All-IP Signaling and Traffic Analysis
RTP/RTCP/Fax (T.38) Analysis

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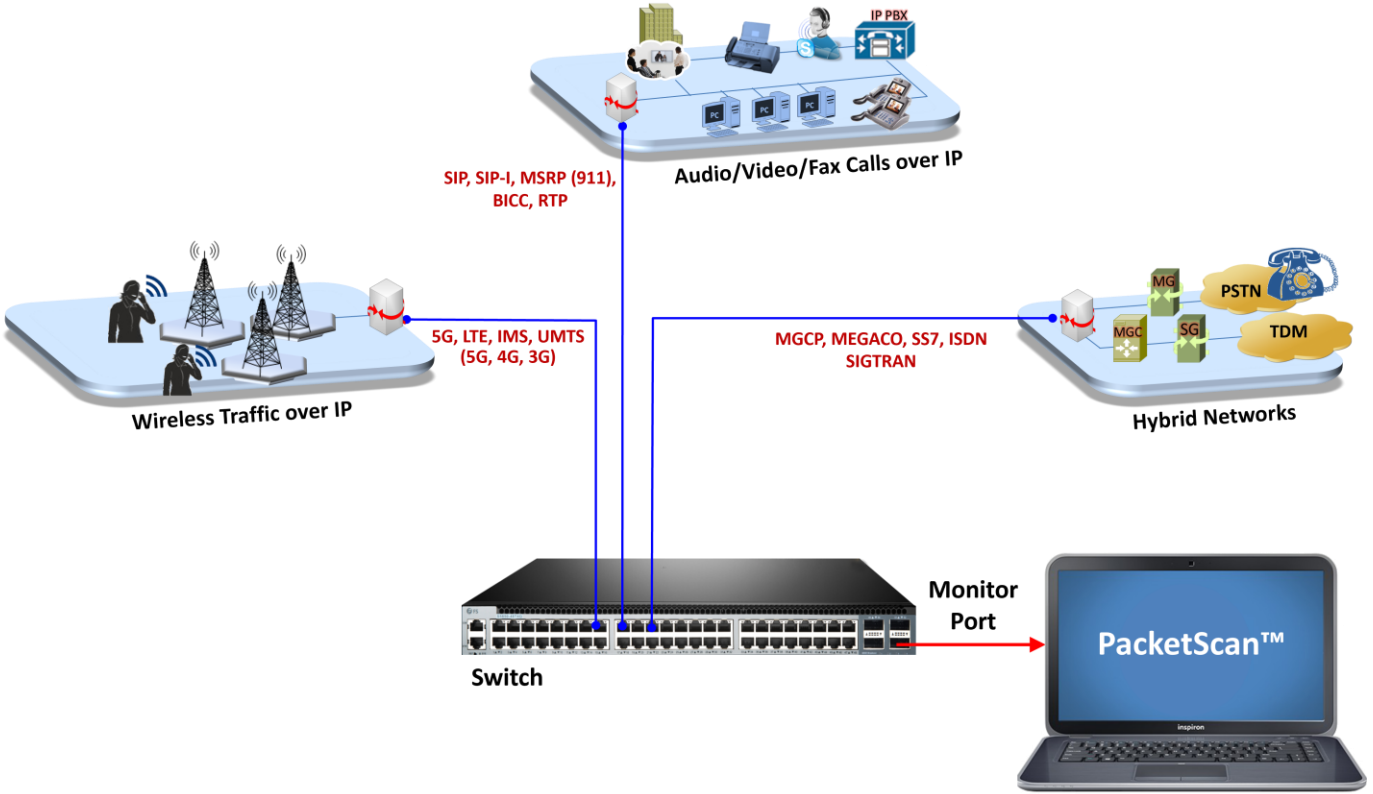
PacketScan™ All-IP Signaling and Traffic Analysis

(5G/4G/3G/2G/VoIP/RTP, RTCP/ Video Analysis)



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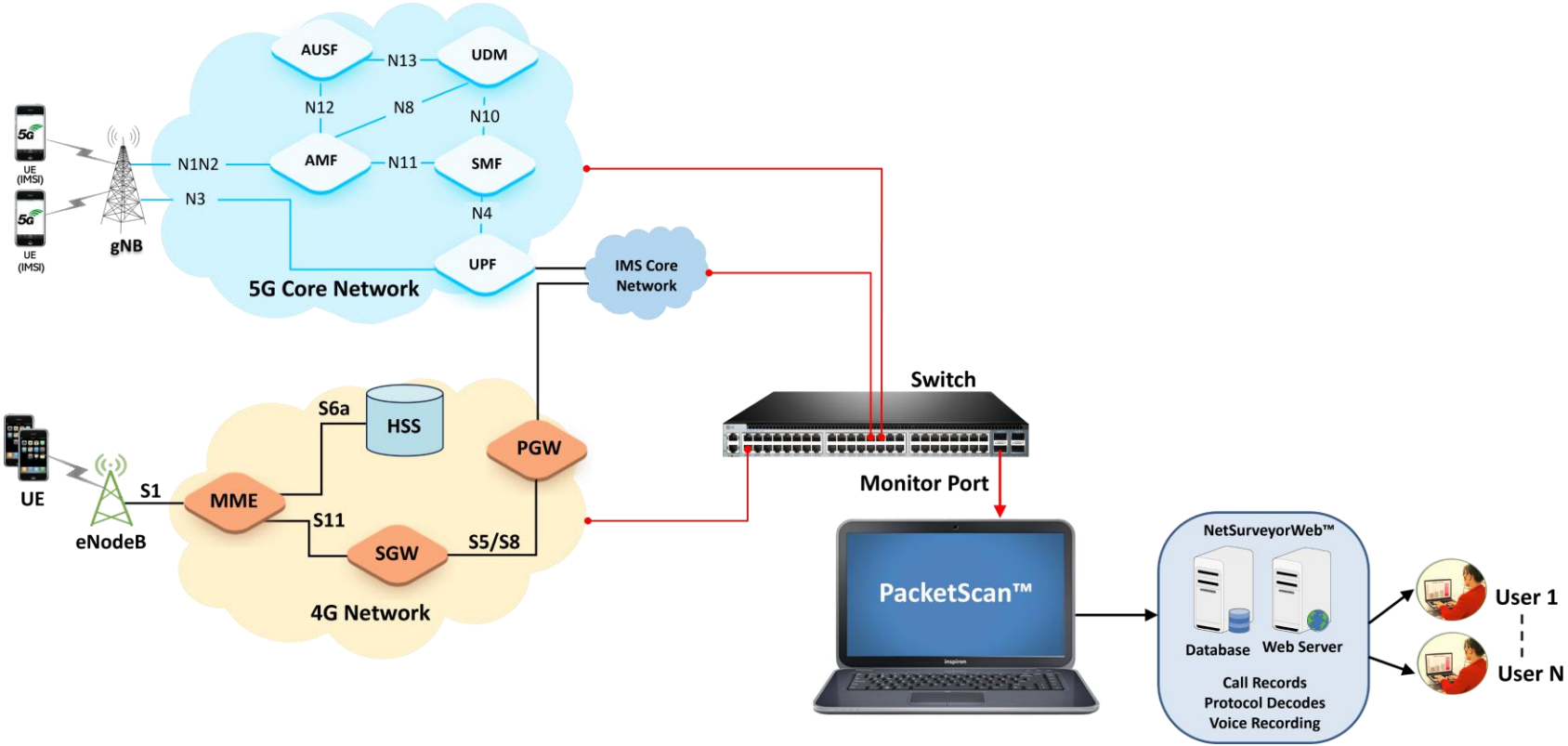
What the Software does?

- Non-Intrusively capture real time IP traffic across high speed
- Captures, segregates, and monitors packets; perform voice quality testing in real-time over VoIP network
- Wirespeed hardware filtering capability to capture packets of interest
- Non-intrusively capture real-time signaling and traffic packets for infinite time and provide call details of per call and aggregated protocol statistics
- Supports monitoring of 5G networks. It captures, segregates, monitors and collects statistics on all calls over N1N2, N4, N8, N10, N11, N12 and N13 interfaces of the 5G network
- Capable of continuous monitoring of communication over IMS network over SIP, S6a, S6d, S13, Cx/Dx, Gx, Rx, Sh, Gy/Ro interfaces
- Monitors and segregates S1AP, NAS, Diameter and eGTP interfaces, deciphers NAS and decrypts Voice over Long-Term Evolution (VoLTE) calls over Internet Secured Protocol Security (IPSEC)
- Can be deployed as a Probe for a centralized monitoring system with Oracle database

5G and LTE Protocol Analysis



Applications

- **Real-time VoIP Traffic Analysis** –
  - Analyze 5G Calls
  - View RTP, SIP, MSRP, H.323, and MEGACO Calls
  - Trigger on Called and / or Calling Party, Packet Impairments
    - Save .HDL (GL's proprietary format) or .PCAP (Ethereal format) or *.PCAPNG file format
    - Save .WAV – time stamped file names
    - Save CDRs
  - MOS R-factor – view quality as the call proceeds
  - Traffic limited only by hard drive capacity
  - T.38 Fax packets decoding
- **Network Monitoring Solutions** –
  - Multiple probes can be used for network monitoring
  - CDRs can be exported in a text format to a flat file or a remote computer
- **Network Monitoring Solutions (*Contd.*)** –
  - CDRs can also be exported to an Oracle data base
  - Results can be accessed remotely using NetSurveyorWeb™, a simple web browser-based application
- Air Traffic Monitoring Solution
- Gateway Delay Measurement along with our TDM Protocol Analyzer

Main Features

Comprehensive Analysis Tool	• Capture calls in real-time for infinite time non-intrusively • Detail Signaling, Audio, Video QoS statistics • Call flow graph and Pictorial representation of the statistics • Inband/Outband Detection, Wave graph, Audio play back, Audio/Video recording • Ability to export Call Data Records of completed calls in CSV file format • Complex Filtering and Search capabilities • 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 automatically create search/filter criteria from the current screen selection • Decode support for multi-layer tunneled traffic - GTP, GRE, VXLAN • Support export frame summary for tunneled traffic
QOS Parameters and **Performance Metrics**	• E-model (G.107) based MOS/R-Factor scores • Media Delivery Index (MDI) for video calls • Provides monitoring and QoS metrics such as delay, jitter, and MDI derived from RTP streams carrying video payloads • Minimum, maximum, and average Round Trip Delay (RTD) • Reports Inband (DTMF & MF) events, Outband events as per RFC 2833 or RFC 4733 events, RTP/RTCP packet count per direction
Triggers and Actions	• Captures calls based on filter criteria and performs set of actions for the completed calls such as recording, sending email, extraction of voice or fax traffic file

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Main Features (Contd.)

SIP Registration Details	• Registration statistics and trace messages depicted graphically
As a Probe with Central Monitoring System – NetSurveyorWeb™	• PacketScan™ can send summary fields, frame octets, status, call detail records, along with traffic summary of captured calls to a central database • NetSurveyorWeb™ displays the data from the database in a simple web-based browser. It features rich graphics, ladder diagrams, CDRs (Call Data Records), custom report and filter configurations
Single Point Analysis System	• Enhanced to work with GL's Voice Band Analyzer and Call Data Records applications to provide useful call detail records for further analysis using built-in tool in Excel®.
Utilities	• Provides HDL File Conversion utility to convert ethereal format file (*.PCAP, *.CAP, and *.PCAPNG) to GL's file format (*.HDL) and vice-versa • Includes Excel® Addins to import CDRs into Excel® to analyze using Pivot Table, and Pivot Charts

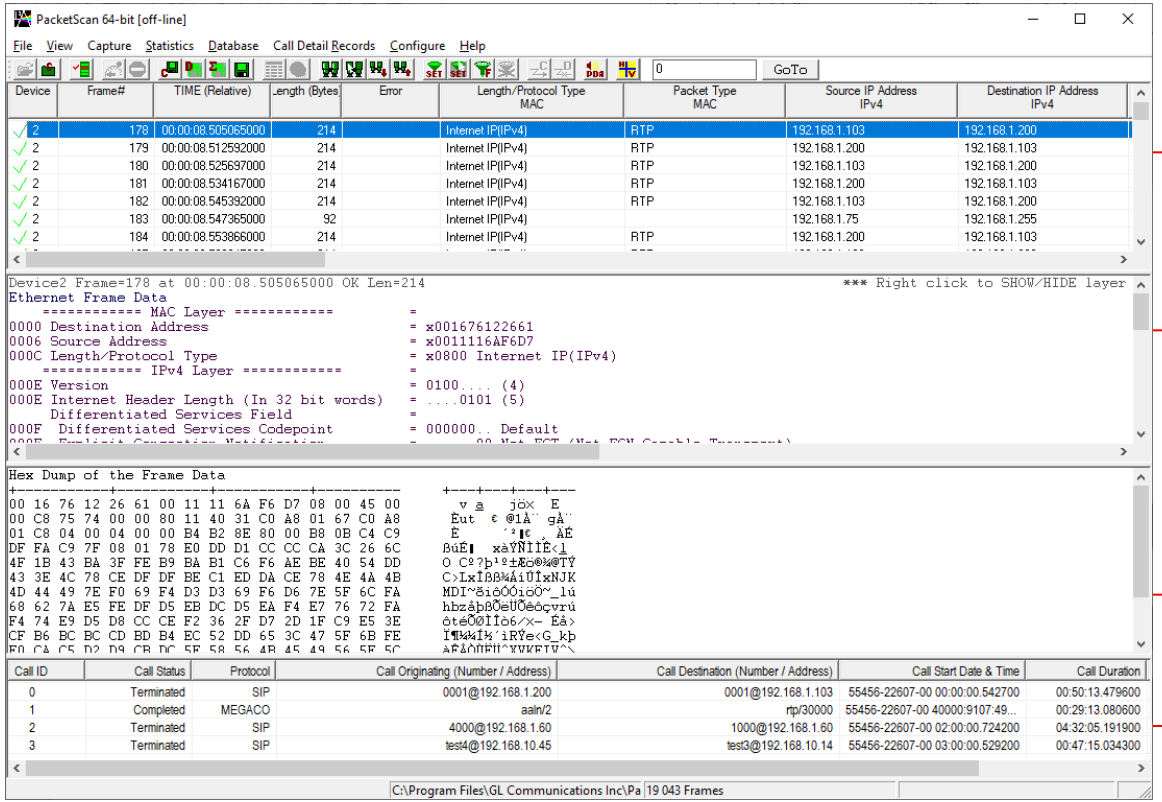
Supported Protocols

- Session Initiation Protocol (SIP) - RFC 3261
- Media Gateway Control Protocol (MGCP) - RFC 2705/3435 (3991)
- Media Gateway Control (MEGACO) - RFC 3525 and 3015
- Message Session Relay Protocol (MSRP)
- RTP/RTCP
- SCTP - RFC 2960
- Connection Oriented Transport Protocol (COTP, ISO 8073)
- 5G – N1N2, N4, N8, N10, N11, N12 and N13
- SCCP (Skinny)
- SS7 SIGTRAN
- ISDN-SIGTRAN
- GSM A over IP
- GPRS over IP
- UMTS over IP
- LTE
- Diameter

Supported Codecs

- G.711 (mu-Law and A-Law), G.711 Application II (A-law and μ-law with VAD)
- G726 (40, 32, 24, 16kbps)
- GSM (13.2kbps), GSM EFR (12.2 kbit/s), GSM HR
- G729, G729B (8kbps)
- G.722, G.722.1
- ILBC_15_2 (for 20 msec), ILBC_13_33 (for 30 msec)
- SPEEX (Narrow band and Wideband)
- SMV* (Modes - 0, 1, 2 and 3)
- Other optional codec include (must be purchased with additional license)
  - AMR (Narrow band and Wideband)
  - EVRC, EVRC0 (Rates - 1/8, ½ and 1)
  - EVRCB, EVRCB0 (Rates - 1/8, ½ and 1); EVRC-C
  - Opus and EVS (Narrow Band, Wideband, Super Wideband, Full Band)

