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# MLPPP Analysis and Emulation

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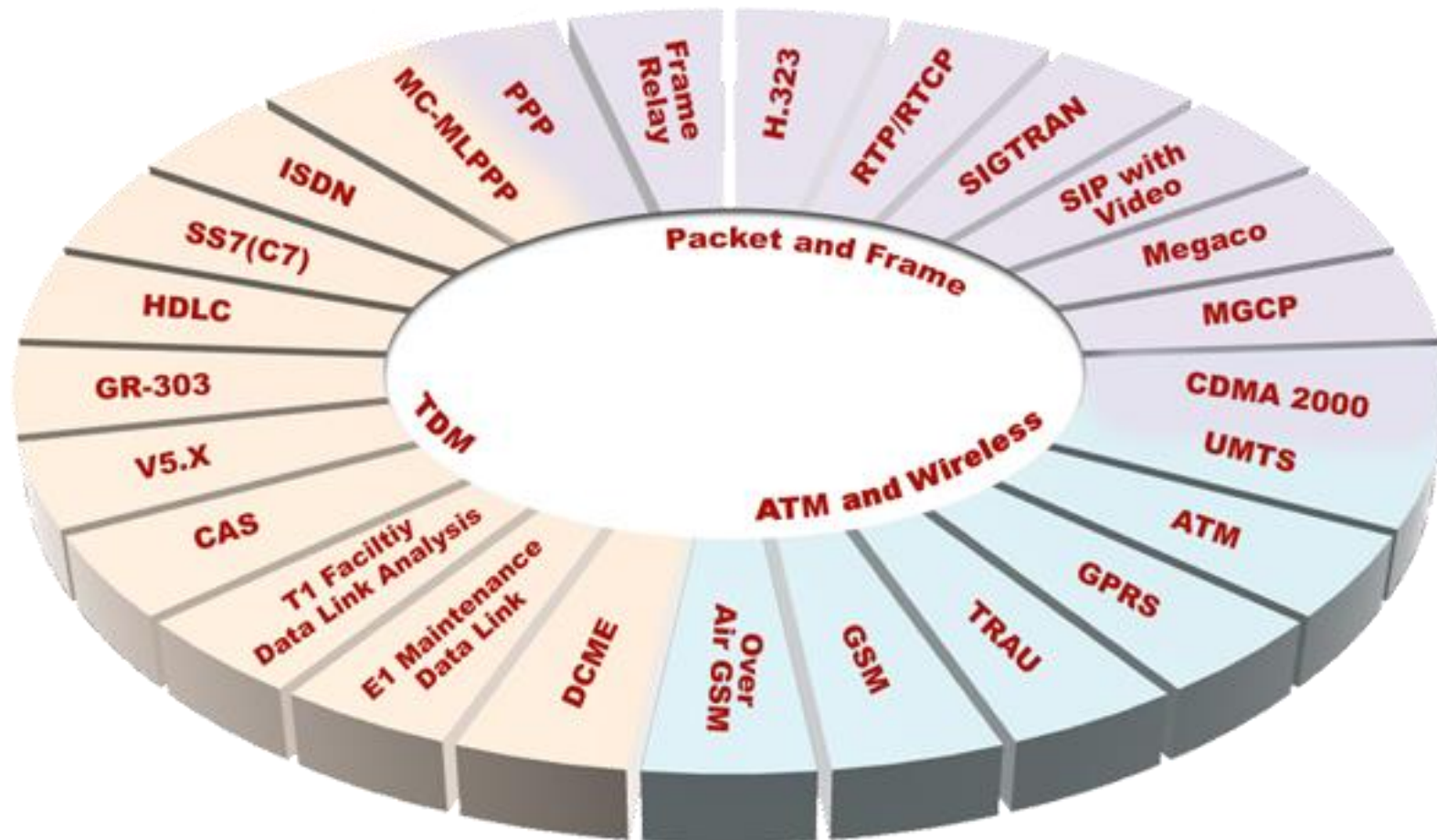
818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878  
Phone: (301) 670-4784 Fax: (301) 670-9187 Email: [info@gl.com](mailto:info@gl.com)  
Website: <https://www.gl.com>

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- MLPPP Conformance Testing using MAPS™
- MLPPP Analyzer with Packet Data Analysis
- Call Data Records and Analysis using Excel®

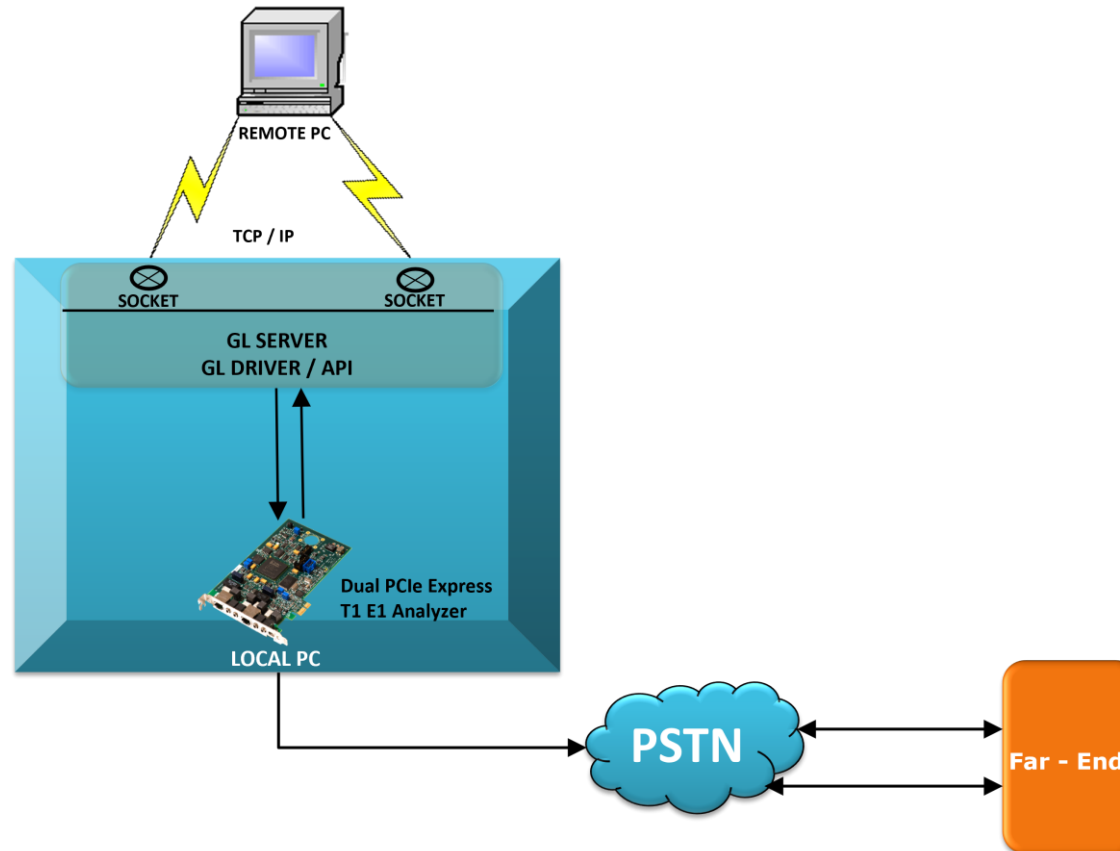
# TDM, Wireless, and VoIP Protocol Analysis

- GL Communications provides a host of protocol analyzers for testing a variety of protocols
- Analysis may be done both in real-time and off-line



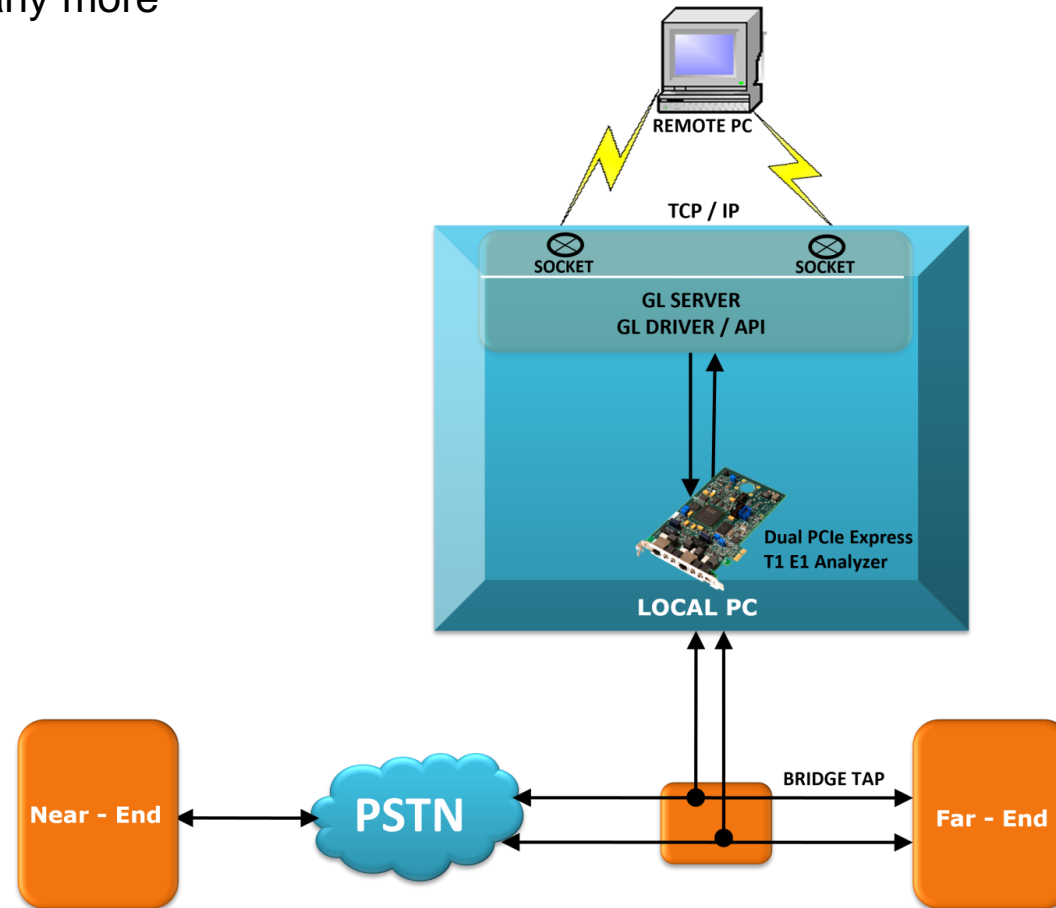
# Types of Testing Intrusive and Non-Intrusive

- Intrusive Testing
- Example Applications:
  - BER Testing, Transmit Tone, Gaussian Noise, Transmit Multi frames, Signaling Bits, Error Insertion, Delay Measurement, Protocol Emulation



# Types of Testing Intrusive & Non-Intrusive

- Non-Intrusive Monitoring
- Example Applications: Capture and Dialed digits, Call Capture & Analysis, Automated record playback, Playback from file, Protocol Analysis, and many more



# Supported Platforms



Dual T1 E1 Express (PCIe) Board



Quad / Octal T1 E1 PCIe Card



Rackmount Quad T1 E1 Analyzer

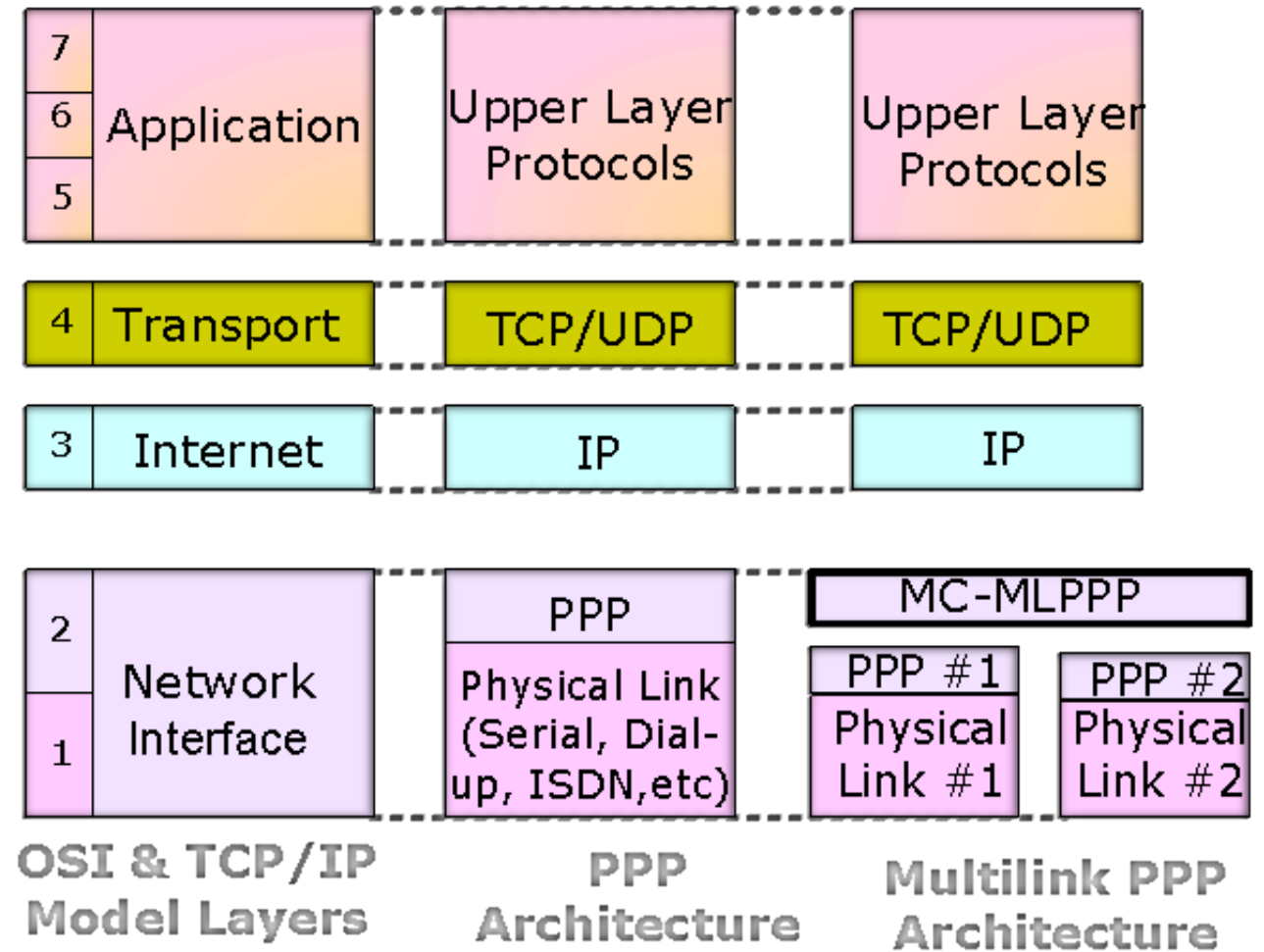
16-Port T1 E1 Breakout-Box



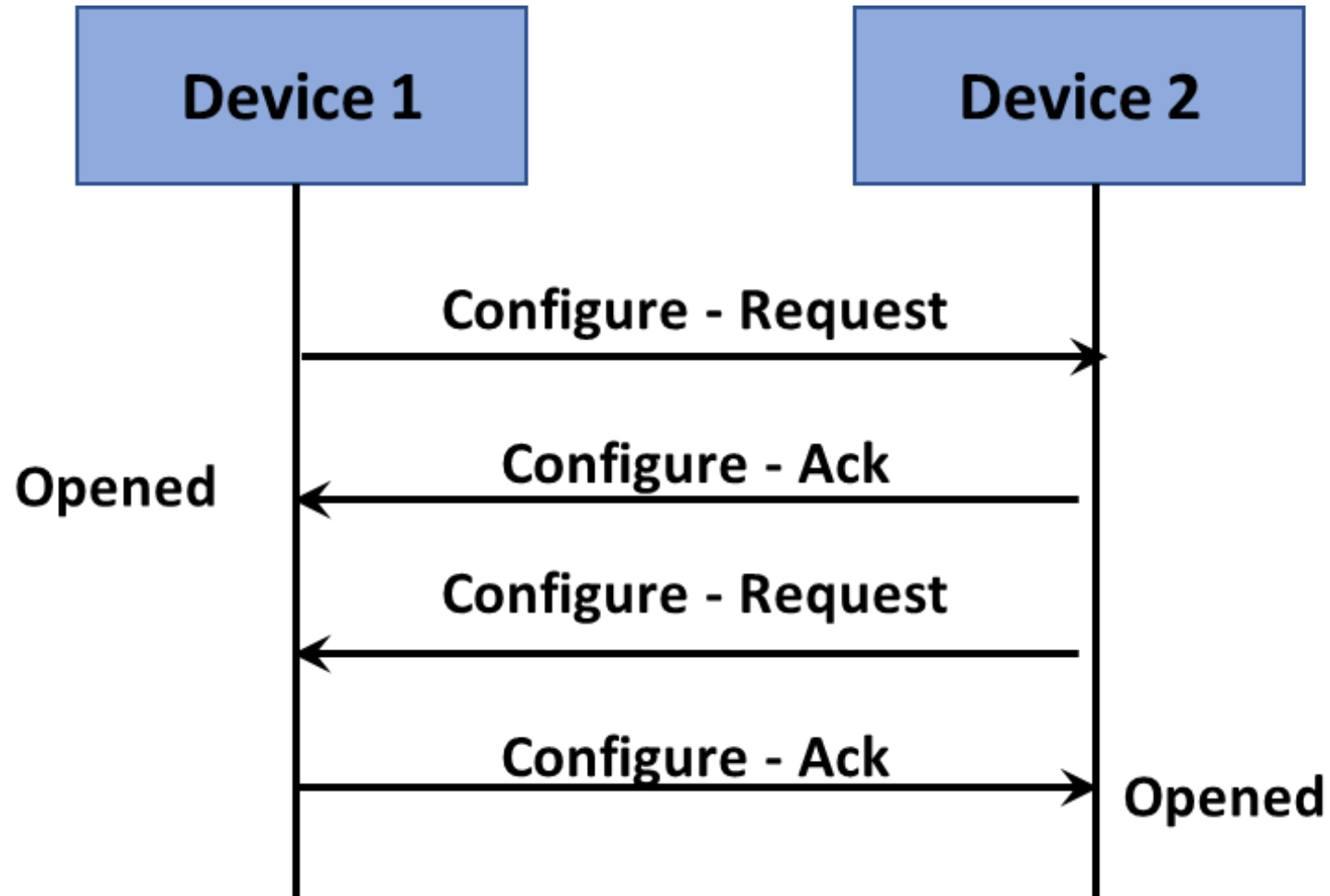
tProbe™ - Portable USB based T1 E1 VF  
FXO FXS and Serial Datacom Analyzer

# Multilink PPP Protocol Standards

- Multilink PPP (MLP), as defined in RFC 1990, is a variant of PPP
- Aggregates multiple WAN links into single logical channel for the transport of traffic
- MLPPP bundles multiple link-layer channels into a single network-layer channel

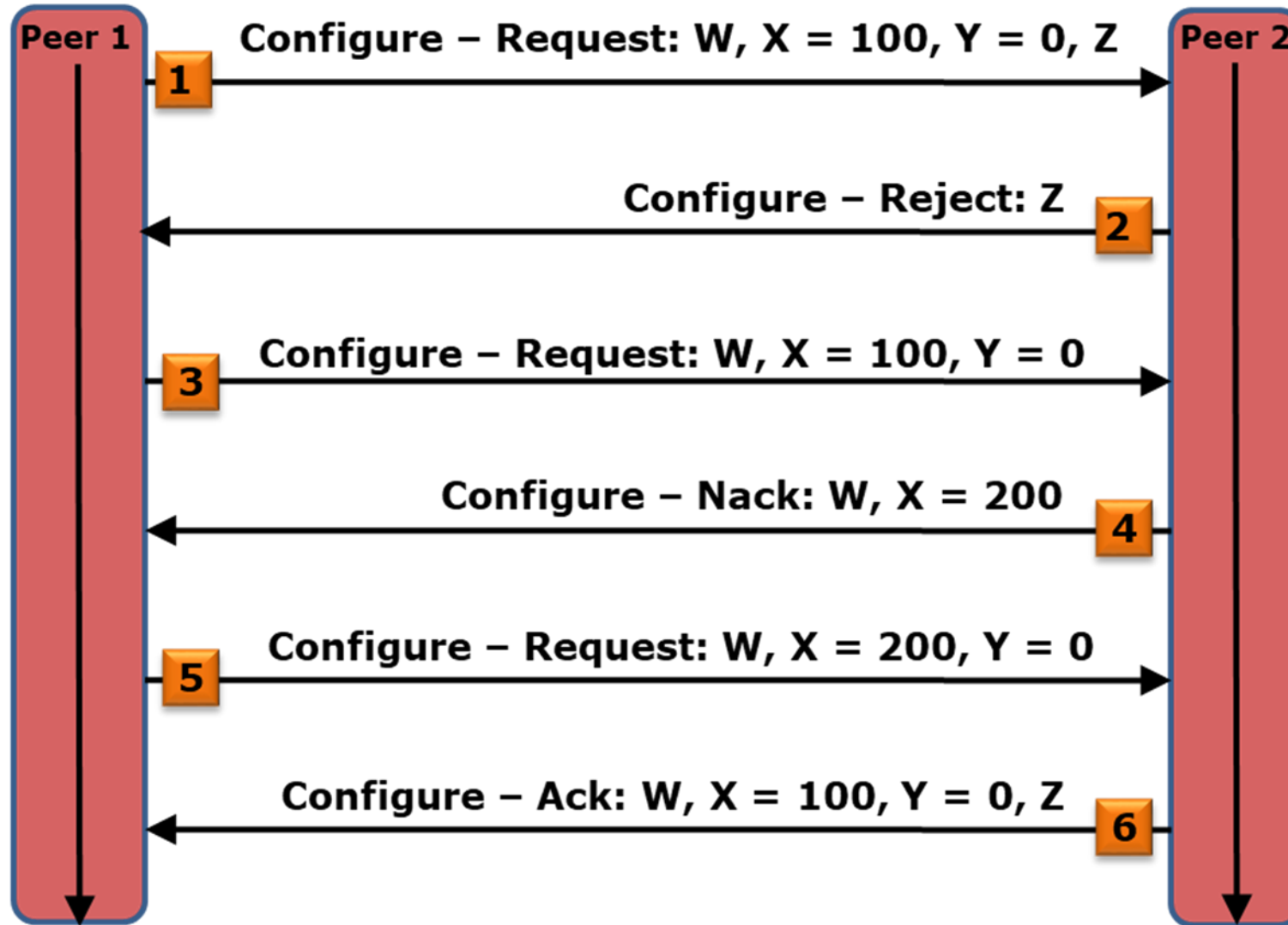


# Link Configuration Protocol (LCP)

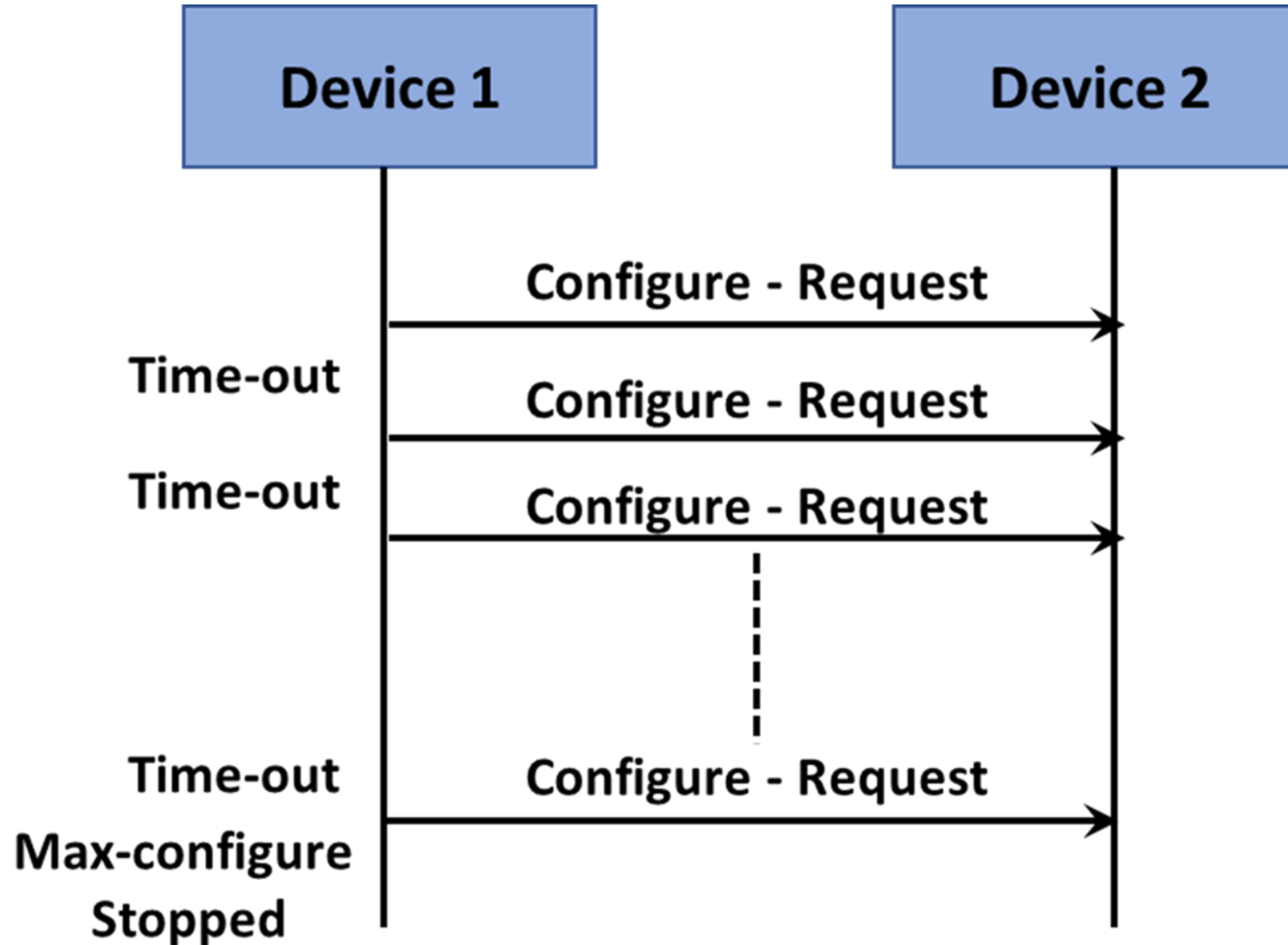




# LCP Negotiation Options

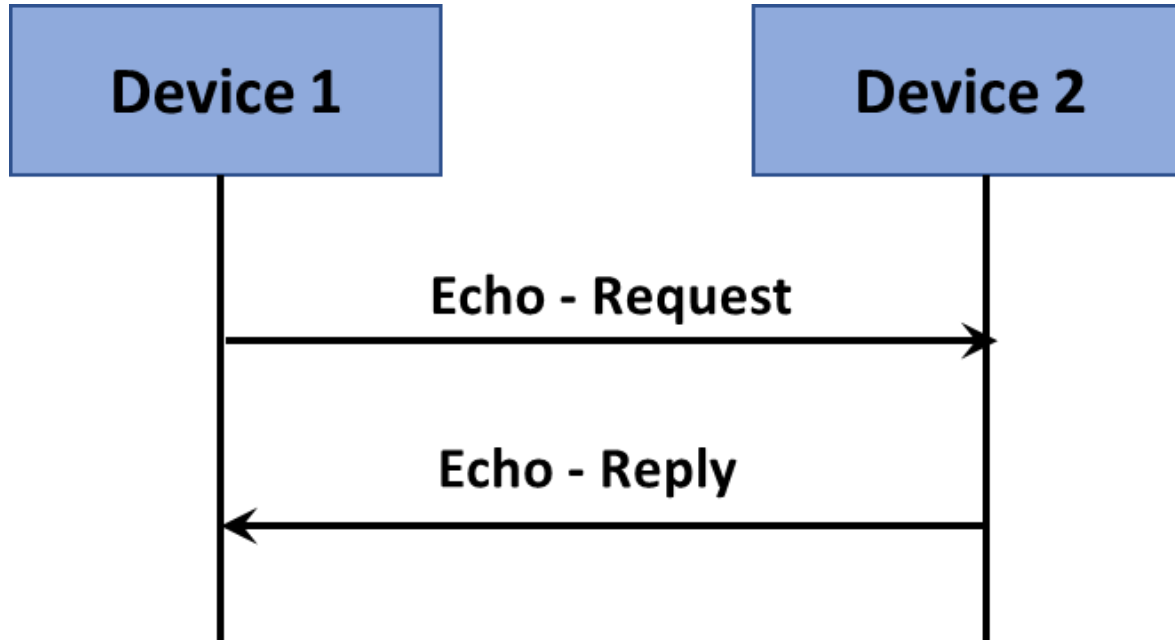


# LCP Retransmission

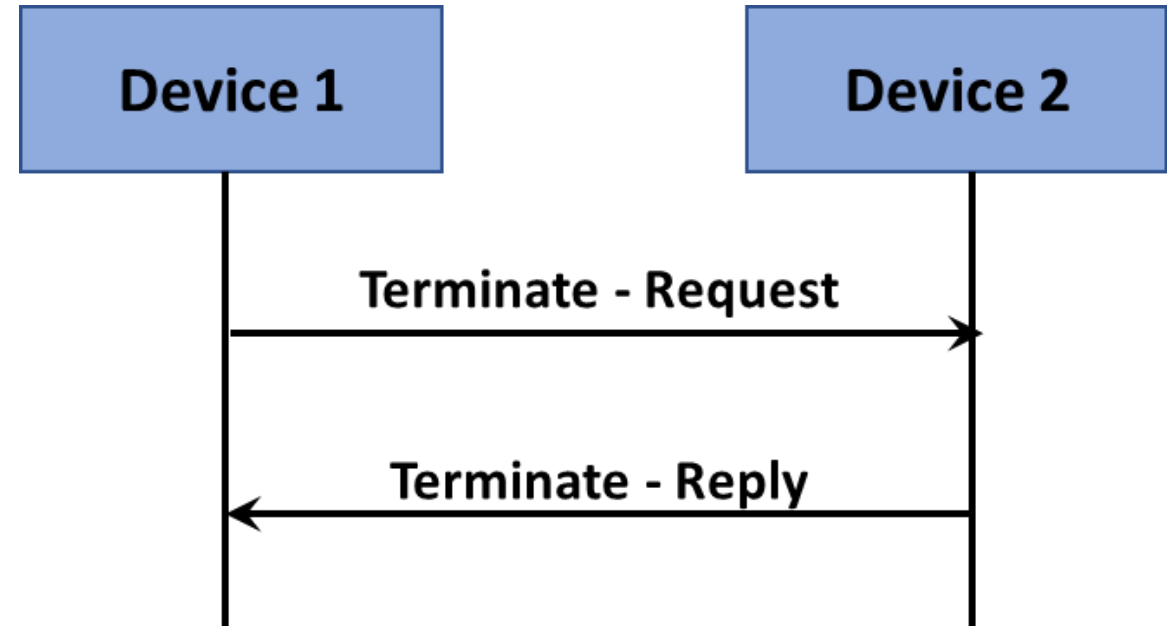


# Link Maintenance and Termination

Link Maintenance



Link Termination



# Network Control Protocols

## IPCP (NCP for IP)

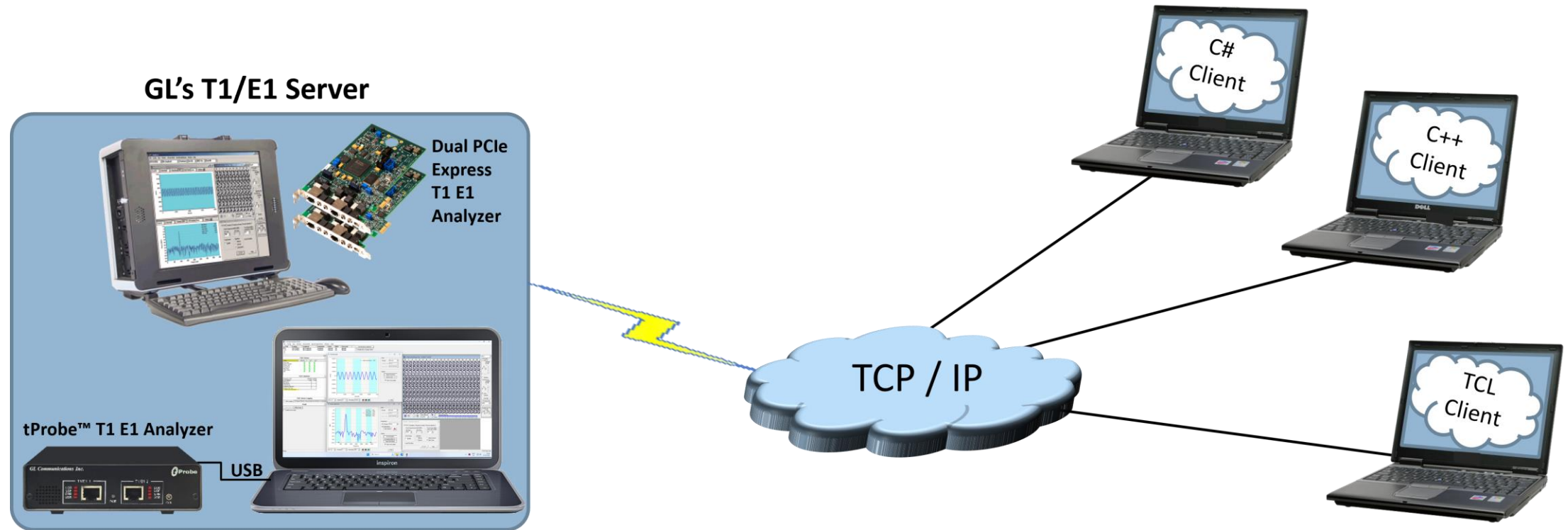
- Responsible for configuring, enabling, and disabling the IP protocol modules on both ends of the point-to-point link
- Supported IPCP standards:
  - RFC 1332 - The PPP Internet Protocol Control Protocol
  - RFC 1877 - PPP Internet Protocol Control Protocol Extensions for Name Server Addresses
- Supported IPCP negotiation options:
  - IP Address
  - IP Address Compression
    - RFC 1144 - Van Jacobson Compression
    - RFC 3544 - IP Header Compression over PPP
    - RFC 2508 - CRTP
    - RFC 2507 - IP Header Compression
  - Primary DNS Server Address
  - Primary NBNS Server Address
  - Secondary DNS Server Address
  - Secondary NBNS Server Address

# Network Control Protocols BCP

- BCP is responsible for establishing and configuring Remote Bridging for PPP links
- Supported standard – RFC 3518
- Supported BCP negotiation options:
  - Bridge Identification
  - Line Identification
  - MAC Support
  - Tinygram Compression
  - MAC Address
  - Spanning Tree Protocol
  - IEEE 802 Tagged Frame
  - Management Inline
  - Bridge Control Protocol Indicator

# MC-ML PPP Emulation using Client-Server

# Windows Client Server MC-MLPPP Emulator



# Features

Remote operation	✓
Automation	✓
Multi-site connectivity	✓
Simultaneous testing of high capacity T1/E1 systems through a single Client	✓
Integration of T1/E1 testing into more complex testing systems	✓
Intrusive / Non-Intrusive T1/E1 Testing	✓



# Connect to T1 / E1 Server

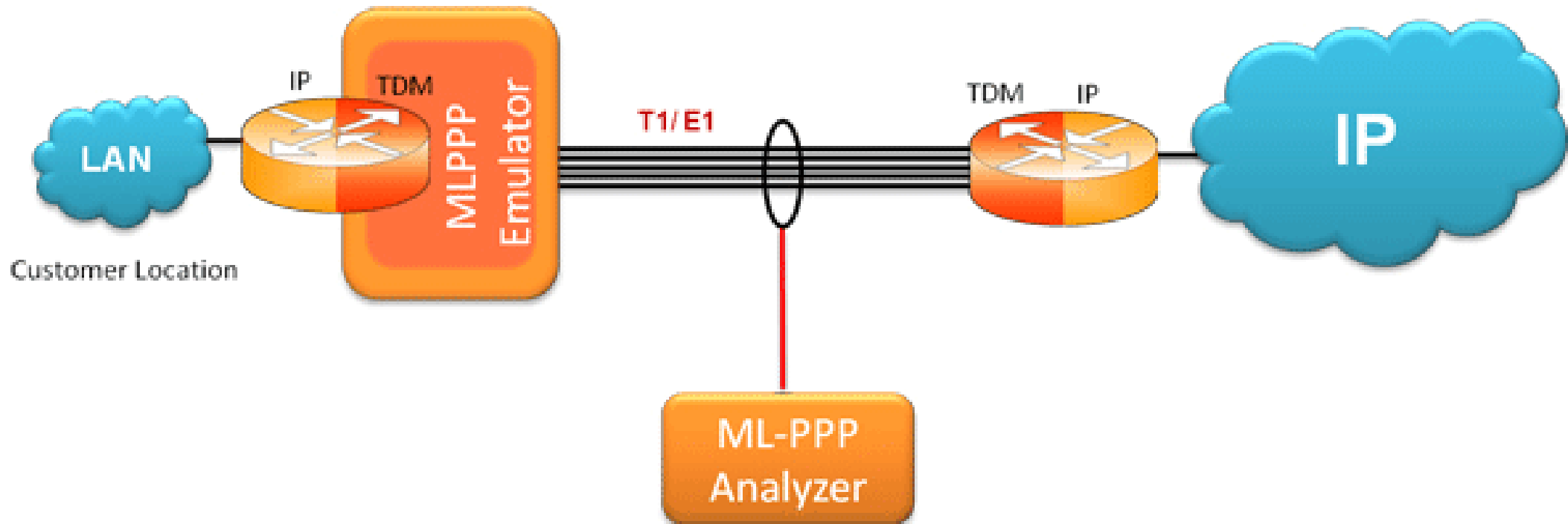
- T1 / E1 is software selectable
- Connects using the same parameters set in server

The screenshot shows a Windows-style dialog box titled "Start GL Server". It contains several configuration options:

- Listen Port:** A text box containing "17090", a dropdown menu showing "<Default>", and a "Restore Default" button.
- Start GL Server:** A large button to initiate the server.
- Exit:** A button to close the dialog.
- Server is Invisible:** A checkbox that is currently unchecked.
- Messaging:** A section with two radio buttons: "Send / Receive Binary Messages" (selected) and "Send / Receive ASCII Messages".
- Version:** A section with two radio buttons: "Send / Receive Version 3 Messages" and "Send / Receive Version 4 Messages" (selected).
- Use These Settings until Further Notice:** An unchecked checkbox.
- Start Server Automatically At Analyzer Start-Up:** An unchecked checkbox.

