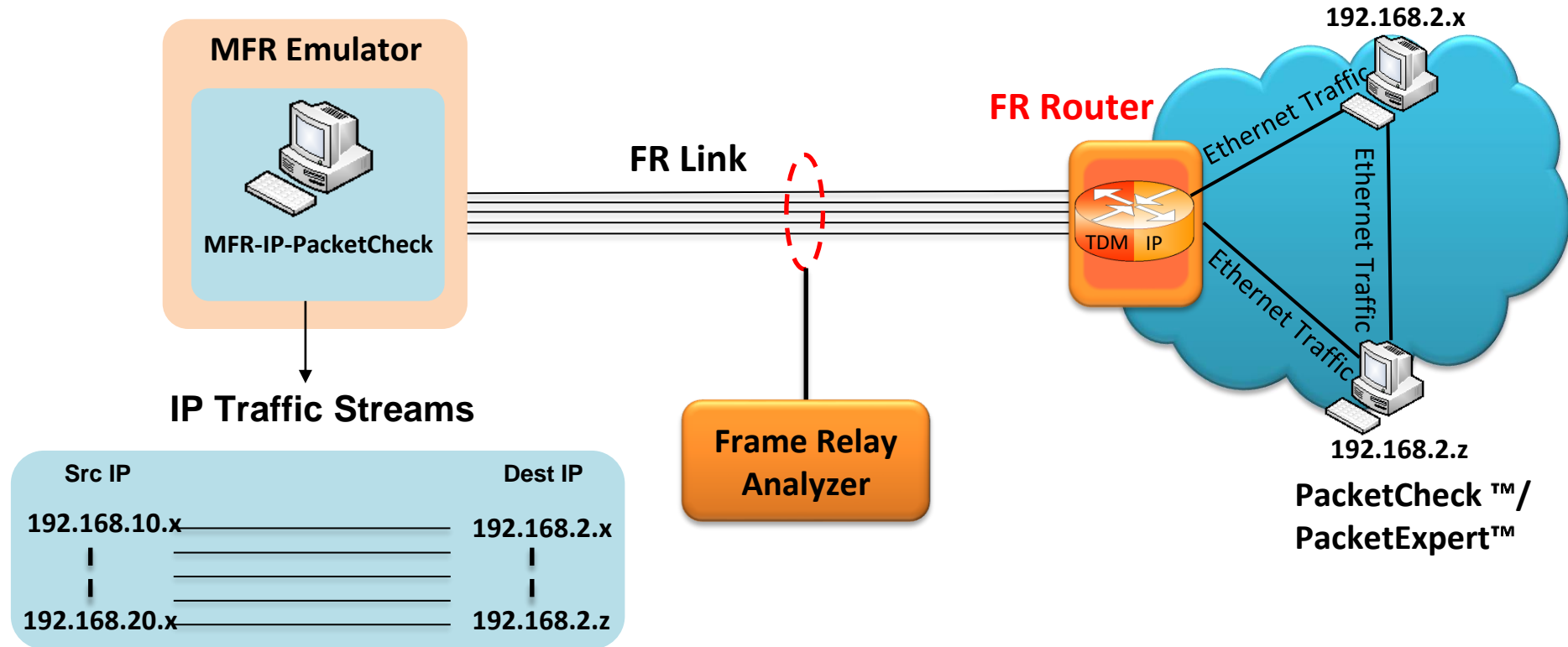


Network Traffic - MFR Emulator as a Bridge



- 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

MFR Emulator - FR Simulation - Untitled

File Action Simulation Help

Server Connection Status ● Links #1:0..31

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

Pattern/File Traffic Network Traffic PacketCheck Traffic

Route Configuration

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	Test1	00-00-00-22-00-22	FF-FF-FF-FF-FF-FF	00-00-00-11-00-11	FF-FF-FF-FF-FF-FF	0000	0.0.0.0	0.0.0.0	0.0.0.0	255.255.255.255
2	Test2	00-00-00-22-00-22	FF-FF-FF-FF-FF-FF	00-00-00-11-00-12	FF-FF-FF-FF-FF-FF	0000	0.0.0.0	0.0.0.0	0.0.0.0	255.255.255.255
3	Test3	00-00-00-11-11-11	FF-FF-FF-FF-FF-FF	00-00-00-22-22-22	FF-FF-FF-FF-FF-FF	0800	192.168.12.1	255.255.255.255	192.168.12.2	255.255.255.255
4	Test4	00-00-00-20-20-20	FF-FF-FF-FF-FF-FF	00-00-00-10-10-10	FF-FF-FF-FF-FF-FF	0800	192.168.12.10	255.255.255.255	192.168.12.11	255.255.255.255
5	Test5	00-20-20-20-20-20	FF-FF-FF-FF-FF-FF	00-01-01-01-01-01	FF-FF-FF-FF-FF-FF	0800	192.168.12.12	255.255.255.255	192.168.12.20	255.255.255.255
6	Test6	00-20-20-20-32-32	FF-FF-FF-FF-FF-FF	00-01-01-01-01-22	FF-FF-FF-FF-FF-FF	0800	192.168.1.12	255.255.255.255	192.168.1.20	255.255.255.255