PacketScan™ Analyzer View



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

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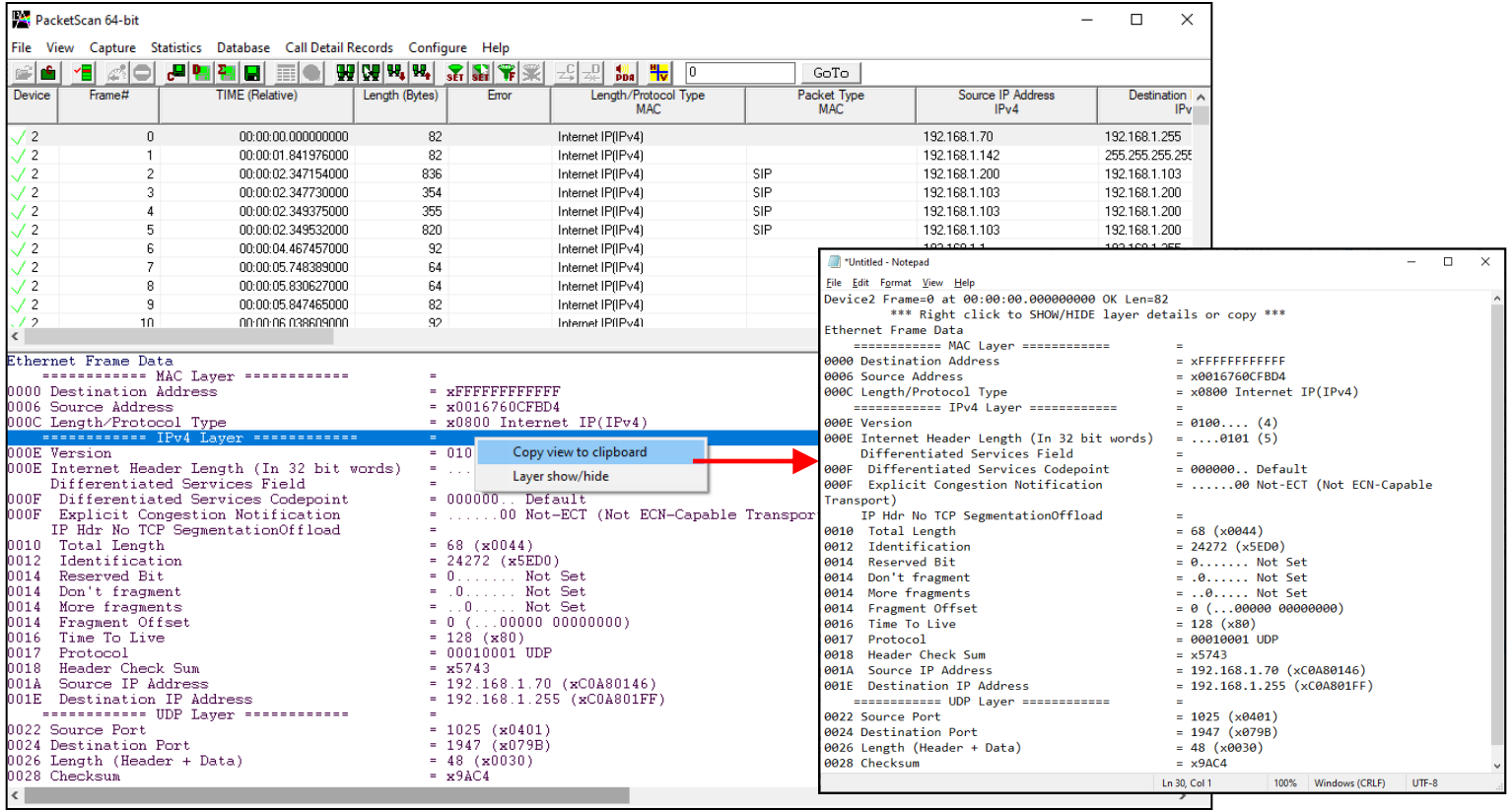
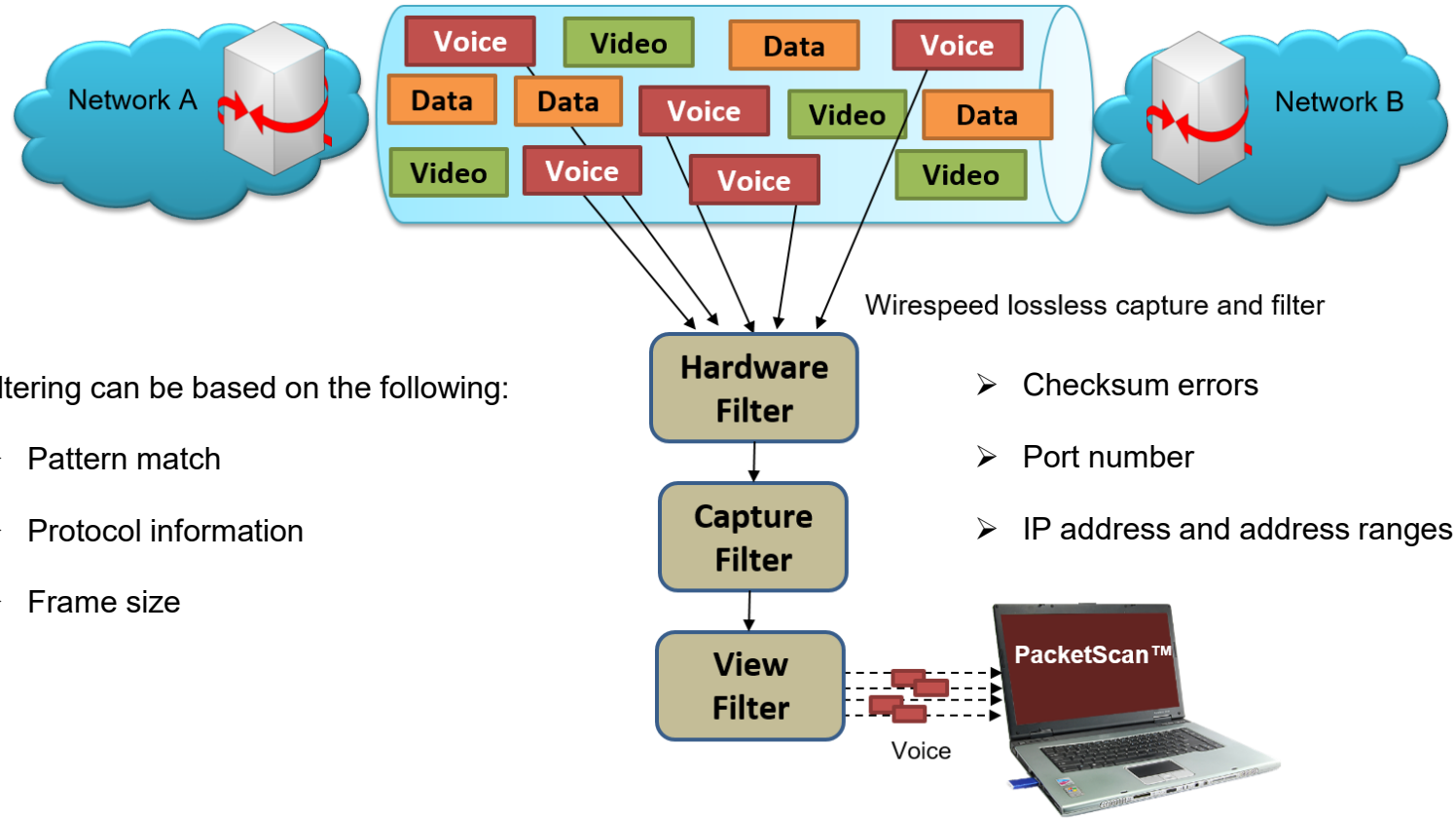
Layer Copy/Show/Hide Options

- Provides option to copy the entire layer decode information to the clipboard



Wirespeed Filtering

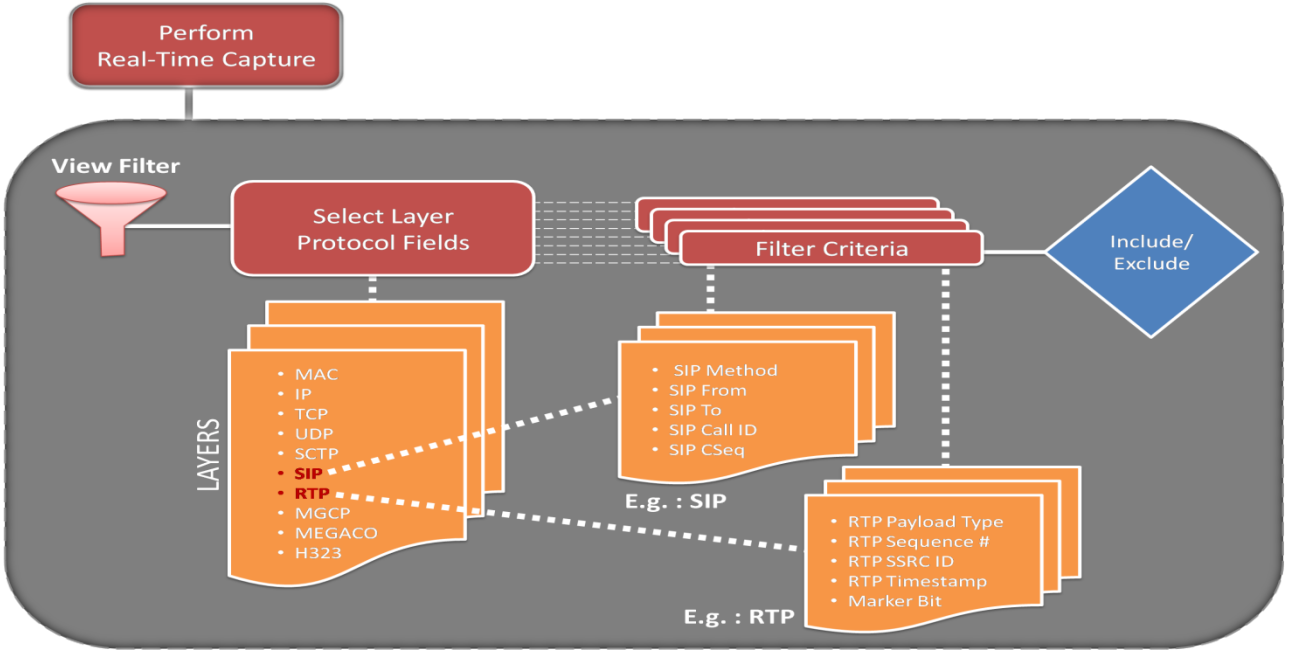


- Filtering can be based on the following:
  - Pattern match
  - Protocol information
  - Frame size
  - Checksum errors
  - Port number
  - IP address and address ranges

3 Stages of Filtering

- Hardware Filter (HWF) – “Special NIC” with hardware filtering - very fast
- Capture Filter (CF) – Powerful software filtering but a little slower
- View Filter (VF) – applies on the captured frames to filter only frames of interest
- PacketScan™ HD captured files to/from Wireshark
- PacketScan™ HD PDA – for detailed voice, fax, and video analysis

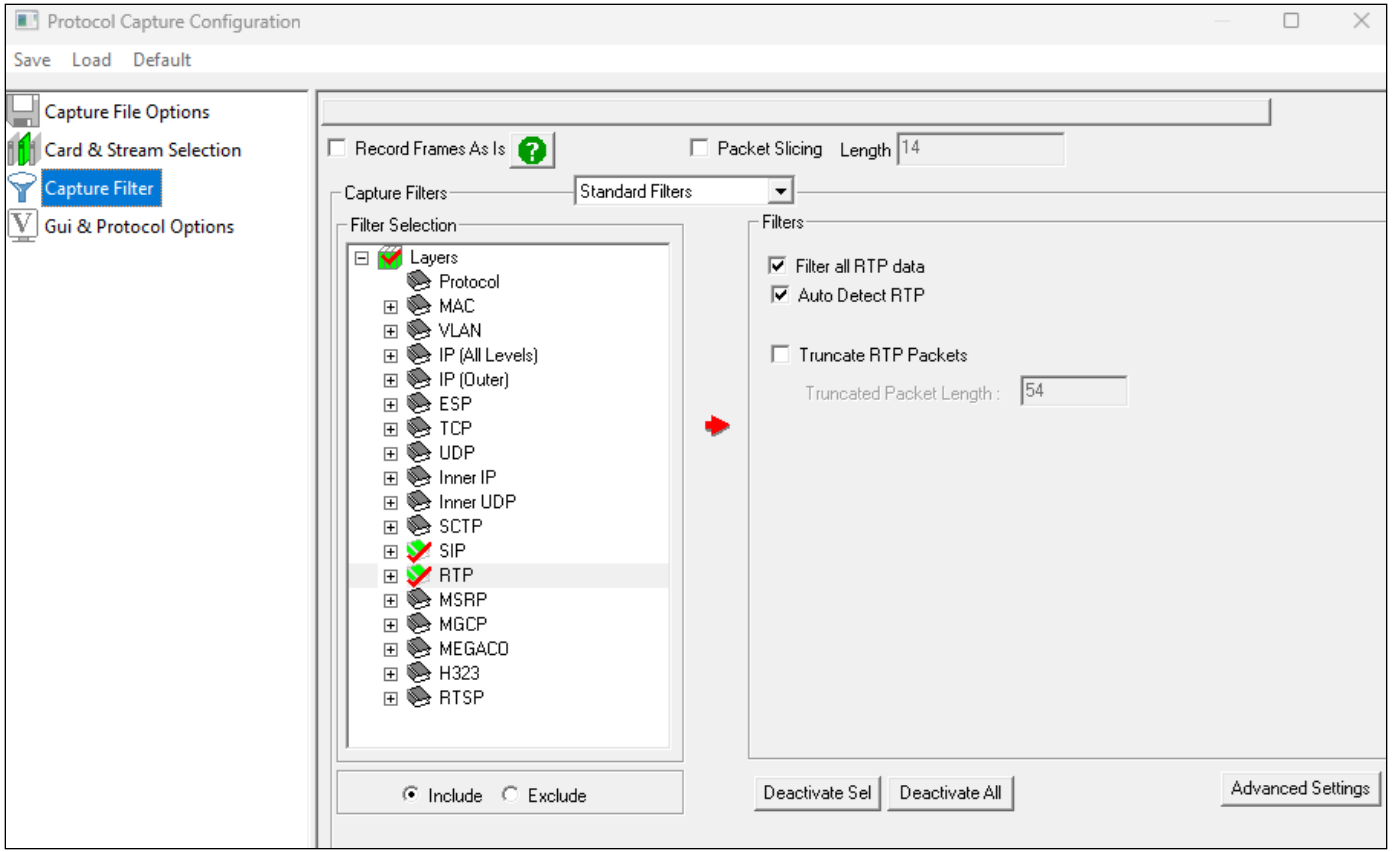
Real-time and Offline Filters



- Filtering and search capability isolates required frames from original frames in real-time / offline based on parameters set in Data Link layer, MAC layer, IP, TCP/UDP and more

Real-time Capture Filter (Standard Filters)

- Quickly filter live traffic using predefined protocol-based filters
- Select from common protocols such as:
  - SIP, RTP, MAC, VLAN, UDP, TCP, IP and more
- Ideal for real-time monitoring and troubleshooting
- Saves time by avoiding manual filter configuration



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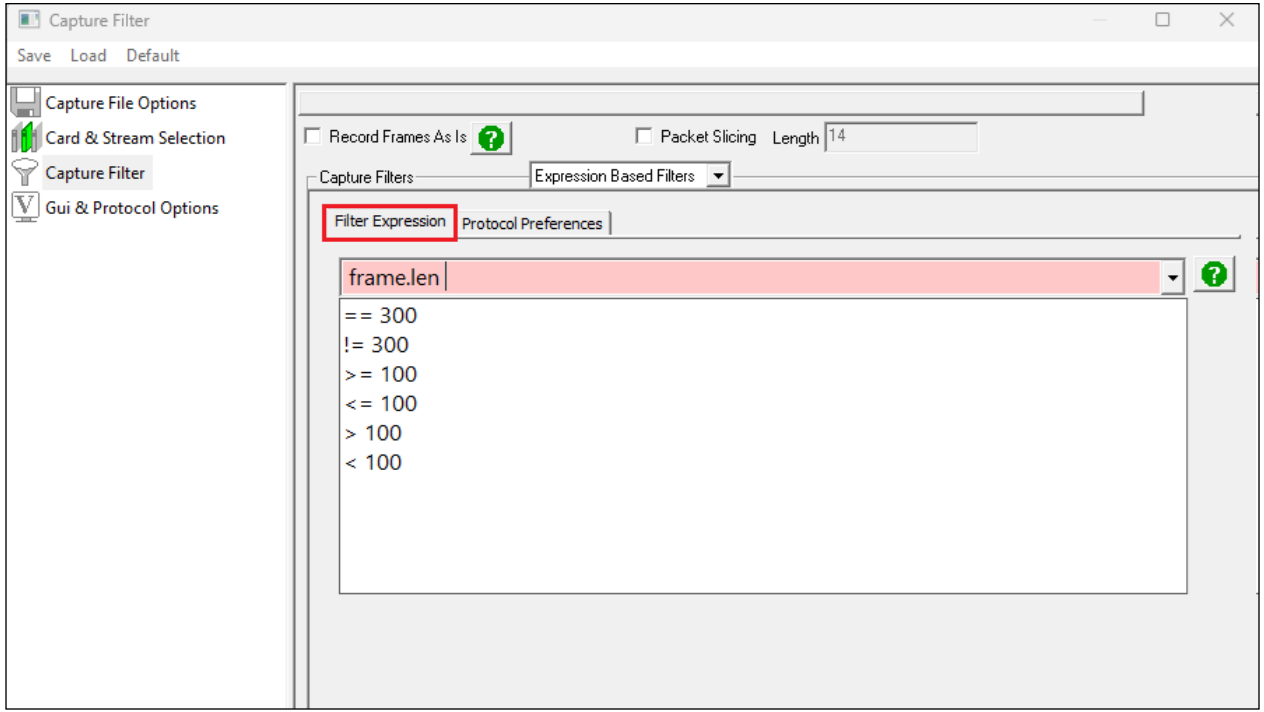
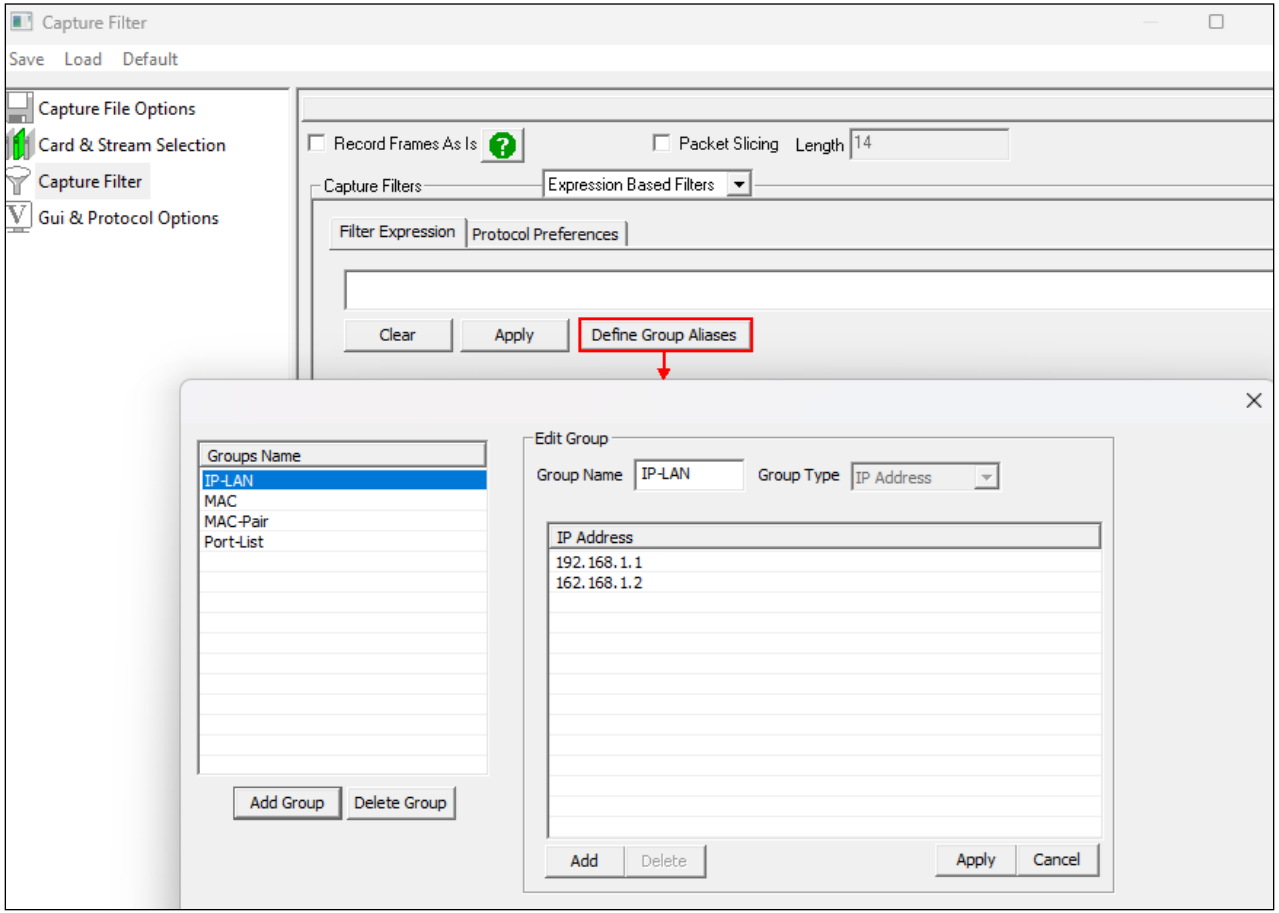
Expression Based Filters – Filter Expression