# MC-MLPPP Emulator

- GUI based WCS client, which simulates MC-MLPPP and PPP protocols over T1/E1 links
- Capable of generating and receiving MC-MLPPP/PPP 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



# Features

- Performs MC-MLPPP as well as PPP simulation
- Supports LCP with the following negotiation options
  - PPP options: MRU, ACFC, PFC, and Magic Number
  - MLPPP Options: MRRU, Short/ Long Sequence Fragment Format, & Endpoint Discrimination
  - Multi-Class Options: Multilink Header Format
- Supports following NCP's:
  - IPCP - RFC 1332 and RFC 1877 standards
  - BCP - RFC 3518 standard
  - PPPMuxCP - RFC 3513 PPP Multiplexing
- Supports PPP Multiplexed data transmission/reception in both PPP and MLPPP frames conforming to RFC 3513
- Supports LCP Echo Test at PPP and MLPPP level
- Payload traffic generation and verification (Sequence number, HDL file (containing packets/frames), Flat Binary file, Ethernet traffic, and User defined frames (ASCII HEX file))
- Transmit and receive Ethernet traffic over T1/E1 links in bridge or router mode

# Features

- Differential link delay insertion between PPP links during transmission
- User configurable bandwidth using flags
- Supports fragmentation and reassembly at MLPPP level
- Supports various impairments at PPP link layer and MLPPP Layer
- Provides detailed PPP and MLPPP statistics
- Provides detailed test (Tx/Rx) results per class / per link in GUI as well as through log file in command line
- Ideal solution for automated testing using command line scripts
- Support for HDLC framing with CRC16, CRC32 or without CRC
- Supports IP compression
  - RFC 3544 – IP Header Compression over PPP
  - RFC 1144 - Van Jacobson TCP/IP Compression
  - RFC 2507 - IP Header Compression
  - RFC 2508 - Compressed RTP

# Supported Protocols

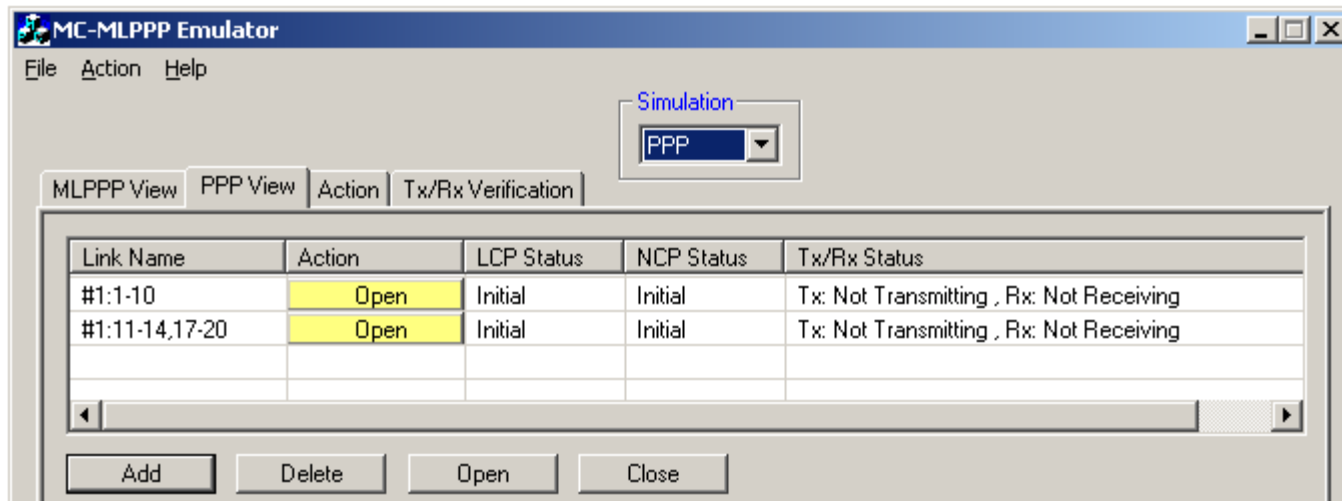
- Point-to-Point Protocol (RFC 1661)
- PPP links in HDLC framing (RFC 1662)
- Multi-link PPP (RFC1990)
- Multi-class extension to MLPPP (RFC 2686)
- Internet Protocol Control Protocol (IPCP) (RFC 1332)
- Internet Protocol Control Protocol Extensions for Name Server Addresses (RFC 1877)
- Bridging Control Protocol (RFC 3518)
- PPP Network Control Protocol for PPP Multiplexing (PPP Mux CP - RFC 3513 )

# PPP Simulation

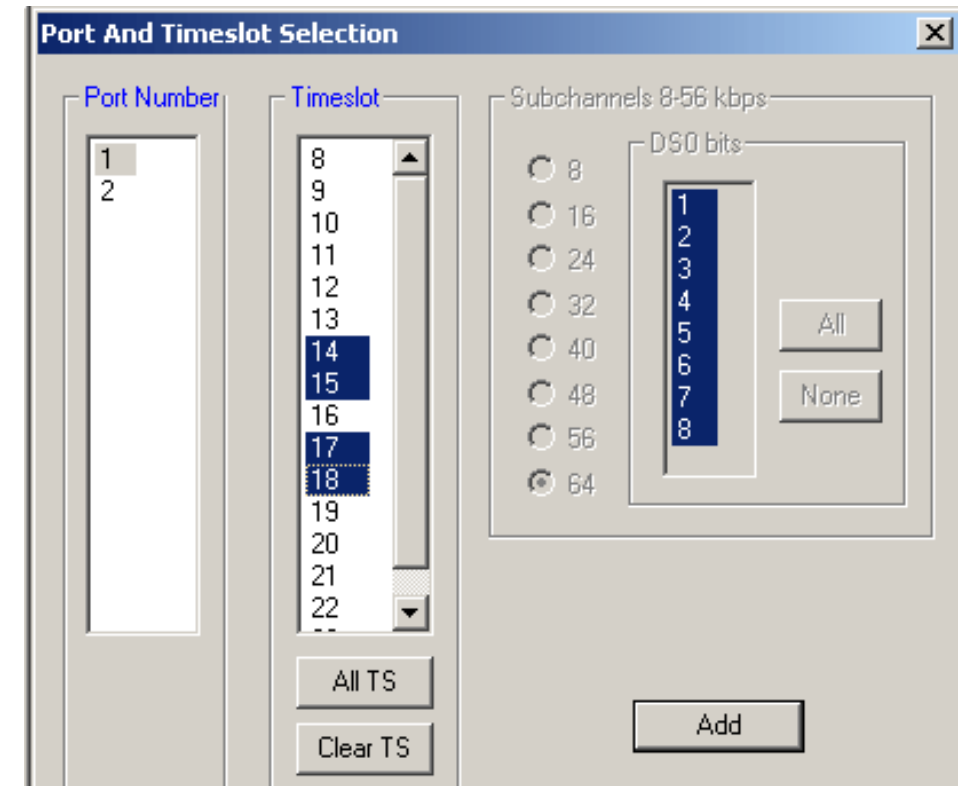
# Adding PPP Links

- Supports up to 16 T1/E1 links
- Timeslot of 64 Kbps or a Hyper Channels of  $n \times 64$  Kbps or sub channels can also be used
- Supports hyper channels with continuous or discontinuous (sparse) timeslots
- Each link is independent and can be configured with the selected LCP options

Added PPP Links

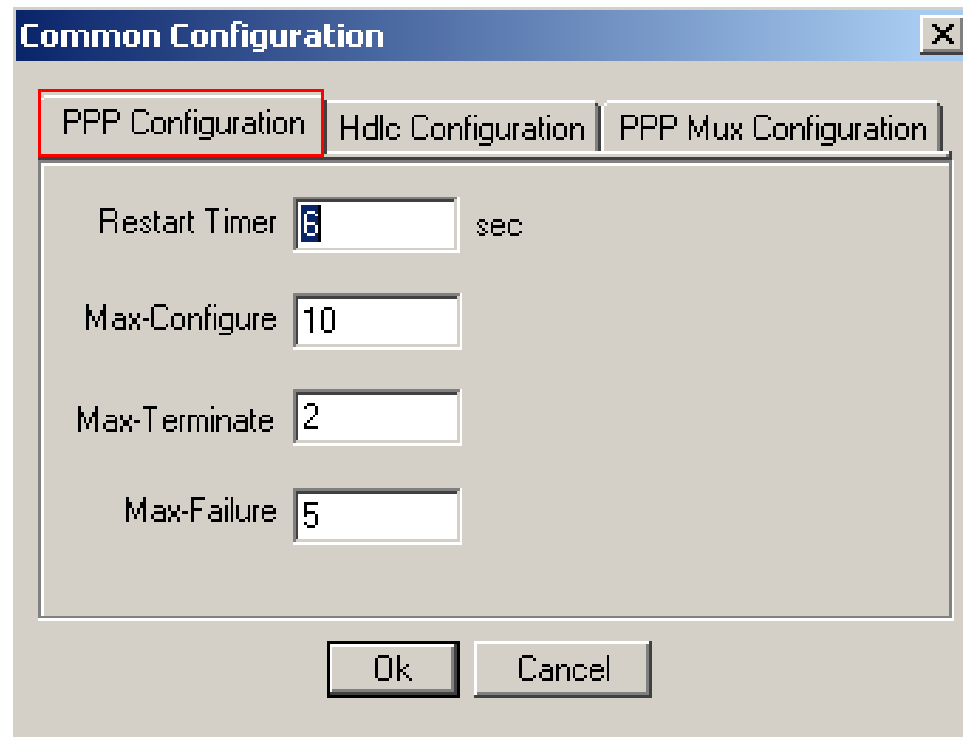


Link Selection



# Common Configuration – PPP and HDLC

- PPP Configuration Parameters:
- User configurable LCP parameters, like Restart-timer, Max-Configure, Max-Terminate, and Max-Failure, can be set for all PPP links
- HDLC Configuration Parameters:
- User configurable HDLC configuration parameters for HDLC framing with CRC 16, CRC 32 or without CRC can be set for all PPP links
- User configurable number of flags between HDLC frames



The image shows the 'Common Configuration' dialog box with the 'PPP Configuration' tab selected. The tab is highlighted with a red rectangle. The dialog contains four input fields: 'Restart Timer' with a value of 6 and a unit of 'sec', 'Max-Configure' with a value of 10, 'Max-Terminate' with a value of 2, and 'Max-Failure' with a value of 5. At the bottom are 'Ok' and 'Cancel' buttons.

Common Configuration

PPP Configuration | Hdlc Configuration | PPP Mux Configuration

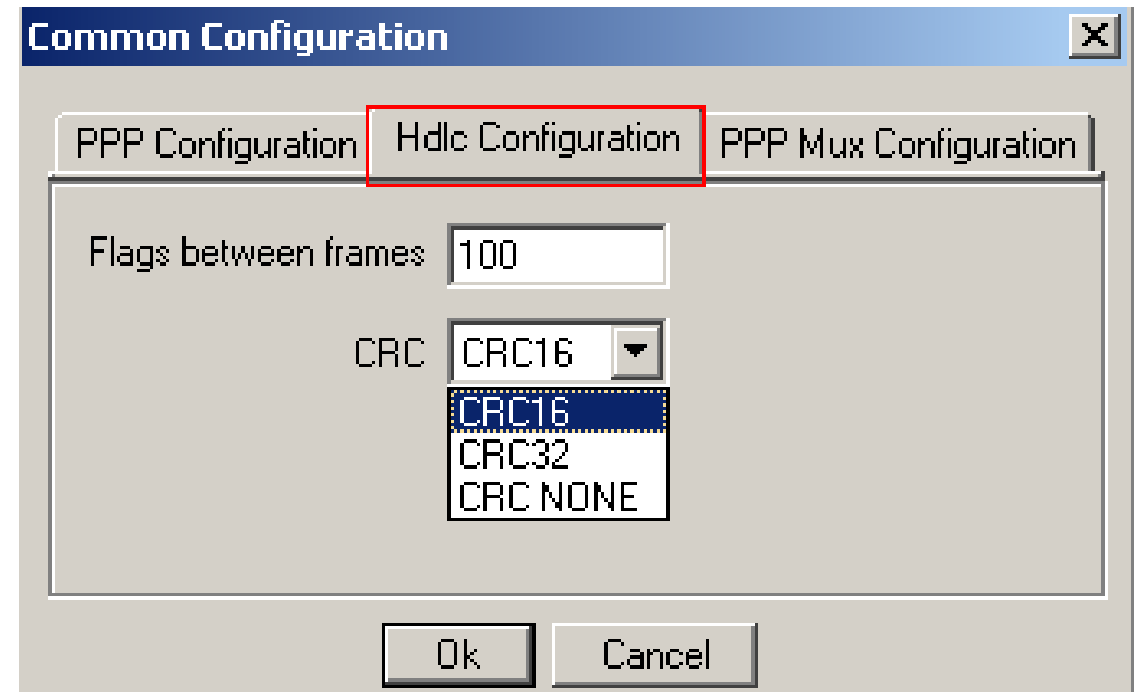
Restart Timer  sec

Max-Configure

Max-Terminate

Max-Failure

Ok Cancel



The image shows the 'Common Configuration' dialog box with the 'Hdlc Configuration' tab selected. The tab is highlighted with a red rectangle. The dialog contains two input fields: 'Flags between frames' with a value of 100, and 'CRC' with a dropdown menu showing 'CRC16' selected. The dropdown menu is open, showing options: 'CRC16', 'CRC32', and 'CRC NONE'. At the bottom are 'Ok' and 'Cancel' buttons.

Common Configuration

PPP Configuration | Hdlc Configuration | PPP Mux Configuration

Flags between frames

CRC

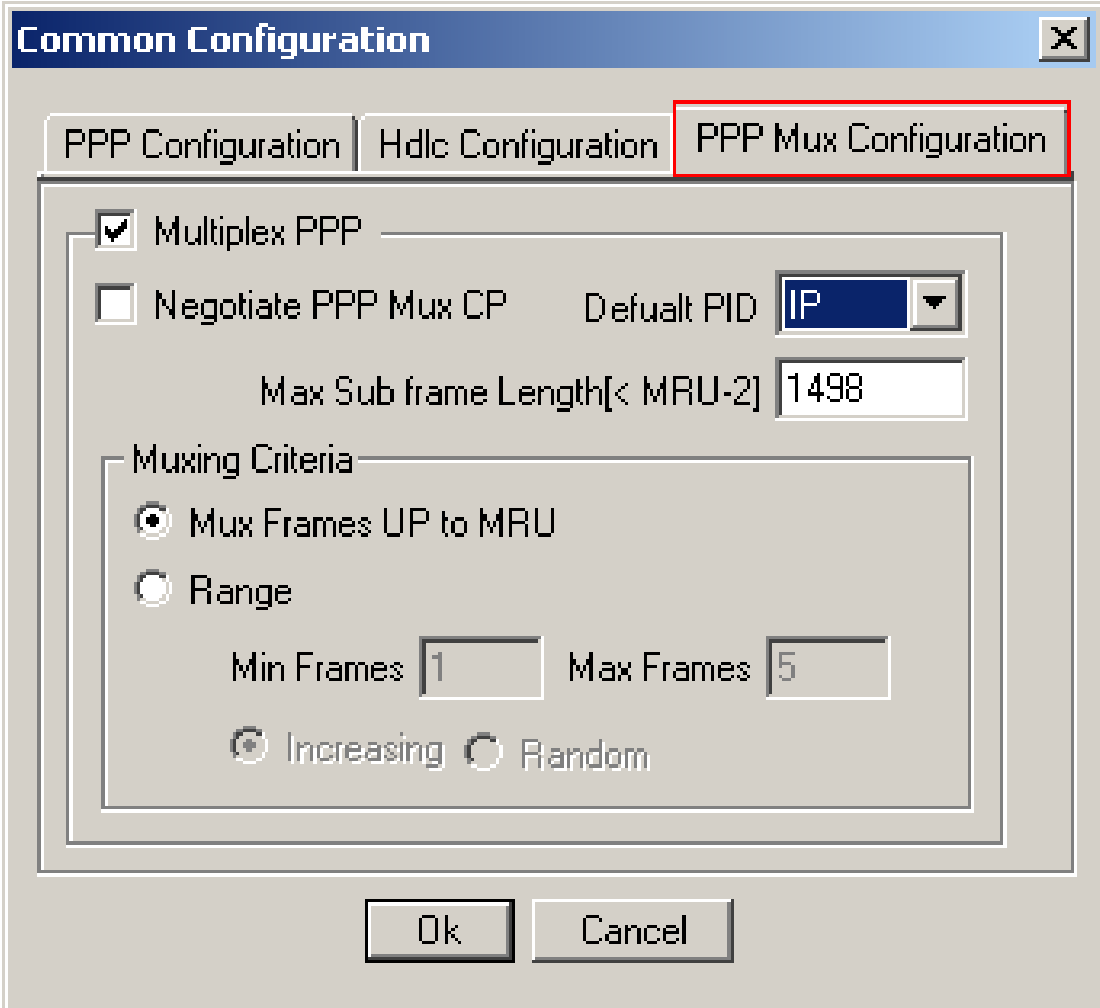
CRC16  
CRC32  
CRC NONE

Ok Cancel



# PPP Mux CP Configuration

- PPP Multiplexing feature allows sending multiple PPP encapsulated packets in a single PPP Multiplexed frame
- PPP Mux configuration is an optional feature, will be negotiated for Default PID when enabled.
- User Configurable Maximum Sub-Frame length
- Supports simulation of different muxing scenarios: Mux sub-frames to up the link MRU and Mux within the configured range of sub-frames incrementing from min to max or randomly within the given range



The screenshot shows a 'Common Configuration' dialog box with three tabs: 'PPP Configuration', 'Hdlc Configuration', and 'PPP Mux Configuration'. The 'PPP Mux Configuration' tab is selected and highlighted with a red border. Inside this tab, the 'Multiplex PPP' checkbox is checked. The 'Negotiate PPP Mux CP' checkbox is unchecked. The 'Default PID' is set to 'IP' in a dropdown menu. The 'Max Sub frame Length[< MRU-2]' is set to '1498' in a text box. Under the 'Muxing Criteria' section, the 'Mux Frames UP to MRU' radio button is selected. The 'Range' radio button is also present but unselected. Below the 'Range' option, there are input fields for 'Min Frames' (set to '1') and 'Max Frames' (set to '5'). At the bottom of the 'Range' section, there are two radio buttons: 'Increasing' (selected) and 'Random' (unselected). At the bottom of the dialog box, there are 'Ok' and 'Cancel' buttons.

# LCP Configuration

- Link configuration is an optional feature, and the following values are negotiated when enabled
  - MRU (Maximum Receive Unit)
  - ACFC (Address and Control Field Compression)
  - PFC (Protocol Field Compression)
  - Magic Number

The screenshot shows a software window titled "LCP Configuration" with several tabs: "LCP Configuration", "NCP Configuration", "Link Test", "Statistics", "HDLC Statistics", and "Impairments". The "LCP Configuration" tab is active. Inside this tab, there is a red rectangular box highlighting a section containing the following settings:

- ☒ **LCP**
- Maximum Receive Unit:
- ☒ Protocol Field Compression
- ☒ Address and Control Field Compression
- ☒ Magic-Number:

To the right of this highlighted section is a text area titled "LCP Negotiated Values" which contains the text "Link is not configured...". At the bottom of the window, there is a checkbox for "Flags between frames" which is checked, followed by a text input field with the value "100" and a "Set Flags" button.

# IPCP Configuration

- IPCP (Internet Protocol Control Protocol) - RFC 1332 and RFC 1877 standards ;
- Following IP compression standards are supported:
  - RFC 3544 IP Header Compression over PPP
  - RFC 1144 Van Jacobson Compression
  - RFC 2507 IP Header Compression
  - RFC 2508 Compressed RTP

The screenshot shows a configuration window for Network Control Protocol (NCP). The 'Network Control Protocol' dropdown is set to 'IPCP'. Under the 'Options' section, the 'Option type' dropdown is set to 'IP Compression Protocol'. Below this, there is a sub-section with an 'Enable' checkbox checked and a dropdown menu set to 'IPHC'. To the right of this sub-section are two lists of server addresses: 'IP Address', 'IP Compression Protocol', 'Primary DNS Server Address', 'Primary NBNS Server Address', 'Secondary DNS Server Address', and 'Secondary NBNS Server Address'. Below these lists are two more dropdown menus: one for 'No Compression', 'Van Jacobson Compression', and 'IPHC' (which is selected), and another for 'Max Time' set to '1'. At the bottom of the sub-section, there are input fields for 'TCP Space' (15), 'Non TCP Space' (15), 'Max Period' (256), 'Max Time' (5), 'Max Header' (168), and a 'Compress RTP' checkbox which is unchecked.

# BCP Configuration

- Supports the following BCP standard
  - BCP in RFC 3518 (Point-to-Point (PPP) Bridging Control Protocol) standard

☒ NCP

Network Control Protocol: IPCP

Options

Option type: IP Address

☐ IP Address

☐ IP Compression Protocol

☐ Primary DNS Server Address

☐ Primary NBNS Server Address

☐ Secondary DNS Server Address

☐ Secondary NBNS Server Address

☐ Peer IP Address

0 . 0 . 0 . 0

☒ NCP

Network Control Protocol: BCP

Options

Option type: Bridge Identification

☐ Select

LAN Segment

Bridge

Bridge Identification

Line Identification

MAC-Support

Tinygram-Compression

MAC-Address

Spanning-Tree-Protocol

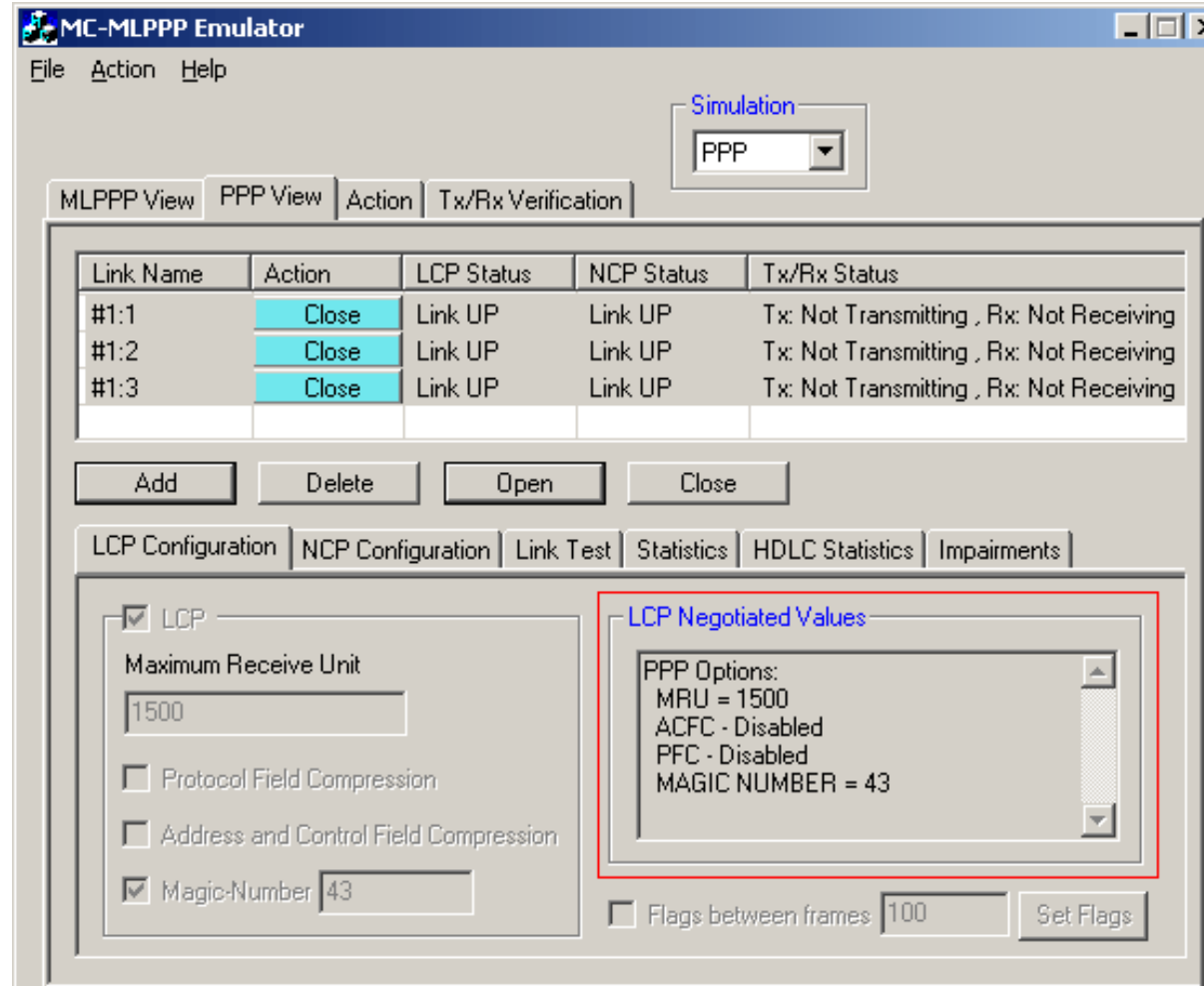
IEEE 802 Tagged Frame

Management Inline

Bridge Control Packet Indicator

# LCP and NCP Negotiation

- The negotiated LCP values will be displayed, once the link is UP
- Dynamically add/remove (open/close) PPP links without loss in data



# Link Test at PPP Level

- Tests link connectivity by sending an echo request and receiving an echo reply
- When the link is up, the test will be started by sending/receiving echo messages

The screenshot shows a network management interface with a tabbed menu at the top: LCP Configuration, NCP Configuration, Link Test (selected), Statistics, HDLC Statistics, and Impairments. The Link Test configuration area contains an 'Enable' checkbox which is checked. Below it, the 'Max Echo Request' is set to -1 with a note '(Enter -1 for Infinite)'. The 'Data' field contains 'DA'. To the right, a 'Statistics' box shows 'Number of Echo Requests sent' as 6 and 'Number of Echo Reply received' as 6, with a 'Reset' button above the first value.

Field	Value
Enable	<input checked="" type="checkbox"/>
Max Echo Request	-1 (Enter -1 for Infinite)
Data	DA
Statistics	
Number of Echo Requests sent	6
Number of Echo Reply received	6

# Link Test at PPP Level

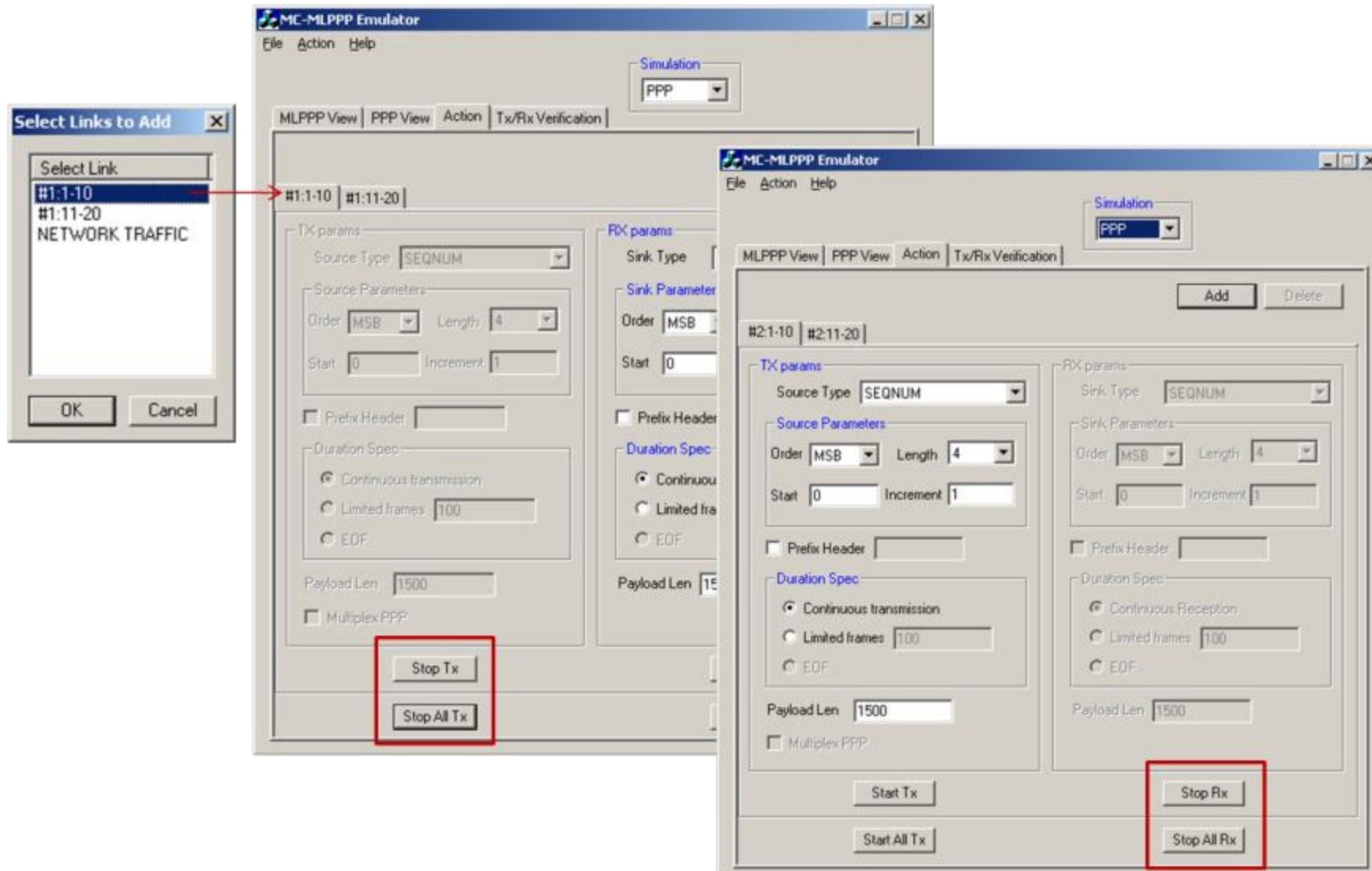
- Parameters include: Max Echo Request, Data, and Statistics
- Max-Echo-Request option allows the user to specify the number of times link should be tested
  - If the count is 0 (zero), then link will not be tested
  - If the count is 'n' , then the link will be tested for n times
  - If it is -1, then it will be tested infinite number of times, until the link goes down
- Data field specifies the data to be carried as Payload in Echo Request Message
- Statistics will provide the number of requests sent and number of replies received

# Transmit and Receive Functions

- PPP traffic can be generated, received, and verified on each PPP link individually
- Sequence numbers (1,2,4 or 8 least significant byte first (LSB) or most significant byte first (MSB)) with configurable start sequence numbers and increments
- User defined HEX string frame, which is ASCII based. Can be edited, loaded and saved
- Binary flat files that allows user to provide any random data
- GL \*.HDL trace file is GL's packet file format which can be constructed pre-hand or captured using MLPPP Analyzer
- Network traffic (LAN traffic) - In bridge or router mode
- User configurable Tx / Rx duration and payload length for each PPP link
- User selectable PPP multiplexing option for each PPP link

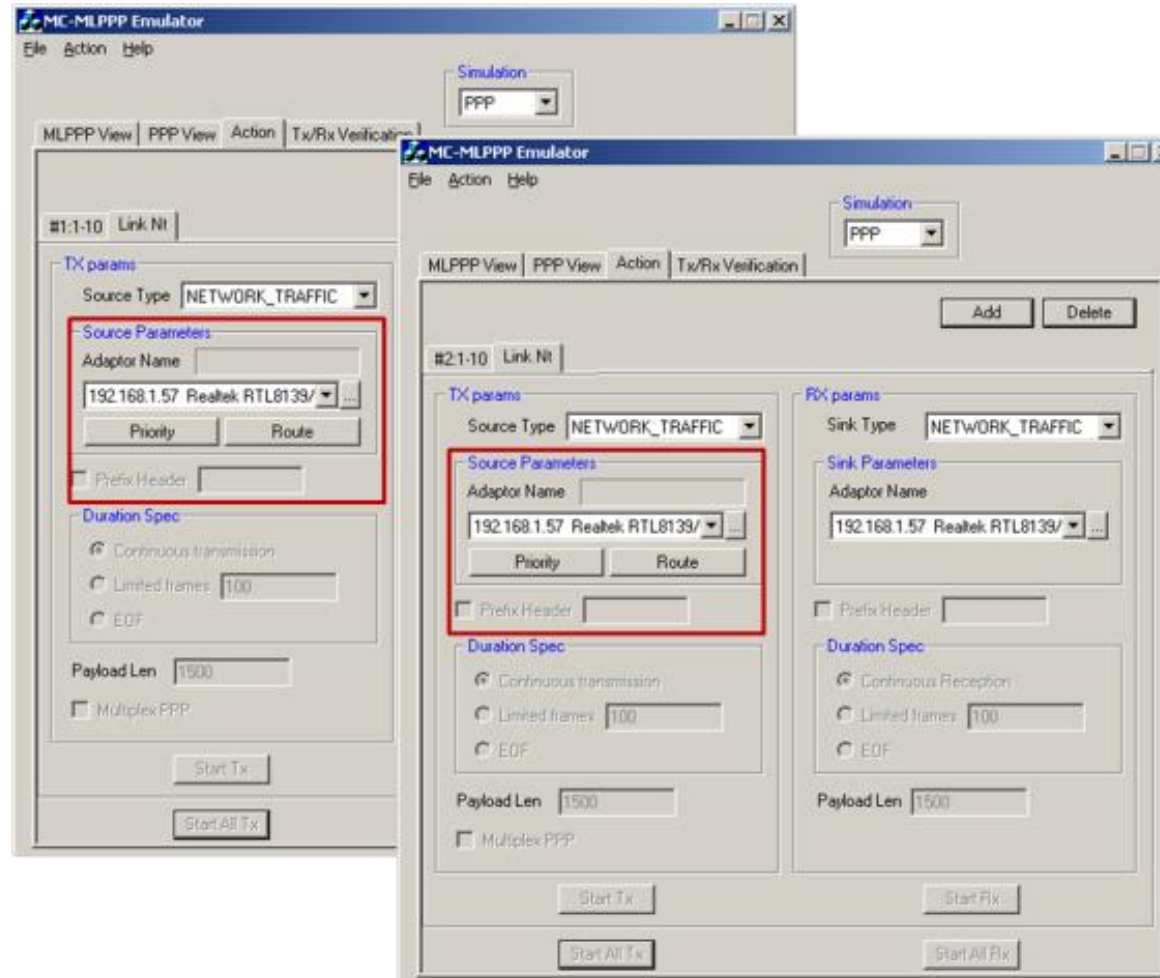


# Tx Rx at PPP Level



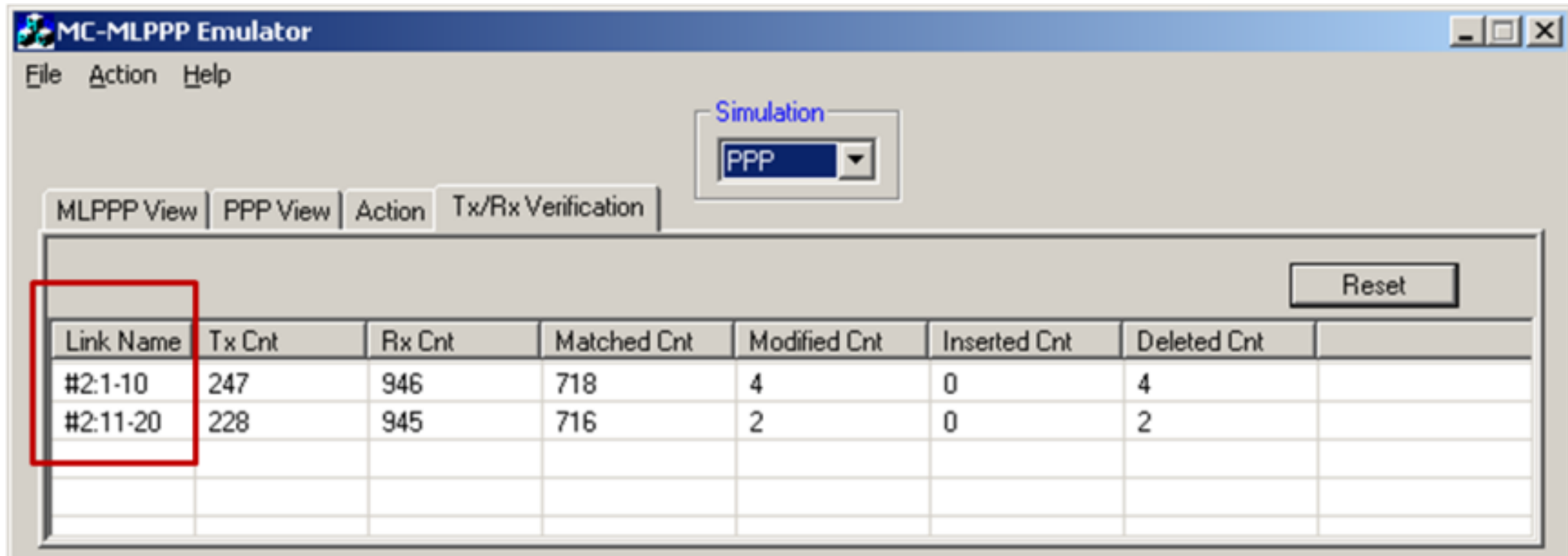
# Tx Rx Network Traffic at PPP Level

- Allows user to receive traffic from Ethernet, convert to PPP traffic and send through T1/E1 line and vice versa
- Emulator can be configured in bridge or route mode



# Tx Rx Verification

- Tx Rx Verification is common GUI that shows Tx/Rx results for each class (in case of MLPPP) or for each link (in case of PPP)



Link Name	Tx Cnt	Rx Cnt	Matched Cnt	Modified Cnt	Inserted Cnt	Deleted Cnt	
#2:1-10	247	946	718	4	0	4	
#2:11-20	228	945	716	2	0	2	

# Impairments at PPP Level

- 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

# Impairments at PPP Level

**Original Frame**

FF	03	00	3D	80	00	00	02
00	21	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

**Impairment : INS ABCD, OFF 10**

FF	03	00	3D	80	00	00	02
00	21	AB	CD	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**

FF	03	00	3D	80	00	00	04
00	21	01	30	A0	CD	40	80
12	54	67	54	33	65	23	95
A1	2D	34	AB	65	76	F4	F5
AC	23	43	A3	24	5C	76	C2
1C	A3	D4	EF	F5	65	F2	81

**Impairment : DEL 10, OFF 10**

FF	03	00	3D	80	00	00	04
00	21	33	65	23	95	A1	2D
34	AB	65	76	F4	F5	AC	23
43	A3	24	5C	76	C2	1C	A3
D4	EF	F5	65	F2	81		

# Impairments at PPP Level

**Original Frame**

FF	03	00	3D	80	00	00	04
00	21	01	30	A0	CD	40	80
12	54	67	54	33	65	23	95
A1	2D	34	AB	65	76	F4	F5
AC	23	43	A3	24	5C	76	C2
1C	A3	D4	EF	F5	65	F2	81

**Impairment: OR 0xFF, OFF10**

FF	03	00	3D	80	00	00	04
00	21	FF	30	A0	00	40	80
12	54	67	54	33	65	23	95
A1	2D	34	AB	65	76	F4	F5
AC	23	43	A3	24	5C	76	C2
1C	A3	D4	EF	F5	65	F2	81

**Impairment: AND 0x00, OFF13**

FF	03	00	3D	80	00	00	04
00	21	01	30	A0	00	40	80
12	54	67	54	33	65	23	95
A1	2D	34	AB	65	76	F4	F5
AC	23	43	A3	24	5C	76	C2
1C	A3	D4	EF	F5	65	F2	81

**Impairment: XOR 0x0A, OFF12**

FF	03	00	3D	80	00	00	04
00	21	FF	30	55	CD	40	80
12	54	67	54	33	65	23	95
A1	2D	34	AB	65	76	F4	F5
AC	23	43	A3	24	5C	76	C2
1C	A3	D4	EF	F5	65	F2	81

# Impairments at PPP Level

The image shows two windows from the MC-MLPPP Emulator. The top window is the 'Impairments' configuration panel, and the bottom window is the 'MC-MLPPP Emulator' main interface.