Load PacketCheck Config Add Route Delete Route Record to File

Start Traffic MFR-IP-PacketCheck

- 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

Linked Statistics

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

The screenshot shows the MFR Emulator interface. The title bar reads "MFR Emulator - FR Simulation - MFRTest". The menu bar includes "File", "Action", "Simulation", and "Help". Below the menu bar, there is a "Server Connection Status" indicator with a green dot. The main area has tabs for "Link View", "Traffic", "VC Statistics", and "Tx/Rx Verification". A table below shows the link status:

Link Name	Action	Status
#1:0..23	Close	Up

Below the table are buttons for "Add", "Delete", "Open", and "Close". At the bottom, there are tabs for "Link Config", "Impairments", "Statistics", and "HDLC Statistics". The "Statistics" tab is selected, showing the following data:

Number of Frames Transmitted	2545226	Reset
Number of Frames Received	2435479	
Number of Octets Transmitted	3848381712	
Number of Octets Received	3633952713	

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

MFR Emulator - FR Simulation - Untitled

File Action Simulation Help

Server Connection Status ●

Link View Traffic VC Statistics Tx/Rx Verification

Link Name	Action	Status
#1:0..23	Close	Up
#2:0..23	Close	Up

Add Delete Open Close

Link Config Impairments Statistics HDLC Statistics


Tx Under/Over Runs

Rx Under/Over Runs

CRC Error Frames

Frame Error Frames

VC Statistics

Server Connection Status  Links #1:1..31

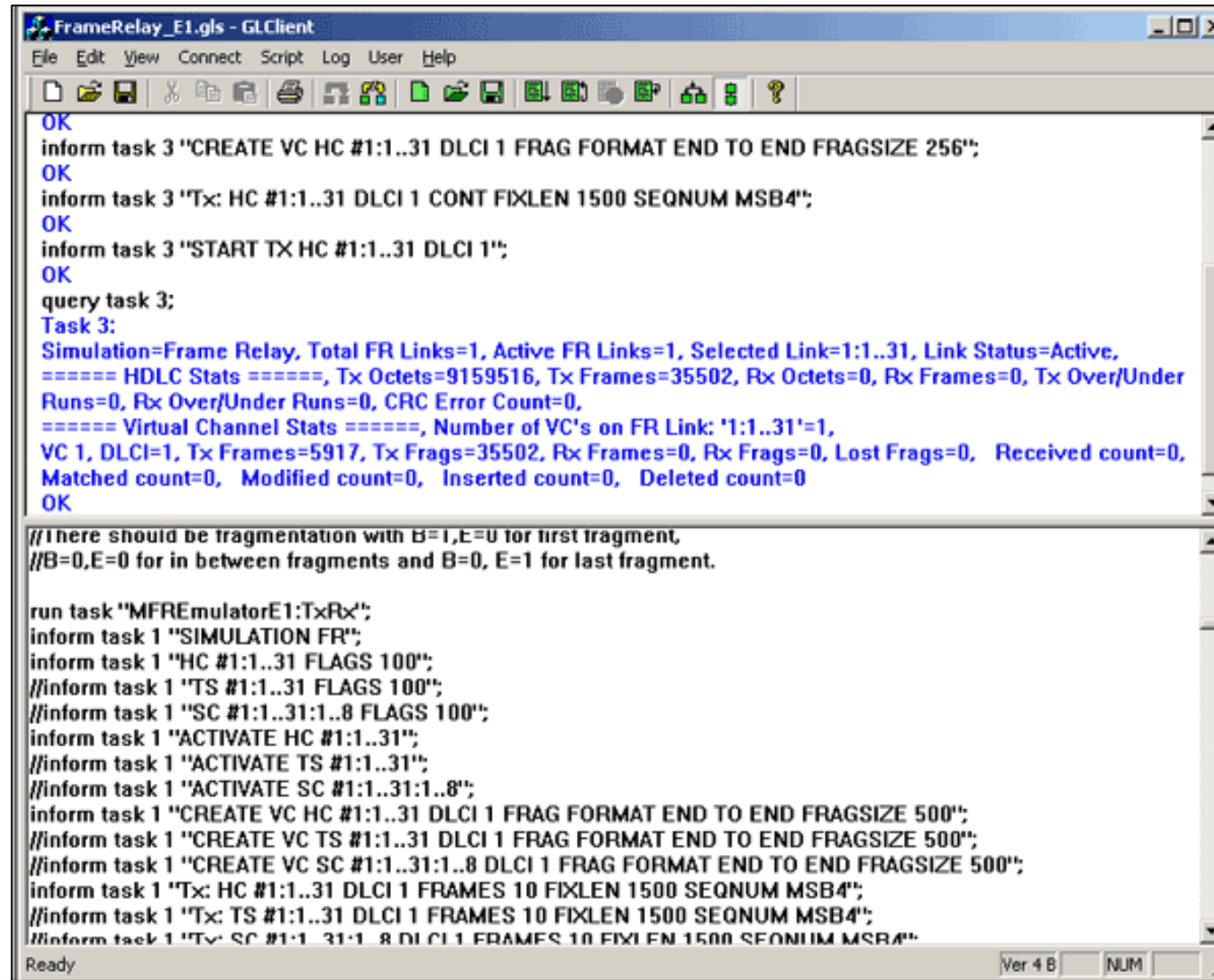
Link View Traffic VC Statistics Tx/Rx Verification

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

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

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
//I here 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 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