- Create powerful custom filter rules for precise packet selection
- Combine multiple conditions using logical operators (==, !=, <, >, &&, ||)
- Filter based on fields such as IP address, port, protocol, caller/callee number, packet count, etc.
- Ideal for advanced troubleshooting and targeted packet analysis
- Examples:
  - frame.len==300



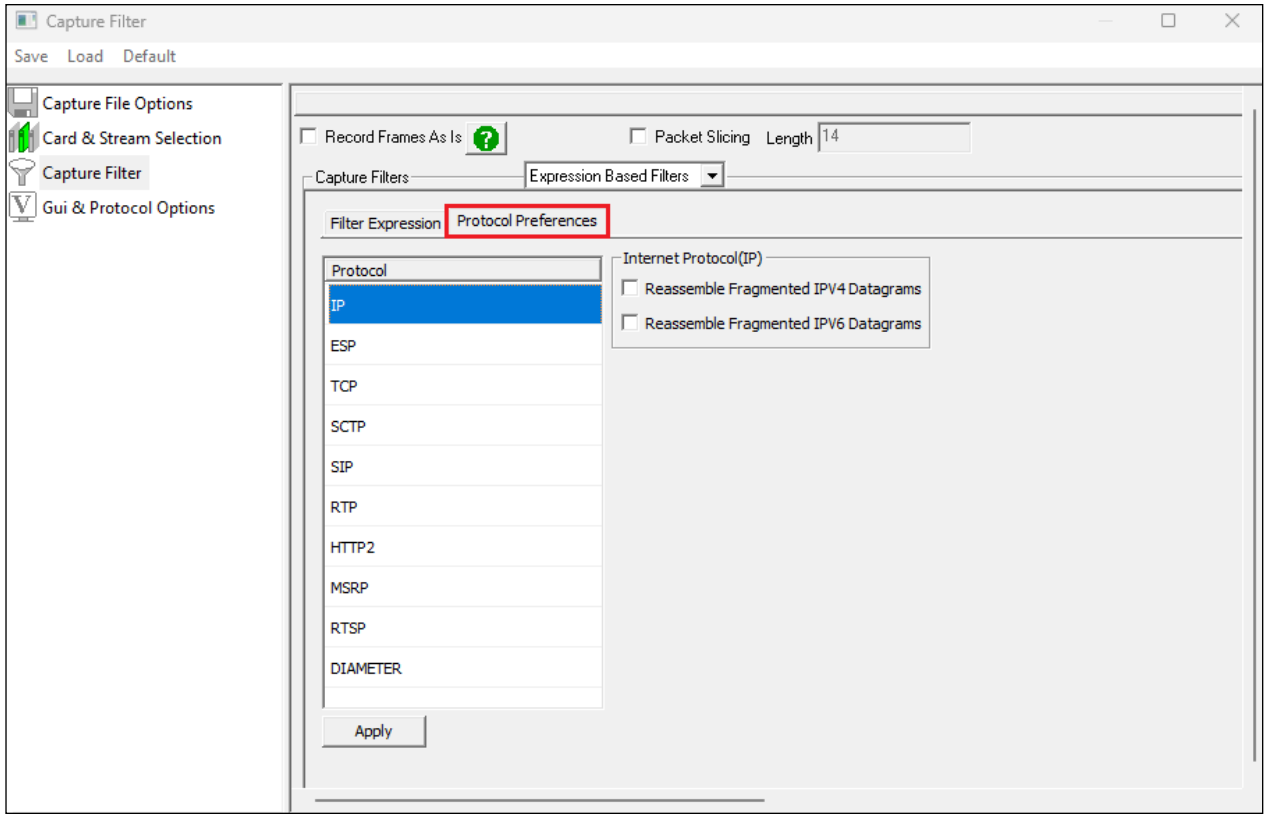
Define Group Aliases

- Organize commonly used filter expressions into reusable groups
- Apply predefined filter groups across multiple capture sessions
- Avoid repeatedly typing filter expressions
- Improve filtering efficiency and consistency
- Simplify selection of frequently used IP, MAC, and port filters

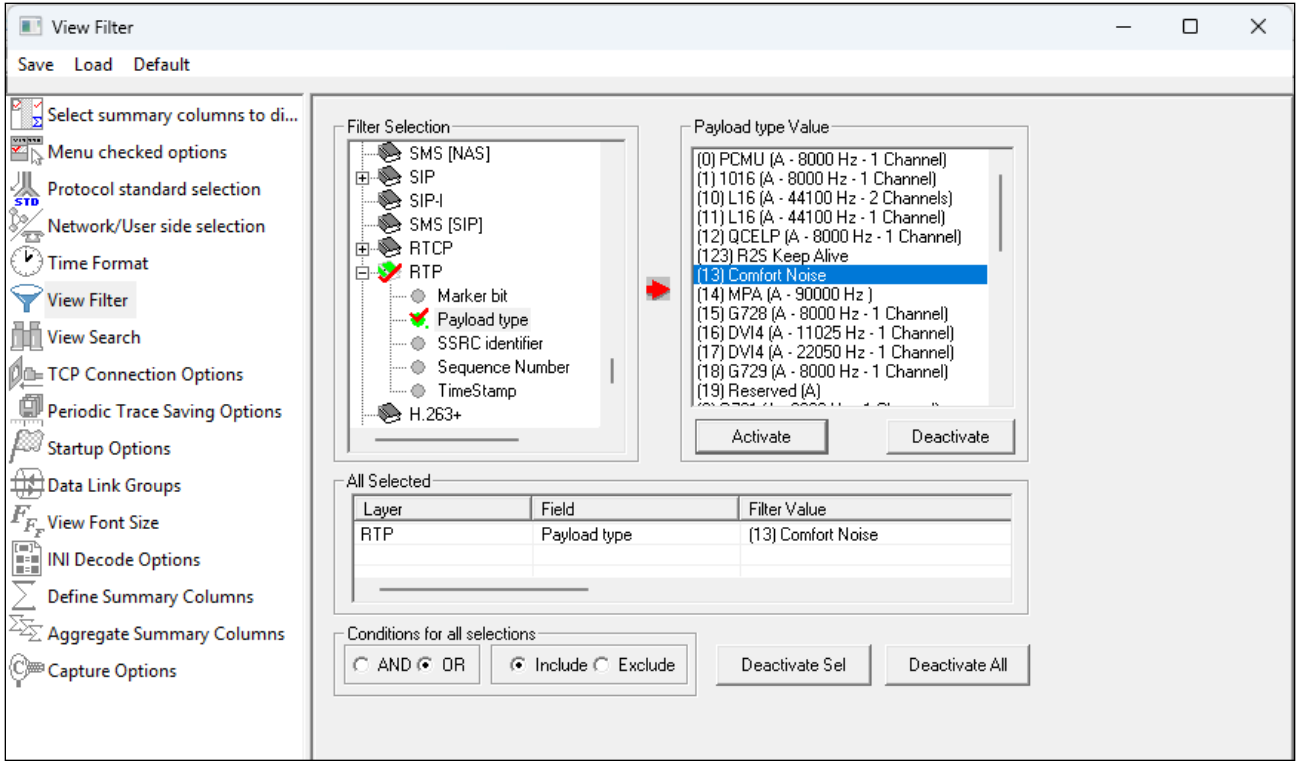


Protocol Preferences

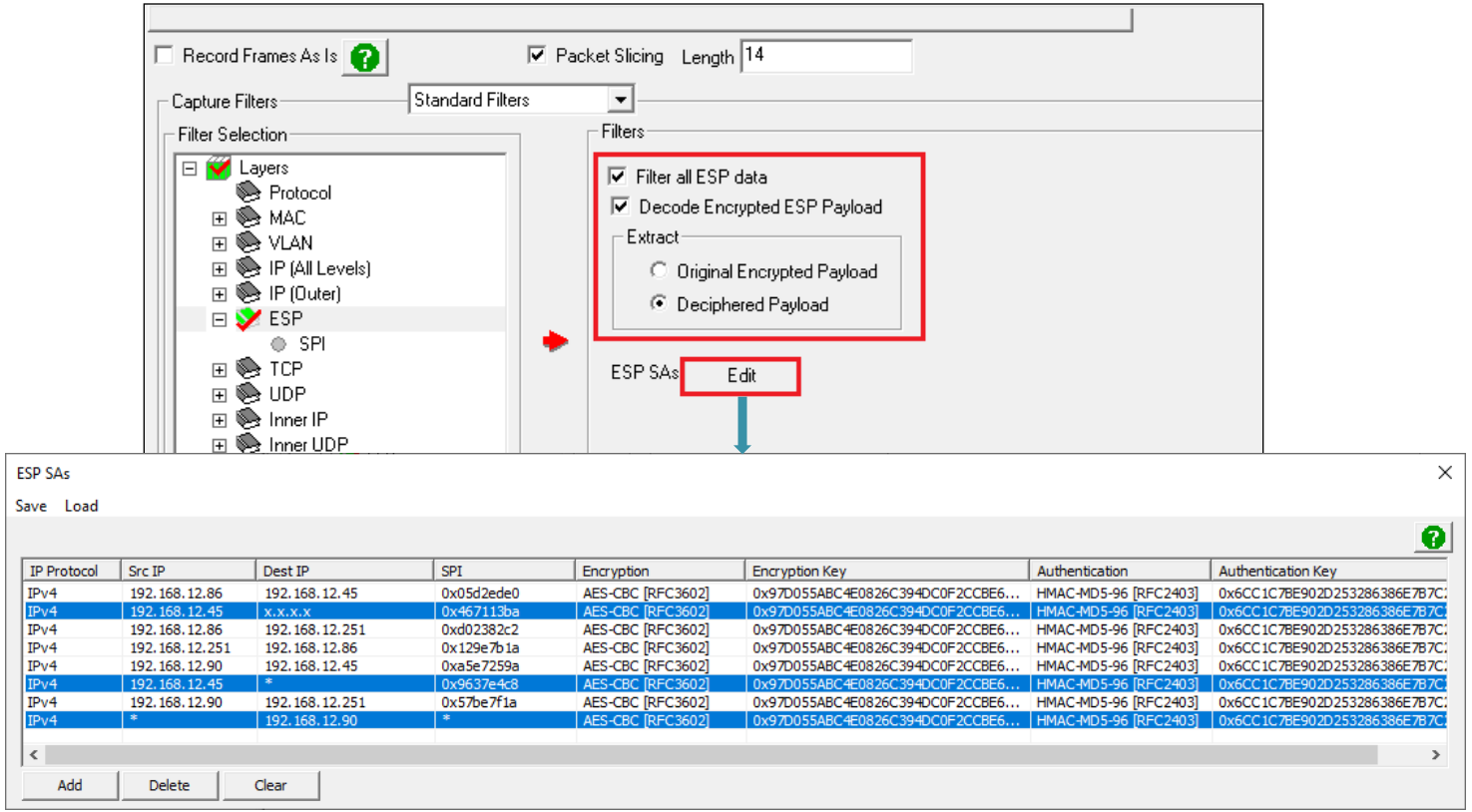
- Optimize packet analysis with protocol-specific decoding options
- Configure preferences for accurate decoding of complex protocols
- Examples:
  - IP fragment reassembly for complete packet reconstruction
  - SIP header parsing for VoIP troubleshooting
  - RTP sequence validation for media stream integrity



Display Filter (Offline)

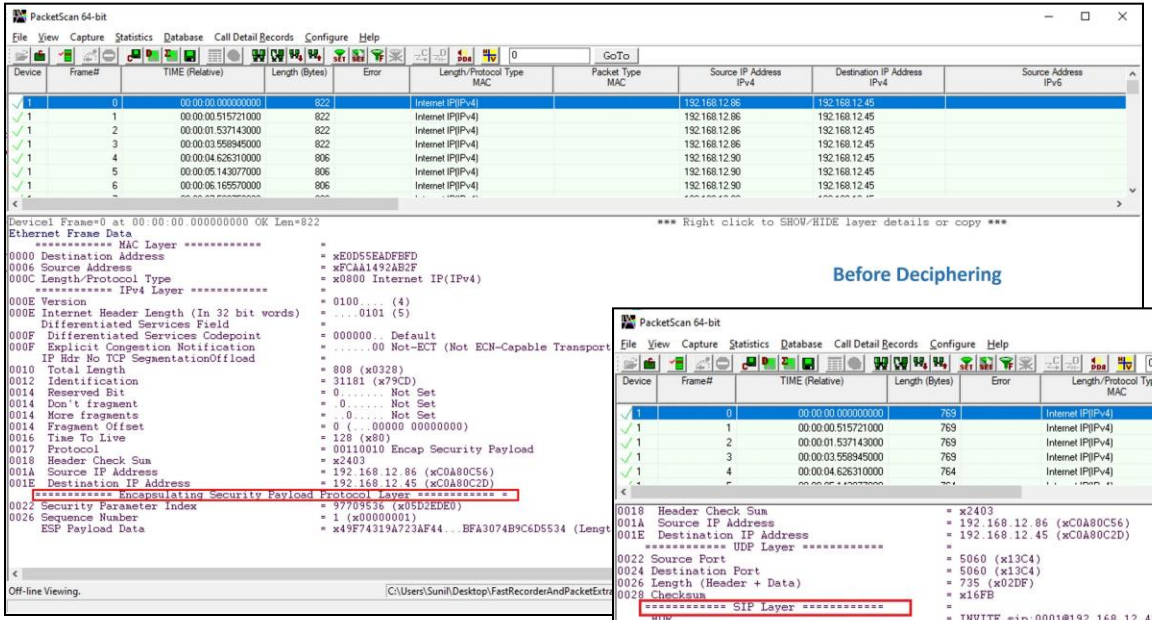


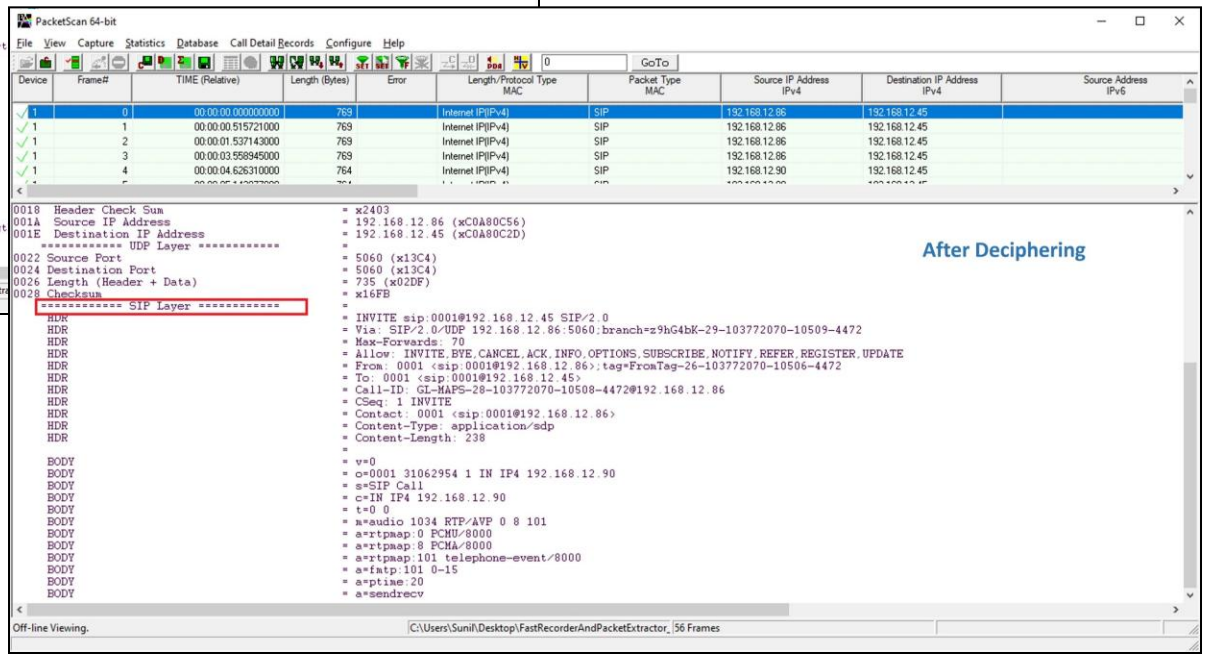
Encapsulated Security Payload (ESP) Deciphering



