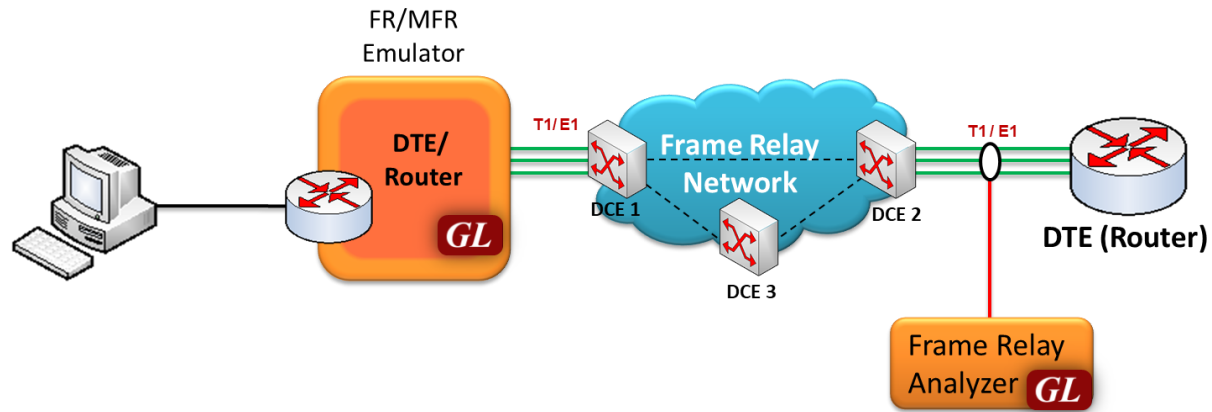


Multi-Link Frame Relay Emulator



Overview

Multi-Link Frame Relay or MFR is used to derive a larger frame relay pipe by aggregating smaller frame relay pipes. For example, 5 T1 frame relay pipes could be bundled to appear as a single 7.5 Mbps frame relay pipe. Some of the advantages of using MFR are: better bandwidth sizing according to customer traffic requirements and potentially better QOS by minimizing delay.

MFR works by bundling multiple T1 circuits into a multilink bundle and fragmenting the individual frame relay frames into fragments. These fragments are then transported in parallel over the multiple T1 circuits. At the other end, the fragments are reassembled into the original frame relay frames. The protocol includes the use of sequence numbers to allow the fragments to be reassembled correctly and to ensure that the reconstructed frames are sent out in the original order in which they entered the network.

FR and MFR can be emulated using GL's client-server based **Multi-Link Frame Relay Emulator** and [Multi-Link Frame Relay Analysis](#) software modules. Multi-Link Frame Relay Emulator can be configured as a router or as a bridge to establish connection and route traffic between LANs.

For more information, please visit [Multi-Link Frame Relay Emulator](#) webpage.

Main Features

- Performs MFR as well as FR simulation on up to 16 T1/E1 lines
- Adheres to FRF.12 standards
- Support two simulation modes – FR and MFR
- FR links can be created on Full or Fractional Timeslots
- Group FR links to create a MFR bundle
- Dynamically add/remove (open/close) of Frame Relay links without loss in data
- Multiple MFR Bundles/FR links can be created with each bundle/link configured with multiple virtual channels for traffic tx/rx
- 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
- Supports both Interface (UNI and NNI) and End-to-End fragmentation
- Supports various traffic source/sink types namely, Sequence Number, Binary File, Hex String, and pre-captured HDL files
- 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/Package level for each Virtual Channel
- Provides detailed statistics for each bundle and virtual channels associated with a bundle
- Transmit and receive Ethernet traffic over T1E1 links by operating either in bridge or router mode



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Simulating FR links

Various links (of any bandwidth varying from 64Kbps to $n \times 64\text{Kbps}$ or sub channels) can be added in FR Simulation. Two or more than two timeslots can be grouped to constitute a Hyper-channel.

Each of the added links can be configured with Fragmentation size, Flags between HDLC Frames, and Impairments.