**Impairments Configuration Panel:**

- Enable:** ☒
- Impairment Type:** **DELETE BYTES** (selected from a dropdown menu)
- Options:**
  - Byte count: 10
  - Byte Offset: 5
  - Skip Before Impair: 4
- Impairment Duration:**
  - ☐ Repeat 1
  - ☒ Continuous
- Activate:** [Button]
- Delay:** 250 msec [Apply]

**Dropdown Menu Options:** DELETE FRAME, INSERT FRAME, DELETE BYTES, INSERT BYTES, DUPLICATE FRAME, CRC ERROR, FRAME ERROR, AND, OR, XOR.

**MC-MLPPP Emulator Main Interface:**

- Simulation:** **PPP** (selected from a dropdown menu)
- Views:** MLPPP View | **PPP View** | Action | Tx/Rx Verification
- Reset:** [Button]
- Table:**

Link Name	Tx Cnt	Rx Cnt	Matched Cnt	Modified Cnt	Inserted Cnt	Deleted Cnt
#2:1-10	247	946	718	4	0	4
#2:11-20	228	945	716	2	0	2

# Statistics

- PPP Statistics provides important statistics information for the selected PPP link
- Errors that occur during file transmission like the Tx Under/Over Runs, Rx Under/Over Runs, Number of PPP packets with bad FCS and Number of Frame Errors are recorded in the HDLC Statistics

## PPP Statistics

LCP Configuration	NCP Configuration	Link Test	Statistics	DL Statistics	Impairments
Number of octets transmitted		1624	Reset		
Number of total frames transmitted		104			
Number of total octets received		1616			
Number of total frames received		102			
Number of PPP packets with bad addresses		0			
Number of PPP packets with bad control bytes		0			
Number of PPP packets too long exceeding the MRU		0			

LCP Configuration	NCP Configuration	Link Test	Statistic	HDLC Statistics	Impairments
Tx Under/Over Runs		104	Reset		
Rx Under/Over Runs		1616			
No of PPP packets bad FCS		102			
No of Frame Errors		0			

## HDLC Statistics

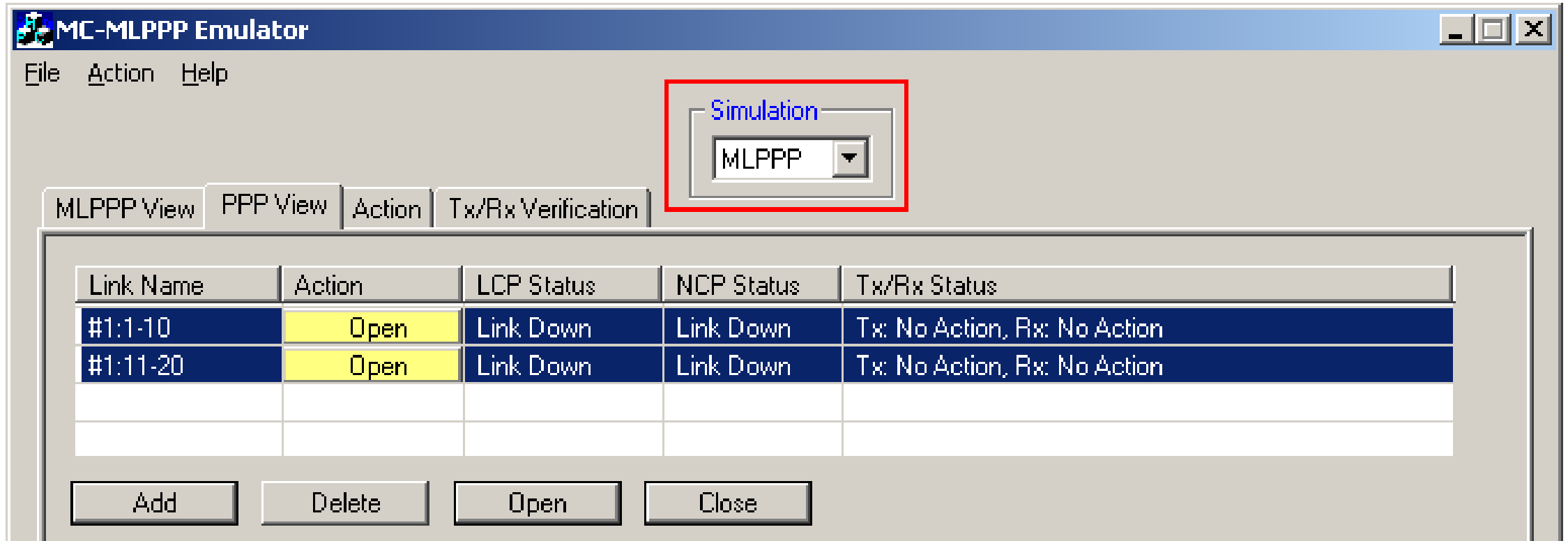
LCP Configuration	NCP Configuration	Link Test	Statistic	HDLC Statistics	Impairments
Tx Under/Over Runs		104	Reset		
Rx Under/Over Runs		1616			
No of PPP packets bad FCS		102			
No of Frame Errors		0			



# MC - MLPPP Simulation

# Adding links to form an MLPPP bundle

- Various PPP links (of any bandwidth varying from 64Kbps to  $n \times 64\text{Kbps}$  or sub channels) can be added to form the MLPPP bundle
- MLPPP bundles multiple link-layer channels into a single network-layer channel



# LCP and NCP Configuration

## MLPPP and MC-MLPPP Level

The screenshot shows the 'MC-MLPPP Emulator' window with the following configuration:

- Simulation:** ☒ MLPPP, ☐ PPP
- Link configuration:** ☐ Link configuration, ☐ Impairments, ☐ Statistics, ☐ Link Test
- MC-MLPPP Options:**
  - Fragment Format: Long Sequence
  - Maximum Receive Reconstructed Unit: 1500
  - ☐ Endpoint Discriminator
    - Class: Locally Assigned
    - Address:
  - ☐ Multi-Class options
    - Suspendable classes: 8
  - PPP in MLPPP:**
    - ☐ Protocol Field Compression
    - ☒ Address and Control Field Compression
    - Maximum Differential Delay: 250 ms
- ☒ **NCP:**
  - Network Control Protocol: IPCP
  - Ncp Over: MLPPP
  - Options:**
    - Option type: IP Address
      - ☐ IP Address: 0 . 0 . 0 . 0
      - ☐ Peer IP Address: 0 . 0 . 0 . 0

# LCP Configuration Options

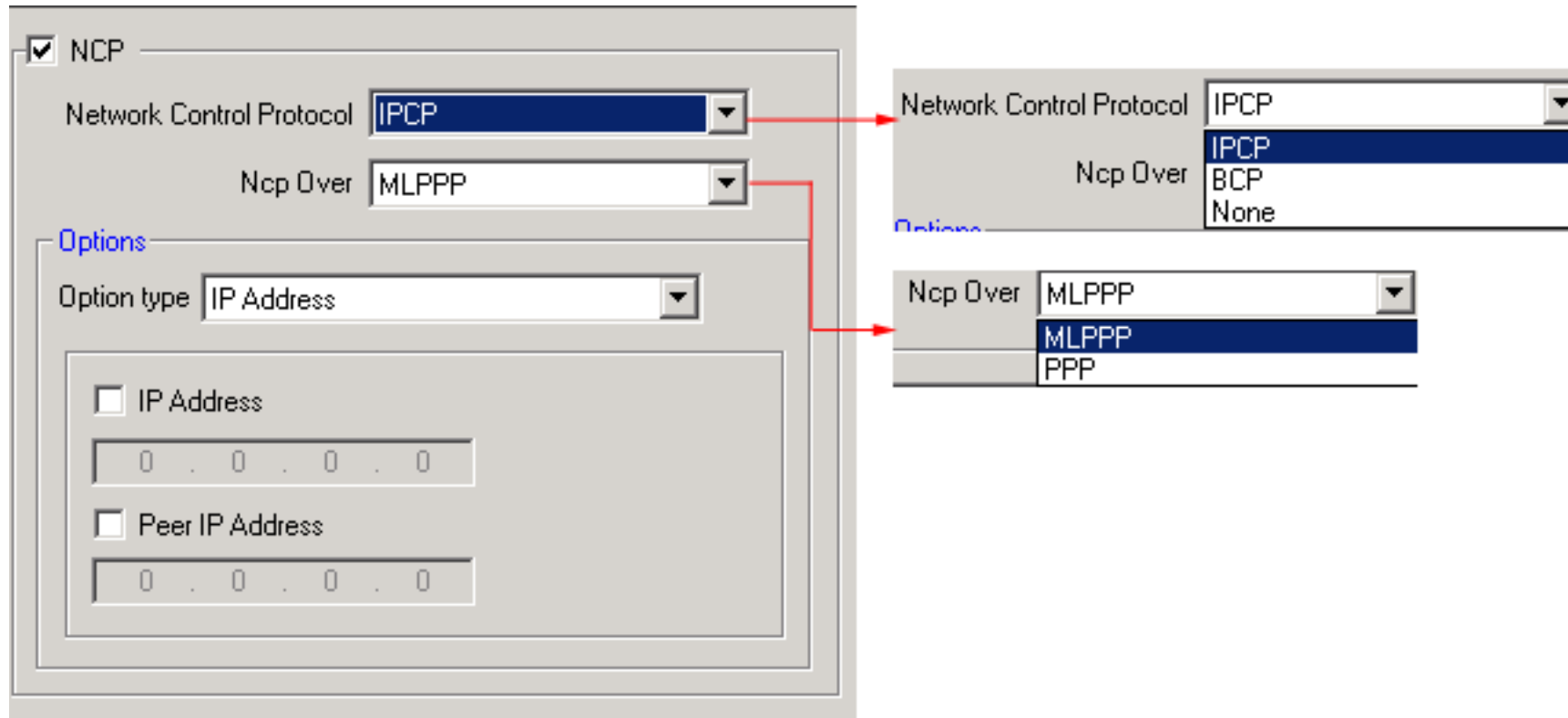
- LCP with the following negotiation options
  - PPP options: MRU, ACFC, PFC, and Magic Number
  - MLPPP Options: MRRU, Short/ Long Sequence Fragment Format, & Endpoint Discrimination
  - Multi-Class Options: Multilink Header Format

## PPP in MLPPP

- ☐ Protocol Field Compression
- ☒ Address and Control Field Compression

# NCP Configuration Options

- Allows user to send NCP packets over MLPPP or PPP
  - NCP Over PPP - It is possible to send NCP packets directly over PPP layer even though the emulator has been configured for MLPPP simulation
  - NCP over MLPPP - The NCP negotiation will occur over MLPPP Layer
- The NCP status column in PPP view shows NCP layer status per link in PPP simulation. In MLPPP simulation, it shows the status of the entire MLPPP bundle



# LCP and NCP Negotiation

MC-MLPPP Emulator

File Action Help

Simulation  
MLPPP

MLPPP View PPP View Action Tx/Rx Verification

Link Name	Action	LCP Status	NCP Status	Tx/Rx Status
#2:1-10	Close	Link UP	Link UP	Tx: No Action, Rx: No Action
#2:11-20	Close	Link UP	Link UP	Tx: No Action, Rx: No Action

Add Delete Open Close

LCP Configuration NCP Configuration Link Test Statistics HDLC Statistics Impairments

☒ LCP

Maximum Receive Unit  
1500

☐ Protocol Field Compression

☐ Address and Control Field Compression

☐ Magic-Number 189

LCP Negotiated Values

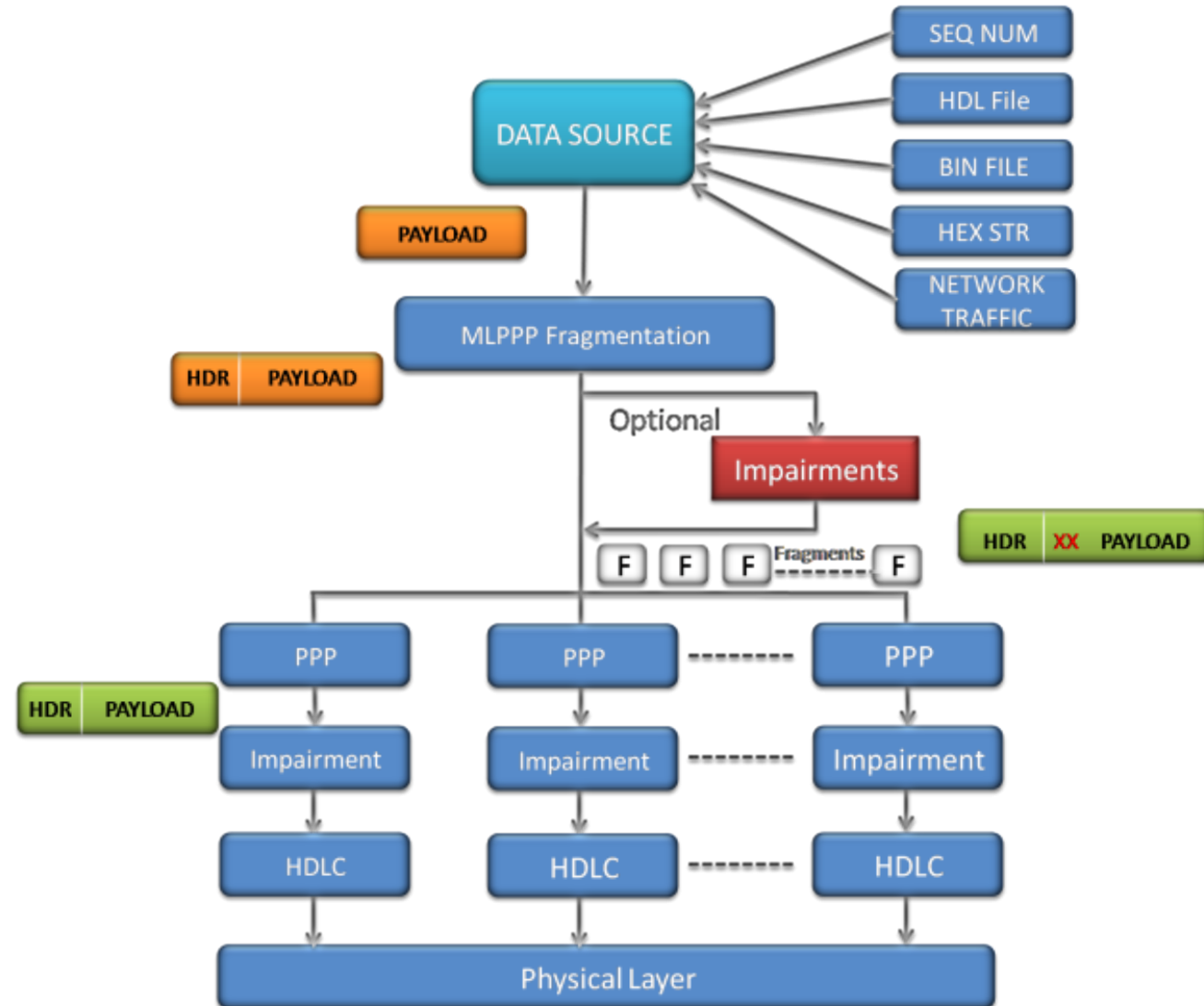
MRU = 1500  
ACFC - Disabled  
PFC - Disabled  
MLPPP Options:  
MRRU = 1500  
Long Sequence

☐ Flags between frames 100 Set Flags

# Tx Rx at MC-ML PPP Level

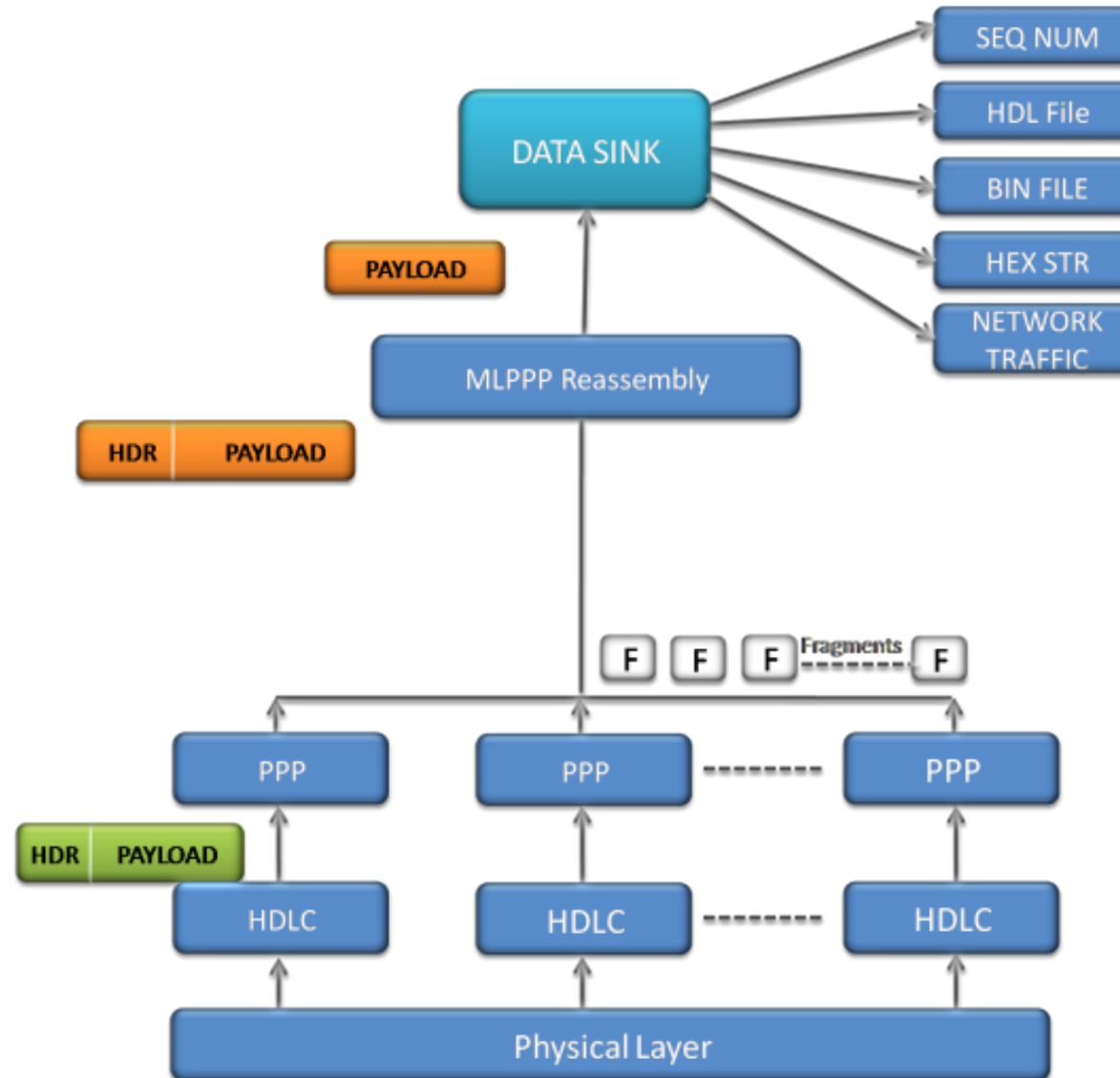
- MLPPP traffic can be generated, received, and verified over multiple classes and MLPPP bundles
- Different source/sink types for each class independently -
  - Sequence numbers (1,2,4 or 8 least significant byte first (LSB) or most significant byte first (MSB)) with configurable start sequence numbers and increments
  - User defined HEX string frame, which is ASCII based. Can be edited, loaded and saved
  - Binary flat files that allows user to provide any random data
  - GL \*.HDL trace file is GL's packet file format which can be constructed pre-hand or captured using MLPPP Analyzer
  - Network traffic (LAN traffic) - In bridge or router mode
- User Configurable ML PPP Packet Size and Fragment Size per class
- Tx/Rx Duration Parameters: Continuous, Limited Frames, EOF (End of File)
- User selectable PPP multiplexing option for each class

# Transmit Functions



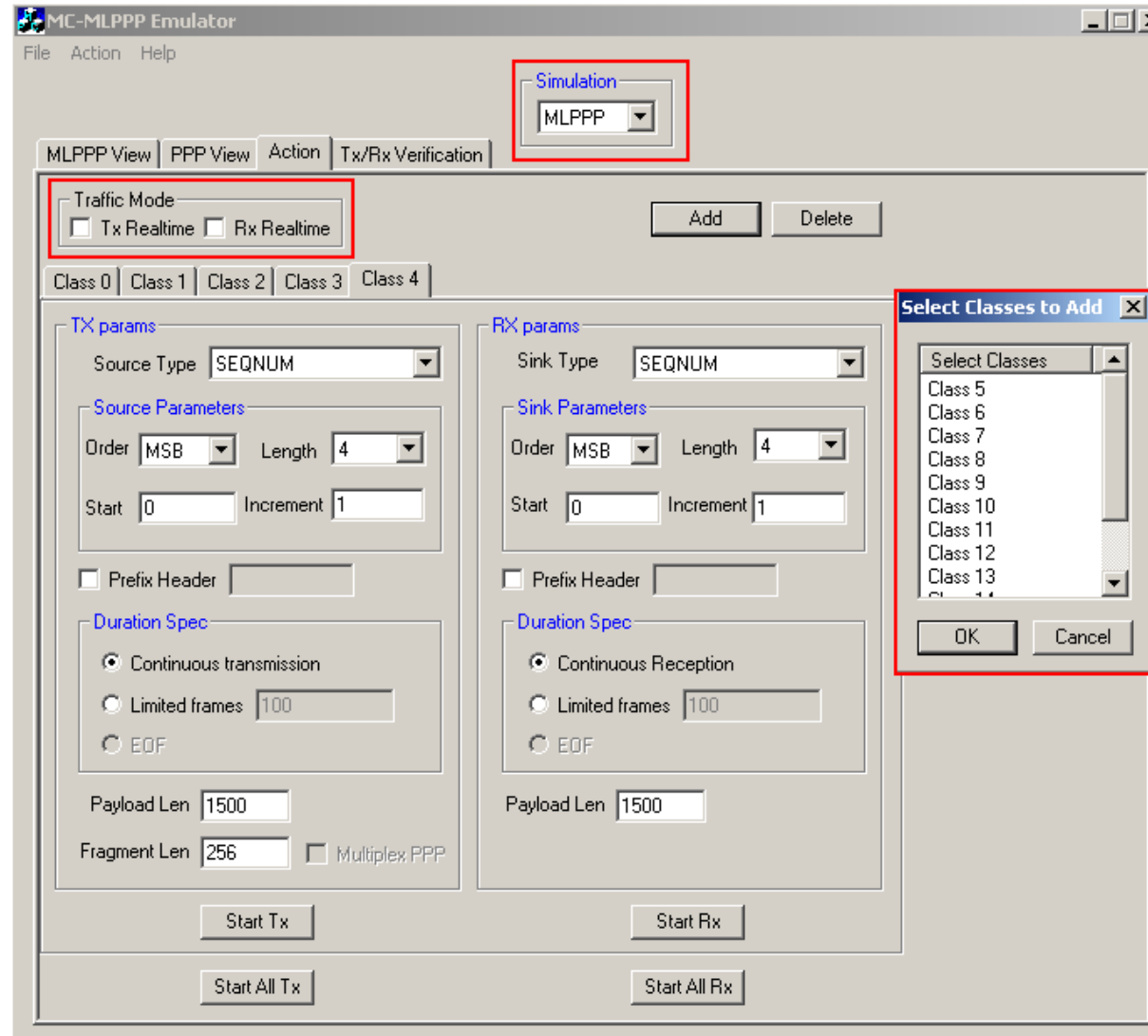


# Receive Functions



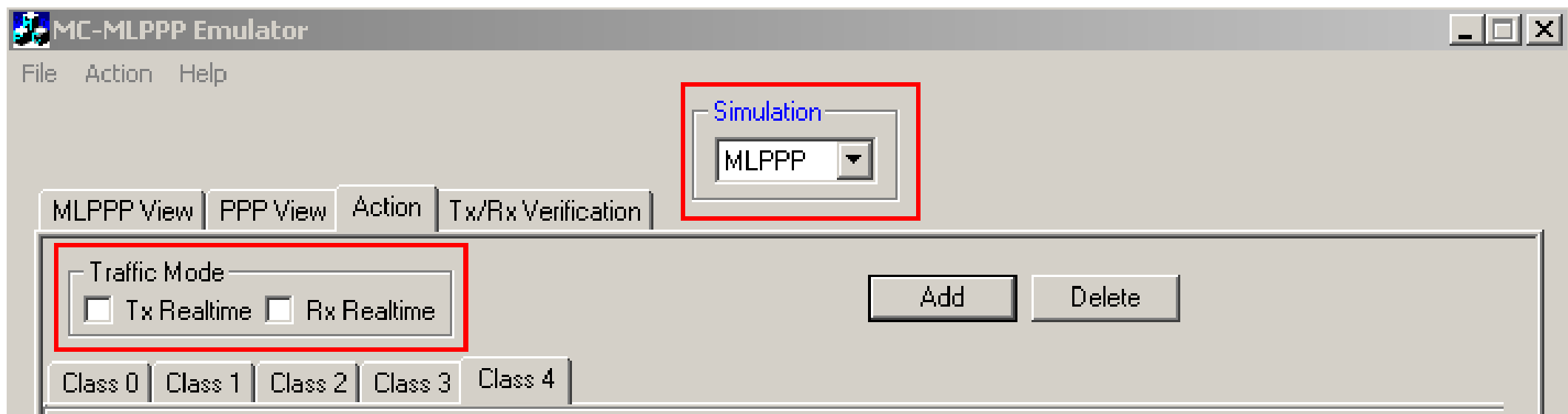
# Tx Rx at MC-ML PPP Level

- Traffic is generated and received on the entire MLPPP bundle for various classes



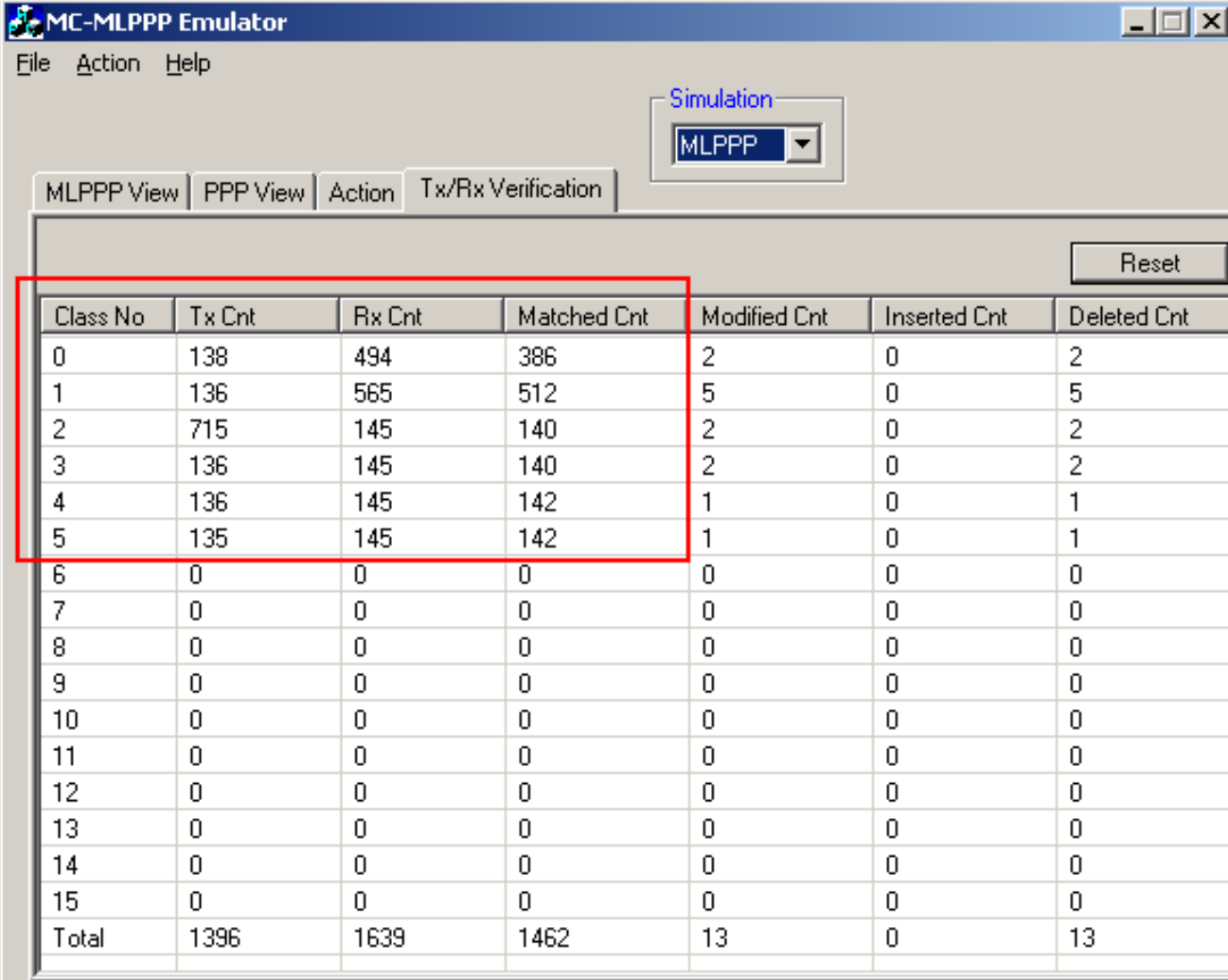
# Tx Rx at MC-ML PPP Level

- Traffic mode provides an option to maintain timing between frames
- Emulator configured as router (using NETWORK TRAFFIC source and sink type) requires to maintain the timing while forwarding packets from Ethernet to T1/E1 and vice versa
  - Tx Real-time: Maintains timing while forwarding packet from NIC to T1/E1
  - Rx Real-time: Maintains timing while forwarding packet from T1/E1 to NIC



# Tx Rx Verification

- Tx Rx Verification is common GUI that shows Tx/Rx results for each class (in case of MLPPP) or for each link (in case of PPP)

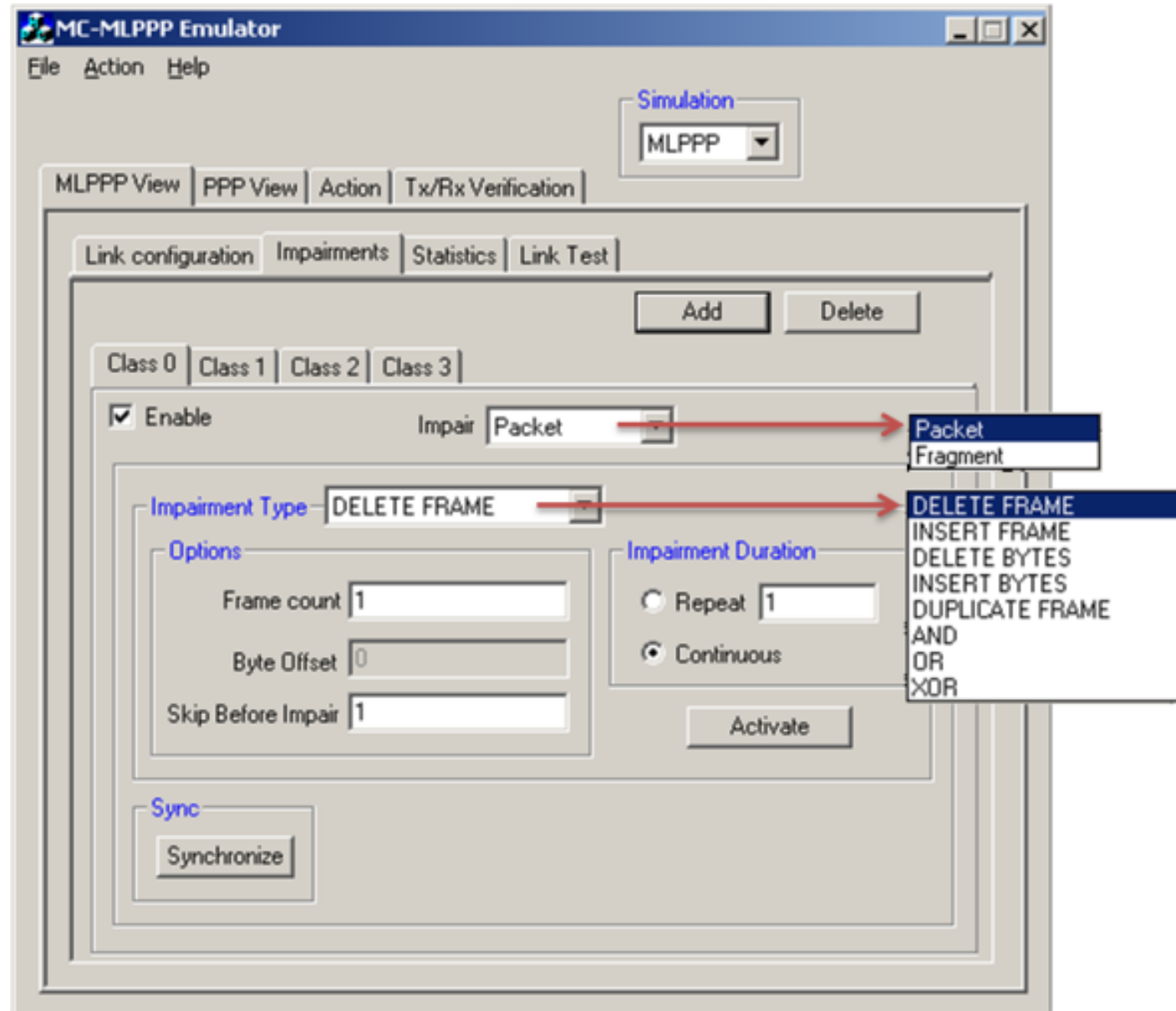


Class No	Tx Cnt	Rx Cnt	Matched Cnt	Modified Cnt	Inserted Cnt	Deleted Cnt
0	138	494	386	2	0	2
1	136	565	512	5	0	5
2	715	145	140	2	0	2
3	136	145	140	2	0	2
4	136	145	142	1	0	1
5	135	145	142	1	0	1
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
Total	1396	1639	1462	13	0	13

# Impairments at MLPPP Level

- Supports various Fragment/Packet level impairments at MLPPP level for each class and/or for any of the PPP links in the bundle
- Impairment Types Include
  - Delete Frame
  - Insert Frame
  - Delete Bytes
  - Insert Bytes
  - Duplicate Frame
  - Bitwise ANDing octets
  - Bitwise Oring octets
  - Bitwise XORing octets

# Impairments at MLPPP Level



# Impairments at MLPPP Level

MC-MLPPP Emulator

File Action Help

Simulation

MLPPP

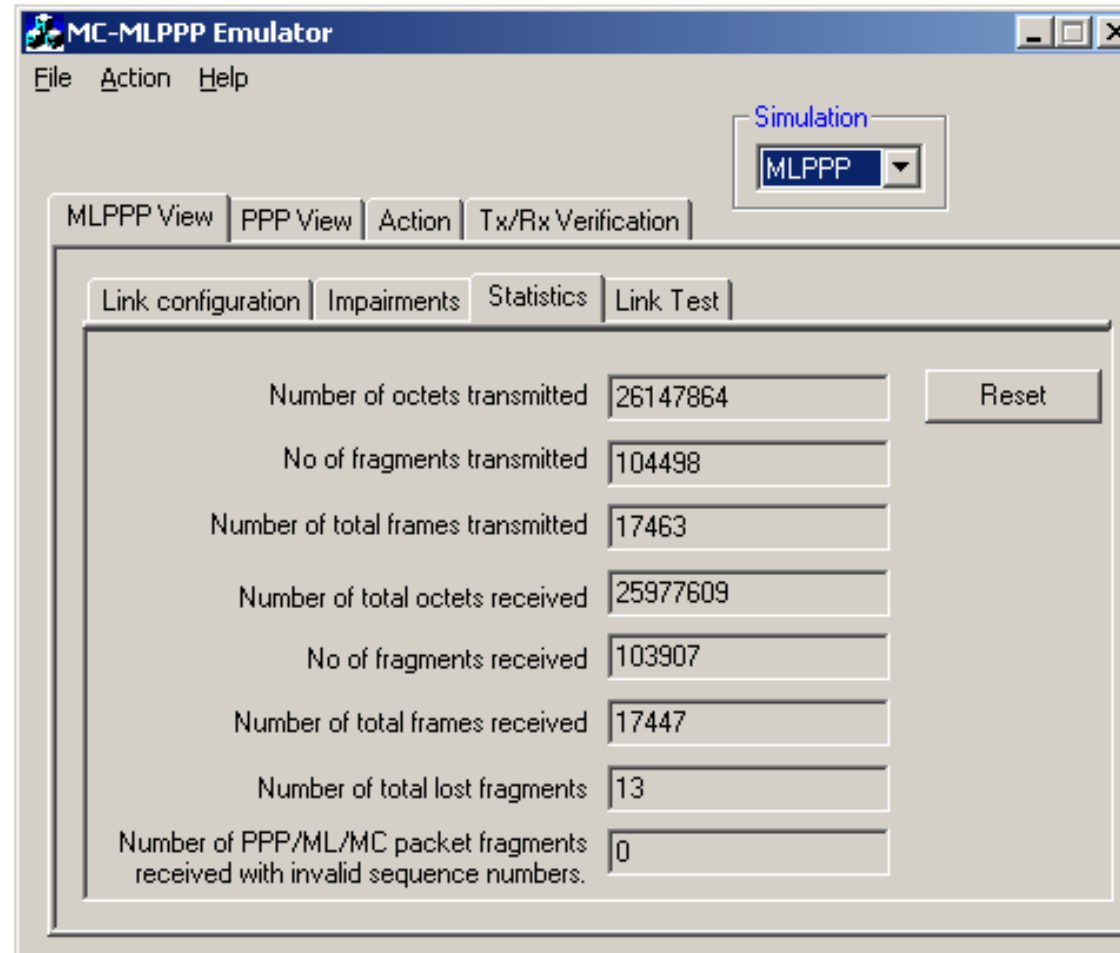
MLPPP View PPP View Action Tx/Rx Verification

Reset

Class No	Tx Cnt	Rx Cnt	Matched Cnt	Modified Cnt	Inserted Cnt	Deleted Cnt
0	524	338	327	5	0	166
1	523	505	496	4	0	4
2	523	324	313	3	0	178
3	522	694	497	3	187	3
4	522	505	494	2	0	2
5	1044	1012	1000	4	0	4
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
Total	3658	3378	3127	21	187	357

# Statistics

- Provides important information about the MLPPP bundle –
  - Number of transmitted/received octets, frames, fragments
  - Number of lost fragments, and
  - Number of PPP/ML/MC packet fragments received with invalid sequence numbers



The screenshot shows the 'MC-MLPPP Emulator' window with the 'Statistics' tab selected. The window has a menu bar with 'File', 'Action', and 'Help'. Below the menu bar is a 'Simulation' dropdown menu set to 'MLPPP'. The main area contains several tabs: 'Link configuration', 'Impairments', 'Statistics', and 'Link Test'. The 'Statistics' tab is active, displaying a list of statistics with their corresponding values in text boxes. A 'Reset' button is located to the right of the first two statistics.