- ESP filter is used to provide **ESP SAs value** to decrypt ESP packets

Comparison of Before and After ESP Deciphering





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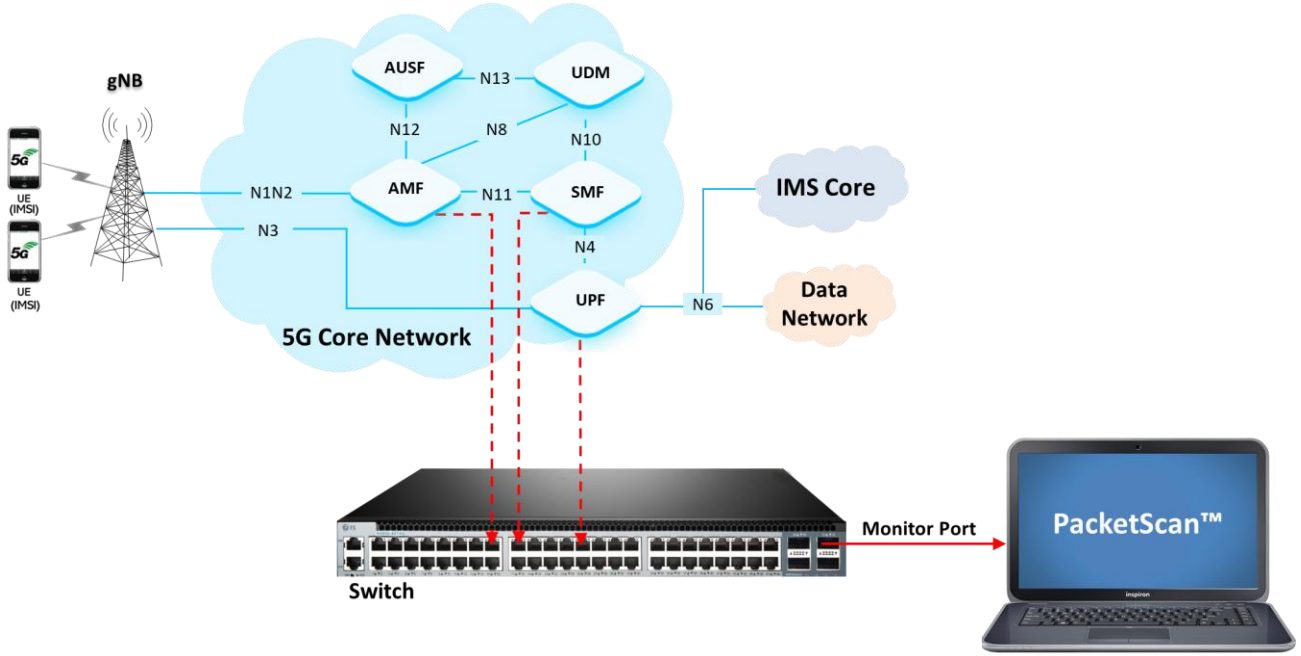
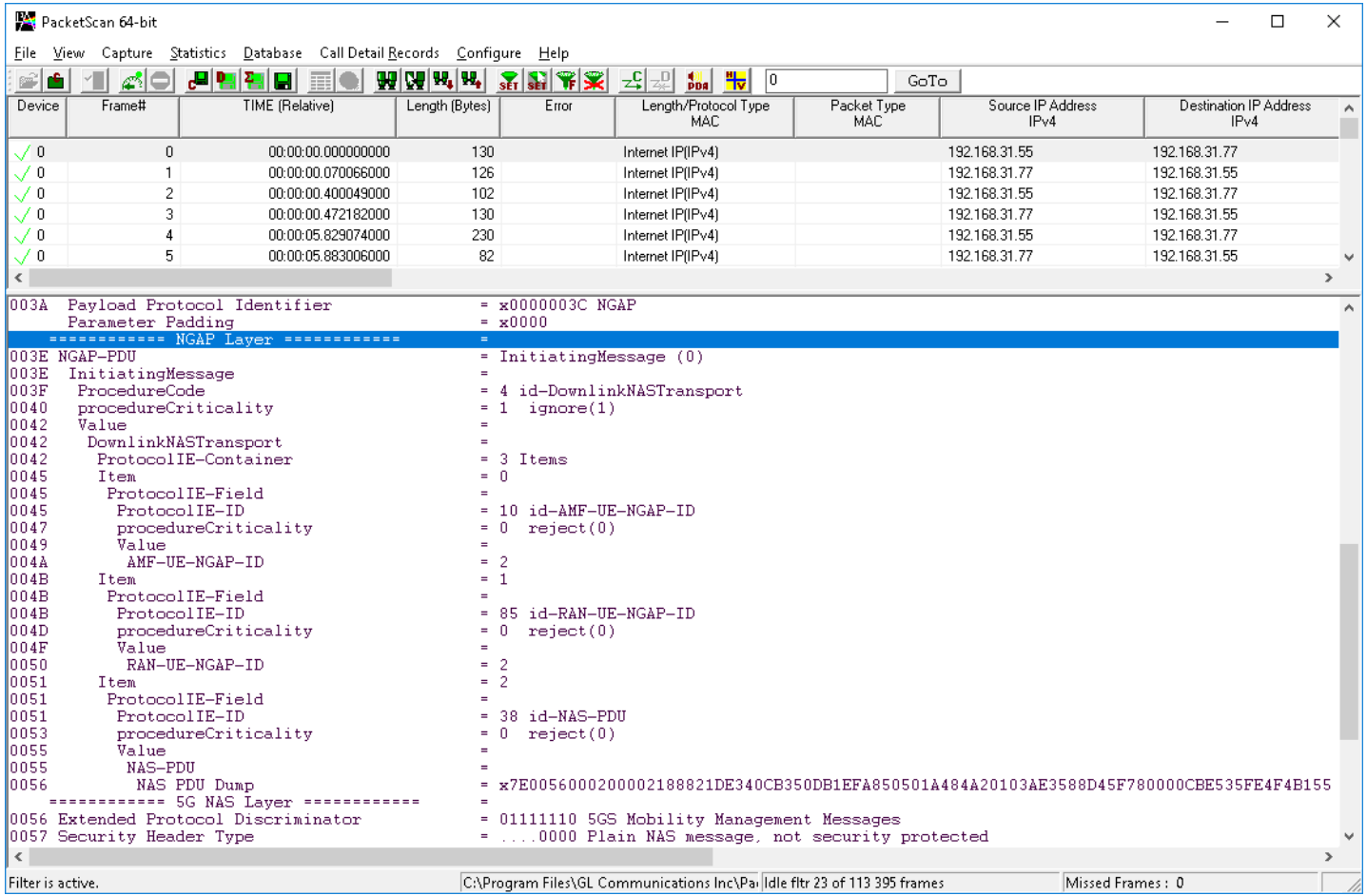
5G Protocol Analysis

- Captures, segregates, monitors and collects statistics on all calls over N1N2, N4, N8, N10, N12 and N13 interfaces of the 5G network
- Provides VoNR call statistics such as caller, callee, MOS scores, discarded packets and voice storage



Decode View - 5G NGAP Layer



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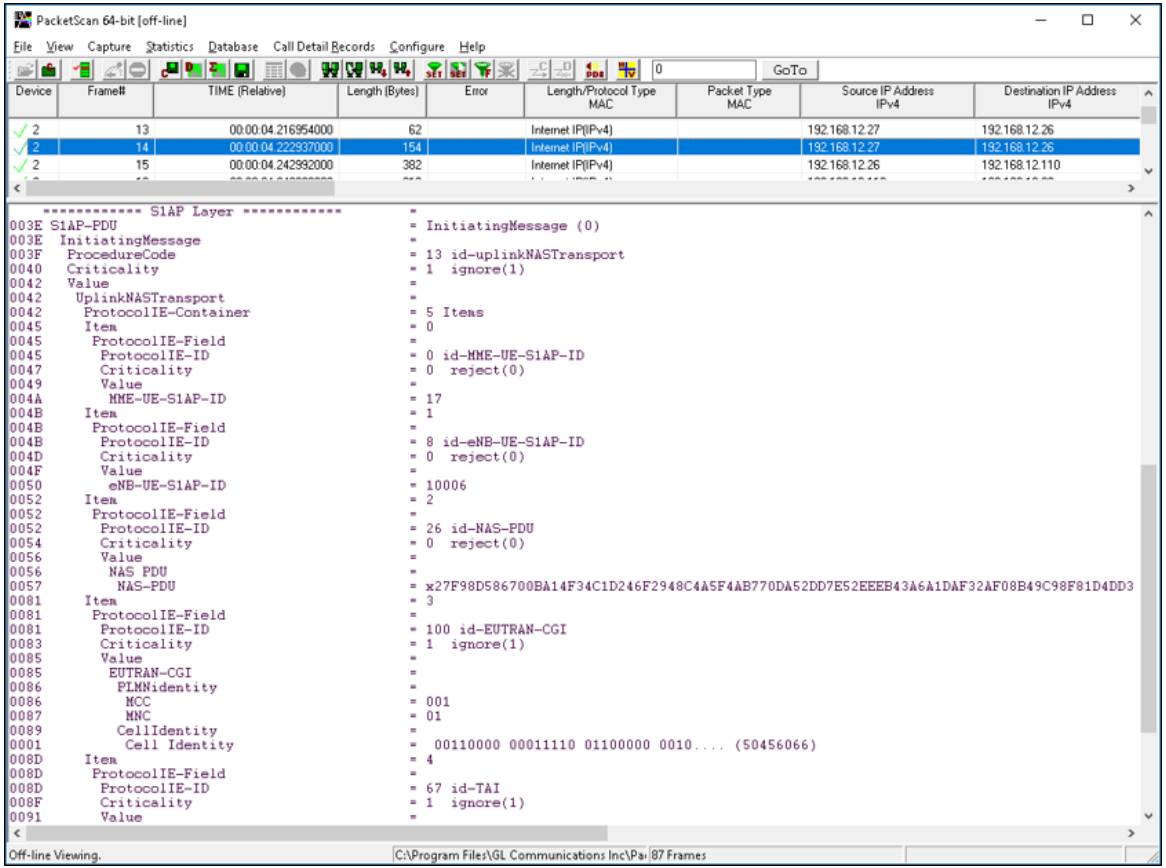
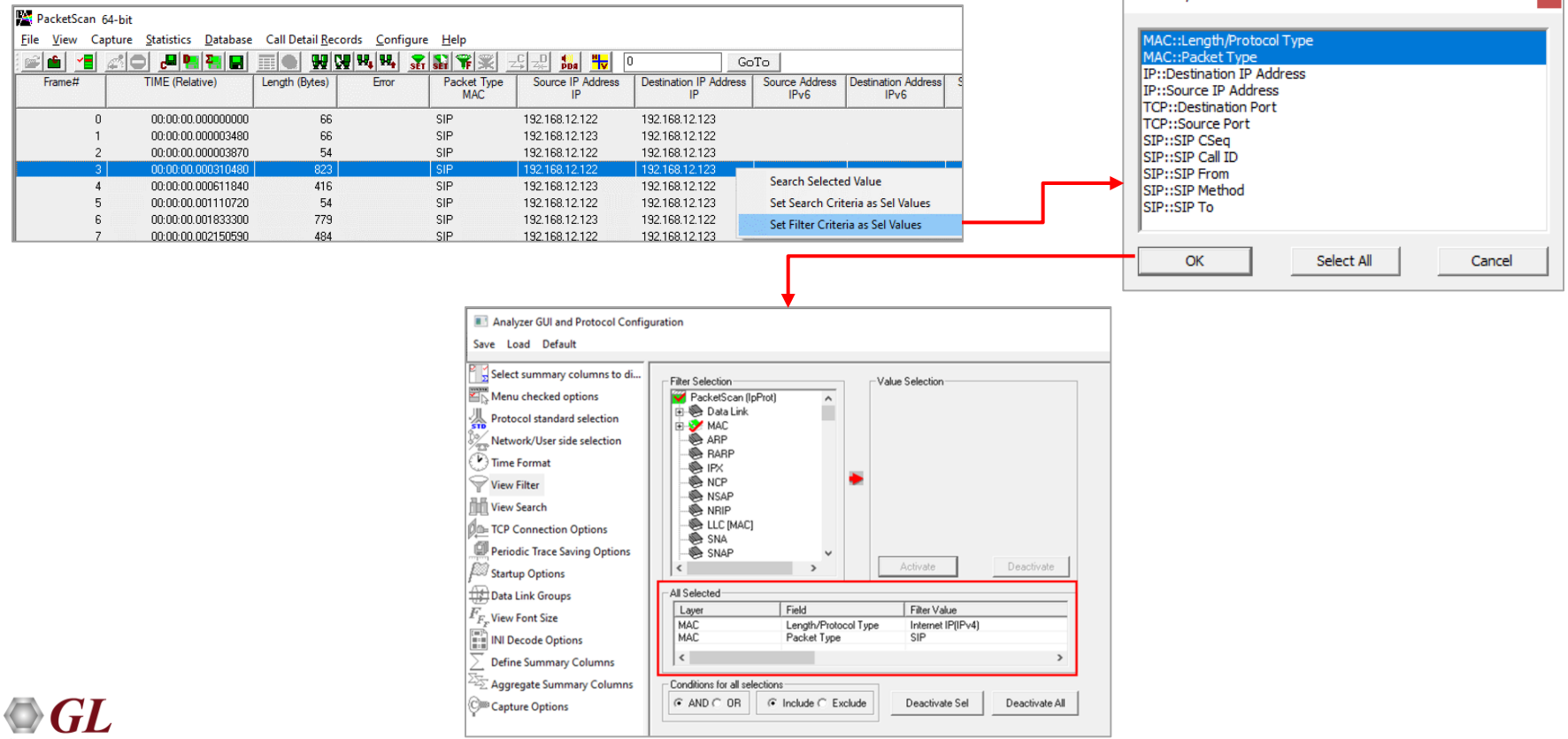
LTE Protocol Analysis

- Captures and monitors real-time signaling and traffic on LTE networks
- The application segregates, monitors and collects statistics on all calls and can test eNodeB or UE over various interfaces, including S1, S3, S4, S5 (or S8), S6a, S10, S11, S13, and X2



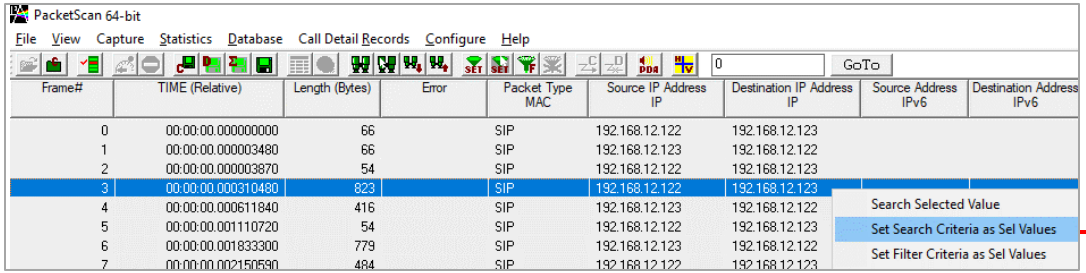
Filter Criteria From Screen Selection

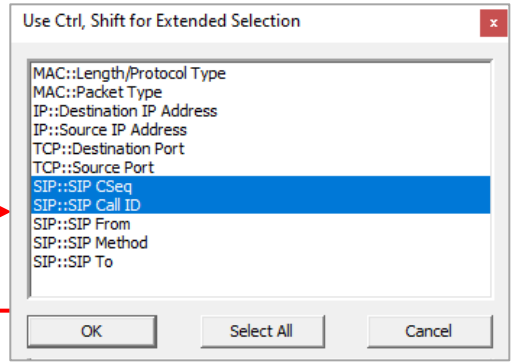
- Allows the user to automatically create filter criteria from the current screen selection