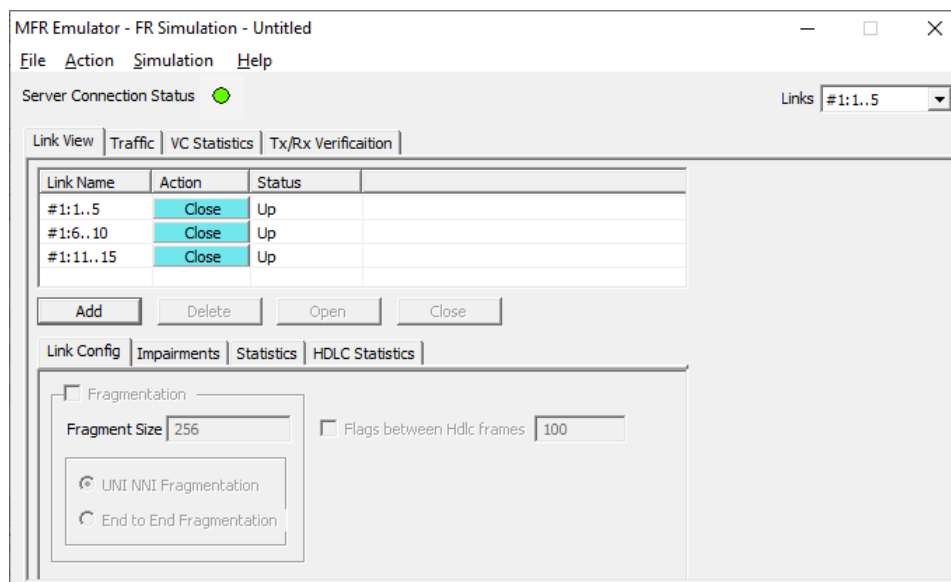


Figure: FR Simulation

Simulating MFR Bundle

MFR bundles multiple link-layer channels into a single network-layer channel. The MFR Simulation allows to create a virtual interface referred as 'bundle' interface. A 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. MFR bundles technique is used to derive larger bandwidth pipe by aggregating smaller bandwidth pipes e.g. from multiple T1s or E1s.

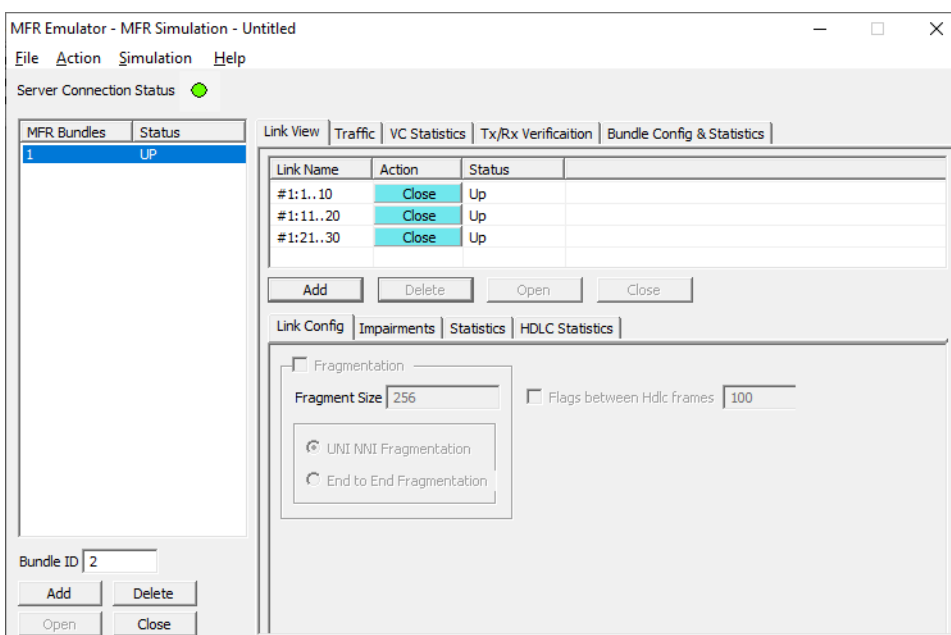


Figure: MFR Simulation

Link Configuration

This feature provides Frame Fragmentation configuration adhering to FRF.12 standard for traffic generation on selected FR links. The application supports two types of fragmentation: **UNI NNI Fragmentation** and **End to End Fragmentation** on a FR link. If fragmentation configuration is not enabled then the generated FR traffic will have 2 byte frame relay header only. The application allows to configure the bandwidth using flags.