Statistic	Value
Number of octets transmitted	26147864
No of fragments transmitted	104498
Number of total frames transmitted	17463
Number of total octets received	25977609
No of fragments received	103907
Number of total frames received	17447
Number of total lost fragments	13
Number of PPP/ML/MC packet fragments received with invalid sequence numbers.	0

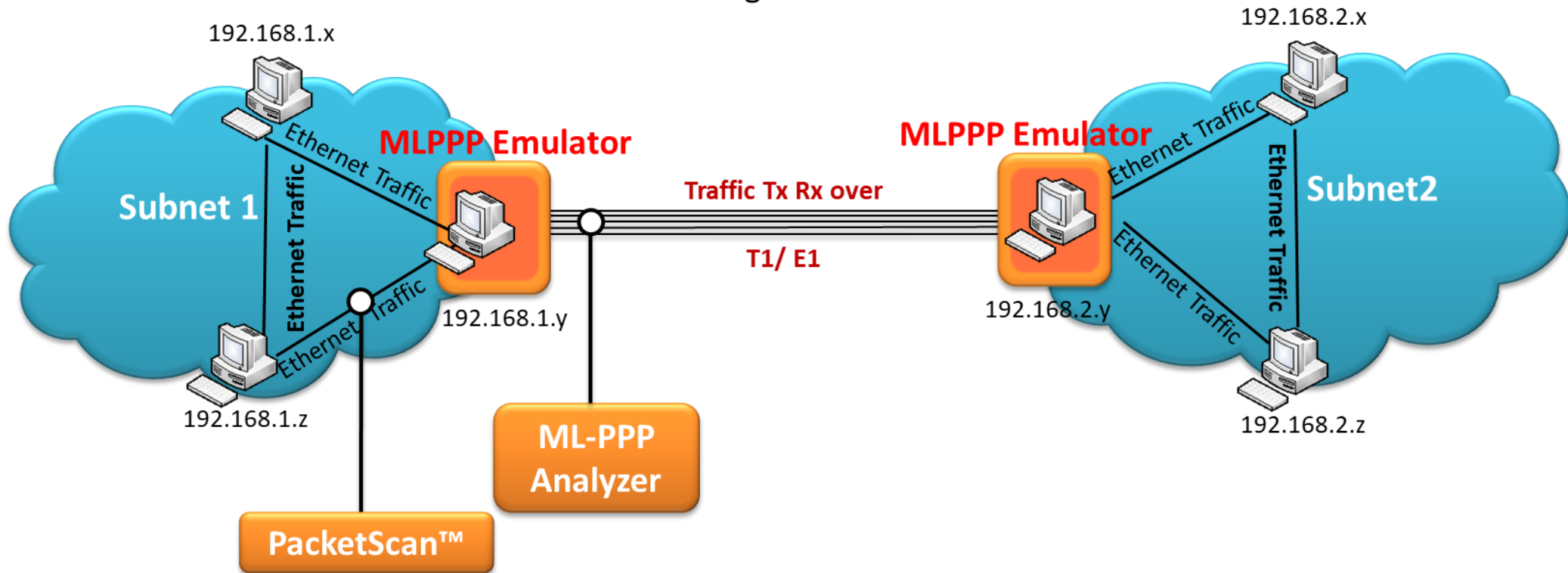


# MLPPP Emulator as Bridge and Router

- To establish connection between two machines residing in two LANs, MLPPP emulator can be configured to work as –
  - MLPPP router (if IPCP type of negotiation is used)
  - or
  - MLPPP Bridge (if BCP type of negotiation is used)

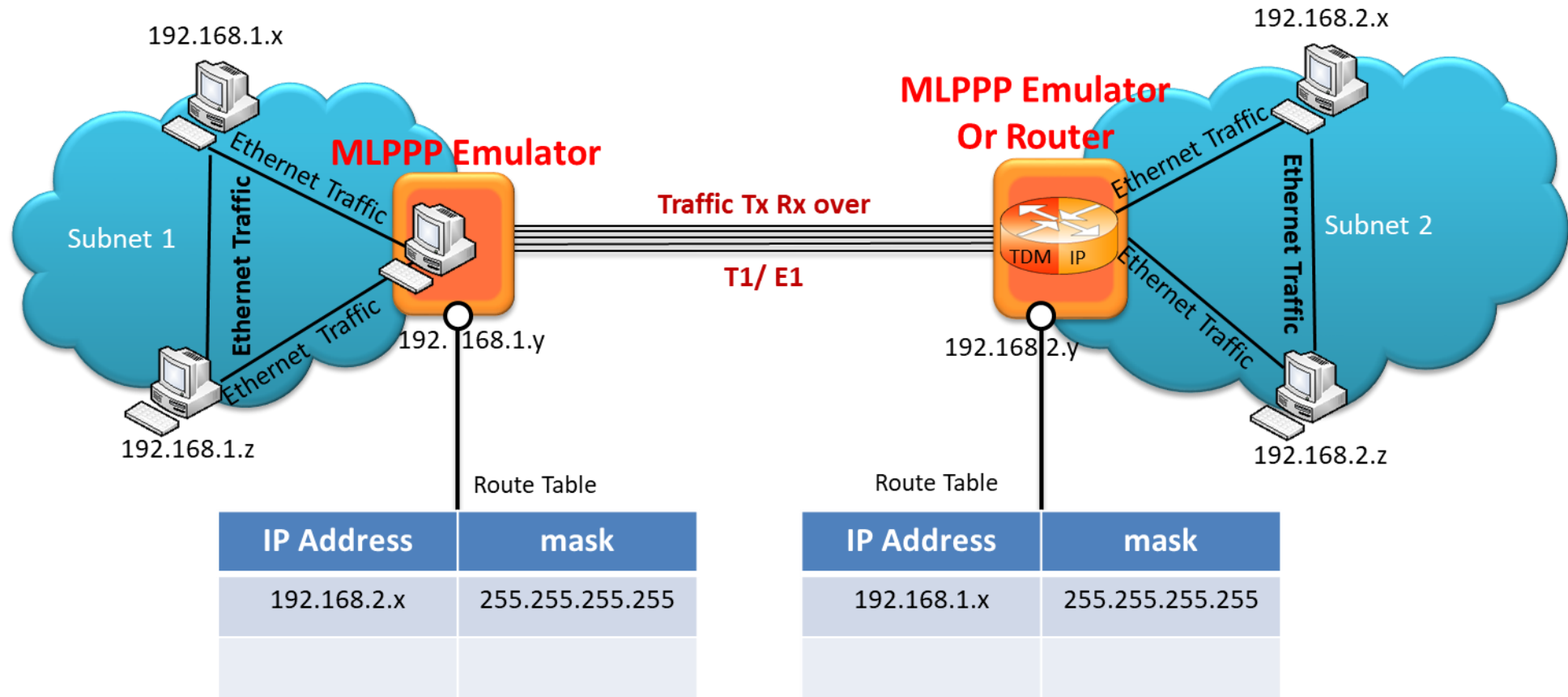
# MC-MLPPP Emulator in Bridge Mode

In Bridge Mode



# MC-MLPPP Emulator in Router Mode

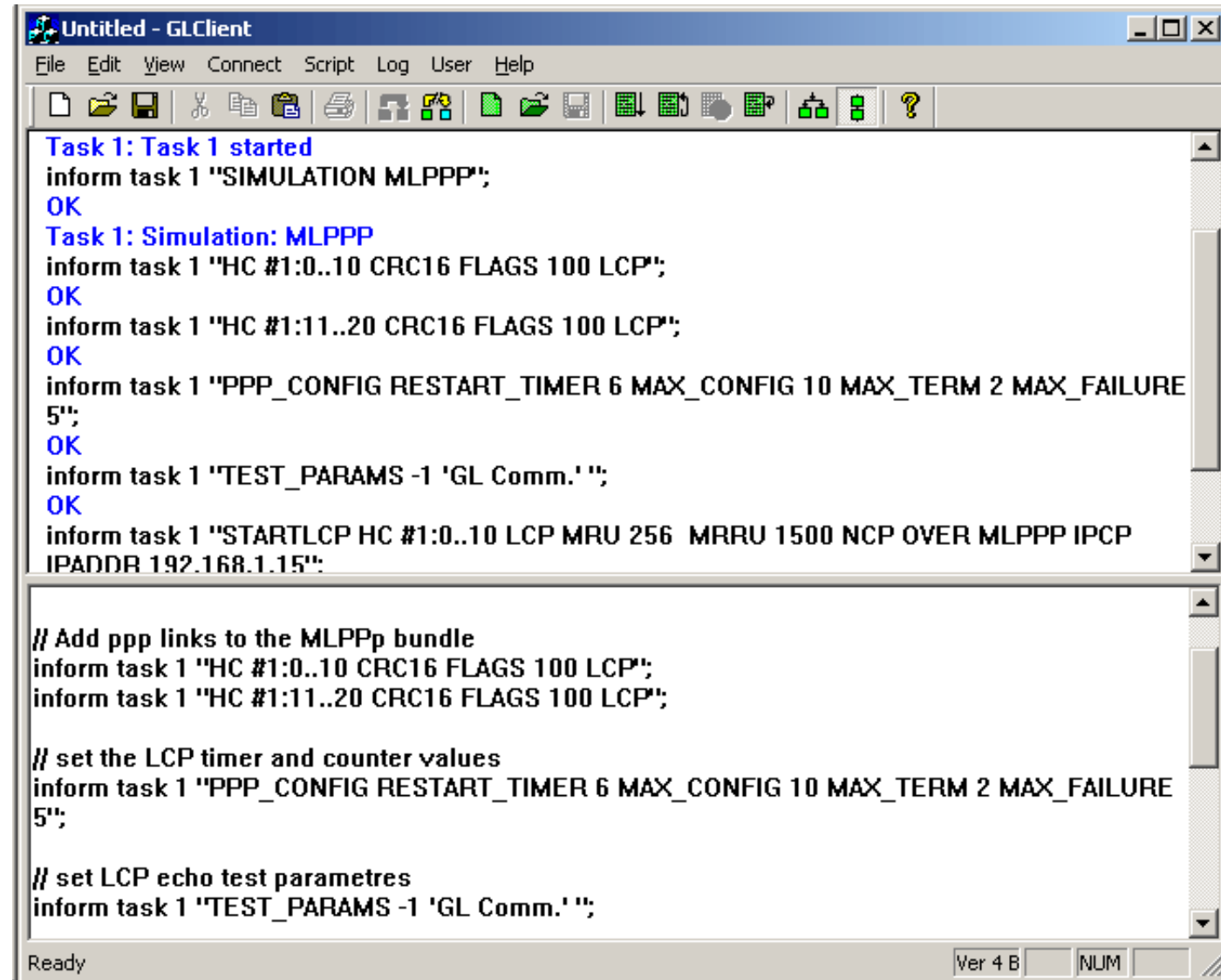
In Routing Mode



# Simulation using Command Line MLPPPTerr Module

# MC- ML PPP Emulator Command Line

- Sends and receives ML PPP frames with or without impairments
- Displays the command syntax, Logs the events
- Lower pane in the screen displays the script; upper pane displays the script and the server responses



The screenshot shows a window titled "Untitled - GLClient" with a menu bar (File, Edit, View, Connect, Script, Log, User, Help) and a toolbar. The main area is divided into two panes. The upper pane shows a sequence of commands and responses for a task named "Task 1". The lower pane shows a script for adding PPP links and setting LCP parameters.

```
Task 1: Task 1 started
inform task 1 "SIMULATION MLPPP";
OK
Task 1: Simulation: MLPPP
inform task 1 "HC #1:0..10 CRC16 FLAGS 100 LCP";
OK
inform task 1 "HC #1:11..20 CRC16 FLAGS 100 LCP";
OK
inform task 1 "PPP_CONFIG RESTART_TIMER 6 MAX_CONFIG 10 MAX_TERM 2 MAX_FAILURE 5";
OK
inform task 1 "TEST_PARAMS -1 'GL Comm.' ";
OK
inform task 1 "STARTLCP HC #1:0..10 LCP MRU 256 MRRU 1500 NCP OVER MLPPP IPCP IPADDR 192.168.1.15";

// Add ppp links to the MLPPp bundle
inform task 1 "HC #1:0..10 CRC16 FLAGS 100 LCP";
inform task 1 "HC #1:11..20 CRC16 FLAGS 100 LCP";

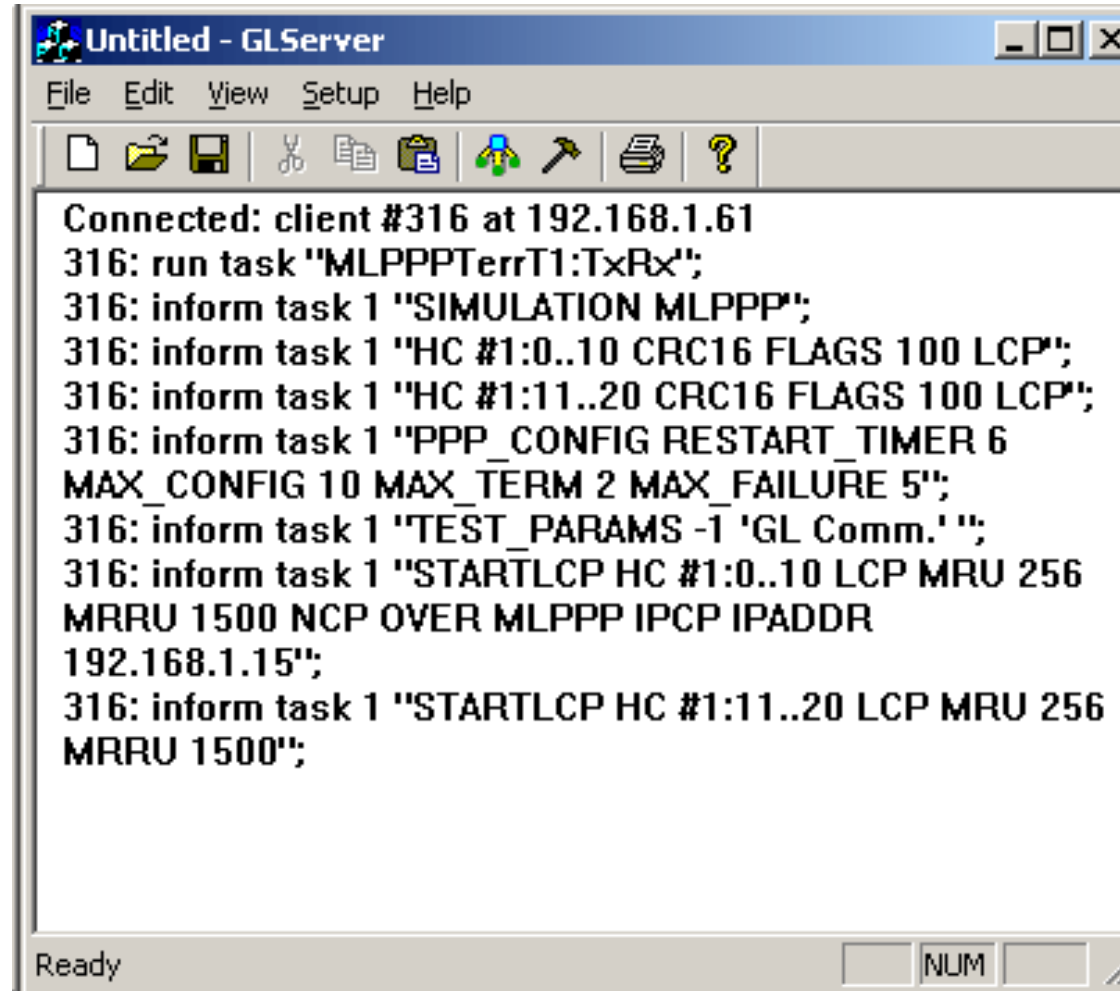
// set the LCP timer and counter values
inform task 1 "PPP_CONFIG RESTART_TIMER 6 MAX_CONFIG 10 MAX_TERM 2 MAX_FAILURE 5";

// set LCP echo test parameters
inform task 1 "TEST_PARAMS -1 'GL Comm.' ";
```

Ready Ver 4 B NUM

# MC- ML PPP Emulator Command Line T1 / E1 Server

- Logs the commands and tasks from the client



The screenshot shows a window titled "Untitled - GLServer" with a menu bar (File, Edit, View, Setup, Help) and a toolbar. The main text area contains the following log entries:

```
Connected: client #316 at 192.168.1.61
316: run task "MLPPPTerrT1:TxRx";
316: inform task 1 "SIMULATION MLPPP";
316: inform task 1 "HC #1:0..10 CRC16 FLAGS 100 LCP";
316: inform task 1 "HC #1:11..20 CRC16 FLAGS 100 LCP";
316: inform task 1 "PPP_CONFIG RESTART_TIMER 6
MAX_CONFIG 10 MAX_TERM 2 MAX_FAILURE 5";
316: inform task 1 "TEST_PARAMS -1 'GL Comm.'";
316: inform task 1 "STARTLCP HC #1:0..10 LCP MRU 256
MRRU 1500 NCP OVER MLPPP IPCP IPADDR
192.168.1.15";
316: inform task 1 "STARTLCP HC #1:11..20 LCP MRU 256
MRRU 1500";
```

The status bar at the bottom shows "Ready" and a "NUM" field.

# Sample Script

// Start a task and set the simulation type

```
run task "MLPPPTerrT1:TxRx";  
inform task 1 "SIMULATION MLPPP";
```

// Add PPP links to the MLPPP bundle

```
inform task 1 "HC #1:0..10 CRC16 FLAGS 100 LCP";  
inform task 1 "HC #1:11..20 CRC16 FLAGS 100 LCP";
```

// set the LCP timer and counter values

```
inform task 1 "PPP_CONFIG RESTART_TIMER 6 MAX_CONFIG 10 MAX_TERM 2  
MAX_FAILURE 5";
```

// set LCP echo test parameters

```
inform task 1 "testlcp HC #1:1..31 'GL Comm' -1" ";
```

// start LCP with selected LCP and NCP negotiation options

inform task 1 "STARTLCP HC #1:0..10 LCP MRU 256 MRRU 1500 NCP OVER MLPPP  
IPCP IPADDR 192.168.1.15";

inform task 1 "STARTLCP HC #1:11..20 LCP MRU 256 MRRU 1500";

// Inform the Tx/rx parameters for the desired class

inform task 1 "Rx: CLASS 0 CONT SEQNUM MSB4 FIXLEN 1500";

inform task 1 "Tx: CLASS 0 CONT SEQNUM MSB4 FIXLEN 1500 FRAGSIZE 256";

// Start Tx/Rx

inform task 1 "STARTRX CLASS 0";

inform task 1 "STARTTX CLASS 0";

// Stop Tx/Rx

inform task 1 "STOPTX CLASS 0";

inform task 1 "STOPRX CLASS 0";

// end the task

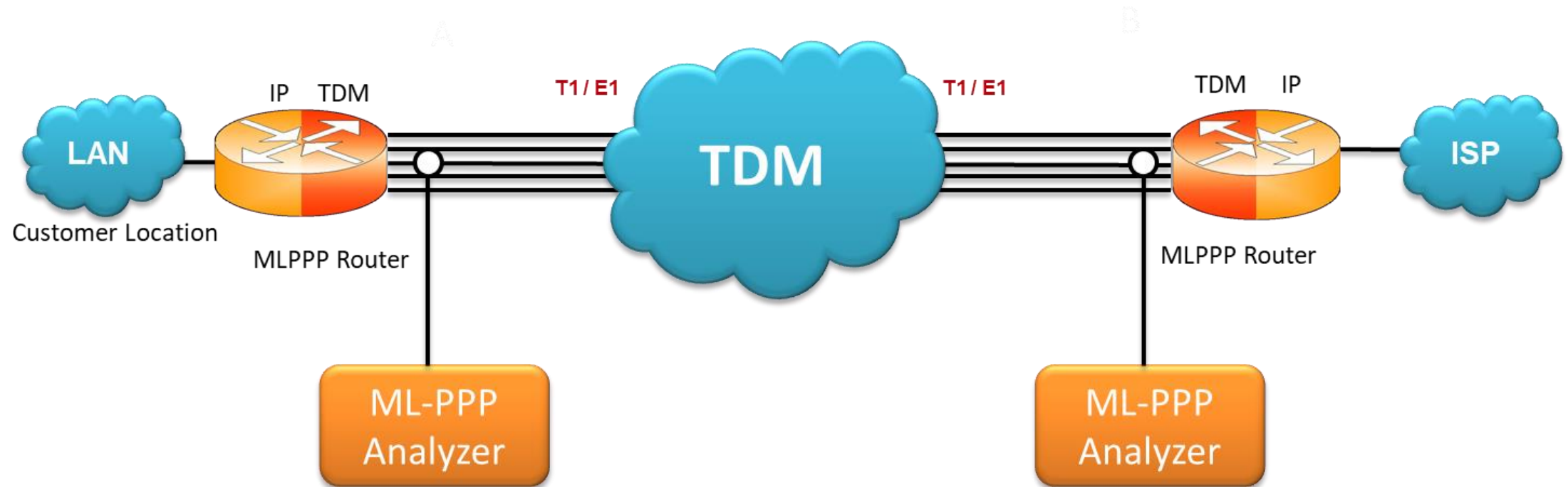
end task 1;



# MLPPP Analyzer

# MLPPP Analyzer

- Ability to decode and analyze PPP, MLPPP, and MC-MLPPP packets exchanged between the two nodes over T1/E1 link
- MLPPP analyzer also supports Packet Data Analysis module (requires additional license) to perform detail analysis of MLPPP packets over IP and segregates them into SIP / H323 / MEGACO/ MGCP / T.38 Fax calls



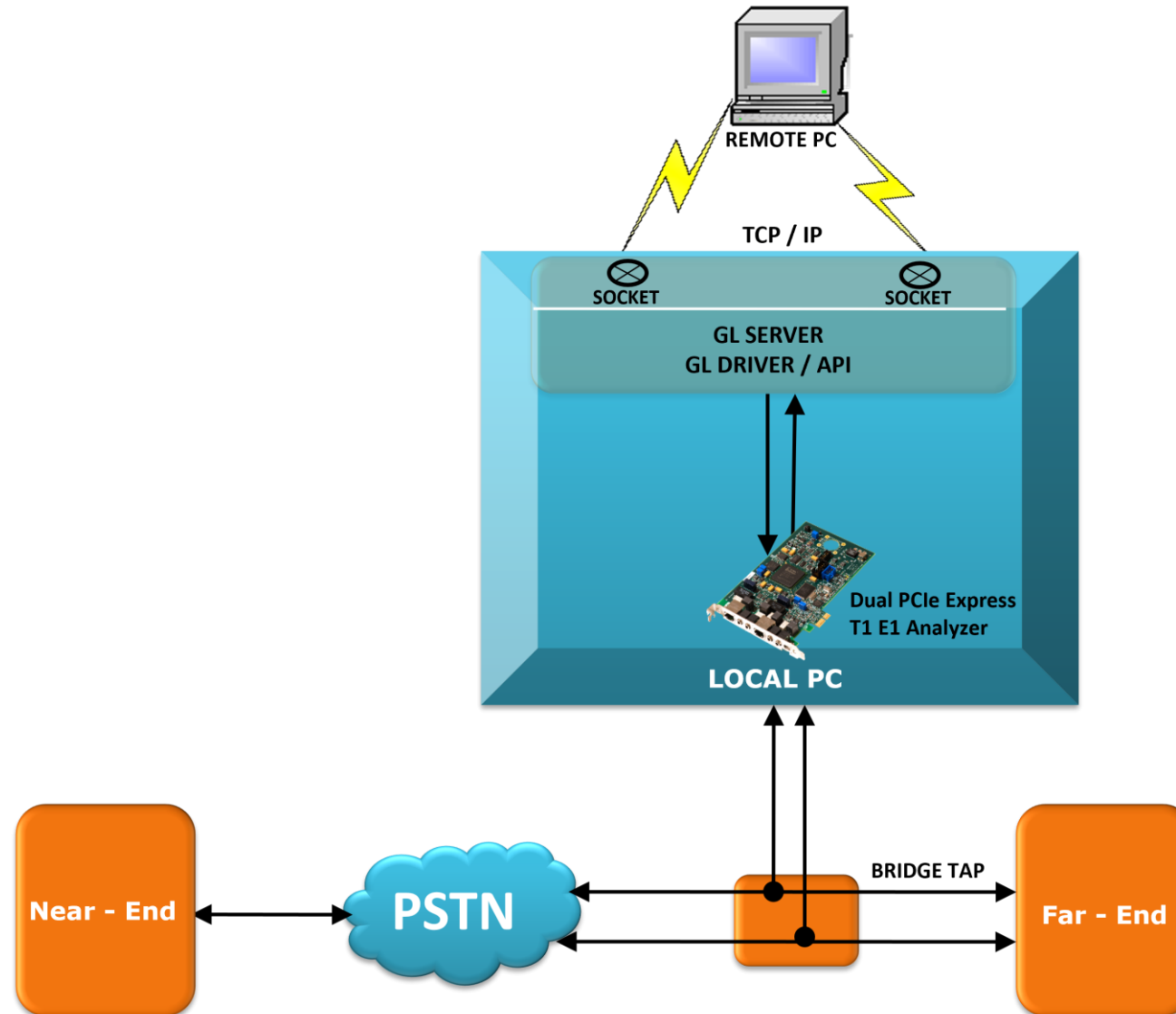
# Features

- Ability to capture and decode both PPP routed protocols, PPP bridged protocols, MLPPP and MC-MLPPP streams of data
- Ability to test and perform numerous measurements across WAN- LAN or LAN-LAN connection
- Ability to test and analyze HDLC based PPP protocol, PPP SIGTRAN, and PPP over IP protocols in synchronous environment
- Supports decoding of frames with two MLPPP layers
- Supports reassembly of captured MLPPP fragments
- Multiple bundle of MLPPP traffic on various T1/E1 channels can be decoded simultaneously in the same or different GUI instances
- 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
- Remote monitoring capability using GL's Network Surveillance System

# Supported Protocols

- Link Control Protocol (LCP)
- Bridging PDU (BPDU)
- PPP, Multiplexed PPP
- Multi-class extension to MLPPP
- Multi-link PPP
- Network Control Protocol (NCP)
  - Internet Protocol Control Protocol (IPCP)
  - Bridging Control Protocol (BCP)
  - PPP Mux CP
- Cisco HDLC decodes
- STUN, SNMP, RIP
- Link Quality Report (LQR)
- DHCP, DNS, ICMP
- Van Jacobson TCP/IP compression decodes
- IPHC
- IP, TCP, UDP
- PAP, CHAP
- SIP, MGCP, MEGACO
- RTP, CRTP, RTCP
- H.263, H.264, H.450
- ISDN H.225, MPEG2
- T.38
- RAS, SCTP
- M2UA, M2PA, M3UA
- ISUP, SCCP
- SUA, IUA, TUP
- Test and Network Management Messages

# Non-Intrusive Testing



# Different Views

- Virtual Packet Analysis (VPA) view
- Packet Data Analysis (PDA)/ Traffic Analyzer (TA) views

## MLPPP Analysis View

- Default panes - summary, detail, and hex dump of the frame data views
- Optional panes – statistics views

## Packet Data Analysis

- Summary view (Call Quality Matrix) displays complete summary of call information in graphical format, along with a summary of alerts
- Detail View (RTP diagnostic) displays packet by packet statistics for particular call information in tabular format
- Registration summary view displays statistics and status of the SIP registration process

# Real-time Analysis

PPP Protocol Analysis PPP 64-bit

File View Capture Statistics Database Configure Help

0 GoTo

Dev	TSlot	SubCh	Frame#	TIME (Relative)	Len	Error	Protocol PPP Link	Code Link Control	Code IPCP	Protocol PPP Link(Level 1)	Protocol PPP Link(Level 2)	Source IP Address IP	Destination IP IP
✓ 258	1-31		0	00:00:00.000000	208		ML PPP			Internet Protocol (IPv4)		192.168.1.200	192.168.1.11
✓ 258	1-31		1	00:00:00.019548	208		ML PPP			Internet Protocol (IPv4)		192.168.1.200	192.168.1.11
✓ 258	1-31		2	00:00:00.040080	208		ML PPP			Internet Protocol (IPv4)		192.168.1.200	192.168.1.11
✓ 258	1-31		3	00:00:00.059556	208		ML PPP			Internet Protocol (IPv4)		192.168.1.200	192.168.1.11
✓ 258	1-31		4	00:00:00.080048	208		ML PPP			Internet Protocol (IPv4)		192.168.1.200	192.168.1.11
✓ 258	1-31		5	00:00:00.100560	208		ML PPP			Internet Protocol (IPv4)		192.168.1.200	192.168.1.11
✓ 258	1-31		6	00:00:00.120076	208		ML PPP			Internet Protocol (IPv4)		192.168.1.200	192.168.1.11

Card258 TimeSlots=1-31 Frame=0 at 00:00:00.000000 OK Len=208 \*\*\* Right click to SHOW/HIDE layer details or copy \*\*\*

HDLC Frame Data + FCS

```

===== PPP Link Layer =====
0000 Protocol = 00111101 ML PPP
===== ML PPP(Level 1) Layer =====
0001 Beginning Fragment = 1..... Yes
0001 Ending Fragment = .1..... Yes
0001 Mlppp Class = ..0000.. (0)
0002 Sequence Number(Long) = 9090 (x002382)
===== PPP Link(Level 1) Layer =====
0005 Protocol = 00100001 Internet Protocol (IPv4)

```

Hex Dump of the Frame Data

```

+-----+-----+-----+-----+-----+-----+-----+-----+
3D C0 00 23 82 21 45 00 00 C8 C1 C3 00 00 80 11 =À #!E EAX e
F3 D6 C0 A8 01 C8 C0 A8 01 72 07 D0 0F A0 00 B4 60A EA r D
75 DA 80 00 A5 34 A2 D4 12 4C C3 59 4F 01 FF FF uUc #4cO LAYO yy
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF yyyyyyyyyyyyyyyy
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF yyyyyyyyyyyyyyyy

```

Device #	Frame Count(Device #)
2	1487
total 2	1487

C:\Program Files\GL Communications Inc\Usb E1 A 1 487 Frames



# Different Views

- Summary View: This pane displays the columns that contain Card Number, Timeslots, Frame Number, Time, Frame Error Status, PPP Layer 3 Protocol, LCP Code, BCP Code, IPCP code, MLPPP Class, 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 various statistics that are calculated based on the protocol fields

# Real-time Analysis

Real-time Analysis Configuration Interface

**Bundle Selection:** Bundle 1 | Bundle 2

**Card Selection:** Card 1 | Card 1

**Buttons:** Add Bundle, Delete Bundle, Add Link, Delete Link

**Timeslot Selection:**

TS
2
3
4
5
6
7
8
9
10

**Data Transmission Rate:**

**Single Channel:**

- ☐ 64 kbps
- ☐ 56 kbps

**Hyper-Channel:**

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

**CRC:** CRC16

**Subchannels 8-56 kbps:**

**DS0 bits:**

1
2
3
4
5
6
7
8

**Buttons:** All, None

**Bit Inversion (1 <-> 0):** ☐

**Octet Bit Reversion (MSB <-> LSB):** ☐

**Mlppp Options:**

**Fragment Format:** Long Se

**Maximum Differential Delay:** 250

**Selected Links:** TS 1:1,HC 1:2..10

**Card and Timeslot Selection Dialog:**

**Card Selection:**

Cards
1
2

**Timeslot Selection:**

TS
0
1
2
3
4
5
6
7
8
9
10
11

**Data Transmission Rate:**

**Single Channel:**

- ☒ 64 kbps
- ☐ 56 kbps

**Hyper-Channel:**

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

**CRC:** CRC16

**Subchannels 8-56 kbps:**

**DS0 bits:**

1
2
3
4
5
6
7
8

**Buttons:** All, None

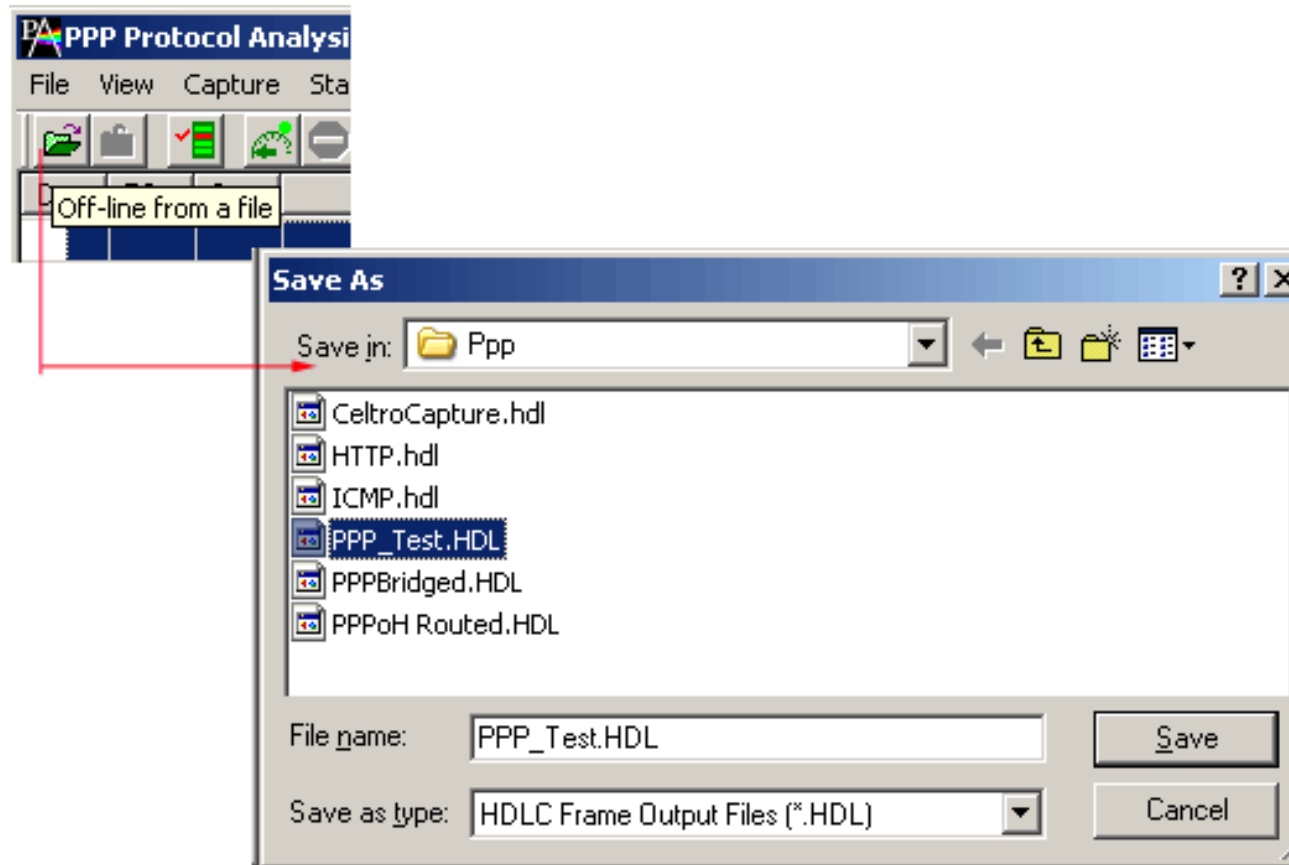
**Buttons:** All TS, Clear TS, OK

# 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 can be captured in either, n x 64 kbps, or n x 56 kbps data channels
- Capture frames based on MLPPP options such as fragment format (long or short), & maximum differential delay
- Supports reassembly and decoding of multiple ML PPP bundles simultaneously. Each MLPPP bundle is created by selecting groups of timeslots on various cards
- 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

- Trace files for offline analysis can be loaded through simple command-line arguments as below:

**Command Syntax: pppprot ppp\Filename.hdl**

The screenshot displays the PPP Protocol Analysis PPP application interface. The main window shows a list of frames with columns: Dev, TS..., Su..., Frame#, TIME (Relative), Len, Error, PPP Layer3Prot..., Mlppp Seq No, Mlppp Class, and PPP(Hihger) La... The frames are as follows:

Dev	TS...	Su...	Frame#	TIME (Relative)	Len	Error	PPP Layer3Prot...	Mlppp Seq No	Mlppp Class	PPP(Hihger) La...
✓ 1	1-30		0	00:00:00.000000	19		Link Control			
✓ 1	1-30		1	00:00:00.391391	19		Link Control			
✓ 1	1-30		2	00:00:04.986112	19		Link Control			
✓ 1	1-30		3	00:00:05.002229	28		ML PPP	0	0	ML PPP
✓ 1	1-30		4	00:00:07.975691	28		ML PPP	1	0	ML PPP
✓ 1	1-30		5	00:00:39.987229	12		Link Control			

A command prompt window is open, showing the following commands and output:

```
C:\D:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.
D:\>cd D:\Program Files\GL Communications Inc\PPP Analyzer
D:\Program Files\GL Communications Inc\PPP Analyzer>pppprot ppp\PPP_Test.hdl
D:\Program Files\GL Communications Inc\PPP Analyzer>
Protocol = 00000000 00111101 ML PPP
===== ML PPP Layer =====
Beginning Fragment = 1..... Yes
Ending Fragment = .1..... Yes
Mlppp Class = ..0000.. (0)
Sequence Number(Long) = 0. (*0000000)
```

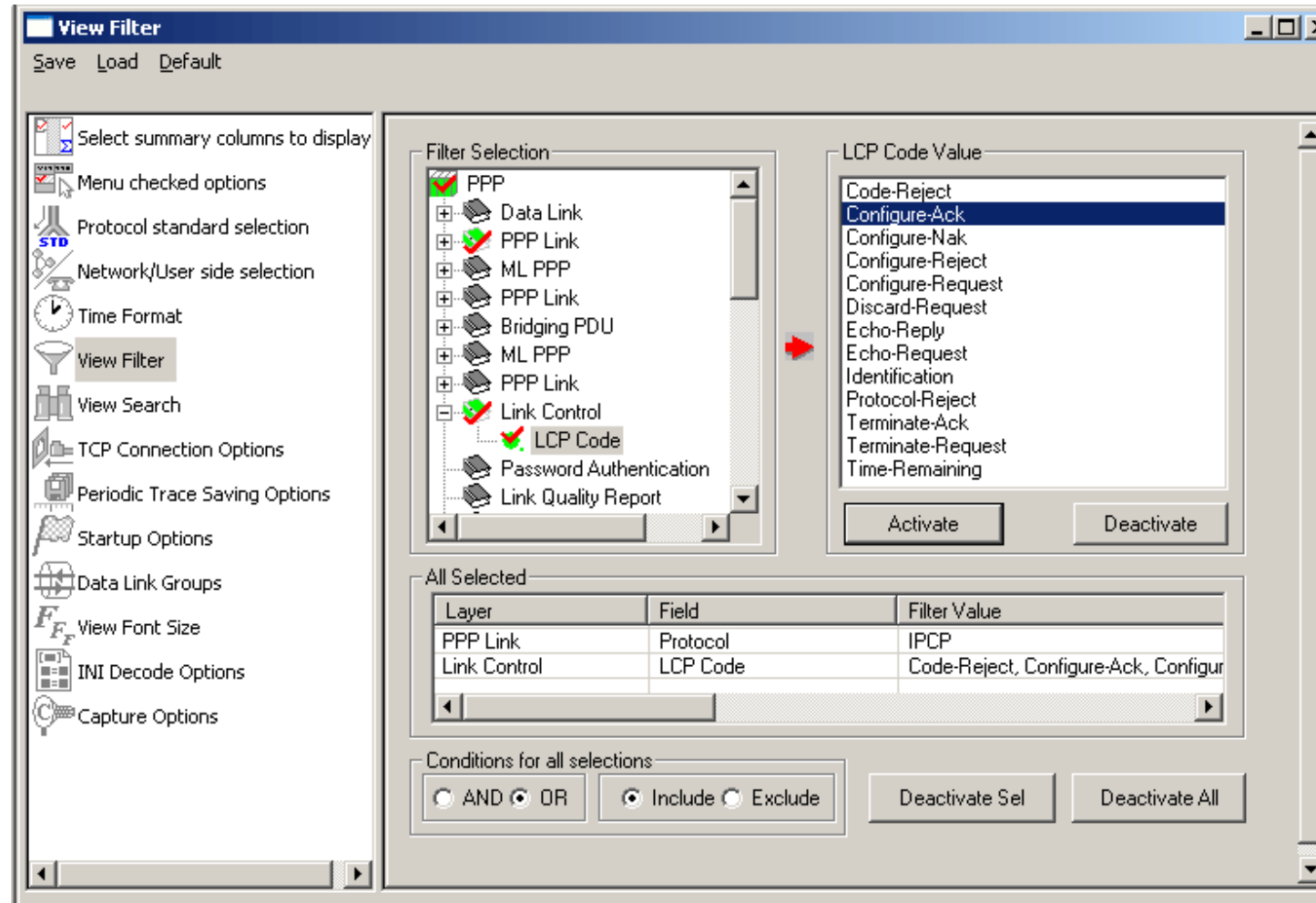
Below the command prompt, the Hex Dump of the Frame Data is shown:

```
Hex Dump of the Frame Data
+-----+-----+-----+-----+-----+-----+-----+-----+
FF 03 00 3D C0 00 00 00 00 3D C0 00 00 00 80 21  y  =A  =A  !!
01 01 00 0A 03 06 0A 00 00 33 85 96                      3!!
```

The status bar at the bottom indicates "Off-line Viewing" and "C:\Program Files\GL Communications Inc\PPP Analyzer\489 Frames".