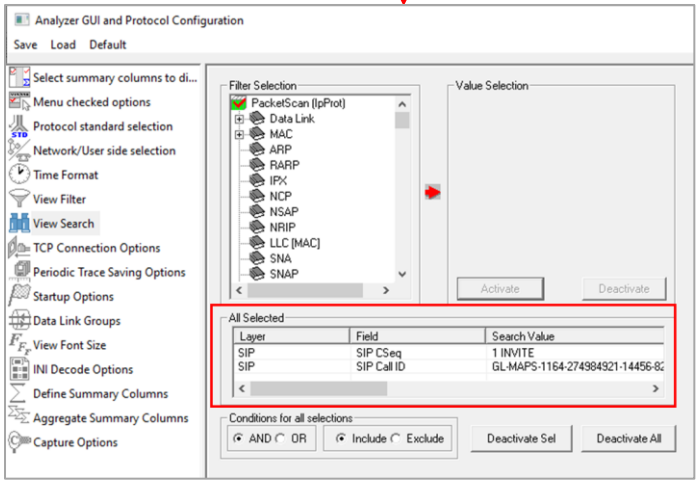


Search Criteria From Screen Selection

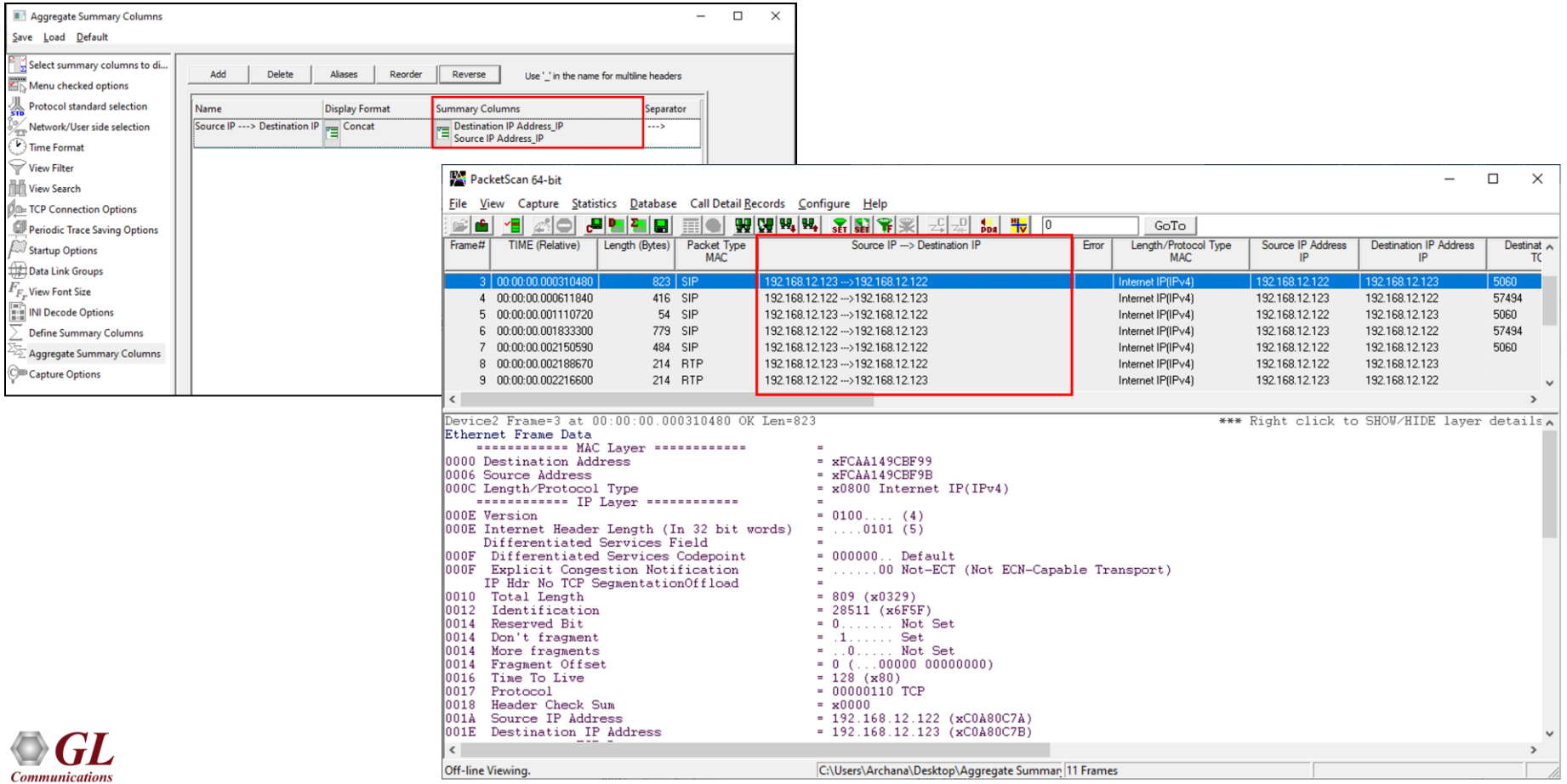
- Allows the user to automatically create search criteria from the current screen selection





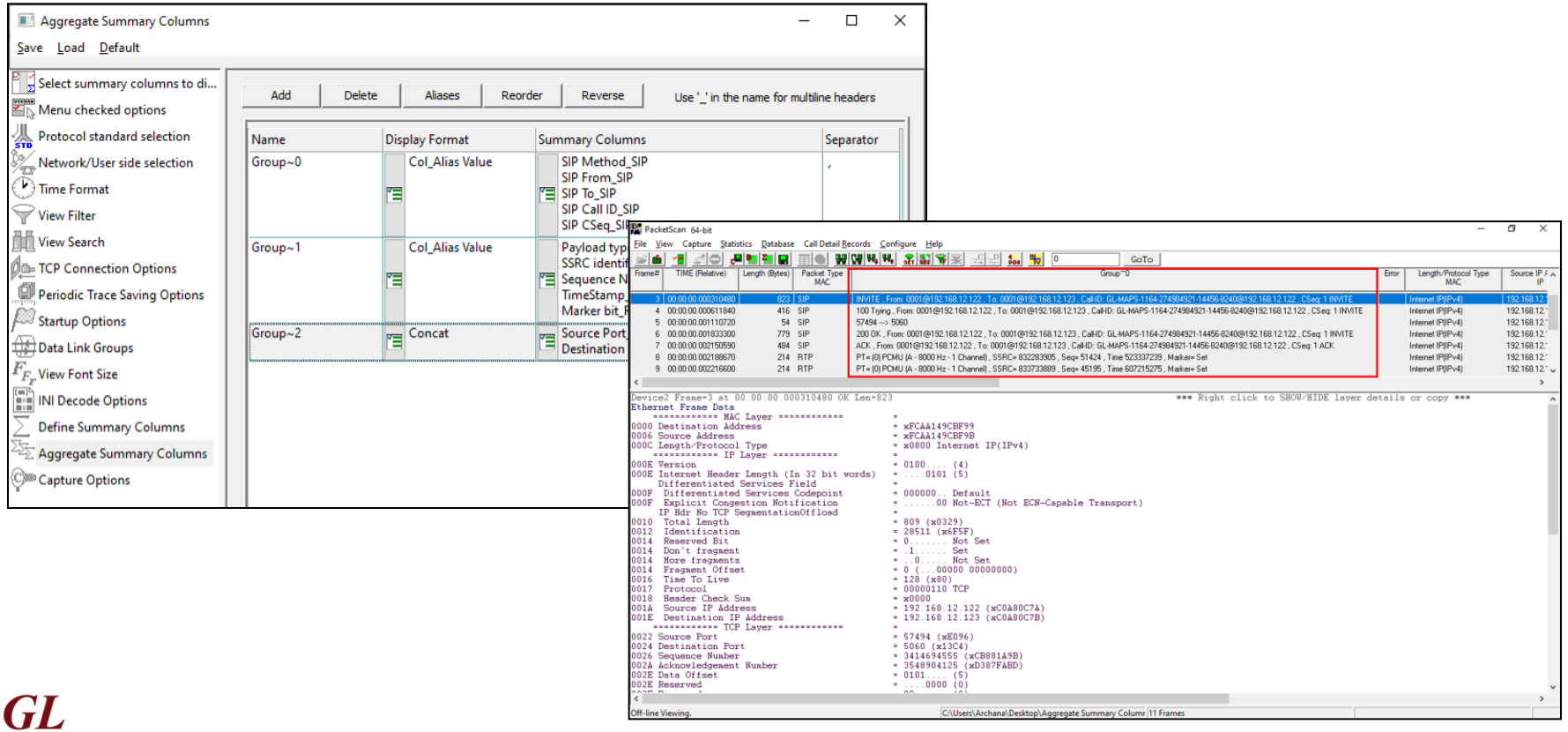


Aggregate Summary Columns



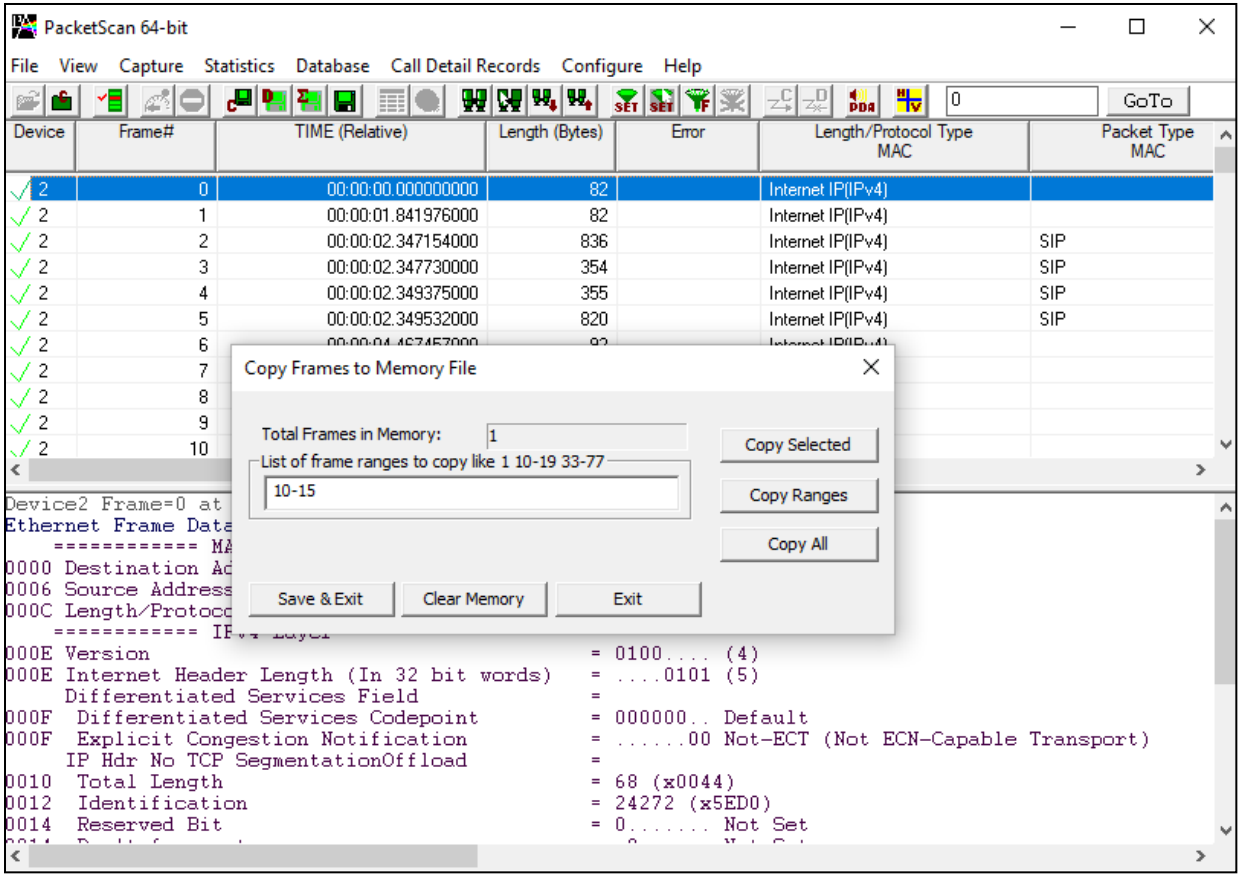
Aggregate Summary Column Group

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

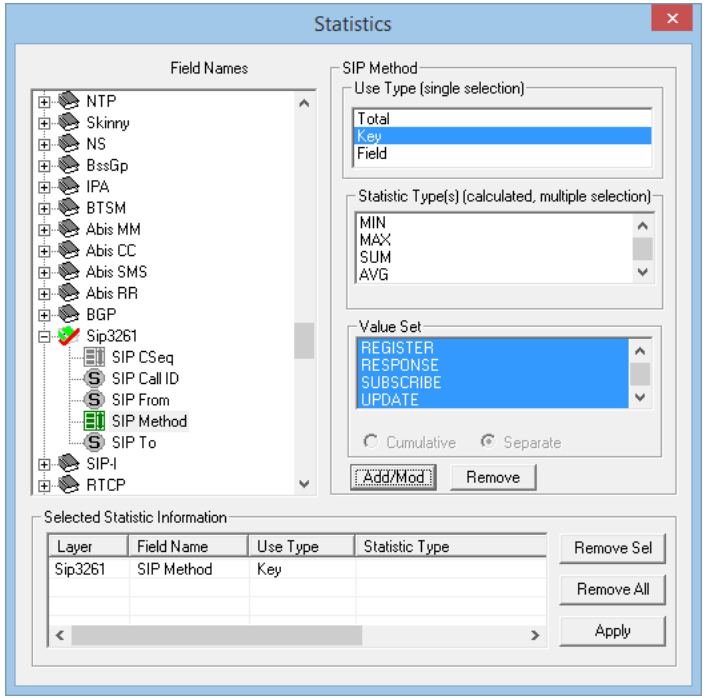


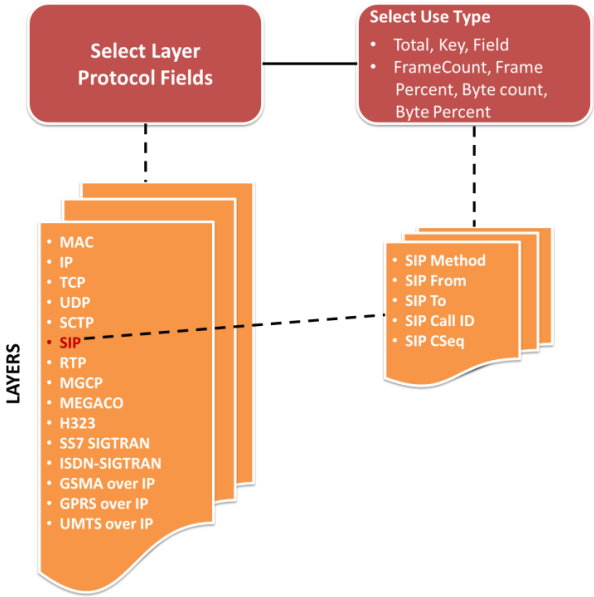
Copy Frames to Memory File

- The user can select and copy the frames (frame range) to the desired location



Statistics



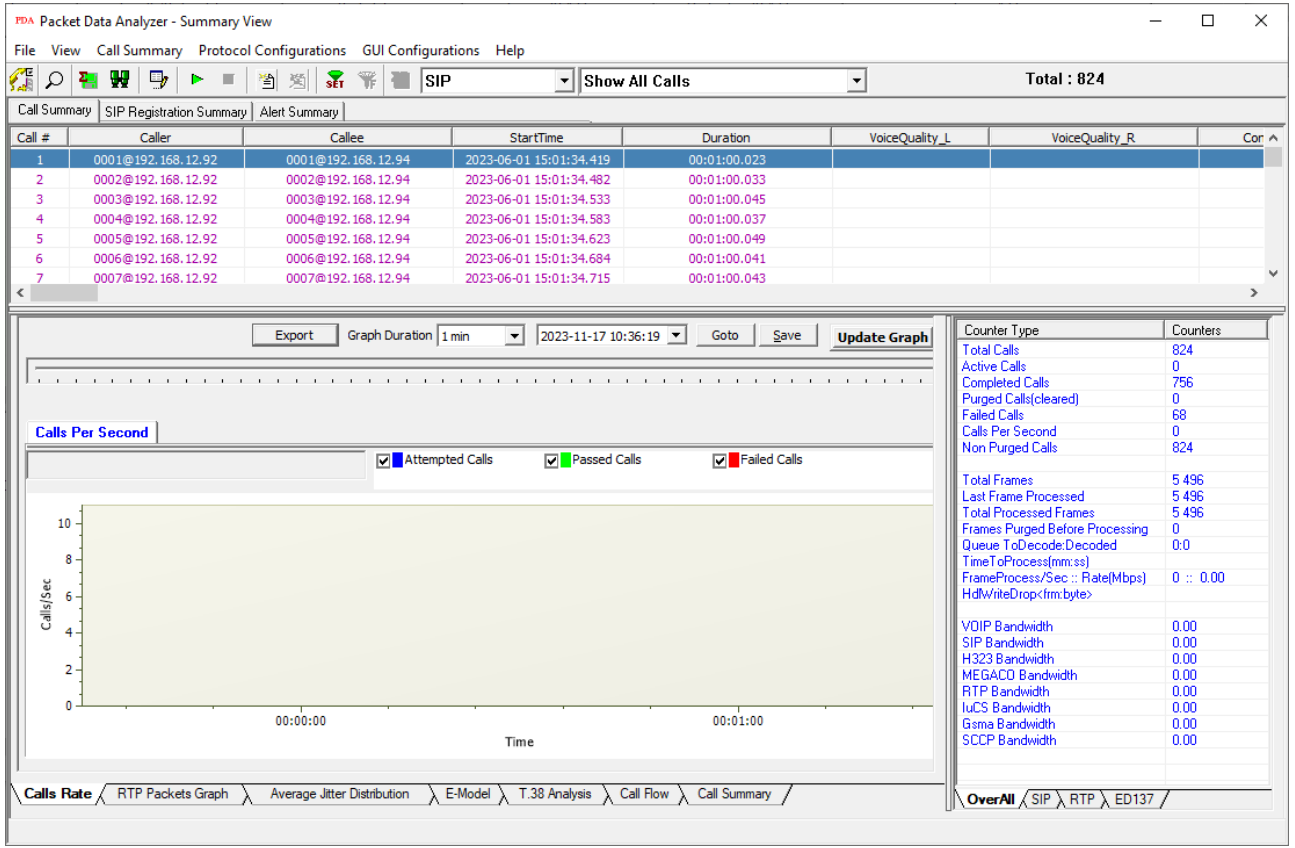


E.g. Device # (Its type Numeric)
Timestamp (String values)
ARP Hardware type (with predefined value set)

- Various statistics can be obtained to study the performance and trend in the VoIP network, based on protocol fields and different parameters