Figure: Link Configuration Layer - FR Simulation

Bundle Configuration and Statistics

Similar to a link, Fragmentation Size and Maximum Differential Delay can be configured for a selected bundle in the **Bundle Config** screen. **Bundle Statistics** will show statistics of transmitted frames, received frames, transmitted octets, and received octets for a selected bundle.

Figure: Bundle Configuration and Statistics

Impairments

Impairments enable the user to intentionally introduce errors in data transmission. Impairments can be applied at the VC or link level.

Impairments can be applied to a link either before data transmission or during the process of data transmission. Different kinds of impairments are available to perform the task. Bytes can be modified through Delete bytes, Insert bytes, and AND/OR/XOR options. An entire FR frame can also be impaired through Delete, Insert, Duplicate, CRC errors, and Frame errors.

For selected links, differential delay can be introduced between links. The delayed links in the links can also be brought back to sync with the **Synchronize** option.

Figure: Impairments

Tx and Rx Traffic

A virtual channel is created for selected links or bundle to perform traffic actions. In FR simulation the VC will be created on the selected link from the 'Links' dropdown menu. In case of MFR simulation VC will be created on the selected bundle.

Multiple Virtual Channels (VC) can be created on the same physical link with same fragmentation format and fragment size.

Tx parameters will generate the FR traffic. Received data is verified with respect to the selected Rx parameters and results of verification are available in Tx/Rx verification tab. The parameters for each VC are independently set. The Tx/Rx parameter includes:

- Data Type (Sequence No, Packets from HDL or BIN files, HEX string, or Network Traffic). Network traffic allows users to receive traffic from Ethernet LAN, convert to FR traffic and send through T1/E1 line and vice versa. MFR emulator can be configured to work as router or bridge to establish connection between two systems residing in two different LANs.
- Data Type Parameters
- Prefix Header
- Duration Specification
- Payload length, Impairments

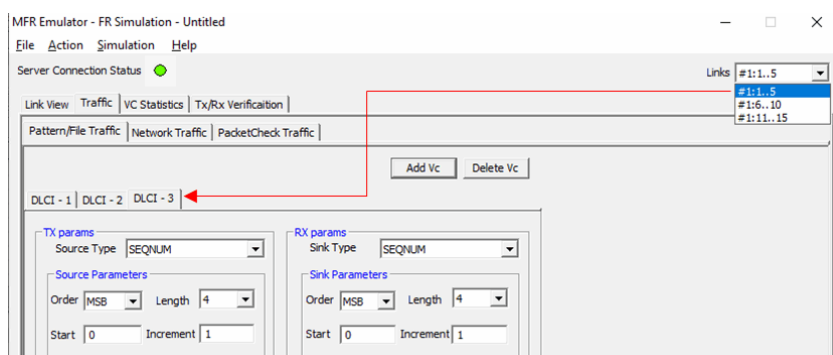


Figure: Tx and Rx Action – FR

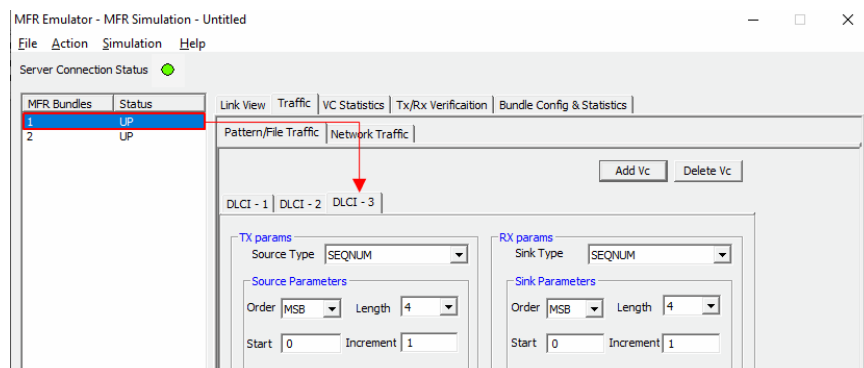


Figure: Tx and Rx Action – MFR

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.