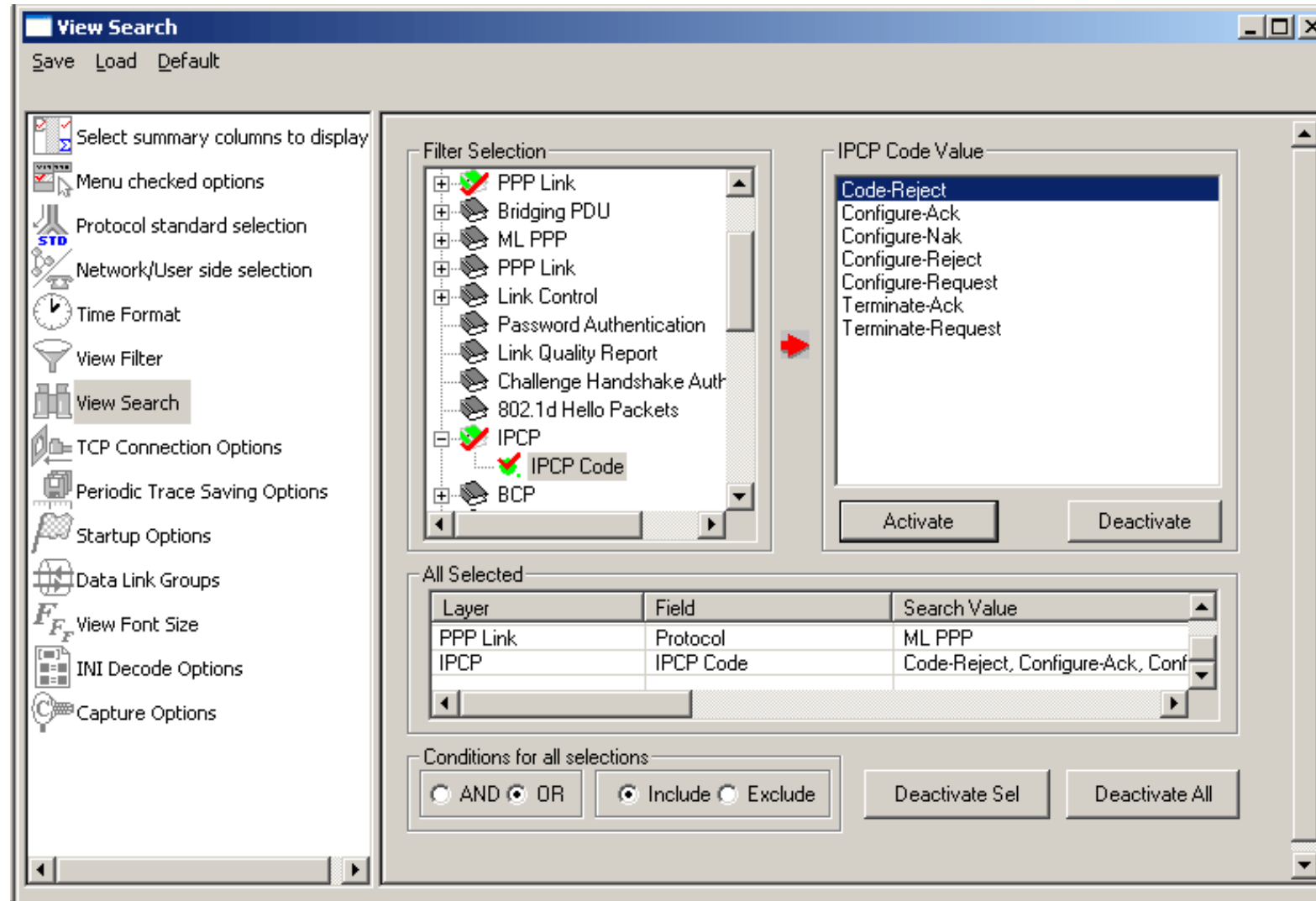
# Filters - Offline View Filter

- Isolates required frames from all frames in real-time, as well as offline
- Allows filtering according to various layers and protocol fields such as LCP Code, IPCP, ML PPP sequence number, message type, mlppp class, TCP / UDP source and destination port and more



# Search Options

- 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

The screenshot shows the 'PPP Protocol Analysis PPP 64-bit' window. The table below displays the captured data:

Dev	TSlot	SubCh	Frame#	TIME (Relative)	Len	Error	Protocol PPP Link	Code Link Control	Code IPCP
✓ 258	1-31		0	00:00:00.000000	208		ML PPP		
✓ 258	1-31		1	00:00:00.019548	208		ML PPP		
✓ 258	1-31		2	00:00:00.040080	208		ML PPP		
✓ 258	1-31		3	00:00:00.059556	208		ML PPP		
✓ 258	1-31		4	00:00:00.080048	208		ML PPP		

Below the table, three options are available:

- Search Selected Value
- Set Search Criteria as Sel Values
- Set Filter Criteria as Sel Values (highlighted)

A dialog box titled 'Use Ctrl, Shift for Extended Selection' is open, showing a list of filter criteria:

- PPP Link::Protocol
- PPP Link(Level 1)::Protocol
- IP::Destination IP Address
- IP::Source IP Address
- UDP::Destination Port
- UDP::Source Port

Buttons at the bottom of the dialog: OK, Select All, Cancel.

The 'Analyzer GUI and Protocol Configuration' window is shown. The 'Filter Selection' pane on the right lists various protocols and their sub-protocols. The 'Value Selection' pane is empty. Below these panes, the 'All Selected' table is highlighted with a red box:

Layer	Field	Filter Value
PPP Link	Protocol	ML PPP
PPP Link(Level 1)	Protocol	Internet Protocol (IPv4)

At the bottom, there are radio buttons for 'Conditions for all selections': AND (selected), OR, Include, and Exclude. There are also buttons for 'Deactivate Sel' and 'Deactivate All'.



# Search Criteria From Screen Selection

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

The image shows a workflow for setting search criteria in the PPP Protocol Analysis tool. It starts with a table of captured packets, followed by a dialog box to select search criteria, and finally the Analyzer GUI where the criteria are applied.

**PPP Protocol Analysis PPP 64-bit**

Dev	TSlot	SubCh	Frame#	TIME (Relative)	Len	Error	Protocol	Code	Code
							PPP Link	Link Control	IPCP
✓ 258	1-31		0	00:00:00.000000	208		ML PPP		
✓ 258	1-31		1	00:00:00.019548	208		ML PPP		
✓ 258	1-31		2	00:00:00.040080	208		ML PPP		
✓ 258	1-31		3	00:00:00.059556	208		ML PPP		
✓ 258	1-31		4	00:00:00.080048	208		ML PPP		
✓ 258	1-31		5	00:00:00.100560	208		ML PPP		

**Use Ctrl, Shift for Extended Selection**

- PPP Link::Protocol
- PPP Link(Level 1)::Protocol
- IP::Destination IP Address
- IP::Source IP Address
- UDP::Destination Port
- UDP::Source Port

OK Select All Cancel

**Analyzer GUI and Protocol Configuration**

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  
Define Summary Columns  
Aggregate Summary Columns  
Capture Options

**Filter Selection**

- PPP
- Data Link
- MLPPP Error
- PPP Link
- ML PPP(Level 1)
- PPP Link(Level 1)
- Bridging PDU
- ML PPP(Level 2)
- PPP Link(Level 2)
- Link Control
- Password Authentication
- Link Quality Report

**Value Selection**

Activate Deactivate

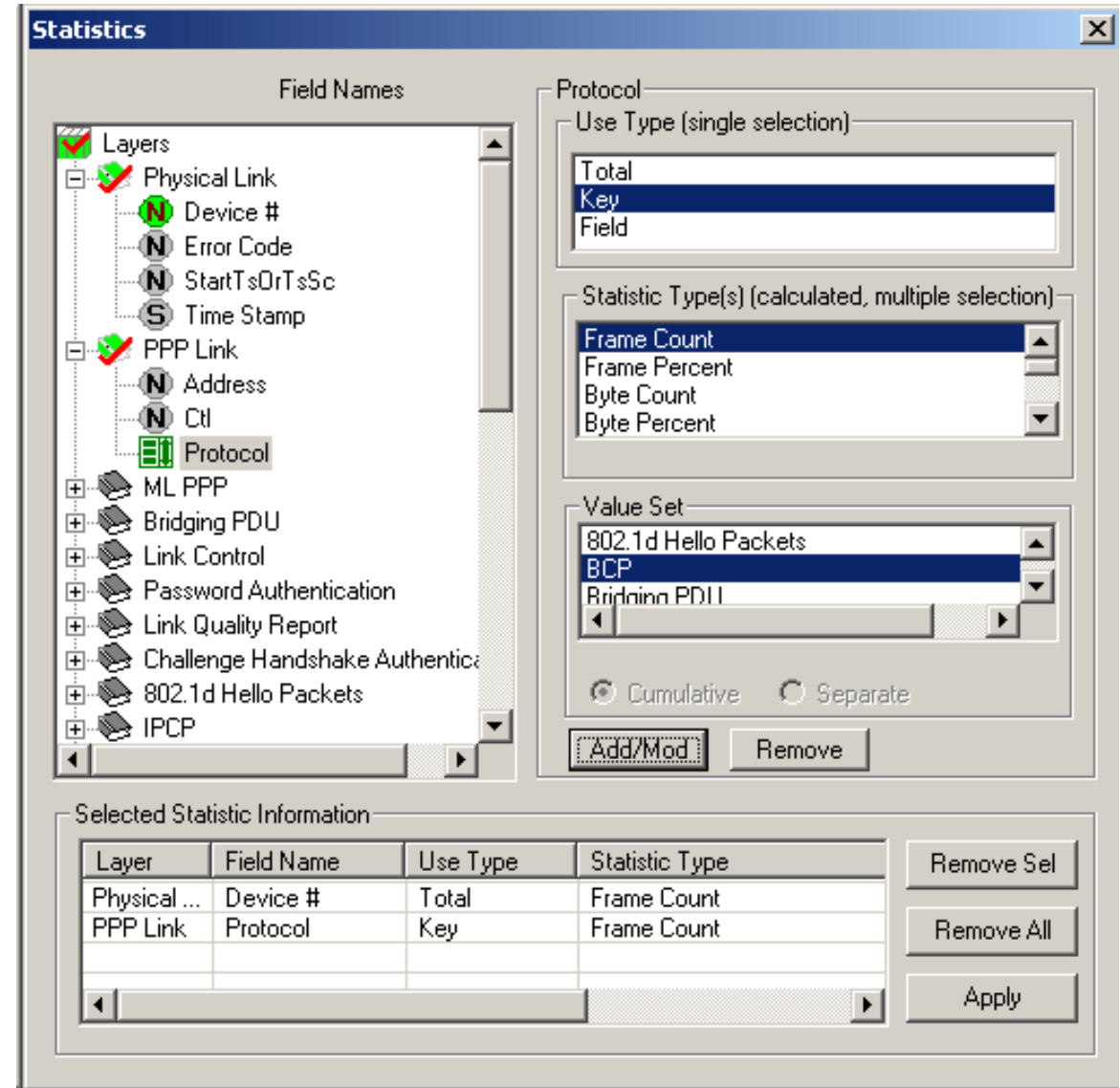
**All Selected**

Layer	Field	Search Value
PPP Link(Level 1)	Protocol	Internet Protocol (IPv4)
IP	Destination IP Address	192.168.1.114

Conditions for all selections:  
☒ AND ☐ OR ☒ Include ☐ Exclude  
Deactivate Sel Deactivate All

# Statistics

- Statistics is an important feature available in PPP analyzer and can be obtained for all frames both in real-time as well as offline mode
- Numerous statistics can be obtained to study the performance and trend in the PPP networks based on various protocol fields and parameters



# 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

123

number of digits

.HDL

file name suffix

☐ Date/Time Formatted Names

%Y%M%D\_%H%i

file name prefix

file name suffix

.HDL

Create a New File After the Specified Limit Has Been Reached

☒ File Size Limit e.g. 1048576 or 1024K or 1M

☐ Frame Count Limit e.g. 1048576 or 1024K or 1M

☐ Time Limit e.g. 24:00 (HH:MM)

Limit Value

1000000

Restrict or Recycle After N Files Options

2147483647

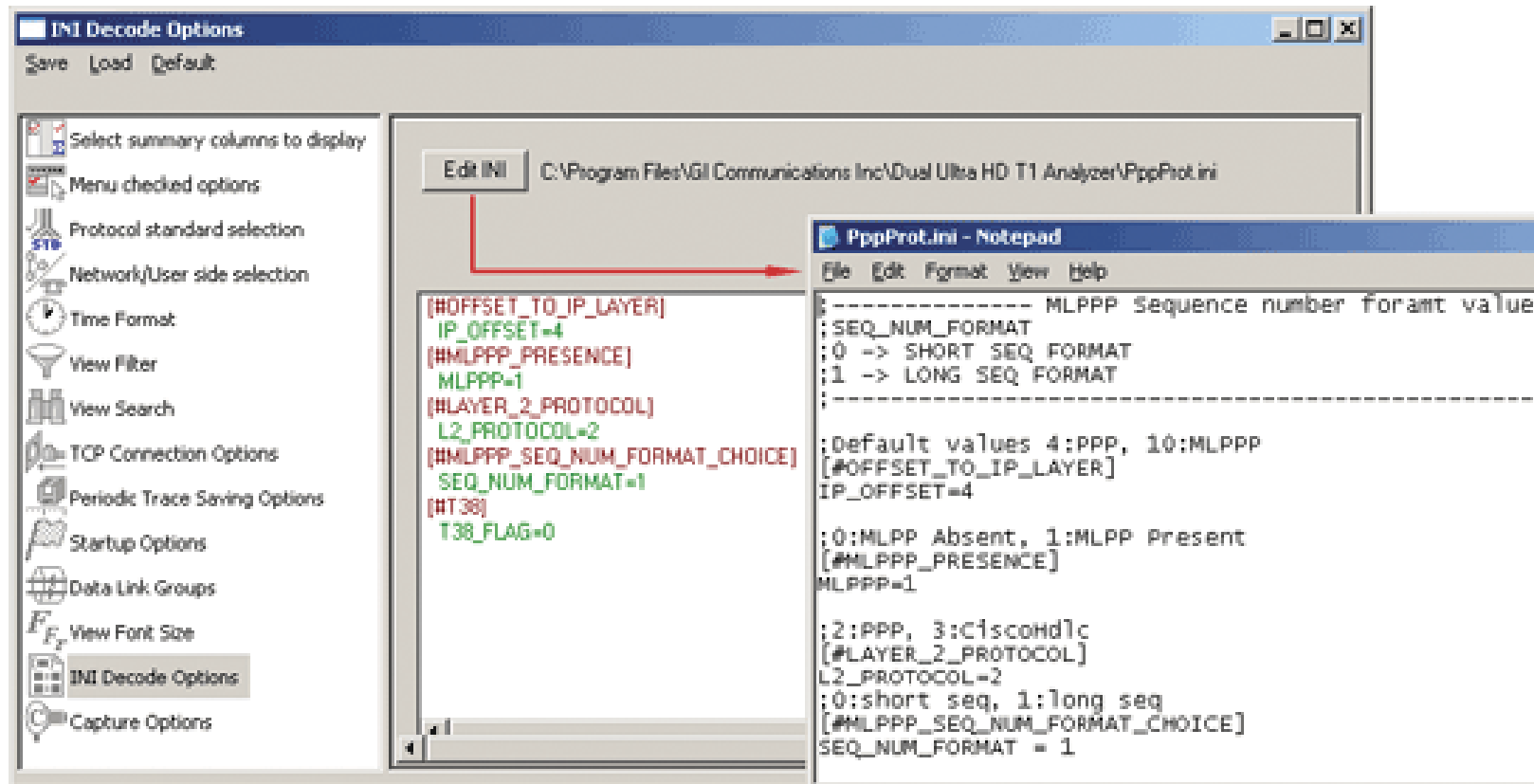
☒ Keep N Latest Files

☐ Stop After N Files

☐ Unrestricted

# Configuring INI Decode Options

- PPPProt.INI configuration file enables –
  - Customization of the value for the sequence number format
  - Select either decoding of MLPPP frames or Cisco HDLC frames



# Define Summary Columns

- Required protocol fields can be added through Define summary column option
- User can remove the protocol field which is not required

Selection of Summary Column

Output display in analyzer

Dev	TSlot	SubCh	Frame#	TIME	Len	Error	Version
2	1-31		0	00:00:00	180		4
2	1-31		1	00:00:00	408		4
2	1-31		2	00:00:00	242		4
2	1-31		3	00:00:00	76		4
2	1-31		4	00:00:00	76		4
2	1-31		5	00:00:00	76		4
2	1-31		6	00:00:00	76		4
2	1-31		7	00:00:00	76		4

Card2 TimeSlots=1-31 Frame=0 at 00:00:00.000000 OK Len=180

HDLC Frame Data + FCS

\*\*\*\*\* PPP Link Layer \*\*\*\*\*

Address = 11111111 (255)

Ctl = 00000011 (3)

Protocol = 00000000 00111101 ML PPP

\*\*\*\*\* ML PPP Layer \*\*\*\*\*

Beginning Fragment = 1..... Yes

Ending Fragment = 1..... Yes

Mlpp Class = ..0000.. (0)

Source Number(Len) = 2122 /-000C2C)

Hex Dump of the Frame Data

```
FF 03 00 3D C0 00 0C 3C 00 21 45 00 00 AA F9 89  +--+--+--+--+
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 2 Si"
```

Off-line Viewing C:\Program Files\GL Communications 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 screenshot displays two windows from the GL Communications software. The 'Aggregate Summary Columns' dialog box is in the foreground, showing a table with three groups of summary columns. The 'PPP Protocol Analysis' window is in the background, showing a table of captured packets with a red box highlighting the 'Group~0' column.

**Aggregate Summary Columns Dialog:**

Name	Display Format	Summary Columns	Separator
Group~0	Concat	Protocol_PPP Link(Level 1) Source IP Address_IP	&
Group~1	<Col_Alias> Value	Destination IP Address_IP	--->
Group~2	Overlay	Source Port_UDP Destination Port_UDP	

**PPP Protocol Analysis Window:**

Dev	TSlot	SubCh	Frame#	TIME (Relative)	Len	Group~0	Error	Protocol PPP Link
✓258	1-31		0	00:00:00.000000	208	Internet Protocol (IPv4) & 192.168.1.200		ML PPP
✓258	1-31		1	00:00:00.019548	208	Internet Protocol (IPv4) & 192.168.1.200		ML PPP
✓258	1-31		2	00:00:00.040080	208	Internet Protocol (IPv4) & 192.168.1.200		ML PPP
✓258	1-31		3	00:00:00.059556	208	Internet Protocol (IPv4) & 192.168.1.200		ML PPP
✓258	1-31		4	00:00:00.080048	208	Internet Protocol (IPv4) & 192.168.1.200		ML PPP
✓258	1-31		5	00:00:00.100560	208	Internet Protocol (IPv4) & 192.168.1.200		ML PPP
✓258	1-31		6	00:00:00.120076	208	Internet Protocol (IPv4) & 192.168.1.200		ML PPP
✓258	1-31		7	00:00:00.139641	208	Internet Protocol (IPv4) & 192.168.1.200		ML PPP
✓258	1-31		8	00:00:00.160108	208	Internet Protocol (IPv4) & 192.168.1.200		ML PPP
✓258	1-31		9	00:00:00.179641	208	Internet Protocol (IPv4) & 192.168.1.200		ML PPP
✓258	1-31		10	00:00:00.200145	208	Internet Protocol (IPv4) & 192.168.1.200		ML PPP
✓258	1-31		11	00:00:00.219665	208	Internet Protocol (IPv4) & 192.168.1.200		ML PPP
✓258	1-31		12	00:00:00.241173	208	Internet Protocol (IPv4) & 192.168.1.200		ML PPP

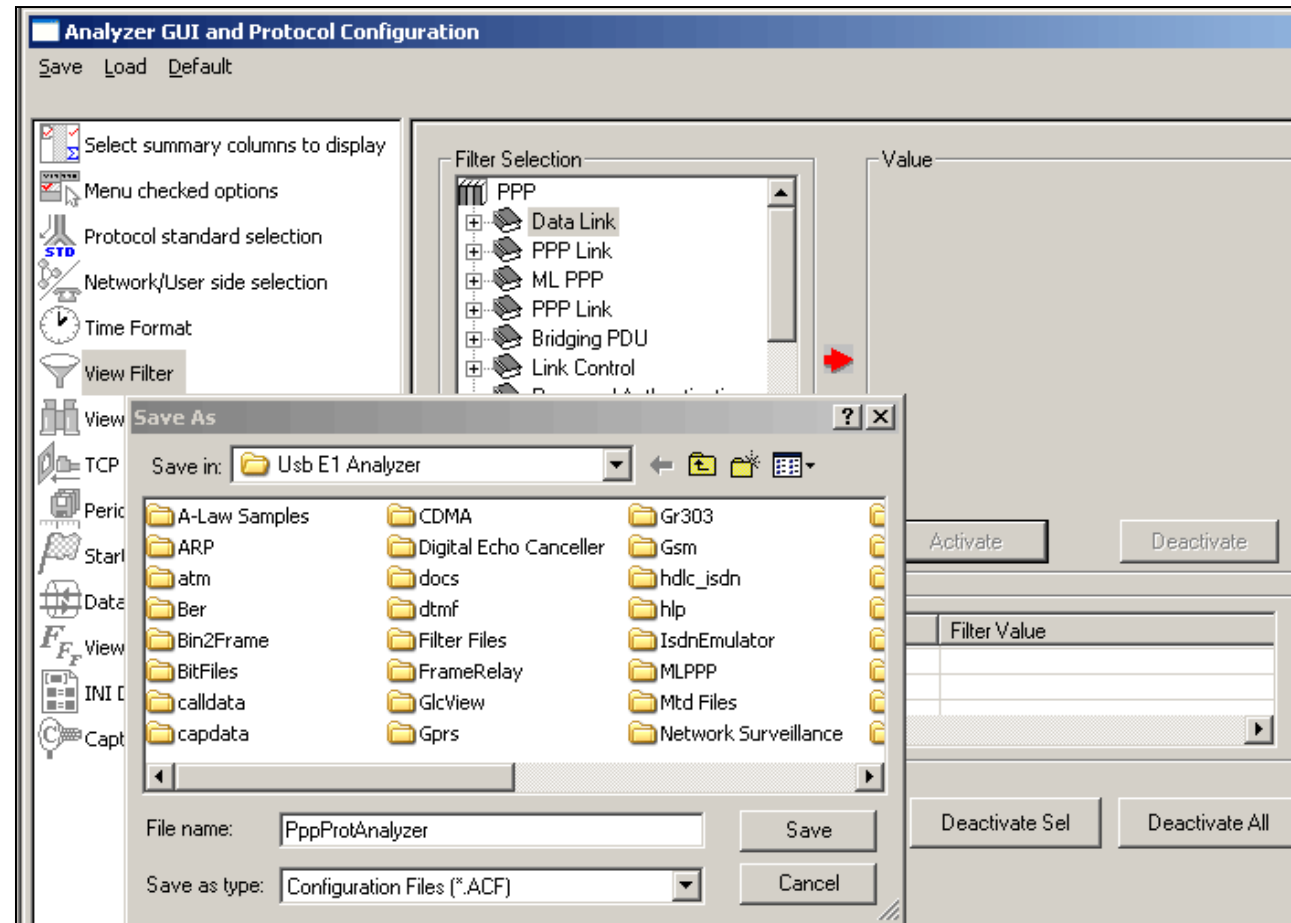
**Packet Details:**

```
Card258 TimeSlots=1-31 Frame=0 at 00:00:00.000000 OK Len=208 ***
HDLC Frame Data + FCS
----- PPP Link Layer ----- =
0000 Protocol = 00111101 ML PPP
----- ML PPP(Level 1) Layer ----- =
0001 Beginning Fragment = 1..... Yes
0001 Ending Fragment = .1..... Yes
0001 Mlppp Class = ..0000.. (0)
0002 Sequence Number(Long) = 9090 (x002382)
----- PPP Link(Level 1) Layer ----- =
0005 Protocol = 00100001 Internet Protocol (IPv4)
----- IP Layer ----- =
0006 Version = 0100.... (4)
0006 Internet Header Length (In 32 bit words) = ....0101 (5)
<
```

Off-line Viewing. C:\Program Files\GL Communications Inc\Urb 1487 Frames

# 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



# HDL File Format

Record Count (4 Bytes)	Version (2 Bytes)	Circular (1 Byte)	Trace Type (1 Byte)
Reserved (12 Bytes)			
Comments (124 Bytes)			
Length of frame 1 (2 Bytes) : Begin of Frame 1			
Frame Header (13 Bytes) [Ref: HdlcTraceRecord2]			
Frame Data (n Bytes)			
Length of frame 1 (2 Bytes) : End of Frame 1			
Length of frame 2 (2 Bytes) : Begin of Frame 2			
Frame Header (13 Bytes) [Ref: HdlcTraceRecord2]			
Frame Data (n Bytes)			
Length of frame 2 (2 Bytes) : End of Frame 2			
...			
...			
...			
Length of frame 'n' (2 Bytes) : Begin of Frame 'n'			
Frame Header (13 Bytes) [Ref: HdlcTraceRecord2]			
Frame Data (n Bytes)			
Length of frame 'n' (2 Bytes) : End of Frame 'n'			



- Record Count: Number of Frames (Records) in the file
- Version: Version of HDL file
- Circular: If circular buffer is used, set it to 1, else set to 0
- Trace Type: Set to 0
- Reserved: Not used, set to 0
- Comments: Not used, set to 0

# Frame Header Information

- Timestamp: Time of capture in 100ns
- Dev No: GL card number
- Sub channels used: Indicates whether sub channels are used or not. If whole of channel is used for one stream, it is set to 0
- Time slot for sub channels: Timeslot number used for sub channels
- Start and End Ts: Starting / ending timeslot or sub channel
- Error flag

# Packet Data Analysis

# Packet Data Analysis

- Packet Data Analysis consists of -
  - Summary view
  - Detail view
  - Registration summary view

# Main Features of PDA

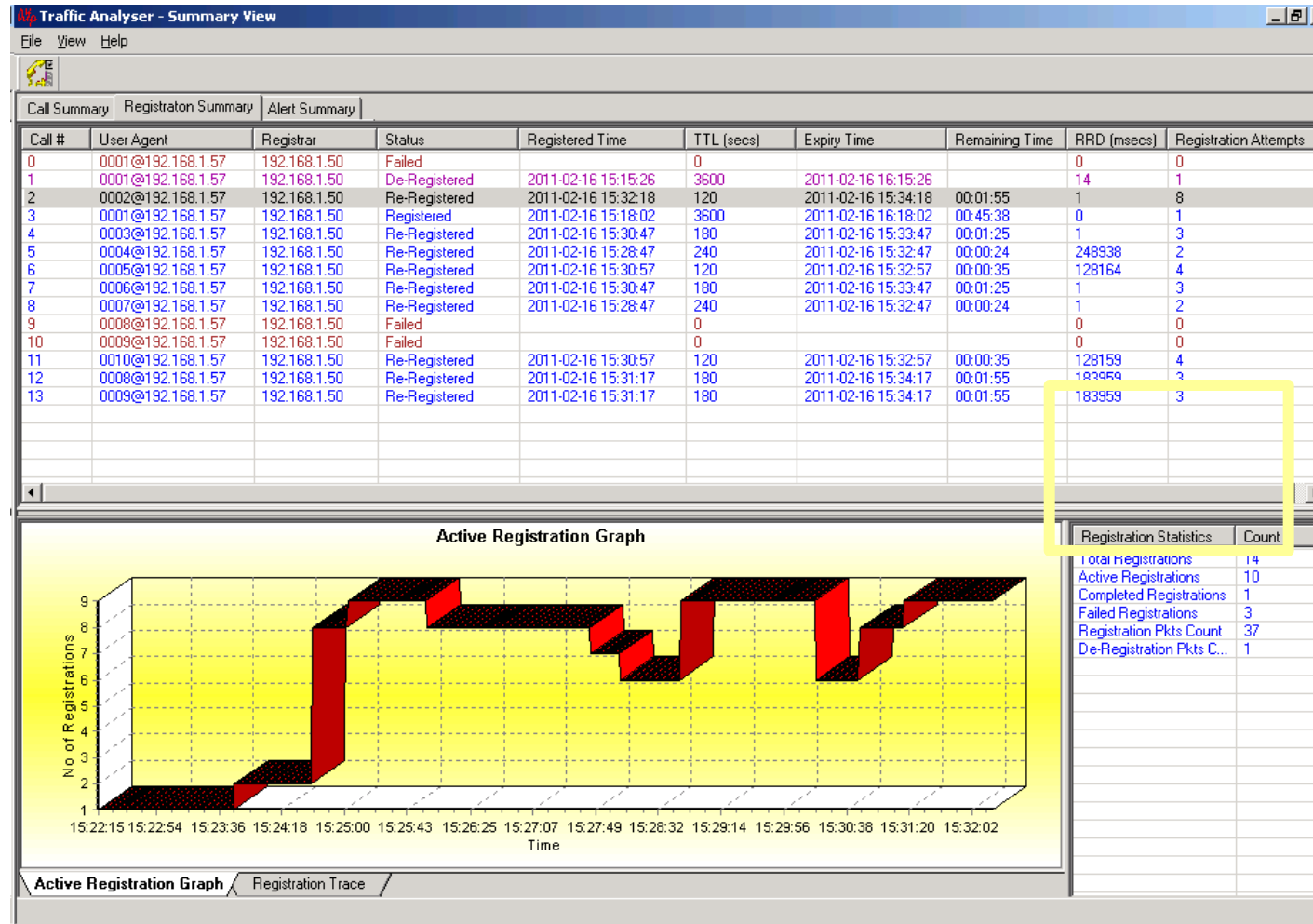
- Supported protocols - SIP (Session Initiation Protocol RFC 2543 and RFC 3261), MEGACO RFC 3525, MEGACO RFC 3015, MGCP, T.38, H323/H225, and RTP
- Full RTP Analysis with audio capture/playback supported for all common codecs
- Supports saving the selected calls from traffic analyzer into \*.HDL or \*.PCAP formats
- T.38 Analysis - User can decode T.38 frames received over VoIP calls and can have ladder diagram for T.38 traffic flow, reassemble the fragmented data & to identify the T.30 message from it
- Displays summary of signaling, audio, and video parameters of each call.
- Video parameters such as Source/Destination Video Channels, Media Type, SSRC, Average Delay/Gap, Packet Counts, Media Delivery Index (MDI- (Delay Factor : Media Loss Rate)), and Frame Rate are calculated are displayed for all video calls

# Main Features of PDA

- Real-time audio/video monitoring of RTP streams; Record audio and video data of a session to a file in QuickTime format
- Supported audio and video codecs: Mul-law, A-law, G.711 App II, G726 (40 , 32, 24 and 16 kbps), G726 with VAD, GSM610, G.722, G.722.1, G729, G729B, AMR, ILBC, SPEEX, EVRC, EVRCB, EVRC-C, H.263, and H.264
- Call Quality Of Service (QOS) for all calls with E-Model based (G.107) Mean Opinion Score (MOS) and R-factor with individual and summary statistics presented in graphical and tabular formats
- Alert Summary tab provides summary of each alerts that have occurred during the analysis
  - Support Video QoS for H.263+ and H.264 video codec; provides video capture & video conference monitoring and video compression capability
  - Capable of displaying Video QoS Statistics such as Missing Packets, Delay, Gap, Video Frame Count, Media Delivery Index (MDI- (Delay Factor : Media Loss Rate)), and Frame Rate, and more

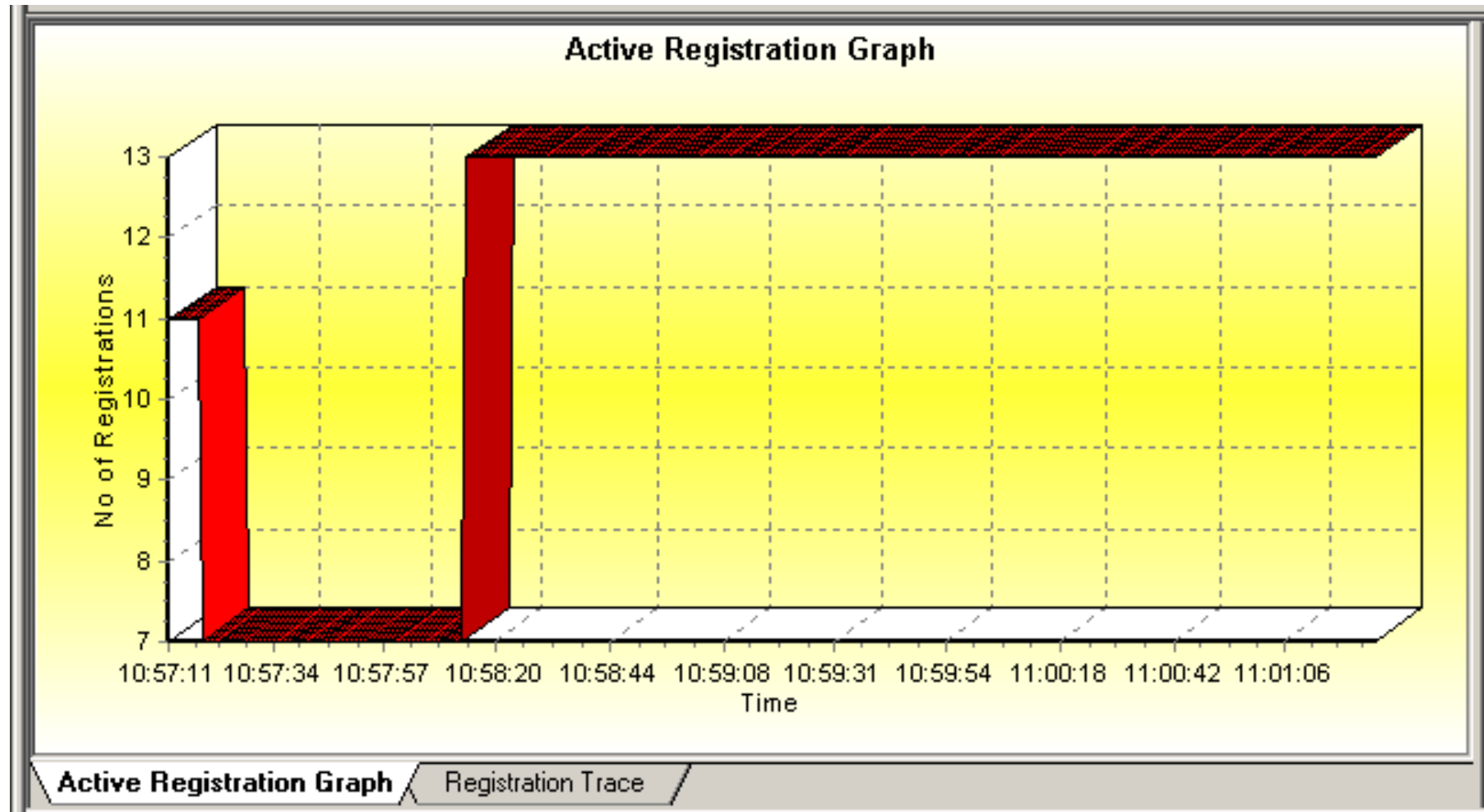
# Registration Summary

- Provides the registration summary of each SIP registration including the user agent, registrar, status, registered time, expiry time, time to live, remaining time, Registration Request Delay (RRD), and number of registration attempts



# Active Registration Graph

- Displays the active registration graph of the entire registration summary
- Simple line graph, depicting the Number Of Active Registration Vs Time