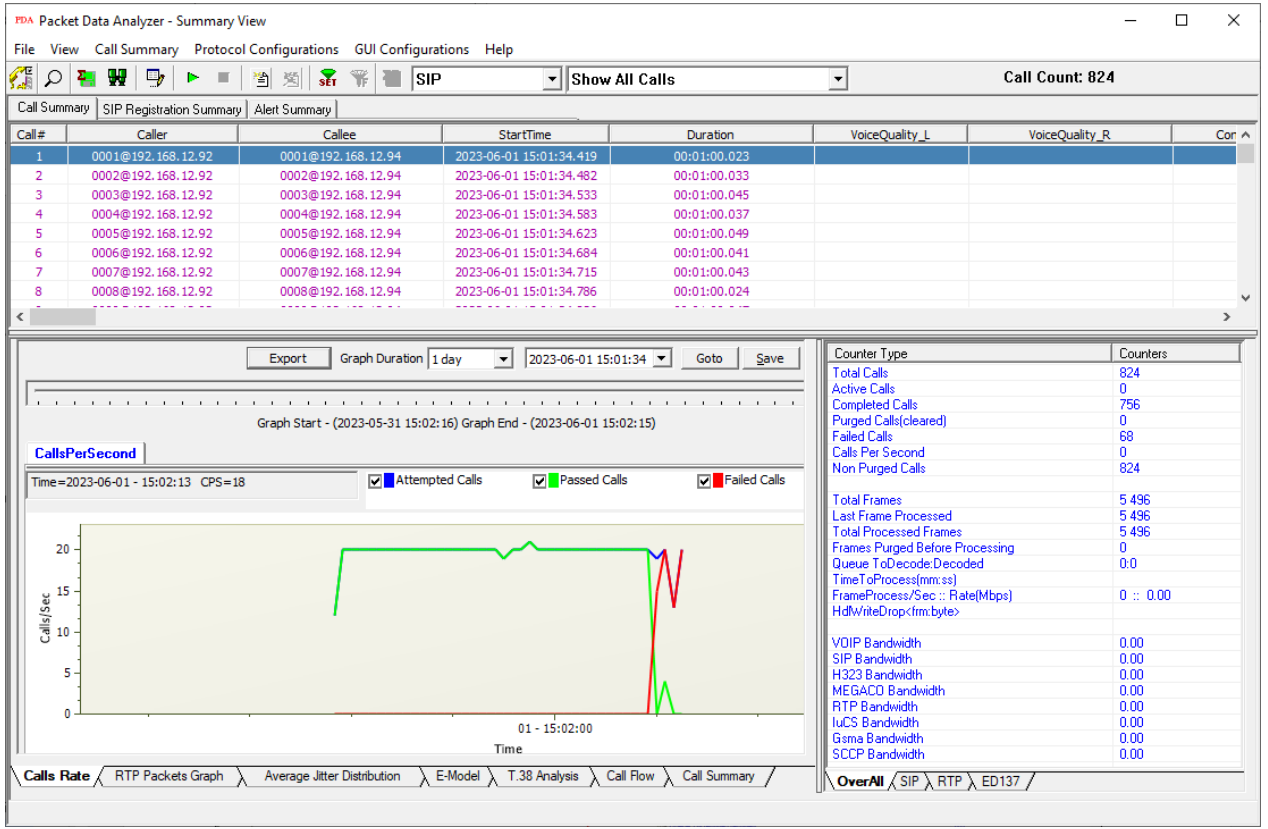
Packet Data Analysis

- Packet Data Analysis in PacketScan™ displays the following views
  - ➢ Summary view
  - ➢ Detail view
  - ➢ Registration summary view



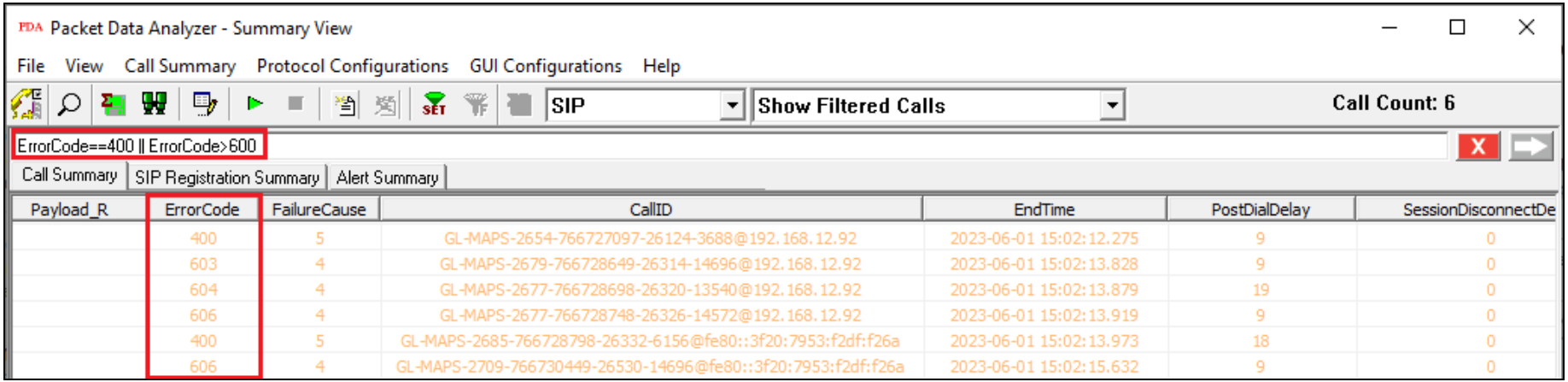
PDA Summary View

- Summary View displays -
  - Summary of data transmission in each direction including calling number, called number, call id, start time, duration, missing packets, etc.
  - Includes separate statistical counts on total packets, calls, failed calls, captured frames, etc., for SIP, H323, MEGACO, and RTP based calls
  - Provides various graphs to view active calls, average jitter distribution, E-model based measurements for R-factor / MOS/ Packet discarded, RTP packets, T.38 fax analysis, and call signaling, Gap, Jitter, Gap/Jitter Distribution, Wave and Spectral Display for media stream analysis, VoIP calls and more

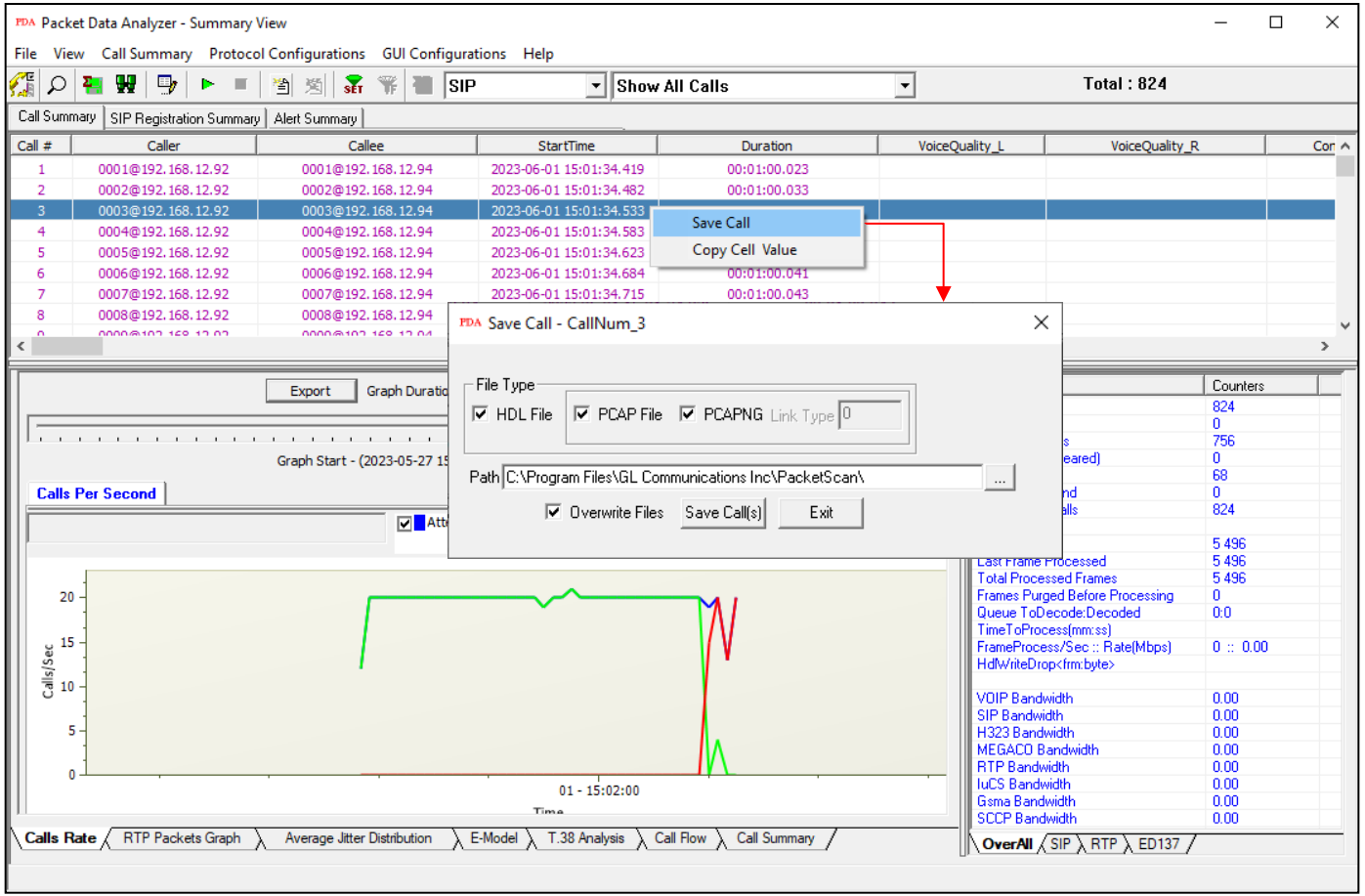


Displaying Filtered Calls using Filter Expressions

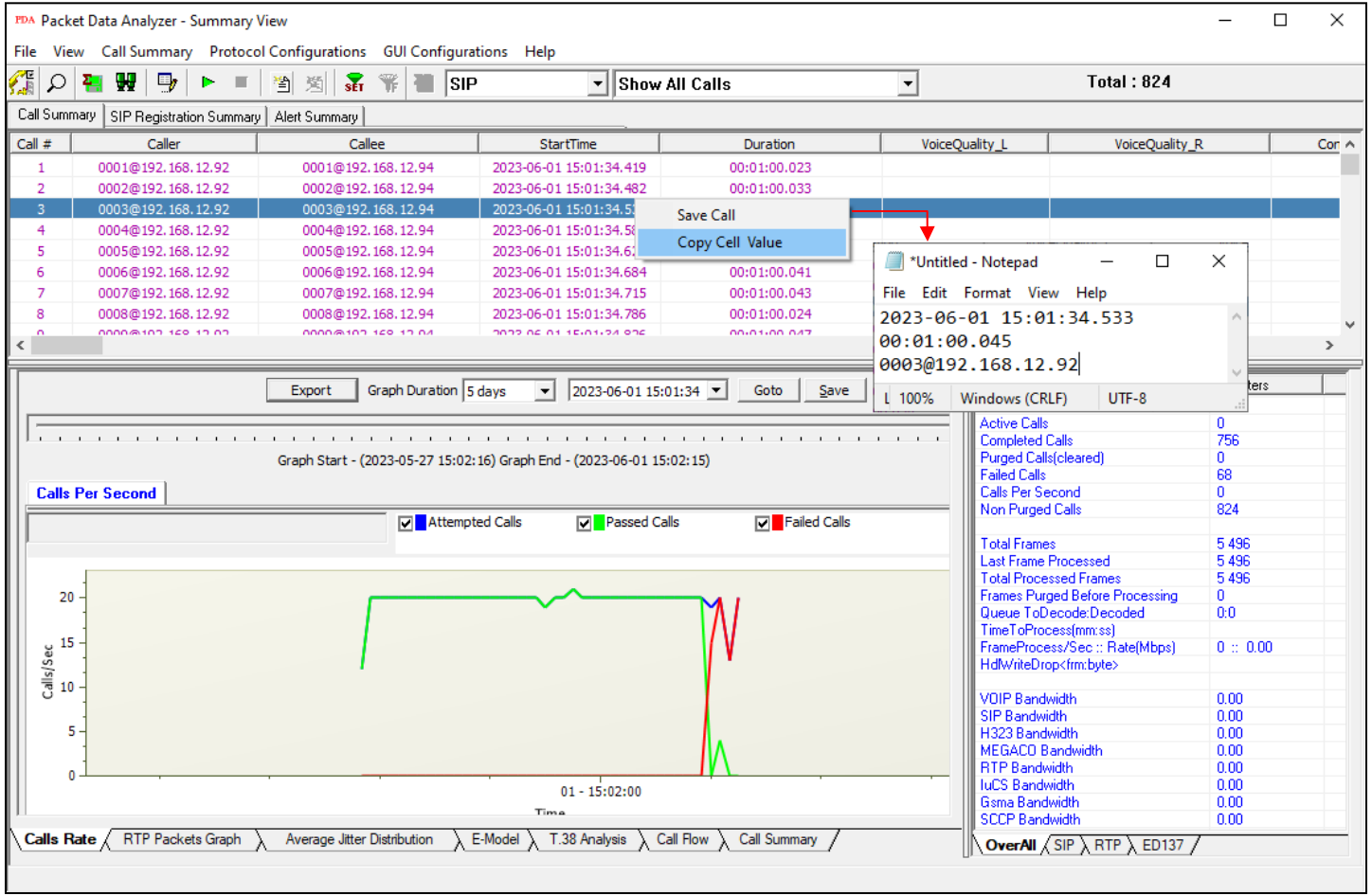
- Filter CDRs (Call Detail Records) based on parameters such as caller, time, message count, etc.
- The expression supports the following mathematical operators: ==, <=, >=, !=, <, >, &&, ||
- For example, the filter expression "ErrorCode==400||ErrorCode>600" will display calls with ErrorCode equal to 400 and calls with ErrorCode greater than 600



Save Call in *.hdl, *.pcap, and *.pcapng Formats



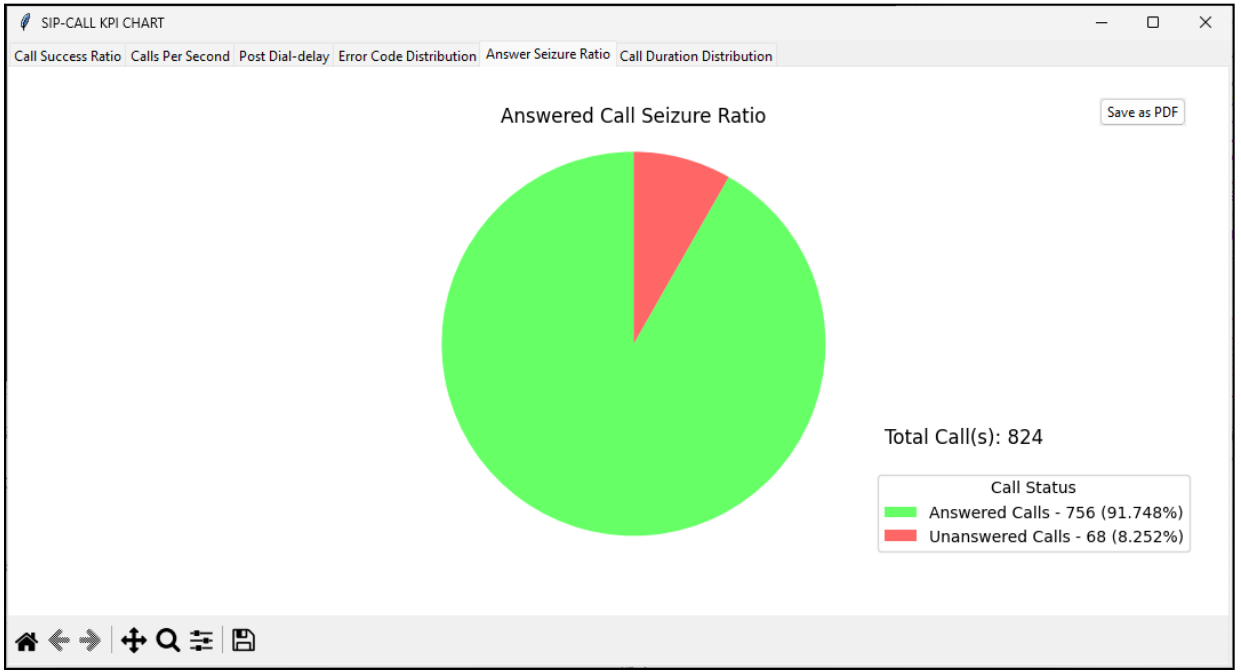
Copy Cell Value to Clipboard



Key Performance Indicators (KPIs) Report for SIP Calls

The SIP Call Summary KPI Report includes KPIs for the following fields:

- **Call Success Ratio**: Displays graph for "Successful" and "Unsuccessful Calls," including counts and percentages (%)
- **Calls Per Second**: Shows graph "Total," "Passed," and "Failed Calls per second."
- **Post Dial Delay**: Shows delay counts in milliseconds (0-250ms, 251-500ms, etc.)
- **Error Code Distribution**: Lists Top 10 Call Failure Causes with counts and percentages (%)
- **Answer Seizure Ratio**: Shows "Answered" and "Unanswered Calls," with counts and percentages (%)
- **Call Duration Distribution**: Provides call counts for different durations (0-1 sec, 1-10 sec, etc.)