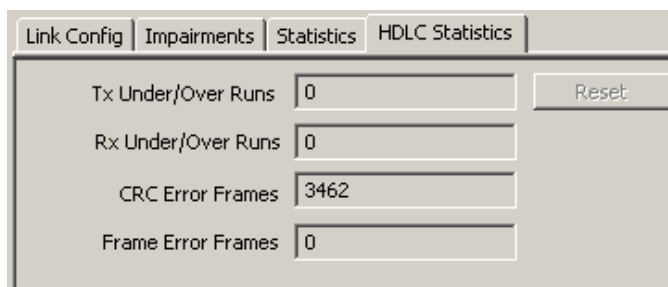


Figure: HDLC Statistics

Tx Rx Verification

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**.

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	

Figure: TxRx Verification

Link and VC 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**.

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

Figure: Link Statistics and VC Statistics

MFR Emulator as a Router

MFR emulator can be configured to work as MFR router to establish connection between two machines residing in two LANs

The MFR emulator 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. The emulator responds to all ARP requests whose IP addresses present in routing table.

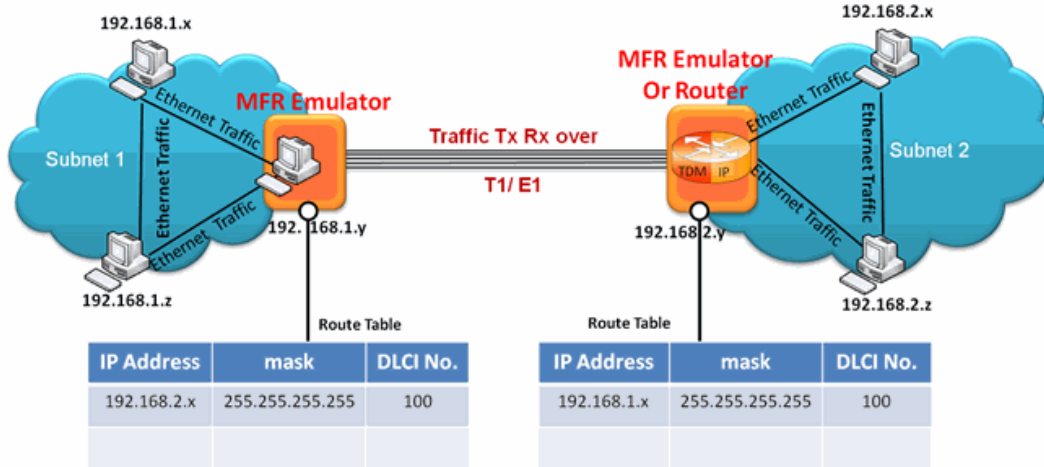


Figure: MFR as a Router

MFR Emulator as a Bridge

MFR emulator can be configured to work as MFR Bridge to establish connection between two machines residing in two LANs

When the emulator is configured to act as bridge between two networks, all 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.