# Registration Trace

**Traffic Analyser - Summary View**

File View Help

Call Summary Registraton Summary Alert Summary

Call #	User Agent	Registrar	Status	Registered Time	TTL (secs)	Expiry Time	Remaining Time	RRD (msecs)	Registration Attempts
0	0001@192.168.1.57	192.168.1.50	Failed		0			0	0
1	0001@192.168.1.57	192.168.1.50	De-Registered	2011-02-16 15:15:26	3600	2011-02-16 16:15:26		14	1
2	0002@192.168.1.57	192.168.1.50	Re-Registered	2011-02-16 15:25:56	120	2011-02-16 15:27:56	00:00:03	1	5
3	0001@192.168.1.57	192.168.1.50	Registered	2011-02-16 15:18:02	3600	2011-02-16 16:18:02	00:50:08	0	1
4	0003@192.168.1.57	192.168.1.50	Re-Registered	2011-02-16 15:27:46	180	2011-02-16 15:30:46	00:02:54	1	2
5	0004@192.168.1.57	192.168.1.50	Registered	2011-02-16 15:24:38	240	2011-02-16 15:28:38	00:00:45	0	1
6	0005@192.168.1.57	192.168.1.50	Re-Registered	2011-02-16 15:26:46	120	2011-02-16 15:28:46	00:00:53	128164	2
7	0006@192.168.1.57	192.168.1.50	Re-Registered	2011-02-16 15:27:46	180	2011-02-16 15:30:46	00:02:54	1	2
8	0007@192.168.1.57	192.168.1.50	Registered	2011-02-16 15:24:38	240	2011-02-16 15:28:38	00:00:45	1	1
9	0008@192.168.1.57	192.168.1.50	Failed		0			0	0
10	0009@192.168.1.57	192.168.1.50	Failed		0			0	0
11	0010@192.168.1.57	192.168.1.50	Re-Registered	2011-02-16 15:26:46	120	2011-02-16 15:28:46	00:00:53	128159	2
12	0008@192.168.1.57	192.168.1.50	Registered	2011-02-16 15:25:03	180	2011-02-16 15:28:03	00:00:09	0	1
13	0009@192.168.1.57	192.168.1.50	Registered	2011-02-16 15:25:03	180	2011-02-16 15:28:03	00:00:09	0	1

192.168.1.57

192.168.1.50

54098

5060

5060

54098

5060

54098

5060

54098

REGISTER

SIP/2.0 200 OK

REGISTER

SIP/2.0 200 OK

REGISTER

SIP/2.0 200 OK

REGISTER

```

REGISTER sip:192.168.1.50 SIP/2.0
Via: SIP/2.0/UDP 192.168.1.57:5060;branch=z9hG4bK729508016-3623
Max-Forwards: 70
Allow: INVITE,BYE,CANCEL,ACK,INFO,PRACK,COMET,OPTIONS,SUBSCRIBE,NOTIFY,
From: 0002 <sip:0002@192.168.1.57>;tag=GLPG_729508016-3624
To: sip:0002@192.168.1.57
Call-ID: GLPG7295080163622
CSeq: 1 REGISTER
Expires: 120
Contact: 0002 <sip:0002@192.168.1.57>
Content-Length: 0
    
```

# Registration Trace

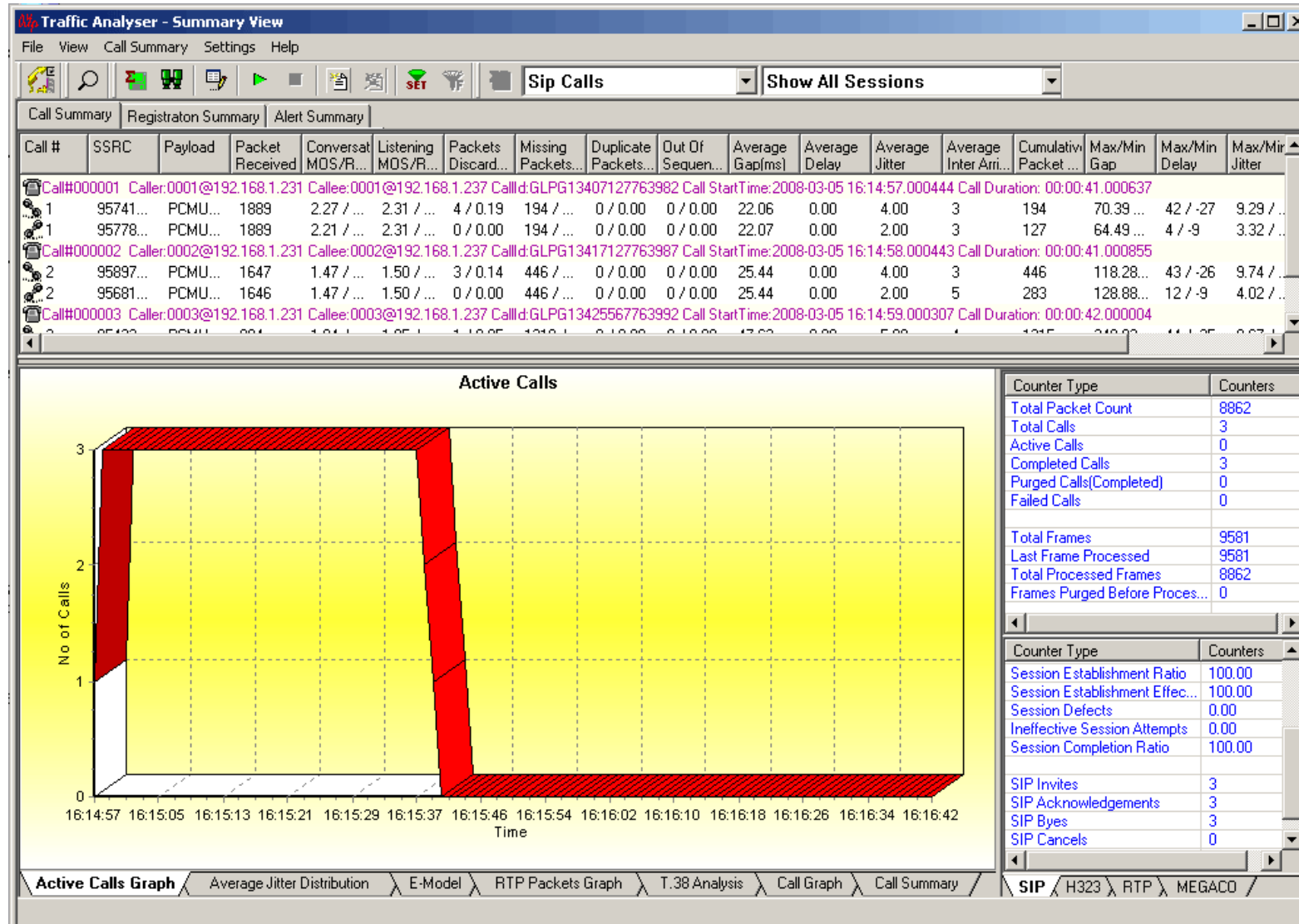
- Displays the message sequence of registered calls
- Message sequence pictorially displays the messages exchanged for a particular scenario between a user agent and the registrar

# Summary View

Summary View displays -

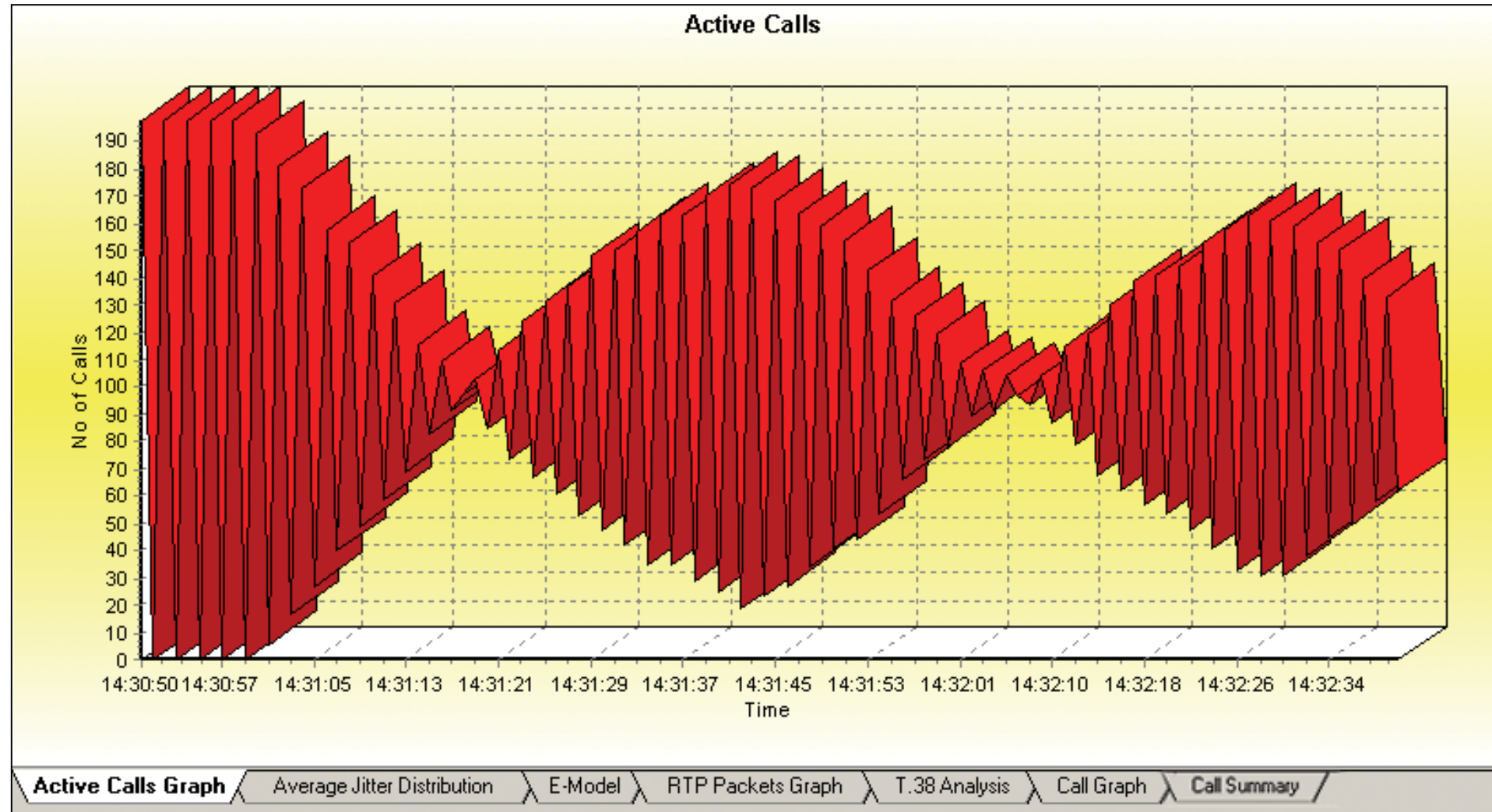
- Summary of data transmission in each direction including calling number, called number, call id, start time, duration, missing packets, and so on
- Includes separate statistical counts on total packets, calls, failed calls, captured frames, etc., for SIP, H323, MEGACO, T.38, and RTP based calls
- Provides various graphs to view active calls, active jitter distribution, E-model based measurements for R-factor / MOS/ Packet discarded, RTP packets, T.38 fax analysis, and call flow graph over the duration of the call

# Summary View



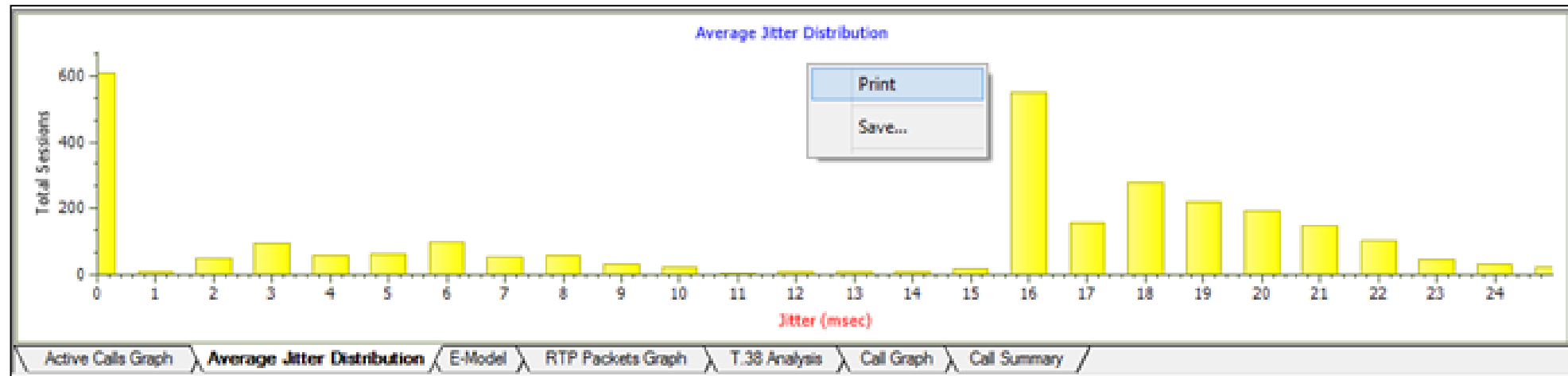
# Active Calls Graph

- Active calls graph depicts the Number Of Calls plotted Vs Time across Total Sessions



# Average Jitter Distribution Graph

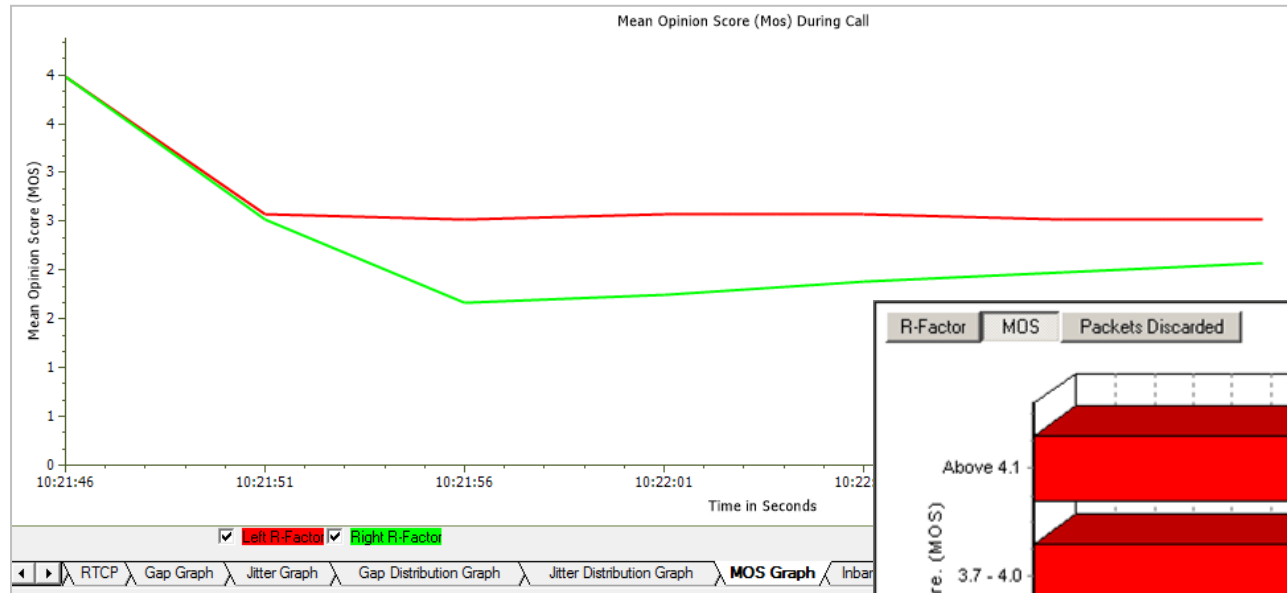
- Distribution of the Average Jitter values across Total Sessions



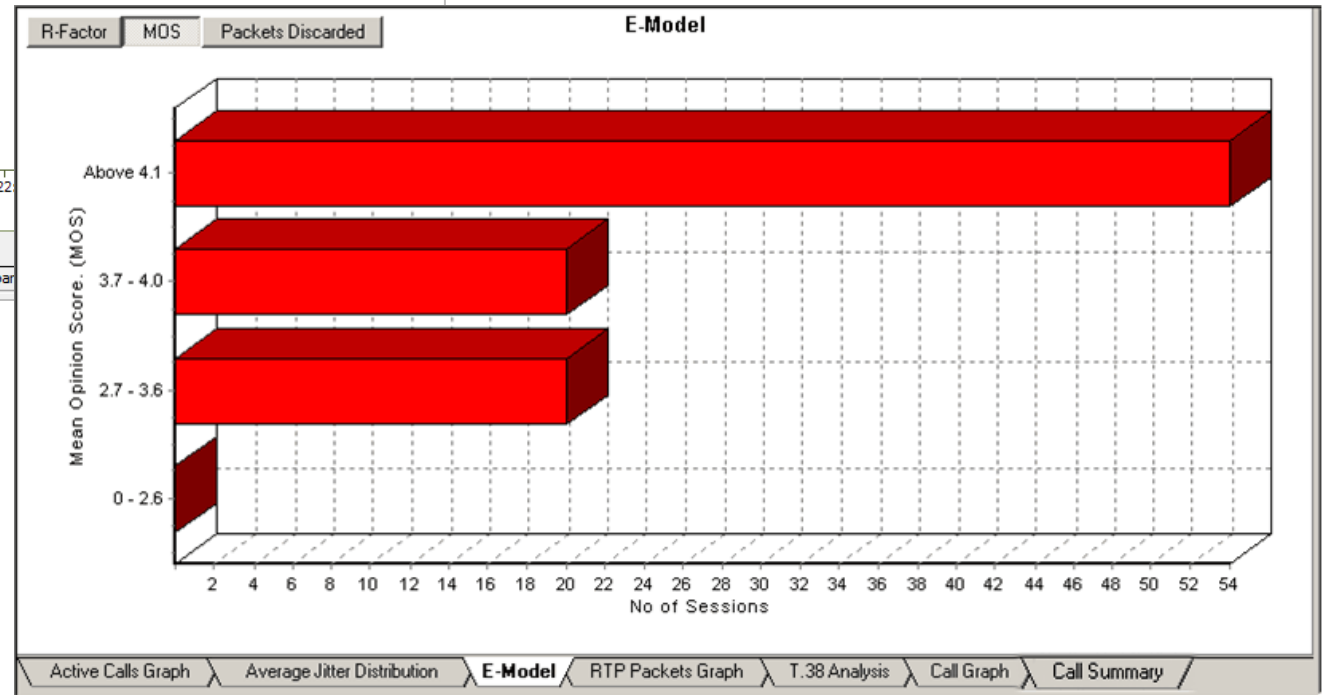
# E-Model Graphs

- E-Model graph provides R-factor, MOS, and packets discarded against number of sessions
- All these three graphs show statistics of terminated calls
  - R-Factor – A bar graph that plots R-Factor across No of Sessions
  - MOS – A bar graph that plots Mean Opinion Score across No. of Sessions
  - Packets Discarded – A bar graph that plots Packets Discarded across No. of Sessions

# MOS Graph and R-Factor Graph



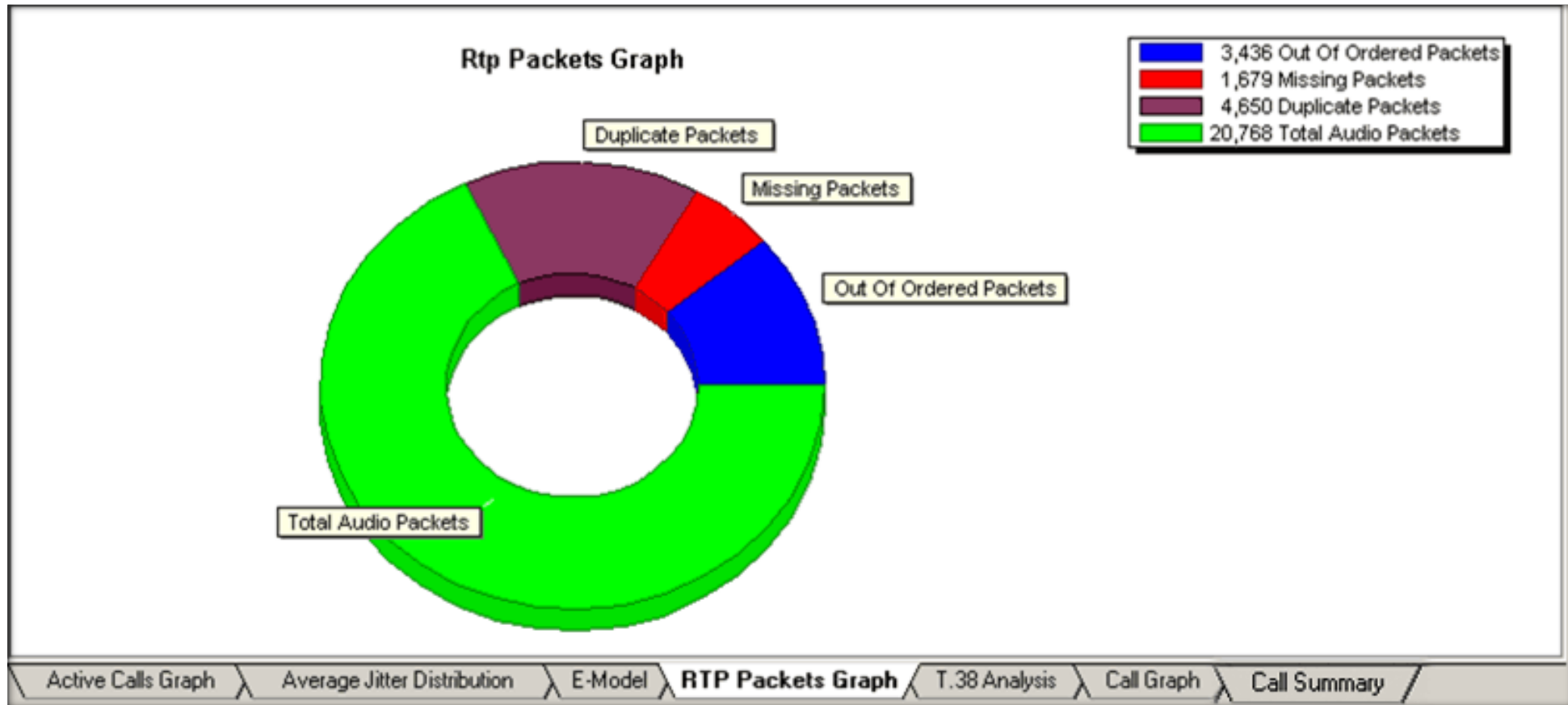
R Factor





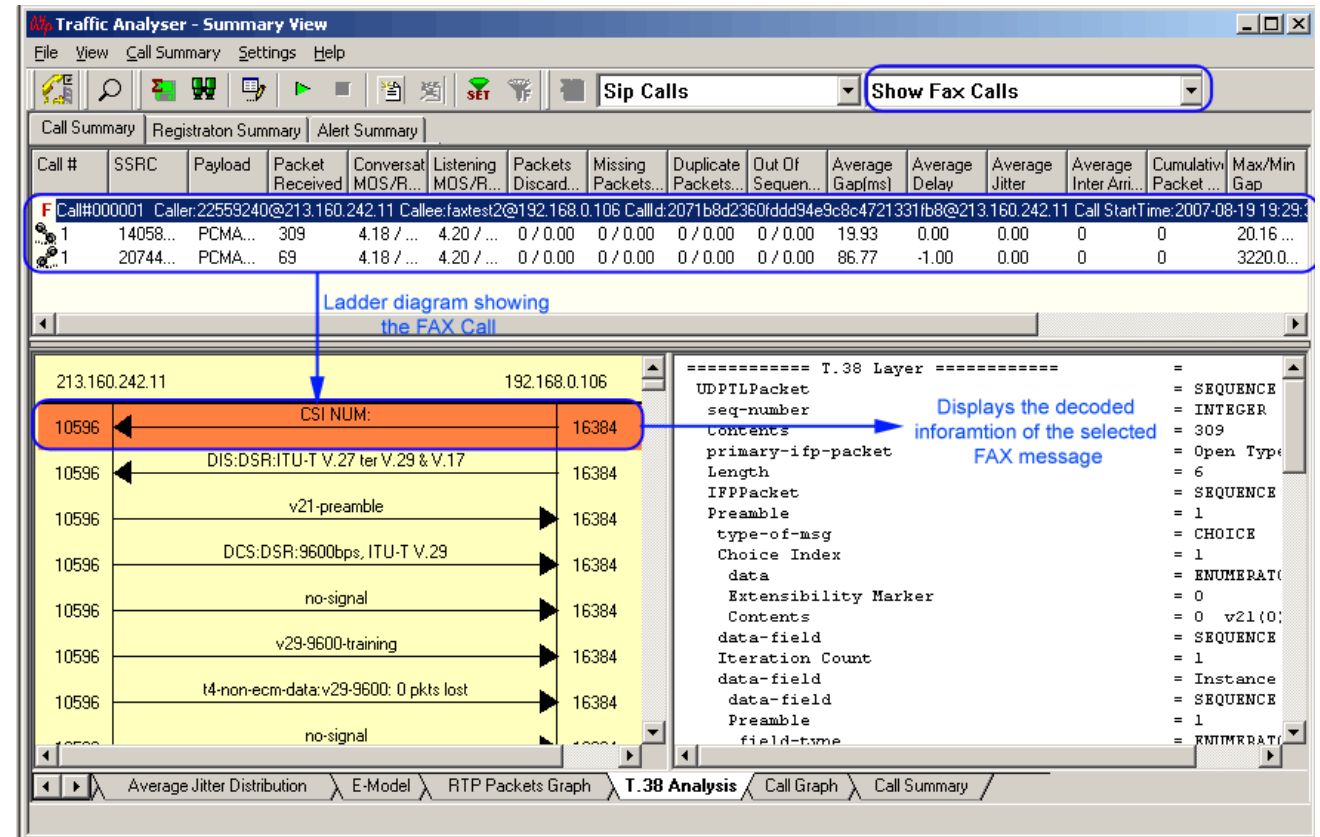
# RTP Packets Graph

- RTP Packets graph plots and compares out of ordered packets, missing packets and duplicate packets against Total Audio Packets



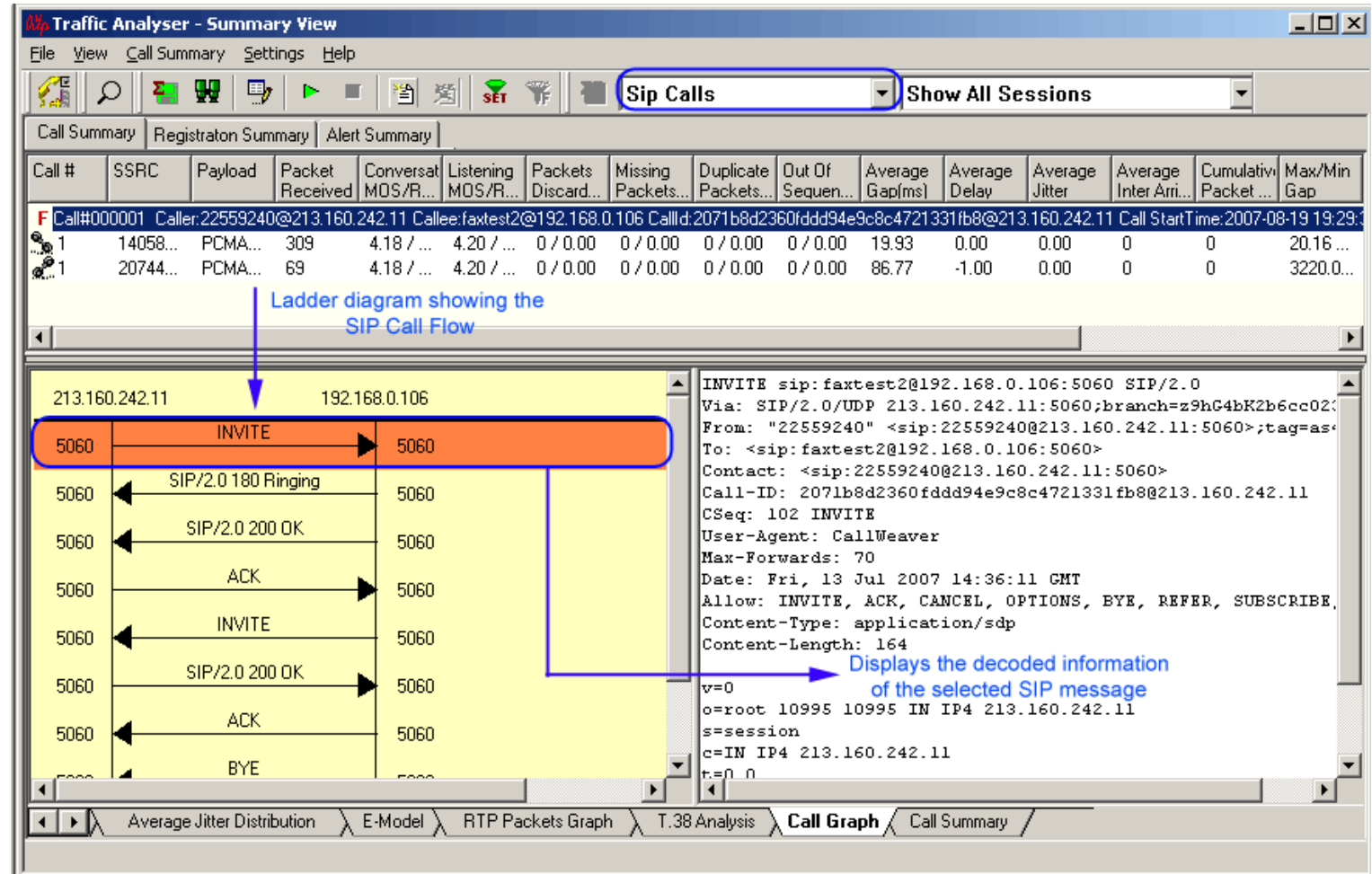
# T.38 Analysis - Fax over IP

- Supports capturing and decoding of Fax (T.38 data) calls over VoIP; also reassembles the fragmented data and identifies the T.30 message from it
- Decodes of selected FAX message is displayed on the right pane
- Captured fax calls can also be analyzed using GLInsight™ by saving the fax calls directly in (\*.PCAP) Ethereal file format



# Call Graph – SIP Call

- Displays the message sequences of captured VoIP calls
- Decodes of the selected SIP message is displayed on the right pane



# Signaling, Audio, and Video Parameters

Traffic Analyser - Summary View

FileViewCall SummarySettingsHelp

# Signaling, Audio, and Video Parameters

- Displays the signaling, audio, and video parameters of each call for SIP, RTP, H323, and MEGACO in a tabular format
- Signaling parameters include caller, callee, call id, call status, call start time & stop time, duration of the call, call terminator, call failure reason, session request delay, and session disconnect delay
- Audio parameters include the source and destination information such as TP Channel, Media Type, SSRC value, Packets Count, Missing Packets, Duplicate Packets, Out of Sequence Packets, and so on
- Video QoS parameters include Video Channels, Codec Info, SSRC, Frame Count, Packet Count, Packets Lost, Duplicate Packets, Out of order Packets, Frame Rate, Media Delivery Index (Delay Factor : Media Loss Rate), Average Media Delivery Index

# Detail View

- Provides a detail look at the two (or one) RTP sessions that are part of a single call
- Left and right panes accommodate the two sessions
- Provides detailed statistical information for Inband (DTMF & MF )events, RFC 2833 events, RTP/RTCP packet count and reports per direction, duplicate and missing packets
- Includes host of graphs such as Gap, Jitter, Gap Distribution, Jitter MOS, Quality, Wave Graph, Spectral Display, R-Factor scores, MOS scores, Delay metrics, Burst metrics, and Jitter Buffer statistics for media stream analysis

# Detail View

**Traffic Analyser - Detail View**

File View Detail View Settings Help

Sip Calls Show All Sessions

Call Summary Registraton Summary Alert Summary

Packet #	Seque...	RTP ...	Payload Type	Paylo...	Packet Seq...	Gap(ms)	I ▲
M 44	8020	1446...	PCMU/8000	160	Session In P...	0.00	
46	8021	1446...	PCMU/8000	160	Session In P...	21.48	
47	8022	1446...	PCMU/8000	160	In Sequence	10.74	
49	8023	1446...	PCMU/8000	160	In Sequence	22.47	
53	8024	1446...	PCMU/8000	160	In Sequence	21.49	
55	8025	1446...	PCMU/8000	160	In Sequence	21.45	
57	8026	1446...	PCMU/8000	160	In Sequence	21.49	
60	8027	1446...	PCMU/8000	160	In Sequence	21.47	
62	8028	1446...	PCMU/8000	160	In Sequence	21.49	
64	8029	1446...	PCMU/8000	160	In Sequence	21.48	

Packet #	Seque...	RTP ...	Payload Type	Paylo...	Packet Seq...	Gap(ms)	I ▲
M 41	56448	1832...	PCMU/8000	160	Session In P...	0.00	
42	56449	1832...	PCMU/8000	160	Session In P...	21.51	
43	56450	1832...	PCMU/8000	160	In Sequence	10.71	
45	56451	1832...	PCMU/8000	160	In Sequence	21.46	
48	56452	1832...	PCMU/8000	160	In Sequence	21.48	
52	56453	1832...	PCMU/8000	160	In Sequence	21.50	
54	56454	1832...	PCMU/8000	160	In Sequence	21.47	
56	56455	1832...	PCMU/8000	160	In Sequence	21.50	
58	56456	1832...	PCMU/8000	160	In Sequence	21.49	
59	56457	1832...	PCMU/8000	160	In Sequence	10.73	

Heading	Value
SSRC	957412353
Source IP Address	192.168.1.231
Destination IP Address	192.168.1.237
Source Port	26550
Destination Port	21708
RTP Packets Count	1886
RTCP Packets Count	3
Packets With Marker Bit	1
Total Audio Bytes	301760
RTCP Sender's Reports	3
RTCP Receiver's Reports	0

Heading	Value
SSRC	957785601
Source IP Address	192.168.1.237
Destination IP Address	192.168.1.231
Source Port	21708
Destination Port	26550
RTP Packets Count	1887
RTCP Packets Count	2
Packets With Marker Bit	1
Total Audio Bytes	301920
RTCP Sender's Reports	2
RTCP Receiver's Reports	0

RTP Statistics RTCP Gap Graph Jitter Graph Gap Distribution Graph Jitter Distribution Graph MOS Graph Quality Factors Inband Events

# RTP Statistics

- RTP Statistics displays details such as Source / Destination IP Address, Source / Destination Port, RTP / RTCP Packets Count, Packets with Marker Bits, Total Audio Bytes, RTCP Sender's and Receiver's Reports, count and percent of Out of Sequence packets, Missing Packets, Discarded Packets, & Duplicate Packets, and MOS-CQ \ Conversational R, MOS-LQ \ Listening R, G.107 R, and Nominal MOS \ Nominal R

Heading	Value	Heading	Value
SSRC	3514759169	SSRC	1149281025
Source IP Address	192.168.1.232	Source IP Address	192.168.1.199
Destination IP Address	192.168.1.199	Destination IP Address	192.168.1.232
Source Port	1024	Source Port	1024
Destination Port	1024	Destination Port	1024
RTP Packets Count	710	RTP Packets Count	665
RTCP Packets Count	2	RTCP Packets Count	2
Packets With Marker Bit	1	Packets With Marker Bit	0
Total Audio Bytes	113600	Total Audio Bytes	106400
RTCP Sender's Reports	2	RTCP Sender's Reports	2
RTCP Receiver's Reports	0	RTCP Receiver's Reports	0
Out Of Sequence Packets \ %	179 \ 21.78	Out Of Sequence Packets \ %	0 \ 0.00
Missing Packets \ %	112 \ 13.63	Missing Packets \ %	246 \ 27.00
Duplicate Packets \ %	0 \ 0.00	Duplicate Packets \ %	223 \ 24.48
MOS-CQ \ Conversational R	1.75 \ 35	MOS-CQ \ Conversational R	1.16 \ 18
MOS-LQ \ Listening R	1.79 \ 36	MOS-LQ \ Listening R	1.18 \ 19
G.107 R	34	G.107 R	17
Nominal MOS \ Nominal R	4.20 \ 93	Nominal MOS \ Nominal R	4.20 \ 93
Discarded Packets	15 \ 1.82	Discarded Packets	0 \ 0.00

Navigation: RTP Statistics | RTCP | Gap Graph | Jitter Graph | Gap Distribution Graph | Jitter Distribution Graph | MOS Graph | Quality Factors | Inband E



# RTCP Details

- Provides Senders and Receivers report , SDES item, and Bye packet in tabular format
- Senders and Receivers report includes details such as frame number, RTP Timestamp, SSRC, Packet count, Sender's SSRC, Fraction Lost, Cumulative Fraction Lost, Jitter, Last SR timestamp, and Delay since last SR
- SDES Item includes details such as frame number, SSRC/CSRC, SDES type, and Content/SDES Item
- Bye packet includes frame number, SSRC, and Reason for leaving

The screenshot displays the 'Traffic Analyser - Detail View' window. The top menu bar includes 'File', 'View', 'Detail View', 'Settings', and 'Help'. Below the menu is a toolbar with various icons. The main window is divided into several sections. The top section shows 'Call Summary', 'Registraton Summary', and 'Alert Summary'. Below this is a table with columns: Packet #, Sequ..., RTP..., Payload T..., Payl..., Packet Se..., Gap(...), and G... . The table contains data for packets 44 through 60. The bottom section shows a 'Sender Report' table with columns: Frame ..., Sender's ..., RTP Tim..., Packets ..., Octet ..., SSRC, and Fraction... . The table contains data for frames 1859, 5774, and 8858. The bottom of the window has a navigation bar with tabs: RTCP, Gap Graph, Jitter Graph, Gap Distribution Graph, Jitter Distribution Graph, MOS Graph, Quality Factors, Inband Events, and RTP Ev.

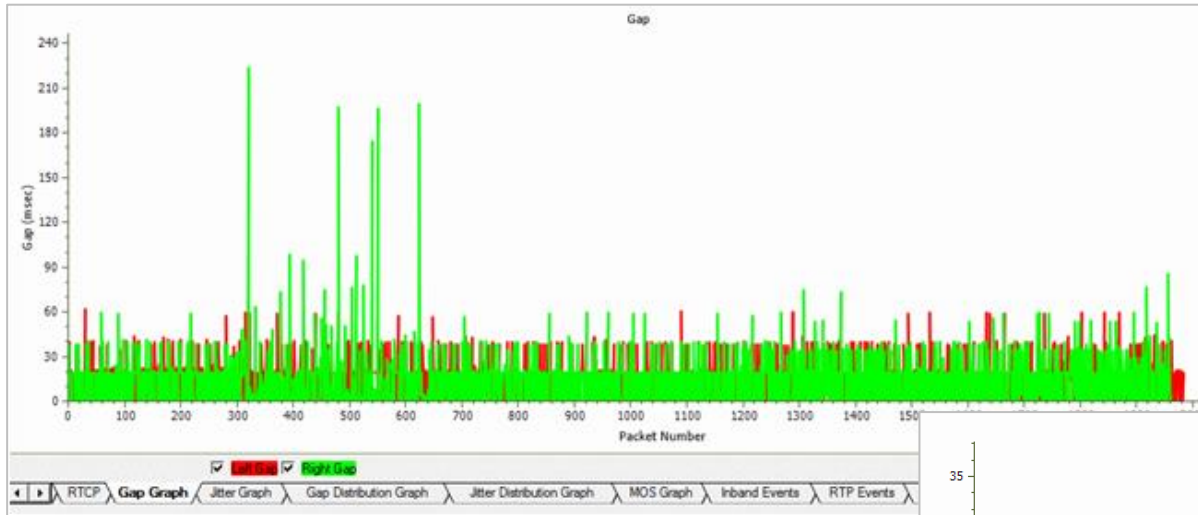
Packet #	Sequ...	RTP...	Payload T...	Payl...	Packet Se...	Gap(...)	G...
44	8020	144...	PCMU/80...	160	Session In ...	0.00	0...
46	8021	144...	PCMU/80...	160	Session In ...	21.48	20...
47	8022	144...	PCMU/80...	160	In Sequence	10.74	20...
49	8023	144...	PCMU/80...	160	In Sequence	22.47	20...
53	8024	144...	PCMU/80...	160	In Sequence	21.49	20...
55	8025	144...	PCMU/80...	160	In Sequence	21.45	20...
57	8026	144...	PCMU/80...	160	In Sequence	21.49	20...
60	8027	144...	PCMU/80...	160	In Sequence	21.47	20...