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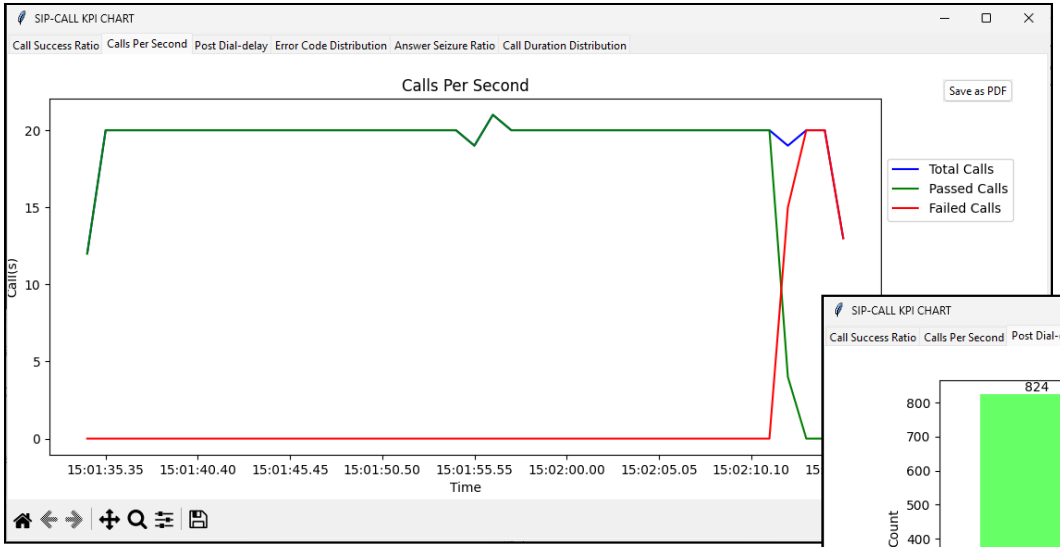
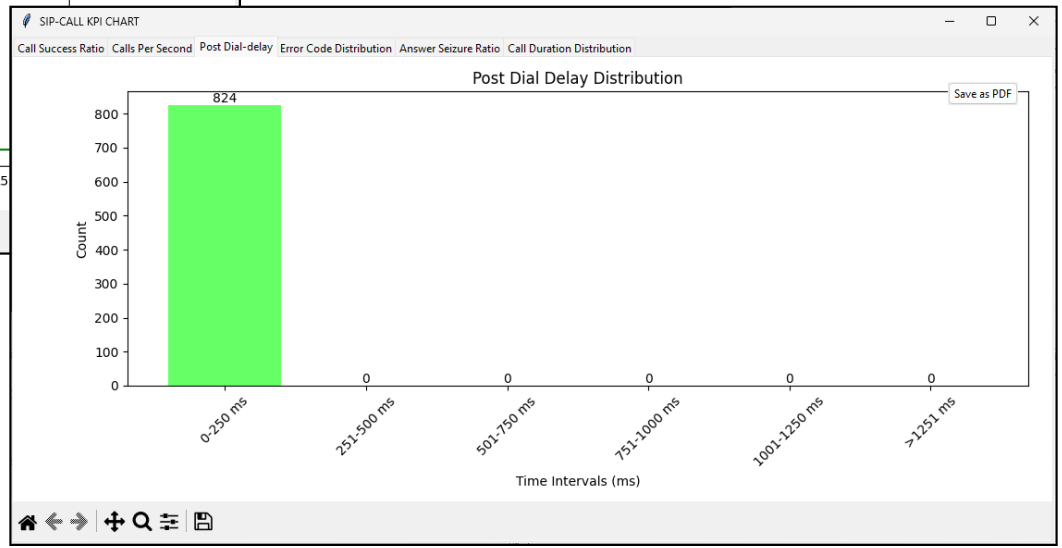
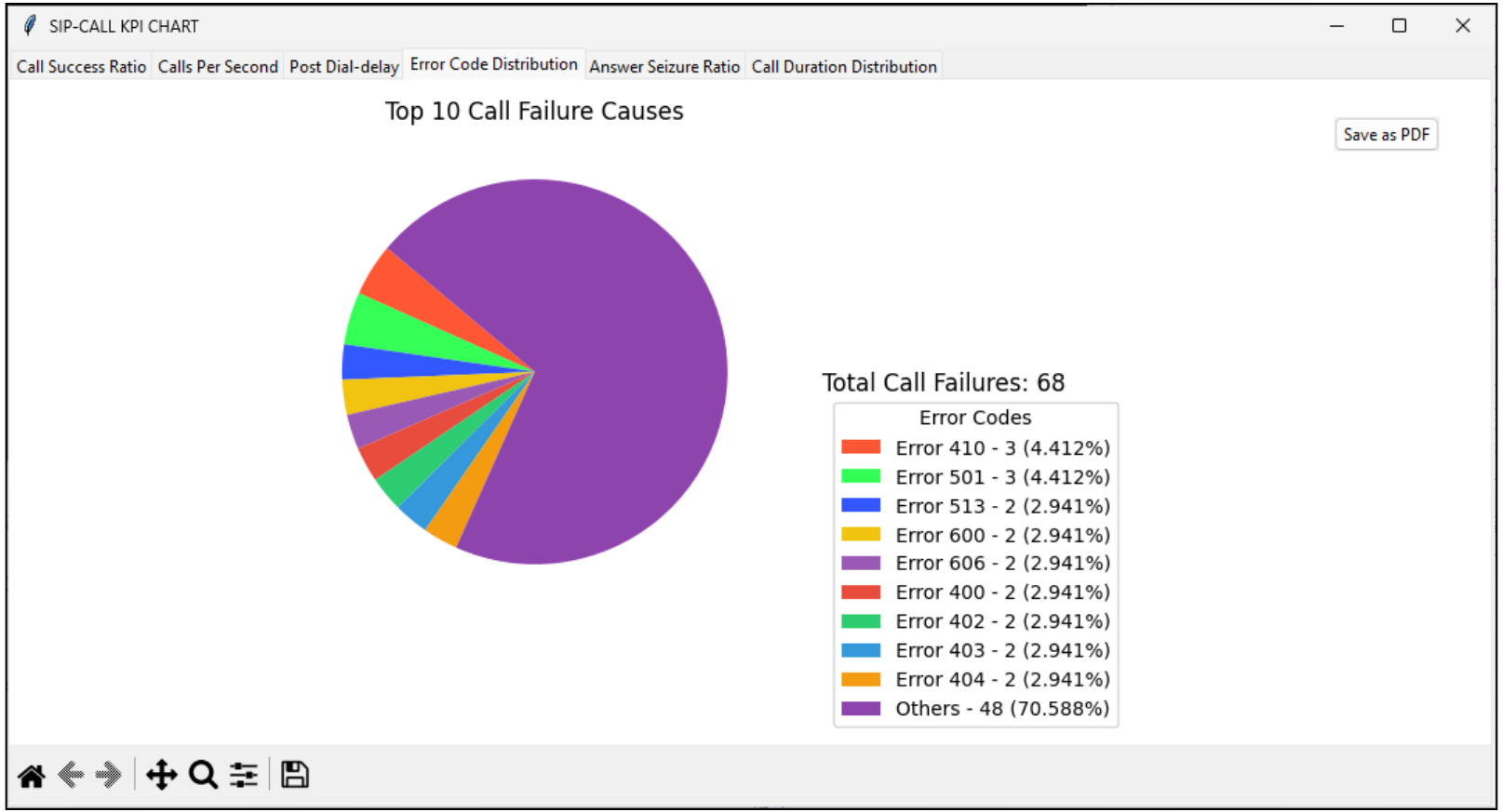
Calls Per Second and Post Delay KPIs





Error Code Distribution KPI



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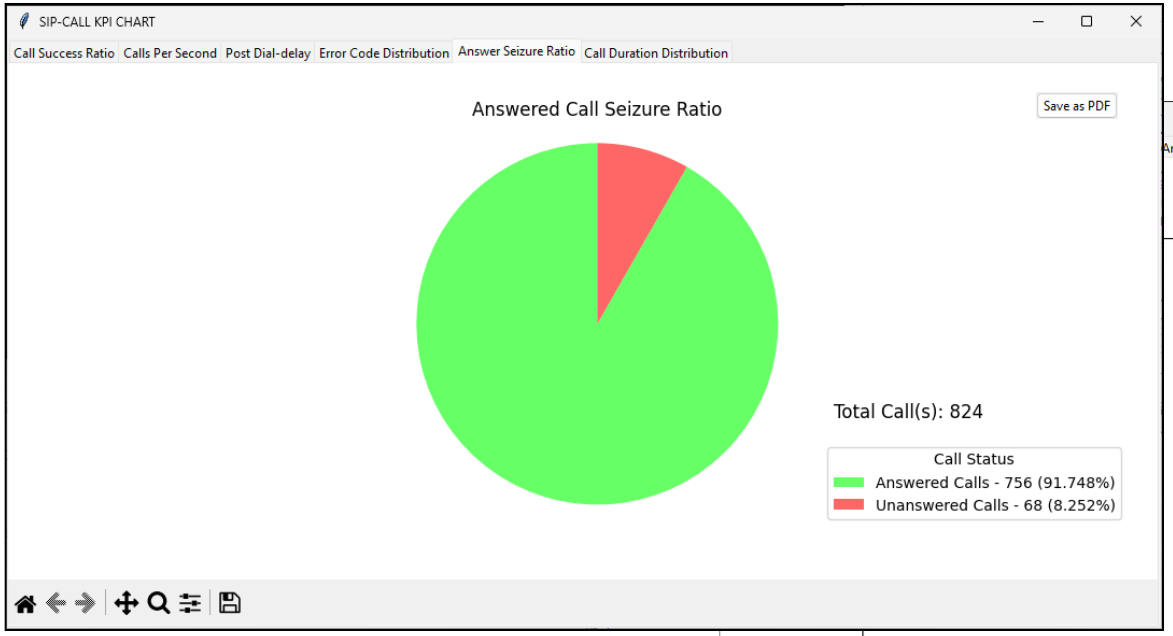
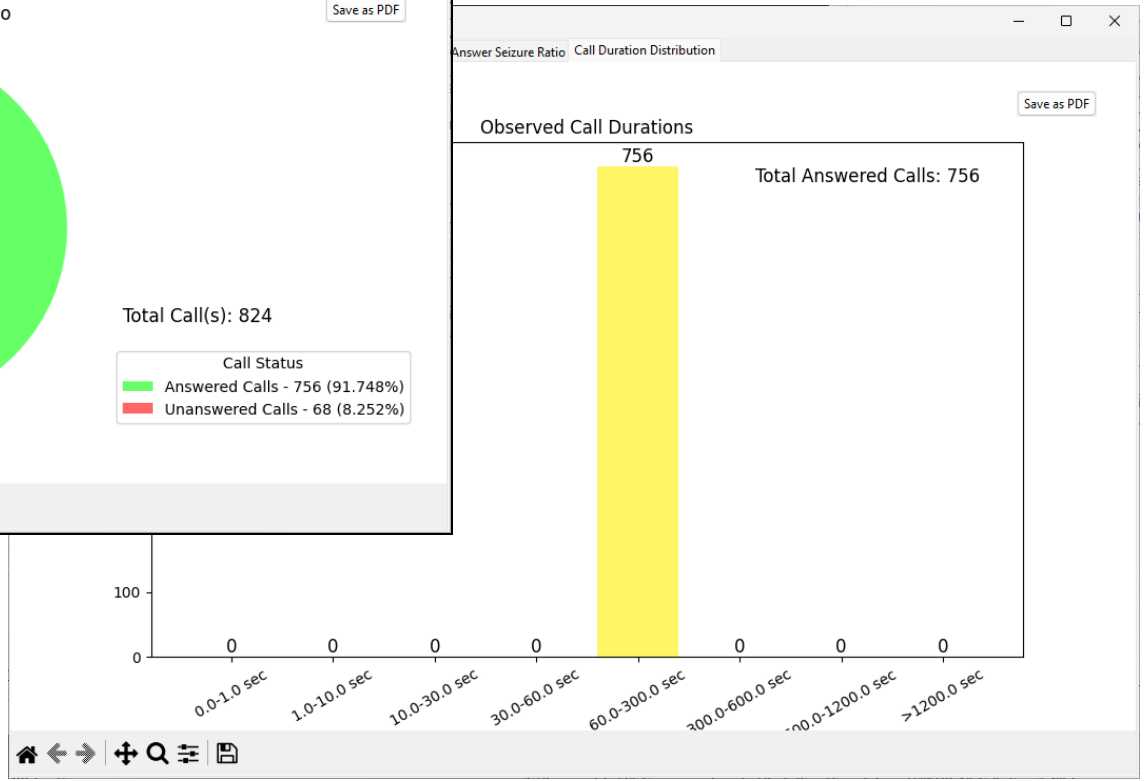
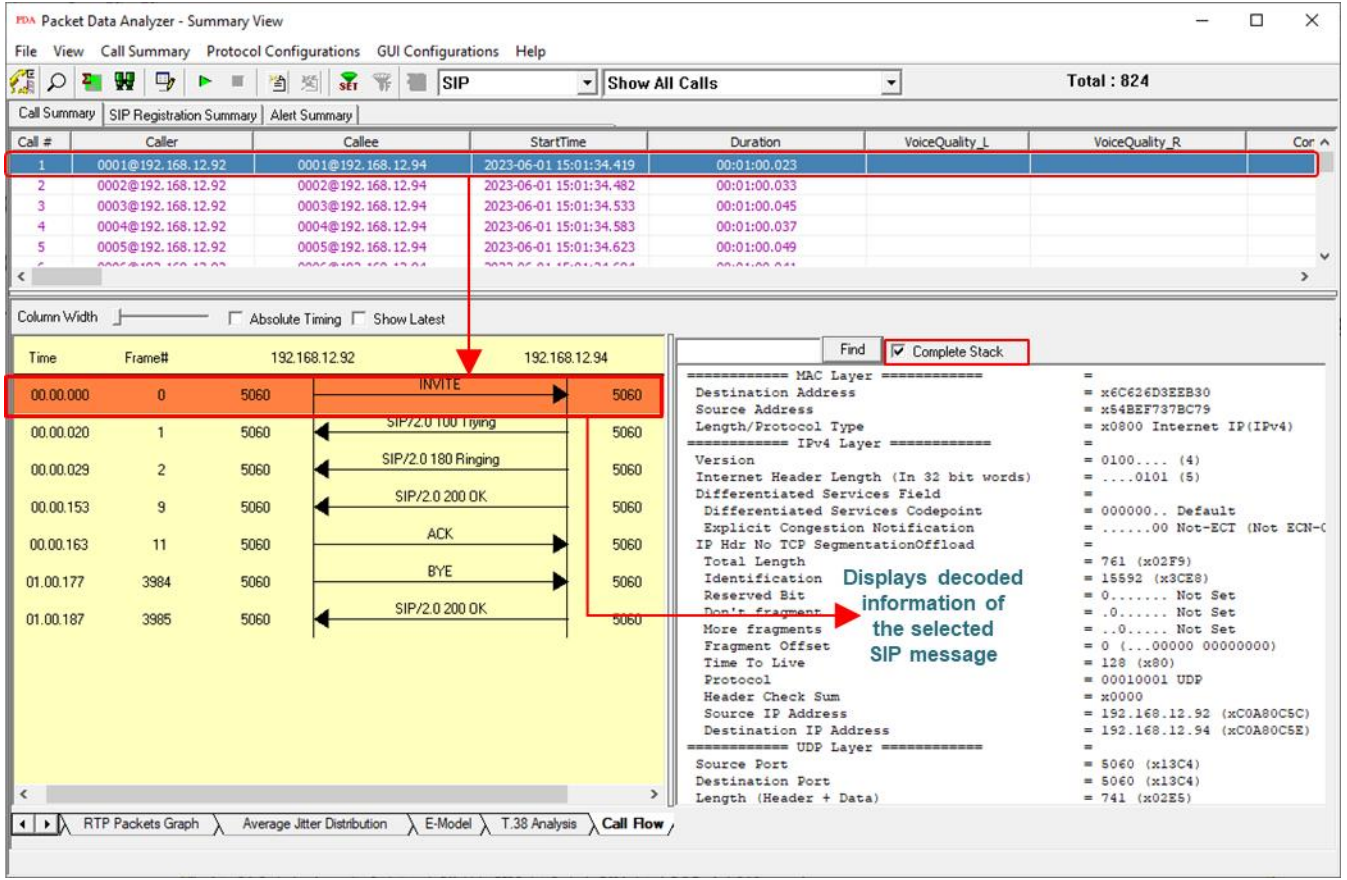
Answer Seizure Ratio and Call Duration Distribution KPIs





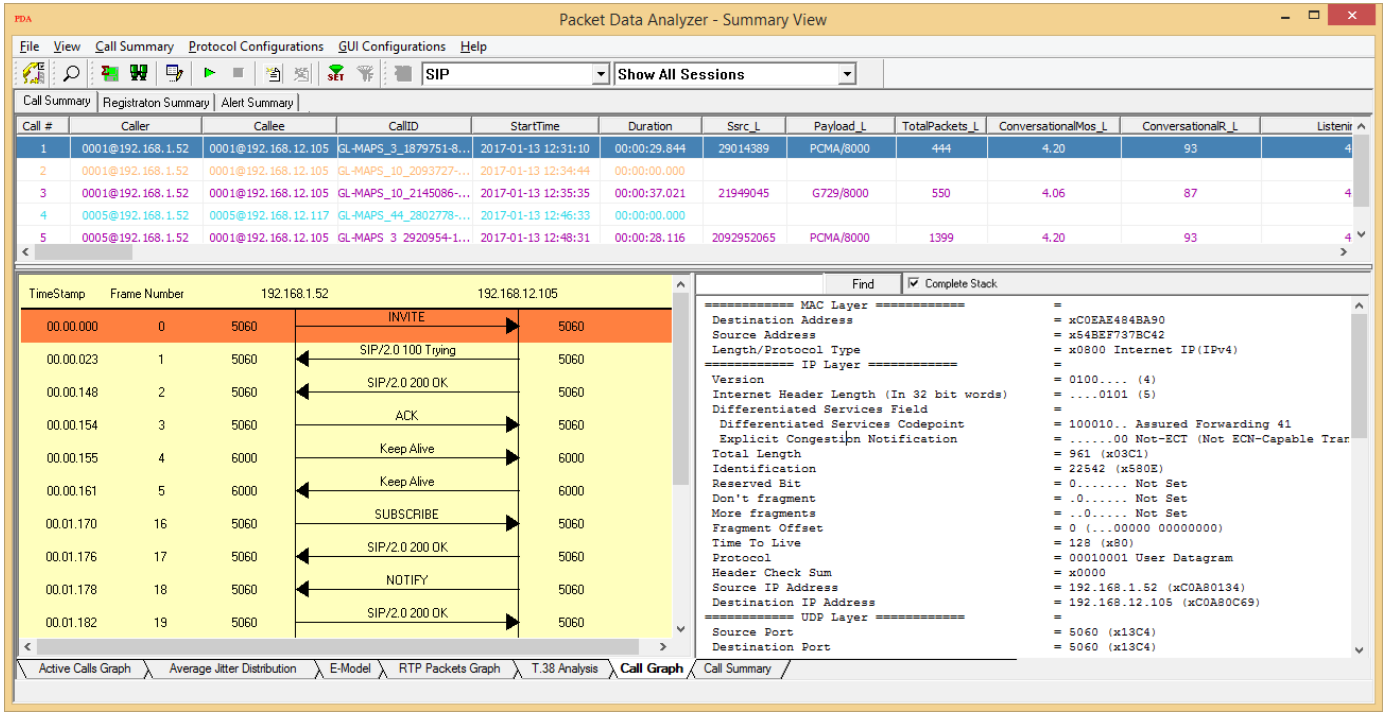
Call Graph – SIP Call

- Displays the message sequences of captured VoIP calls
- Decodes of the selected SIP message is displayed on the right pane
- The Complete Stack option enables the user to view the full call details for the selected message on the ladder diagram