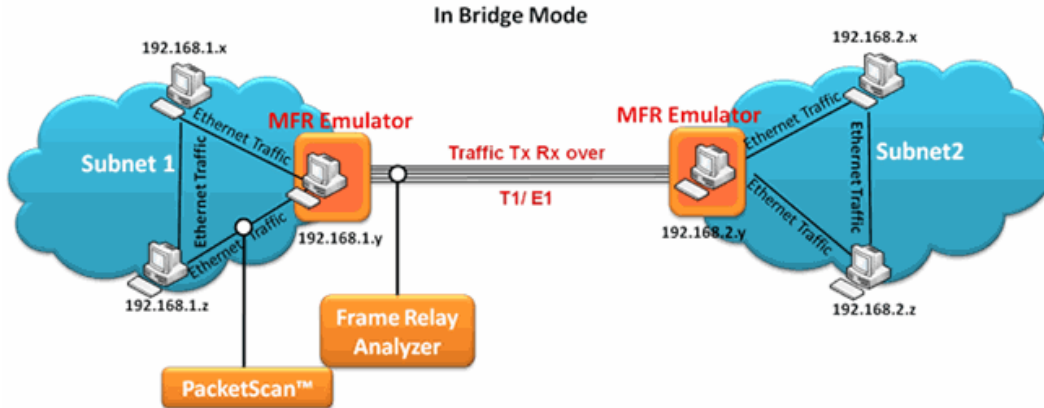


Figure: MFR as a Bridge

MFR-IP-PacketCheck™ Traffic

MFR-IP-PacketCheck™ traffic option 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. Each IP traffic streams can be configured to modify 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. The FR Router shall be tested for routing the received packets to the proper destination. Using GL's IP tools like PacketCheck™ and PacketExpert™, one can conduct end-to-end testing of the FR link through the FR router.

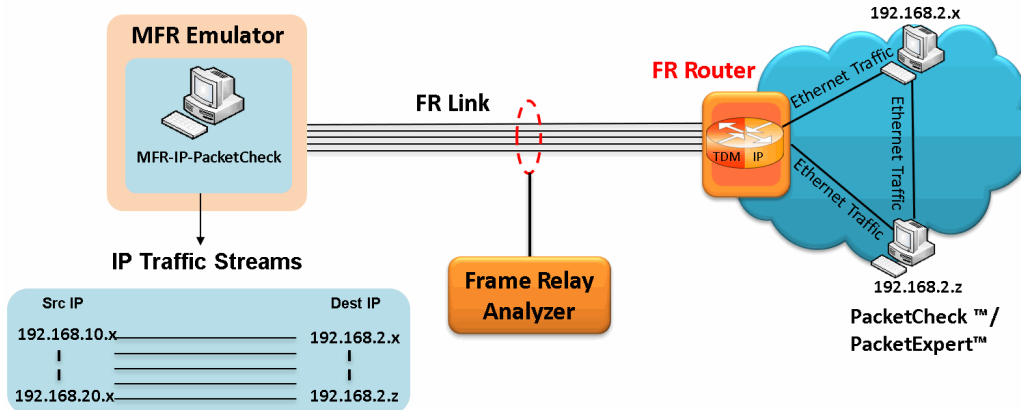


Figure: MFR-IP-PacketCheck™ Traffic

Buyer's Guide

Item No	Product Description
XX655	Client-Server MFR Emulation (requires XX634)
PTE001	tProbe™ Dual T1 E1 Laptop Analyzer
HTE001	Universal T1/E1 Card
UTE001	Portable USB based Dual T1 or E1 Laptop Analyzer
ETH100	PacketCheck™

Item No	Related Software
XX635, XX636	Multi-link Multi-Class PPP Emulator
XX634	Multi-Channel HDLC Emulation and Analysis & File based High Throughput HDLC Record/Playback
XX130	T1 or E1 Real-Time Frame Relay Protocol Analyzer
OLV130	Offline / Remote Frame Relay Analyzer
XX135	T1 or E1 Real-time MLPPP Protocol Analyzer
XX136	Real-time Packet Data Analysis for MLPPP Protocol Analyzer

Item No	Related Hardware
XTE001	Dual Express (PCIe) T1 E1 Boards
PTE001	tProbe™ Dual T1 E1 Laptop Analyzer with Basic Analyzer Software
HDT001/ HDE001	Legacy HD T1 or E1 (PCI) Cards with Basic Analyzer Software
UTE001	Portable USB based Dual T1 or E1 Laptop Analyzer with Basic Analyzer Software

For more information, please visit [Multi-Link Frame Relay Emulator](#) webpage.



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