Frame ...	Sender's ...	RTP Tim...	Packets ...	Octet ...	SSRC	Fraction...
1859	957412353	1832527...	452	72320	957785...	24
5774	957412353	1832672...	1358	217121	957785...	23
8858	957412353	1832787...	2080	332641	957785...	23

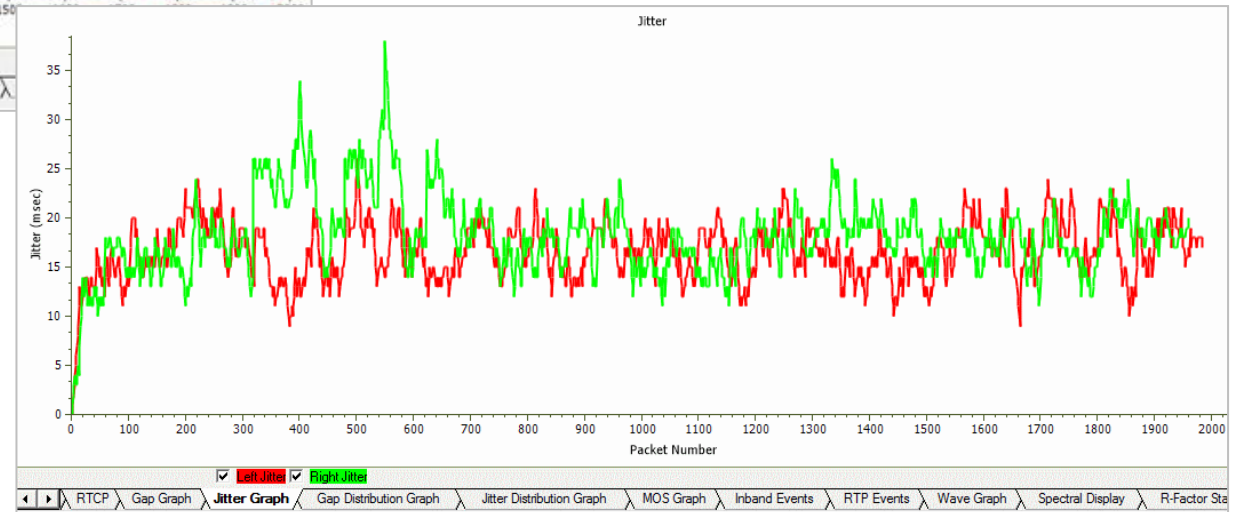
# Gap and Jitter Graph

- Gap graph plots the Gap (in milliseconds) versus the packet number
- Jitter graph plots the Jitter versus the packet number

## Gap Graph

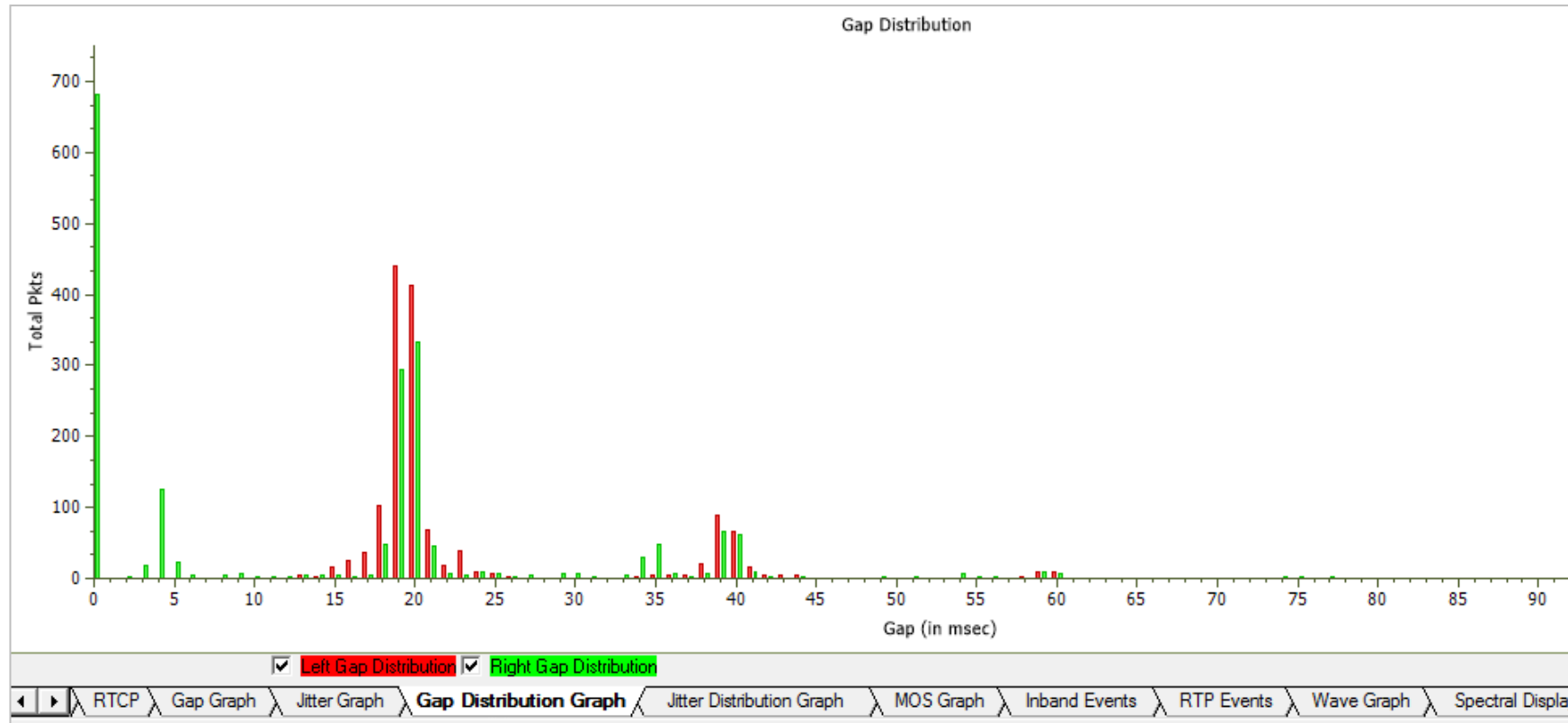


## Jitter Graph



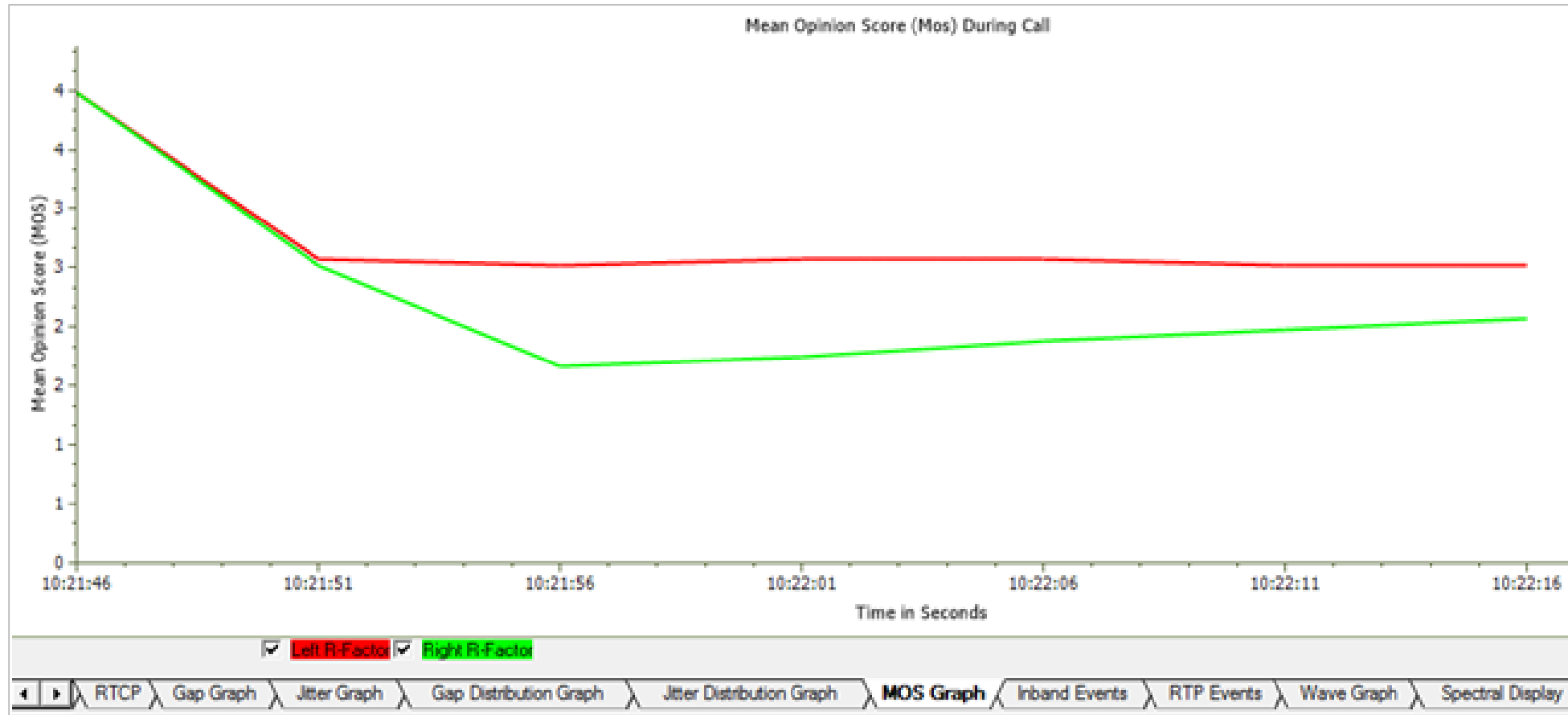
# Gap and Jitter Distribution Graph

- Number of packets with a particular value of gap is plotted against the (gap) value



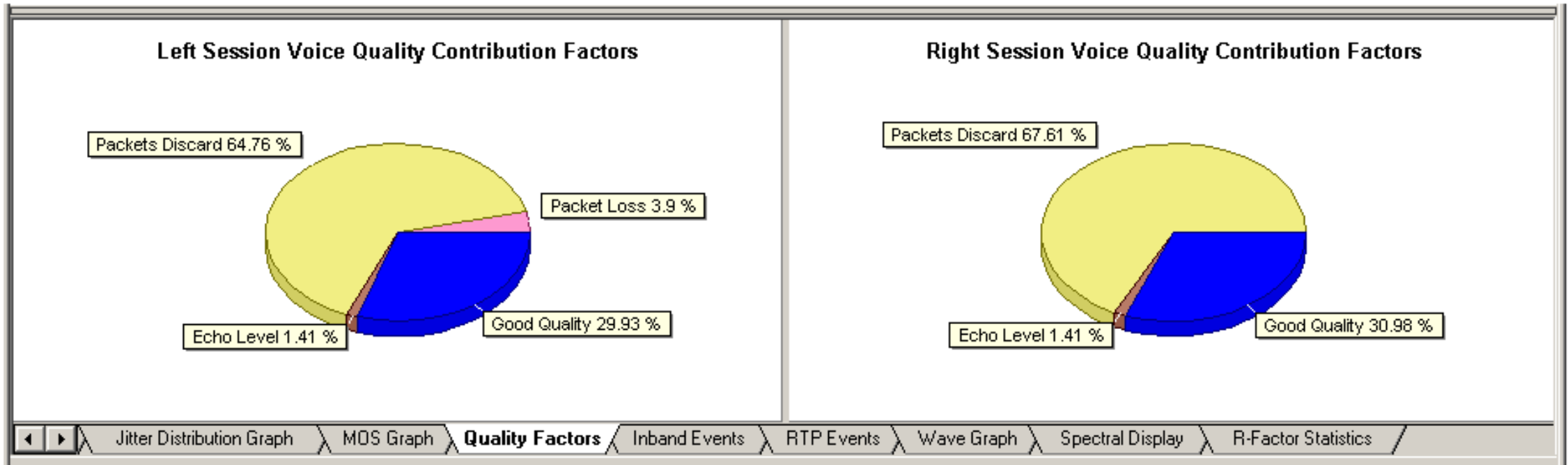
# MOS Graph

- MOS Graph plots Mean Opinion Score values throughout the duration of the call



# Quality Factors

- Quality Factors graph plots and compares Good Quality packets, Packets Discarded, and Echo level against total Packets for each individual sessions



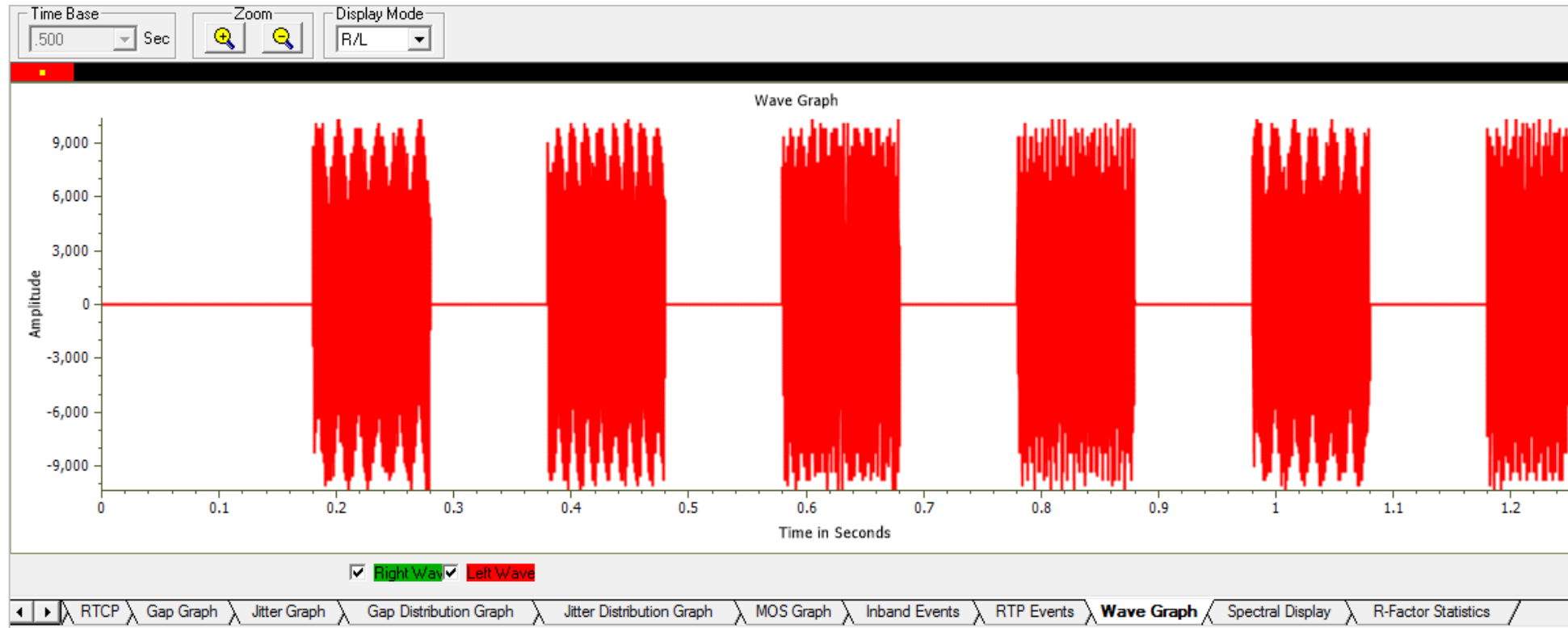
# Inband and RTP Events

- In-band Event tab displays inband DTMF and MF digits as they are received on selected RTP stream
- RTP Events tab displays all Out of band RTP events defined in RFC 2833

TimeStamp	Event	Volume [-dB]	Duration	TimeStamp	Event	Volume [-dB]	Duration
10:06:31.000853	Comfort Noise	88	0	10:06:32.000571	Comfort Noise	85	0
10:06:32.000779	Comfort Noise	91	0	10:06:32.000797	Comfort Noise	85	0
10:06:32.000854	Comfort Noise	85	0	10:06:32.000904	Comfort Noise	85	0
10:06:32.000876	Comfort Noise	85	0	10:06:33.000850	Comfort Noise	88	0
10:06:33.000080	Comfort Noise	85	0	10:06:34.000666	Comfort Noise	88	0
10:06:33.000177	Comfort Noise	85	0	10:06:34.000980	Comfort Noise	91	0
10:06:33.000853	Comfort Noise	88	0	10:06:35.000044	Comfort Noise	85	0
10:06:34.000648	Comfort Noise	85	0	10:06:35.000044	Comfort Noise	85	0
10:06:34.000745	Comfort Noise	88	0	10:06:35.000259	Comfort Noise	85	0
10:06:34.000842	Comfort Noise	88	0	10:06:35.000787	Comfort Noise	88	0
10:06:34.000949	Comfort Noise	88	0	10:06:35.000808	Comfort Noise	85	0
10:06:35.000046	Comfort Noise	88	0	10:06:36.000456	Comfort Noise	85	0
10:06:35.000142	Comfort Noise	88	0	10:06:36.000456	Comfort Noise	88	0
10:06:35.000239	Comfort Noise	88	0	10:06:36.000456	Comfort Noise	88	0
10:06:36.000099	Comfort Noise	85	0	10:06:36.000456	Comfort Noise	88	0
10:06:36.000561	Comfort Noise	88	0	10:06:36.000456	Comfort Noise	88	0
10:06:37.000948	Comfort Noise	85	0	10:06:36.000790	Comfort Noise	88	0
10:06:38.000045	Comfort Noise	85	0	10:06:37.000660	Comfort Noise	85	0
10:06:38.000152	Comfort Noise	85	0	10:06:38.000264	Comfort Noise	85	0
10:06:38.000249	Comfort Noise	85	0	10:06:38.000779	Comfort Noise	88	0

# Wave and Spectral Graphs

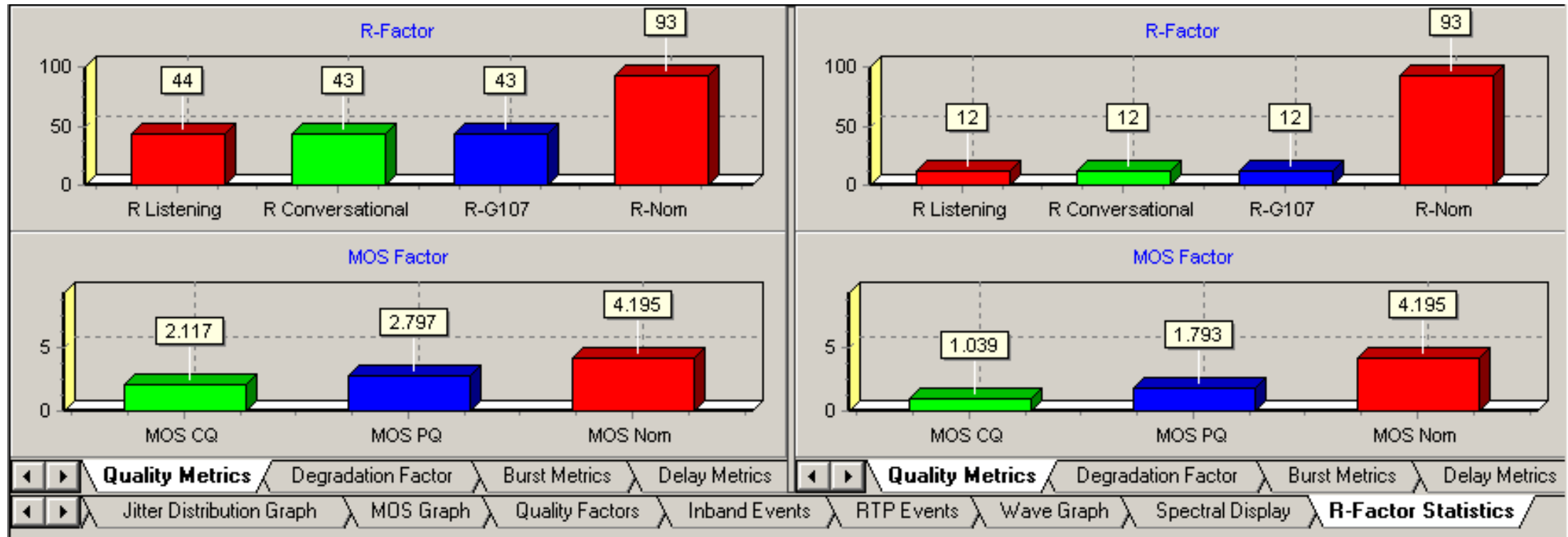
- Wave graph - Displays the amplitude of the incoming signal in a selected call as a function of time
- Spectral Display - Displays the power of incoming signal while the capturing is going on as a function of frequency



# R-Factor Statistics – Quality Metrics

Quality Metrics based on E-model - R-Factor and MOS Factor

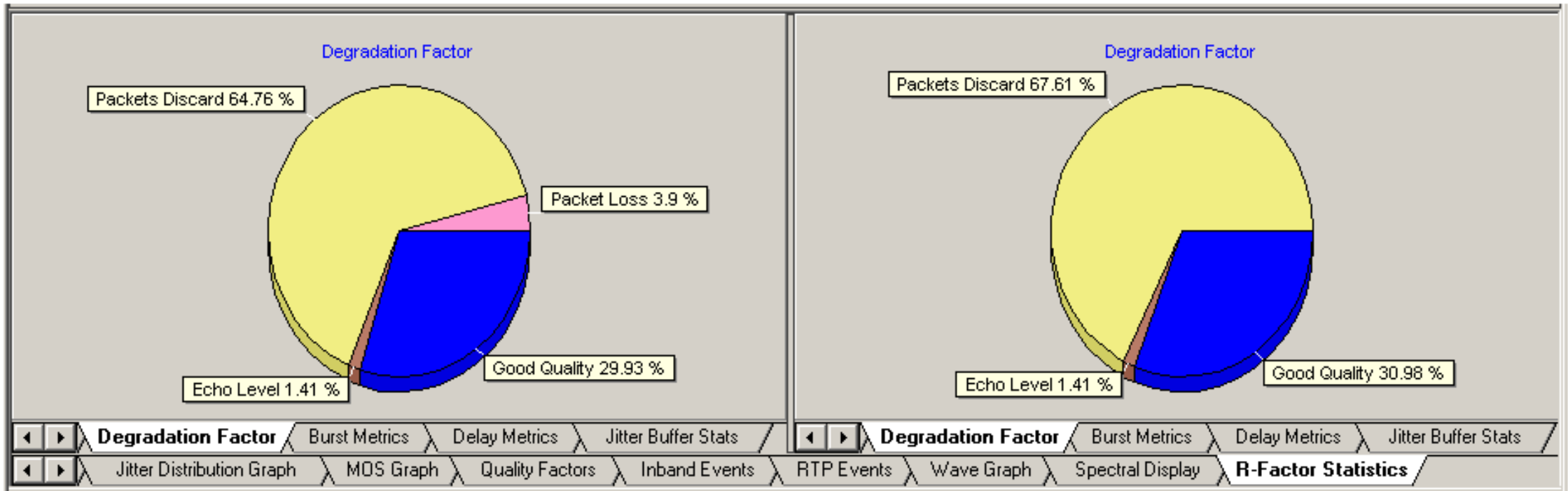
- R-Factor display statistics such as R Listening, R Conversational, R-G107, and R-Nominal values
- MOS Factor display current values such as MOS CQ, MOS PQ, and MOS Nominal values during a call





# R-Factor Statistics – Degradation Factor

- Quality Factors graph plots and compares Good Quality packets, Packets Discarded, Packet Loss, and Echo level against Total Packets for each individual sessions



# R-Factor Statistics – Burst Metrics

- Burst metrics displays the statistics for Burst R, Burst Count, Average Burst Loss Rate, Average Burst Packet Count, Average Burst Length, Gap R, Average Gap Loss Rate, Average Gap Packet Count, Average Gap Length, Average Loss/Discard Rate, Average Net Loss Rate, and Average Discard Rate

Burst R	43	Burst R	12
Burst Count	1	Burst Count	1
Avg Burst Loss Rate	10.82 %	Avg Burst Loss Rate	56.65 %
Avg Burst Packet count	3383	Avg Burst Packet count	3511
Avg Burst Length	3383	Avg Burst Length	3511
Gap R	92	Gap R	92
Avg Gap Loss Rate	0.00 %	Avg Gap Loss Rate	0.00 %
Avg Gap Packet Count	5	Avg Gap Packet Count	1
Avg Gap Length	5 msec	Avg Gap Length	1 msec
Avg Loss/Discard Rate	10.80 %	Avg Loss/Discard Rate	56.63 %
Avg Net Loss Rate	9.85 %	Avg Net Loss Rate	56.23 %
Avg Discard Rate	0.94 %	Avg Discard Rate	0.40 %

◀ ▶

**Burst Metrics**

Delay Metrics

Jitter Buffer Stats

◀ ▶

Jitter Distribution Graph

MOS Graph

Quality Factors

Inband Events

RTP Events

Wave Graph

Spectral Display

**R-Factor Statistics**

## R-Factor Statistics – Delay Metrics

- Delay metrics displays the statistics for Average / Maximum Round Trip Delay, Average / Maximum One Way Delay, Average / Maximum Originating / Terminating End system Delay, and Average / Maximum Packet Variation Delay

Avg Round Trip Delay	n/a	Avg Round Trip Delay	n/a
Max Round Trip Delay	n/a	Max Round Trip Delay	n/a
Avg One Way Delay	40	Avg One Way Delay	43
Max One Way Delay	40	Max One Way Delay	43
Avg Orig.End System Delay	n/a	Avg Orig.End System Delay	n/a
Max Orig.End System Delay	n/a	Max Orig.End System Delay	n/a
Avg Term.End System Delay	21	Avg Term.End System Delay	27
Max Term.End System Delay	41	Max Term.End System Delay	41
Avg Packet Delay Variation	4.169000 msec	Avg Packet Delay Variation	4.202000 msec
Max Packet Delay Variation	55.653000 msec	Max Packet Delay Variation	30.332000 msec

< >

Burst Metrics **Delay Metrics** Jitter Buffer Stats

Jitter Distribution Graph MOS Graph Quality Factors Inband Events RTP Events Wave Graph Spectral Display **R-Factor Statistics**

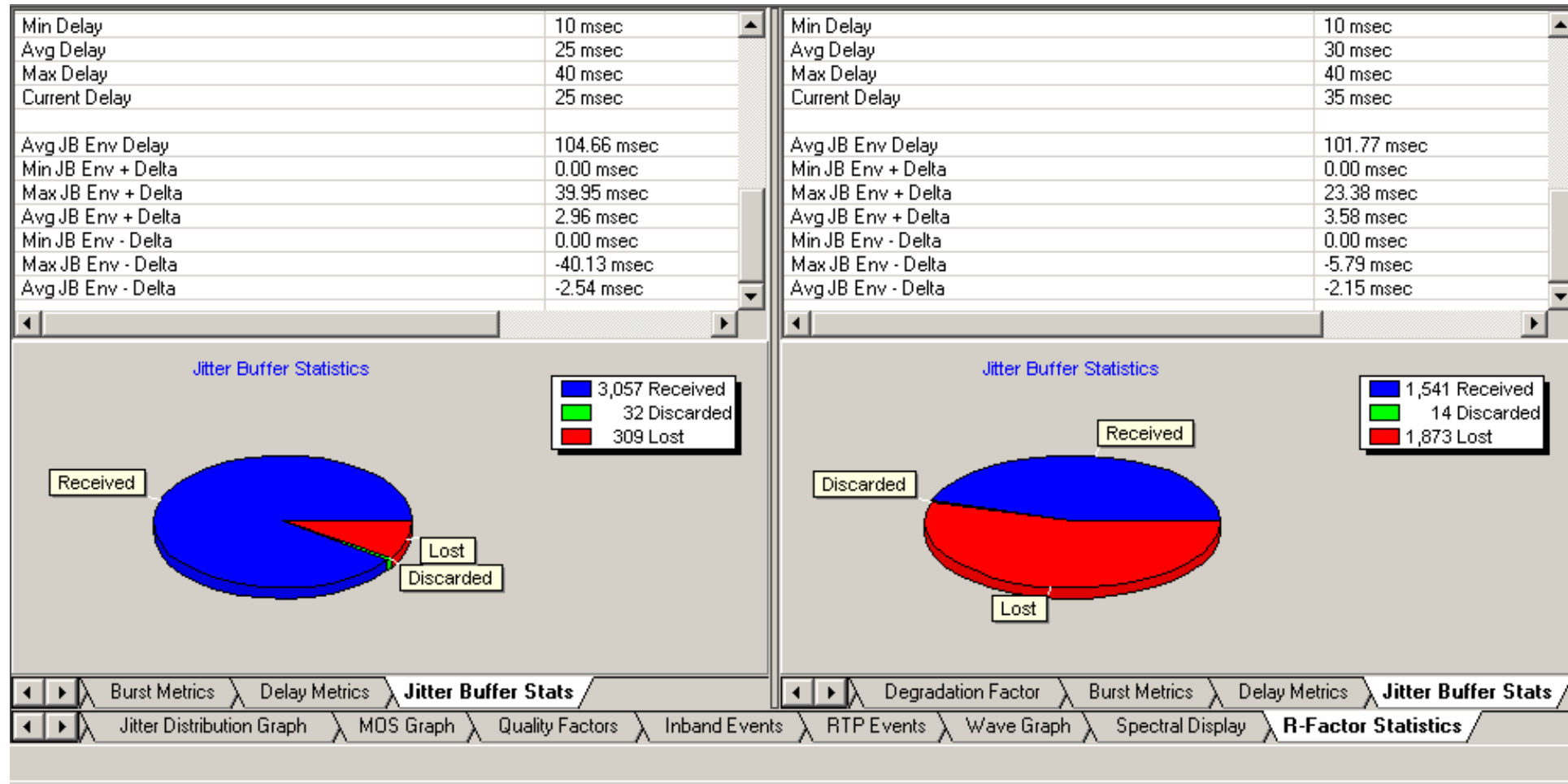
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Burst Metrics **Delay Metrics** Jitter Buffer Stats

Jitter Distribution Graph MOS Graph Quality Factors Inband Events RTP Events Wave Graph Spectral Display **R-Factor Statistics**

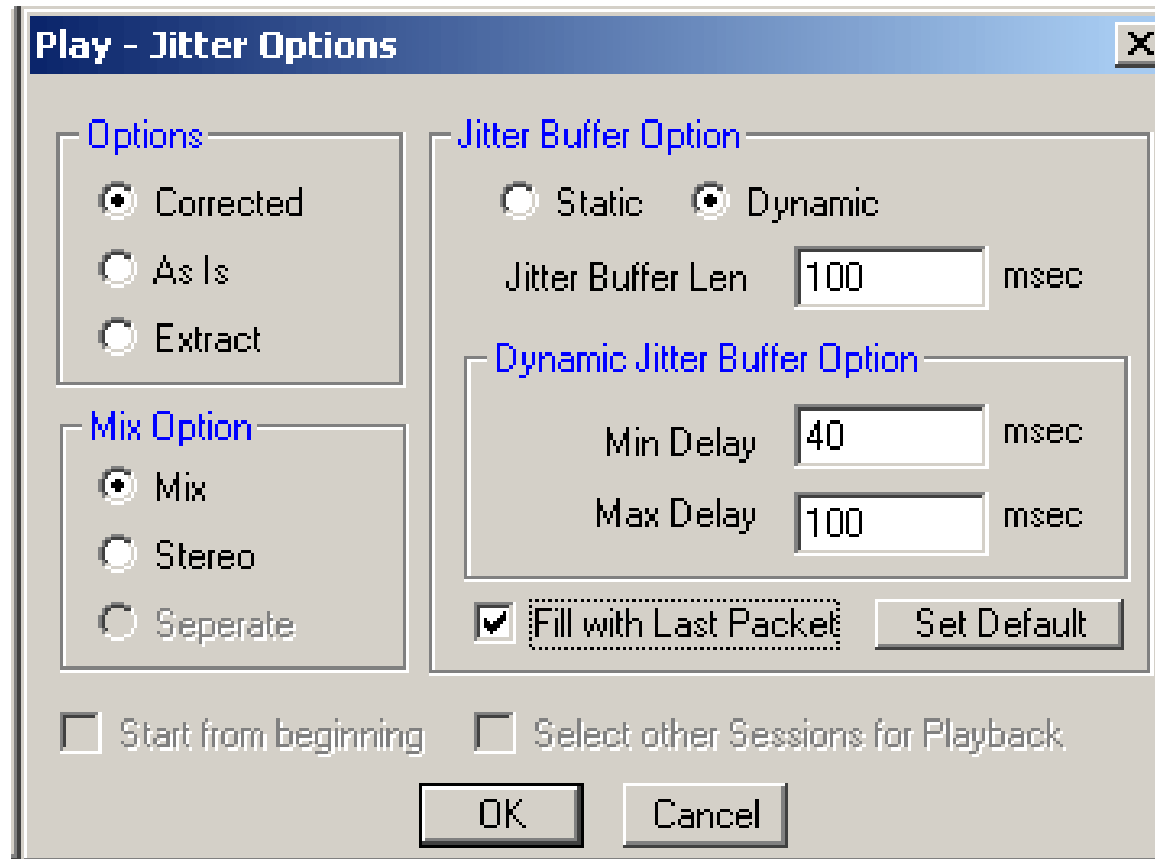
# R-Factor Statistics – Jitter Buffer Statistics

- Plots and compares packets received, packets discarded, and packets lost against total Packets for each individual sessions. Also provides a tabular data on average



# Play to Speaker

- Plays the RTP streams of a call to the PC speaker using a sound card
- Provides a host of options such as jitter buffer settings, audio mixing, and so on to play a live call in real-time or play captured voice files



# Write to File

- Provides various options to save the captured file in a required format
- Uses the files with voice quality analysis software to investigate more about the quality of voice in the network
- Records the RTP stream to a file in \*.wav format

**Write To File - Jitter Options**

**Options**

☒ Corrected  
☐ As Is  
☐ Extract

**Mix Option**

☒ Mix  
☐ Stereo  
☐ Seperate

**Jitter Buffer Option**

☒ Static ☐ Dynamic  
Jitter Buffer Len  msec

**Dynamic Jitter Buffer Option**

Min Delay  msec  
Max Delay  msec

☒ Fill with Last Packet

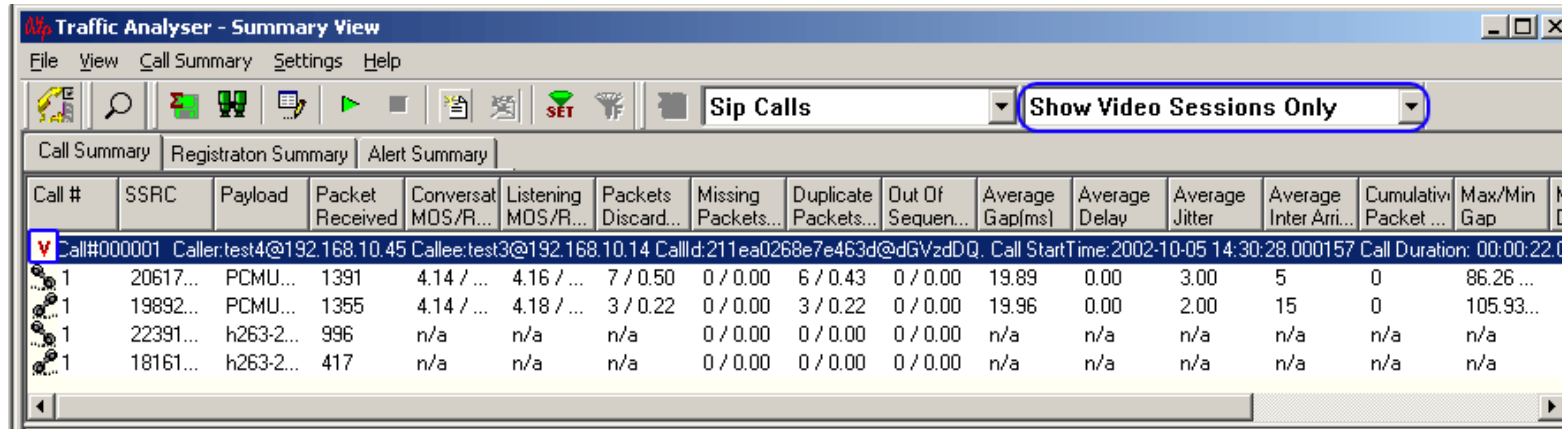
☐ Start from beginning

**File Record**

☐ Use SSRC for File Name

☐ Invoke Cool Edit after write

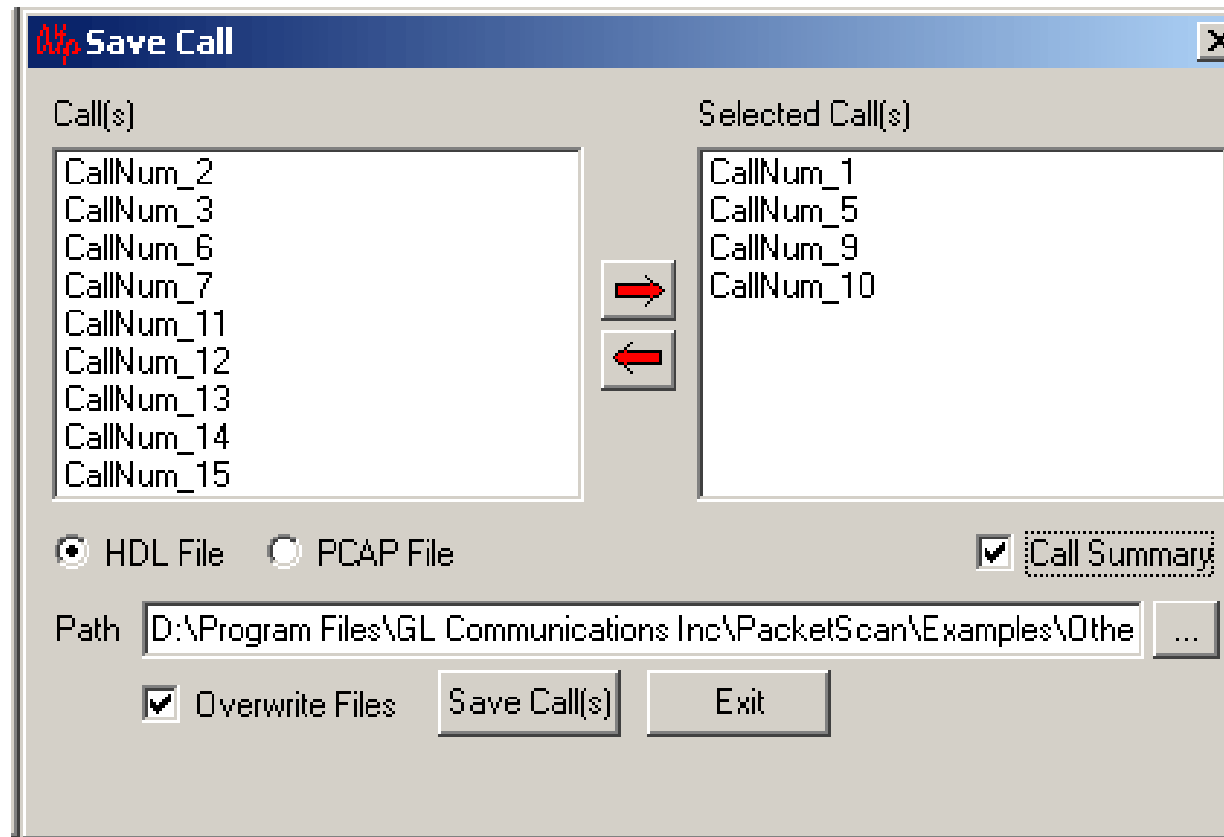
# Record Video



- Record video option is available for both Auto Detected RTP Calls and SIP Calls
- Records audio and video data of a session to a file in QuickTime format
- Supported Video Codecs are:
  - H263+
  - H263++ CIF 190 kbps
  - H263++ CIF 350 kbps
  - H263++ CIF 512 kbps
  - H263++ QCIF 128 kbps
  - H263++ QCIF 64 kbps
  - H263++ QCIF 80 kbps
  - H264 is an industry standard codec for video compression, the codec offers better compression performance over previous standards

# Save Call

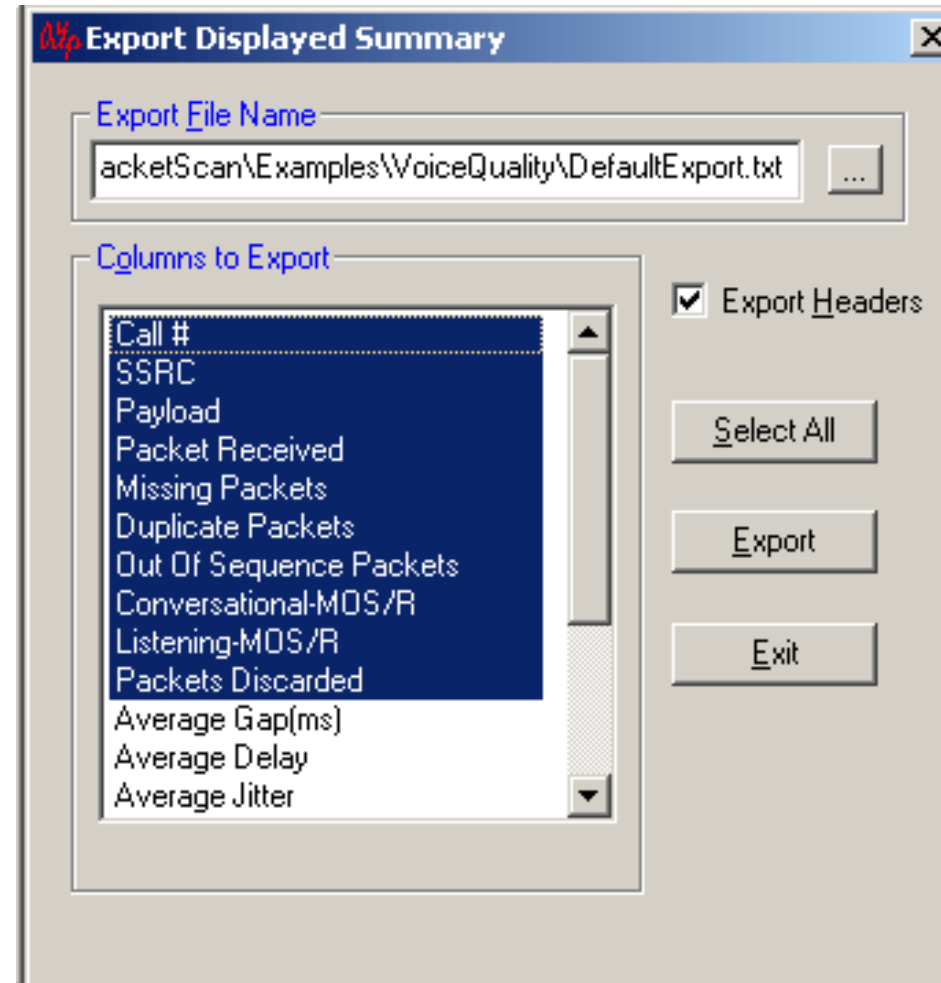
- Saves a particular call in either GL's proprietary HDL file format or Ethereal PCAP file format
- Saves the Call Summary details including signaling and audio / fax/ video parameters for a particular call in \*.rtf file
- Helps in getting data from real-time traffic locations to the lab for detailed analysis





# Export Displayed Summary

- Saves the call records and statistics to a comma-separated file
- Imports the exported summary into a database or spreadsheet for post processing



# Dynamic Payload Mapping and Codec Packing

- Dynamic payload assignments are made at call setup based on receive side assignment
- Dynamic payload mapping is used to define payload type for supported codecs
- Additional parameters can be set to codecs such as G726, AMR, EVRC, EVRCB, EVRC-C, G722.1, and AMR-WB using codec parameter settings

**Payload Mapping Table**

Audio Codec	PayLoad
ALAW	8
MuLAW	0
G726_40	96
G726_32	97
G726_24	98
G726_16	99
G723	4
G729	19
G729B	18
GSM610	3
AMR	100
EVRC	101

OK

**Codec Parameters Settings**

Codec Type

- G726
- AMR
- EVRC**
- G722\_1
- AMR\_WB
- EVRCB

Rtp Packet Format

Bundled Format

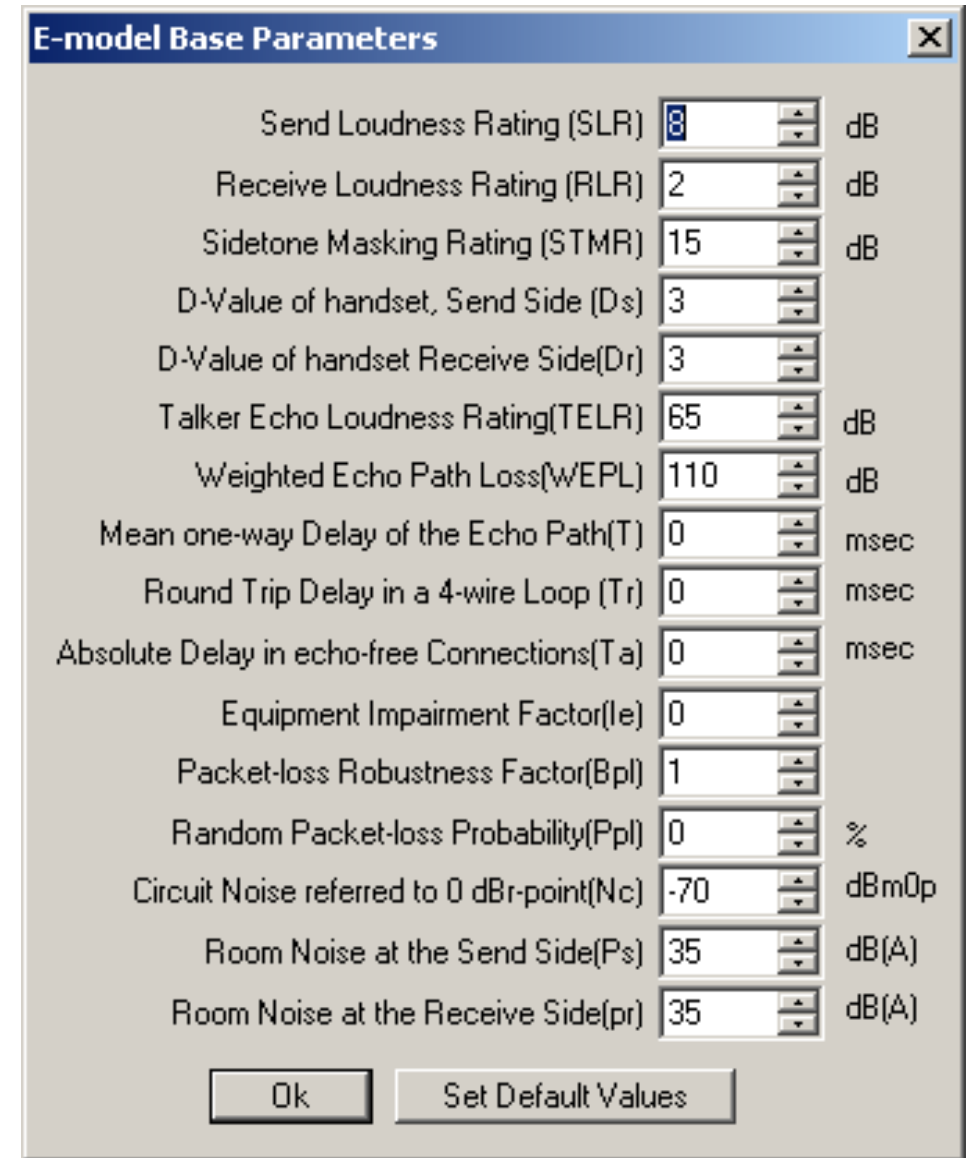
Payload Packing Format

☒ LSB ☐ MSB

Save

# E-Model Base Parameters

- E-Model ( ITU – T Rec. G. 107 [1]) is a transmission-planning tool
- Provides a prediction of the expected voice quality
- Considers many basic parameters in estimating voice quality



The screenshot shows a dialog box titled "E-model Base Parameters" with a close button (X) in the top right corner. The dialog contains a list of parameters, each with a numerical input field and a unit. The parameters and their values are:

Parameter	Value	Unit
Send Loudness Rating (SLR)	8	dB
Receive Loudness Rating (RLR)	2	dB
Sidetone Masking Rating (STMR)	15	dB
D-Value of handset, Send Side (Ds)	3	
D-Value of handset Receive Side(Dr)	3	
Talker Echo Loudness Rating(TELR)	65	dB
Weighted Echo Path Loss(WEPL)	110	dB
Mean one-way Delay of the Echo Path(T)	0	msec
Round Trip Delay in a 4-wire Loop (Tr)	0	msec
Absolute Delay in echo-free Connections(Ta)	0	msec
Equipment Impairment Factor(Ie)	0	
Packet-loss Robustness Factor(Bpl)	1	
Random Packet-loss Probability(Ppl)	0	%
Circuit Noise referred to 0 dB-point(Nc)	-70	dBmOp
Room Noise at the Send Side(Ps)	35	dB(A)
Room Noise at the Receive Side(pr)	35	dB(A)

At the bottom of the dialog, there are two buttons: "Ok" and "Set Default Values".

# VQMon Settings

- Sets jitter buffer emulator settings to emulate received VoIP call
- Static or dynamic buffer can be set depending upon the requirement

**VqMon Settings**

Jitter Buffer Emulator - Summary

Type: **Adaptive** (dropdown)

Minimum: **40** ms

Nominal: **40** ms

Maximum: **100** ms

Jitter Buffer Emulator - Detail Analysis

Type: **Adaptive** (dropdown)

Minimum: **40** ms

Nominal: **40** ms

Maximum: **100** ms

VQMon Standards

☐ Japan ☒ North America

**Ok** **Set Default**

# Trigger and Action Settings

Triggers and Action Settings - Untitled

File

Trigger List

- ☒ Trigger1

Enter Trigger Name

Trigger1

Add Delete

Filter Selection

- ☒ SIP
  - ☒ Calling Party
  - ☐ Called Party
  - ☐ Fax Calls
  - ☐ Incomplete Calls
  - ☐ Failed Calls
  - ☐ Sip Error Code
  - ☐ Call Duration (mins)
  - ☐ Session Request Delay (msecs)
  - ☐ Session Disconnect Delay (msecs)

Enter String Value

1000@192.168.1.183

Activate DeActivate

Conditions

☐ And ☒ Or

Action

- ☒ Save Call
- ☒ Audio Recording
- ☒ User Defined
- ☒ Send e-mail
- ☒ Alert Summary
- ☒ Call Detail Record

Save Call To File Options

File Name Mask

%l\_%Y\_%M\_%D\_%h-%m-%s

Files Destination Directory

C:\Program Files\GL Communications ...

Save Options

☒ HDL File

☐ PCAP File

☐ Call Summary

Create File Options -- If File Exists

☒ Overwrite ☐ Skip Operation ☐ Append Sequence Number

Ok Cancel

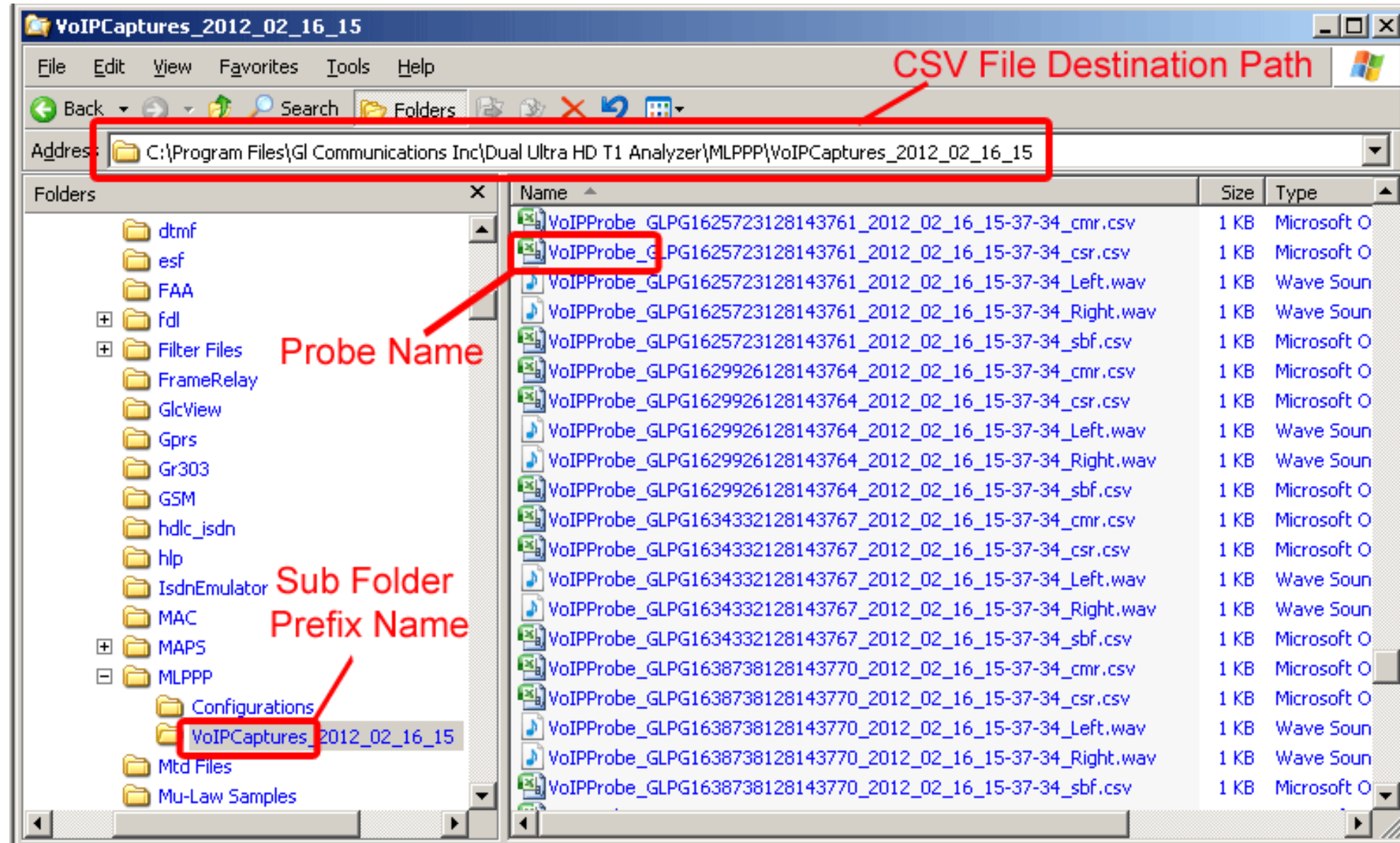
- Sets the triggers and actions criteria to further filter calls and perform additional actions on these subset of completed calls
- Triggers on certain SIP, RTP, MEGACO, and H323 parameters
- It allows users to specify the formats and the type of calls to be saved as \*.hdl, or \*.pcap, and/or \*.wav format
- Triggering factors includes calling number, called number, incomplete calls, fax calls, call duration, MOS factor, sip error code, average jitter, and more
- Actions include saving call to a file, recording audio to a file, sending an email, posting alert summary, and viewing custom calls in summary view
- Call detail record trigger option will output three types of Comma Separated Value (CSV) files such as Call Master Record, Call Side Record, and Call Events Record. Each set of CSV file is specific to an individual call

# Call Detail Record (CSV)

The screenshot shows a configuration window titled "Action". On the left, there is a list of actions with checkboxes: ☒ Save Call, ☒ Audio Recording, ☒ User Defined, ☒ Send e-mail, ☒ Alert Summary, and ☒ Call Detail Record. On the right, there are several settings:   
 - Checkboxes for ☒ Call Side Record, ☒ Call Master Record, and ☒ Call Events Record.   
 - A "Probe Name" field containing "VolPProbe".   
 - A "CSV Files Destination Directory" field containing "C:\Program Files\GL Communications" with a browse button "...".   
 - A "Use Sub Folders" checkbox which is checked.   
 - A "Folder Prefix" field containing "VolPCaptures" and a "Create Subfolder Every" dropdown set to "1" with "hr" (hours) next to it.   
 - A section titled "Create File Options -- If File Exists" with three radio buttons: ☒ Overwrite, ☐ Skip Operation, and ☐ Append Sequence Number.

- Creates three types of Comma Separated Value (CSV) files such as Call Side Record, Call Master Record, and Call Events Record
  - Call Side Record: It is a record concerning each party participating in the call. For example: Probe ID, Call ID, Side, Address, File Name, SSRC, Codec, Total Packets, and so on
  - Call Master Record: It contains fields concerning the call as a whole, For example: Probe ID, CALL ID, Side 1, Side 2, Protocol name, Start & Released dated and time, and so on
  - Call Event Record: It gives an event-by-event account of the call. For example: Probe ID, Call ID, Side, Class ID, Start, Duration, Source IP address, Destination IP Address, and so on
- Use Sub Folders option to automatically create the subfolders after some time duration

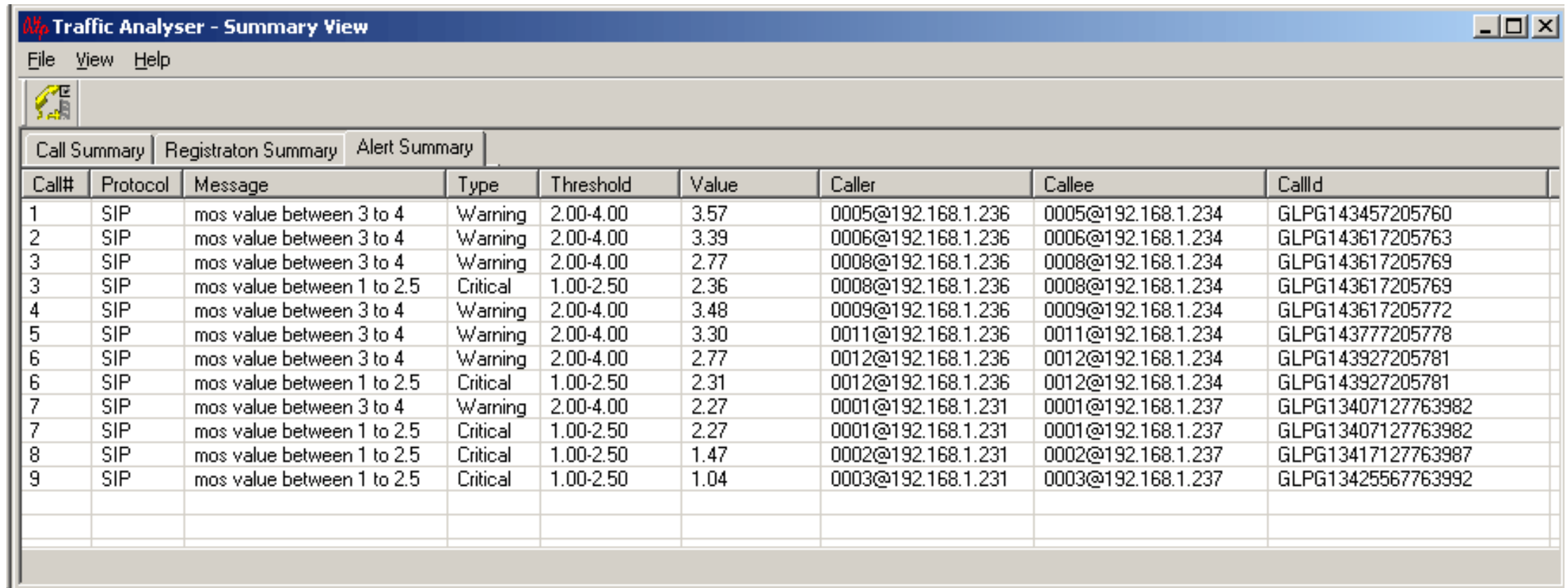
# CSV Outputs





# Alert Summary

- Generates alerts when particular vital parameters go beyond a specified value
- Provides an active list of the alerts for the events in a tabular column
- Displays the summary of call#, user-defined message, threshold value, actual value for which the alert occurred, callee, caller, and callid

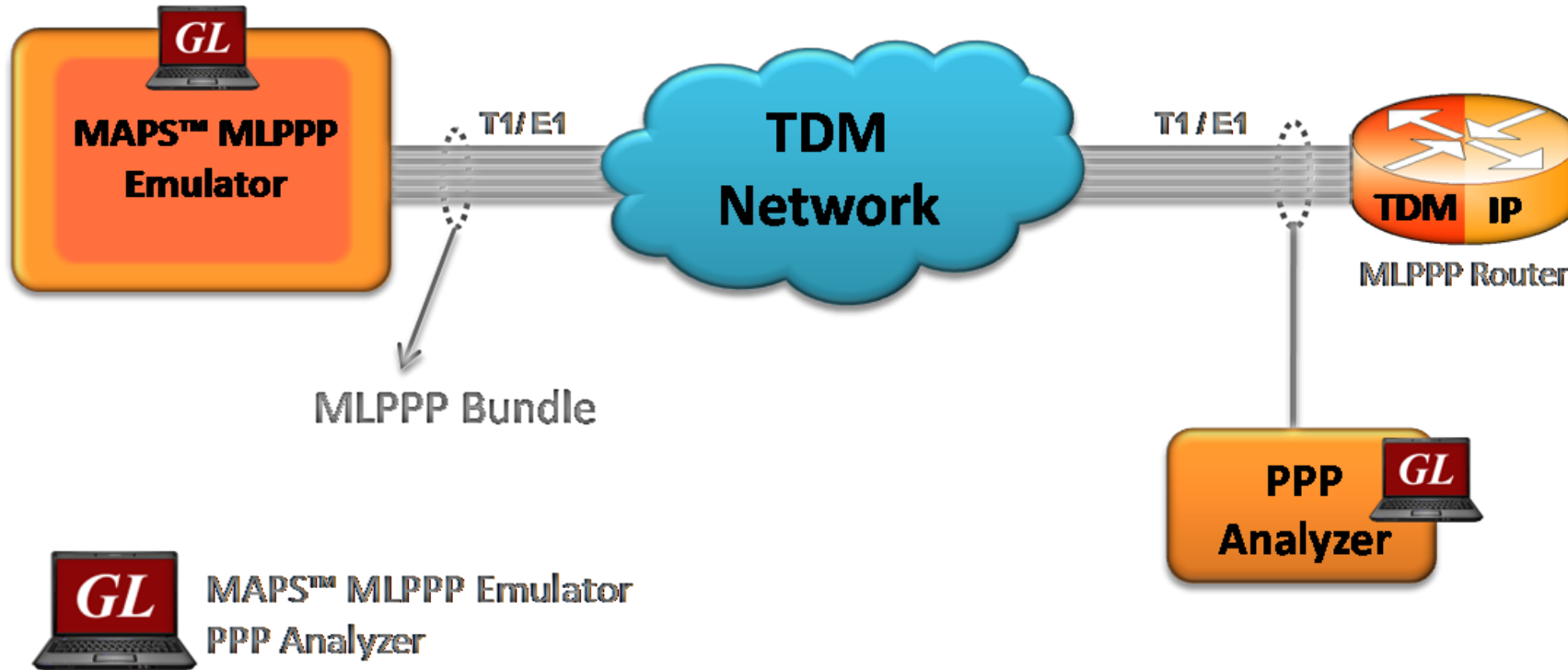


Call#	Protocol	Message	Type	Threshold	Value	Caller	Callee	Callid
1	SIP	mos value between 3 to 4	Warning	2.00-4.00	3.57	0005@192.168.1.236	0005@192.168.1.234	GLPG143457205760
2	SIP	mos value between 3 to 4	Warning	2.00-4.00	3.39	0006@192.168.1.236	0006@192.168.1.234	GLPG143617205763
3	SIP	mos value between 3 to 4	Warning	2.00-4.00	2.77	0008@192.168.1.236	0008@192.168.1.234	GLPG143617205769
3	SIP	mos value between 1 to 2.5	Critical	1.00-2.50	2.36	0008@192.168.1.236	0008@192.168.1.234	GLPG143617205769
4	SIP	mos value between 3 to 4	Warning	2.00-4.00	3.48	0009@192.168.1.236	0009@192.168.1.234	GLPG143617205772
5	SIP	mos value between 3 to 4	Warning	2.00-4.00	3.30	0011@192.168.1.236	0011@192.168.1.234	GLPG143777205778
6	SIP	mos value between 3 to 4	Warning	2.00-4.00	2.77	0012@192.168.1.236	0012@192.168.1.234	GLPG143927205781
6	SIP	mos value between 1 to 2.5	Critical	1.00-2.50	2.31	0012@192.168.1.236	0012@192.168.1.234	GLPG143927205781
7	SIP	mos value between 3 to 4	Warning	2.00-4.00	2.27	0001@192.168.1.231	0001@192.168.1.237	GLPG13407127763982
7	SIP	mos value between 1 to 2.5	Critical	1.00-2.50	2.27	0001@192.168.1.231	0001@192.168.1.237	GLPG13407127763982
8	SIP	mos value between 1 to 2.5	Critical	1.00-2.50	1.47	0002@192.168.1.231	0002@192.168.1.237	GLPG13417127763987
9	SIP	mos value between 1 to 2.5	Critical	1.00-2.50	1.04	0003@192.168.1.231	0003@192.168.1.237	GLPG13425567763992

# MAPS™ MC-MLPPP Conformance Testing

# MAPS™ MC-MLPPP Conformance Testing

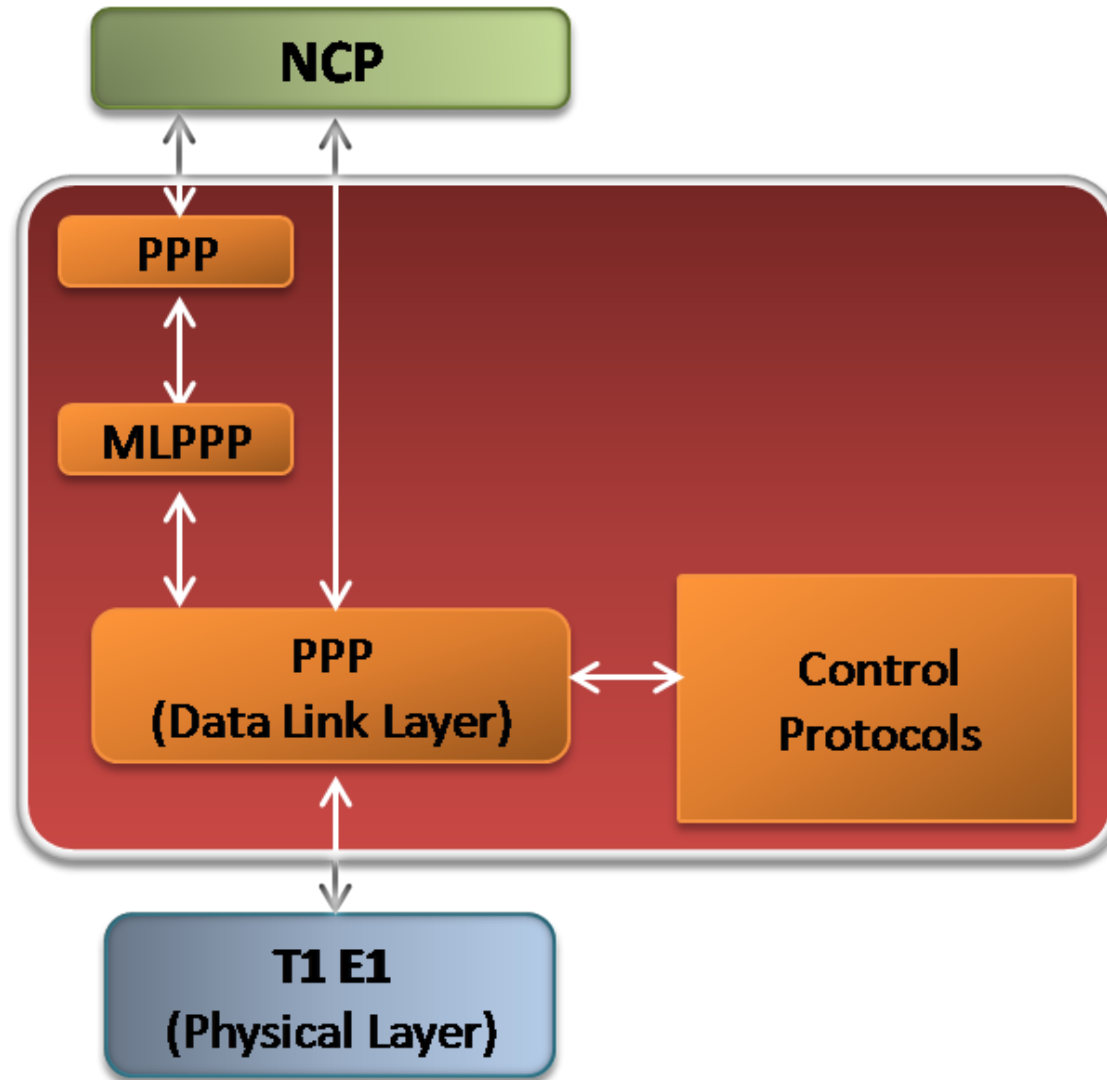
- MAPS™ MLPPP is an advanced tool for MLPPP simulation over TDM (T1 E1) that can simulate peer endpoints (Router or a Switch), with MLPPP signaling specification conforms to IETF standards



# Features

- Performs MC-MLPPP as well as PPP simulation over TDM (T1/E1)
- Supports LCP with the following negotiation options
  - PPP options: MRU (Maximum Receive Unit), ACFC (Address and Control Field Compression), PFC (Protocol Field Compression), and Magic Number
  - MLPPP Options: MRRU (Maximum Received Reconstructed Unit), Short Sequence Number Format, Long sequence header format, Endpoint Discrimination, and Multi-class option
  - Multi-Class Options: Multilink Header Format
- Supports the following NCPs -
  - IPCP - RFC 1332 (The PPP Internet Protocol Control Protocol) and RFC 1877 (PPP Internet Protocol Control Protocol Extensions for Name Server Addresses) standards
  - PPPMuxCP - RFC 3153 (PPP Network Control Protocol for PPP Multiplexing) standard
- Supports IP compression negotiation option conforming to RFC 3544
- Supports full or fractional timeslots for PPP Link
- Ideal solution for automated testing using command line scripts

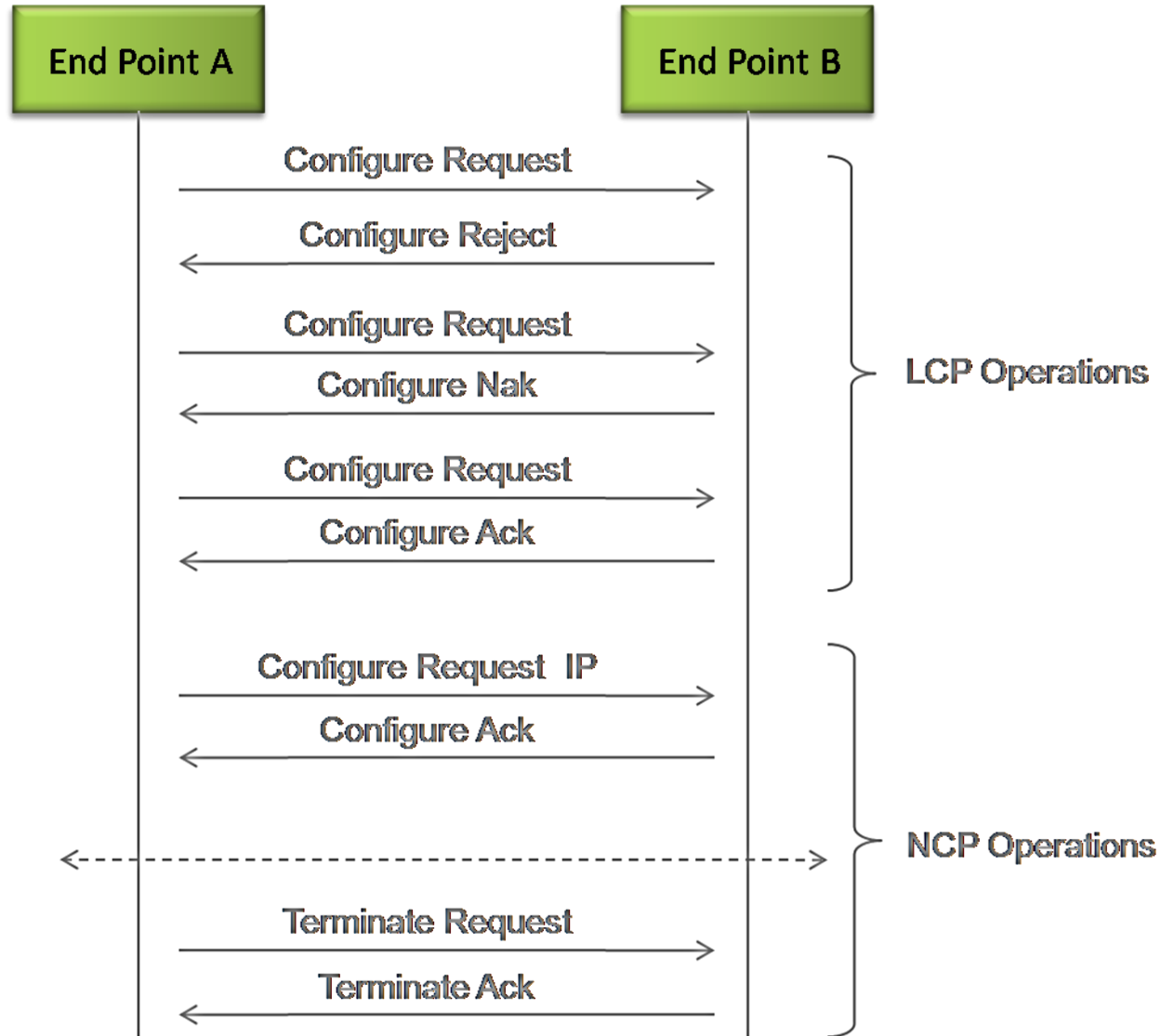
# Protocol Stack



# Supported Protocol Standards

Supported Protocols	Standard / Specification Used
Point-to-Point Protocol	RFC1661
Multi-Link PPP	RFC1990
Multi-Class Extension to Multi-Link PPP	RFC2686
IPCP	RFC1332
IPCP Extensions	RFC1877
PPPMuxCP	RFC3153

# Typical MLPPP Negotiation Operations



# Call Generation and Call Reception

**Active Calls** ←

→ **Completed Calls**

**Load Scripts and Profiles**

**Script Contents**

**Executing Commands**

**Receiving Scripts**

**Message Sequence of a selected call**

**Message Decodes of the selected ISDN message**

**Call Generation - Untitled**

Sr ...	Script Name	Profile	Call Info	Script Execution	Status	Events	Events Profile	Result	Total Iteratio...	Completed Iterati...
1	OpenStateTest.gls	Profile_openState...		Abort	Request Sent	None		Unknown	1	0

Buttons: Add, Delete, Insert, Start, Abort, Refresh, Start All, Abort All

☐ View Executing Line

**Script Contents**

```

acksent="No" ;
IDSent=$Identifier;
MRU=1500;
send "Configure-Request" "ConfigureRequestImport""StreamId"=StreamId retxmit Timer (10,TimeSpan sec);
Eventlog ("ConfigReq Sent");
Status="Request Sent" ;
RecvTime=30 ;
"MainLoop":
recv msg wait RecvTime sec;
if (MsgReceived)
    
```

**Executing Commands**

**Call Reception**

Sr No	Script Name	Call Info	Script Execution	Status	Events	Events Profile	Results
1	TestLoopBackUsingPeerMagicNumber.gls		Completed		None		Fail
2	TestLoopBackUsingPeerMagicNumber.gls		Completed		None		Pass
3	TestLoopBackUsingPeerMagicNumber.gls		Completed		None		Pass
4	TestLoopBackUsingPeerMagicNumber.gls		Completed		None		Unknown
5	TestLoopBackUsingPeerMagicNumber.gls		Completed		None		Unknown
6	TestLoopBackUsingPeerMagicNumber.gls		Completed		None </tr		

Buttons: Abort, Auto Trash, Trash

**Message Sequence of a selected call**

**Message Decodes of the selected ISDN message**

```

===== PPP Link Layer =====
Address Compression Choice = 1111... No Address Co
Address = 11111111 Broadcast Ad
CC = 00000011 UnSequenced I
ProtoCol Field Selection = .....0 ProtocolField
Protocol = 11000000 00100001 Lin
===== Link Control Layer =====
Code Type =
Code = 00000001 Configure-Re
Identifier = 1 (x01)
Length = 18 (x0012)
Magic-Number =
IE id = 00000101 Magic-Number
Length of Options = 6 (x06)
    
```



**Thank You!**