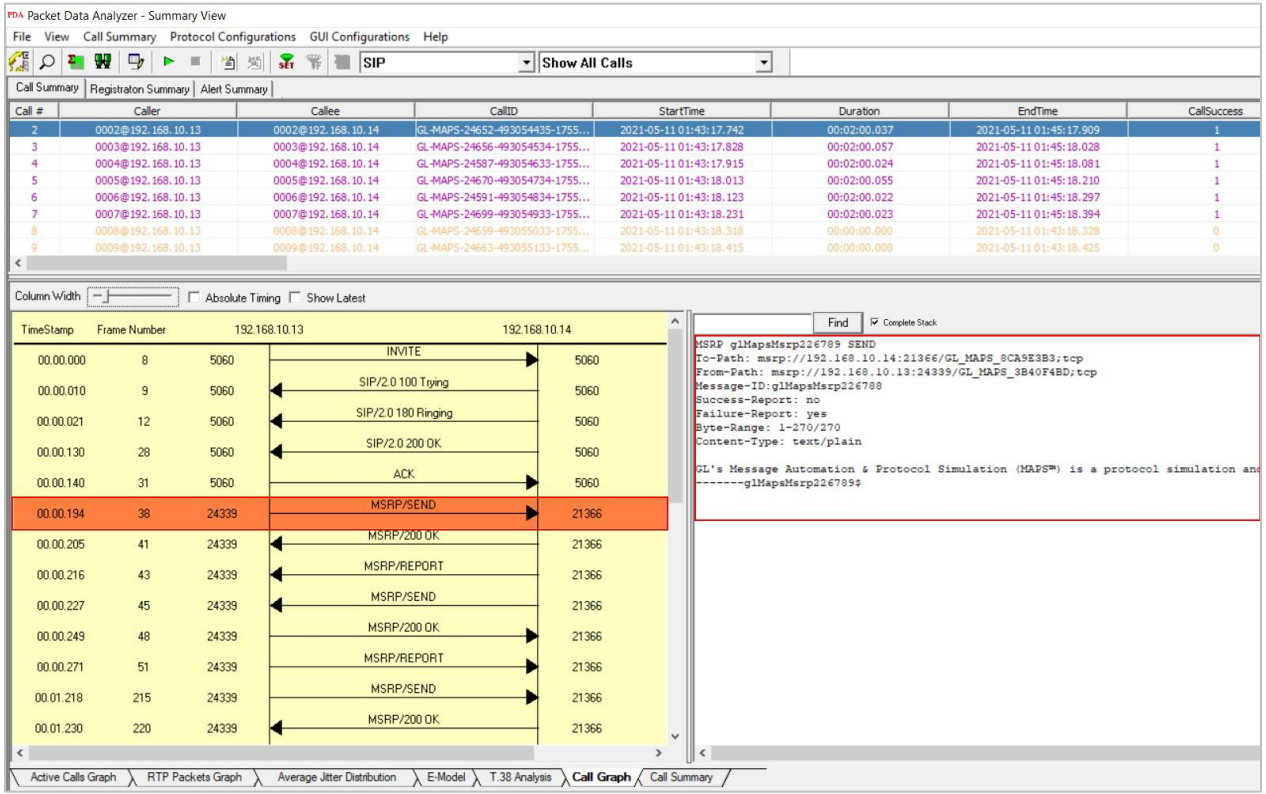
Call Graph – SIP ED-137

- Displays the message sequences of SIP ED-137 call
- Decodes of the selected SIP message is displayed on the right pane

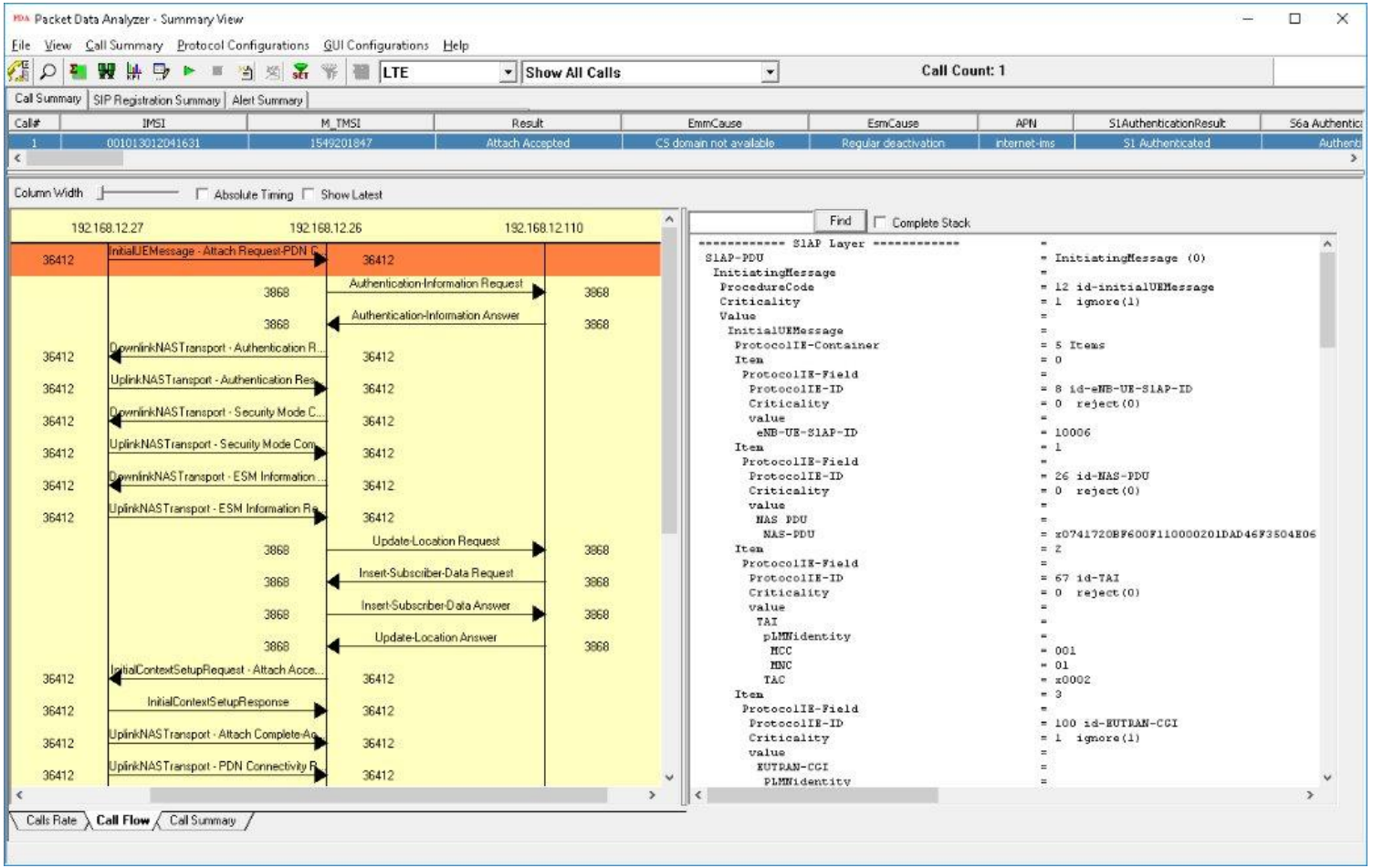


Call Graph – MSRP Call

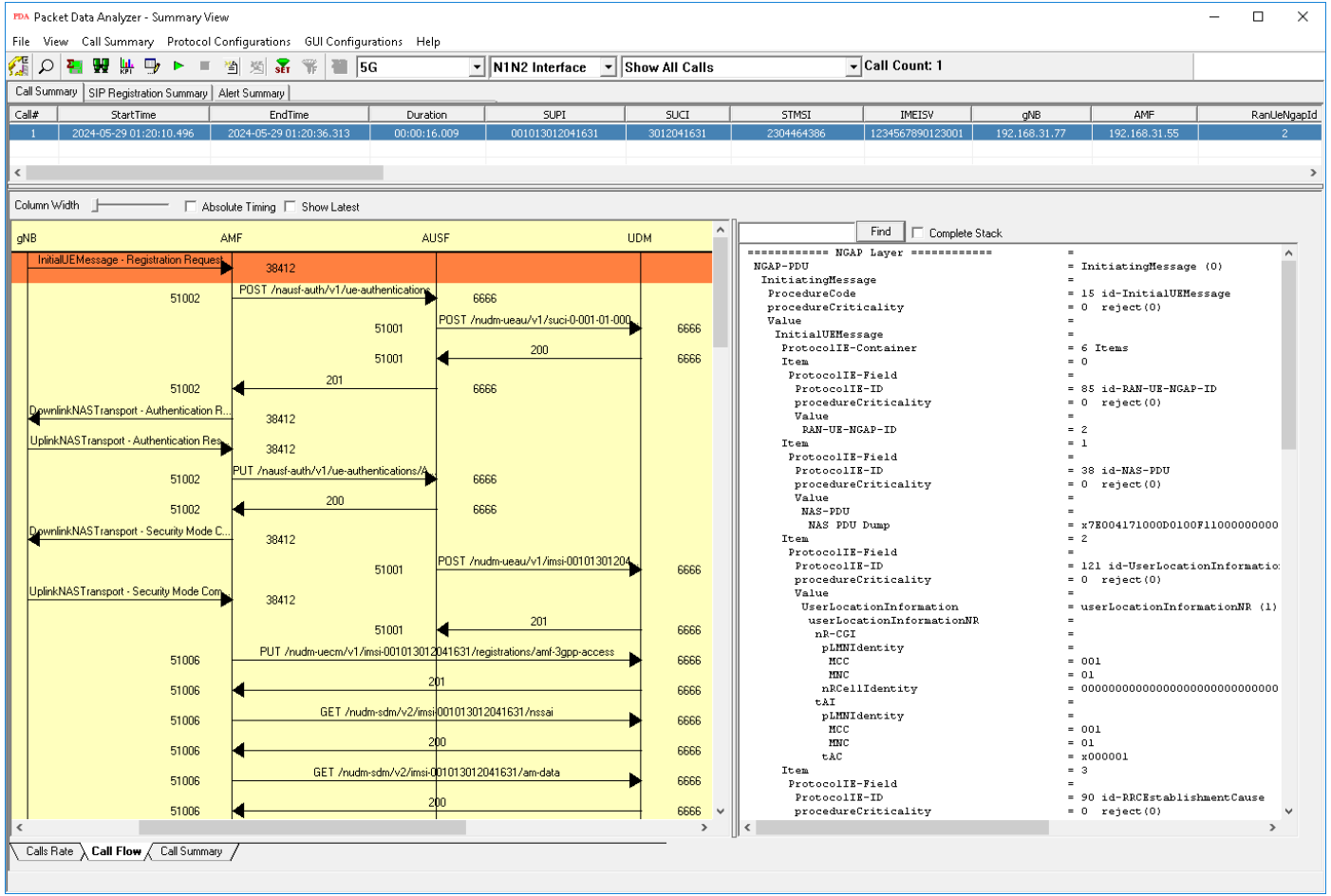
- Decodes of the selected MSRP message is displayed on the right pane



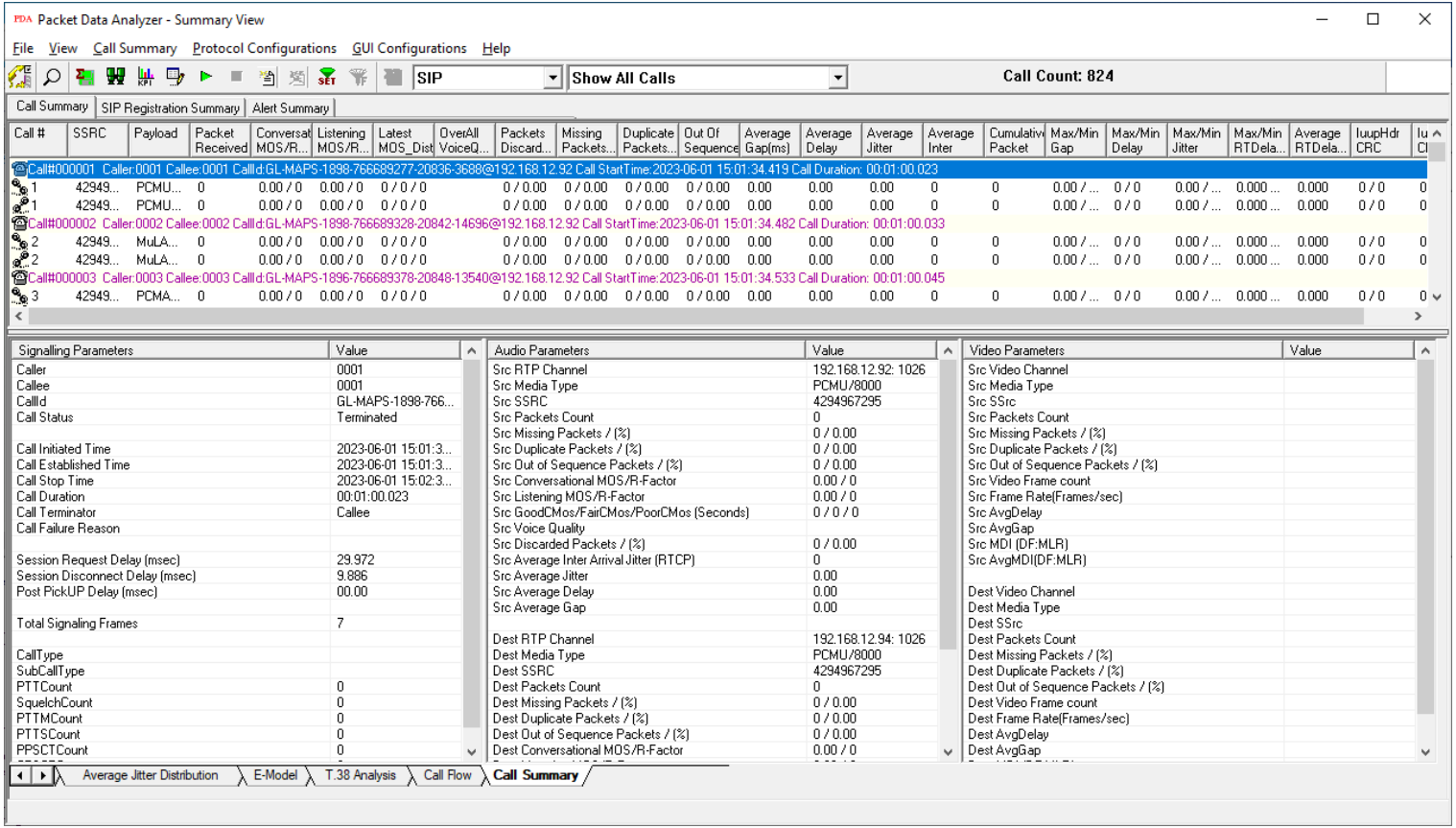
LTE Call Flow



Call Graph – 5G N1N2 Call

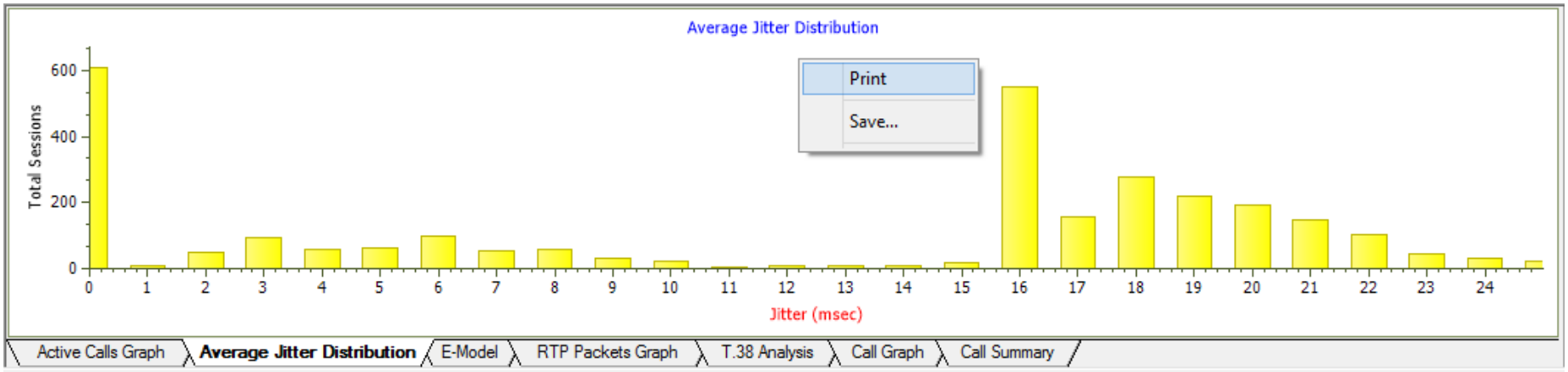


Signaling / Audio/ Video QoS Parameters



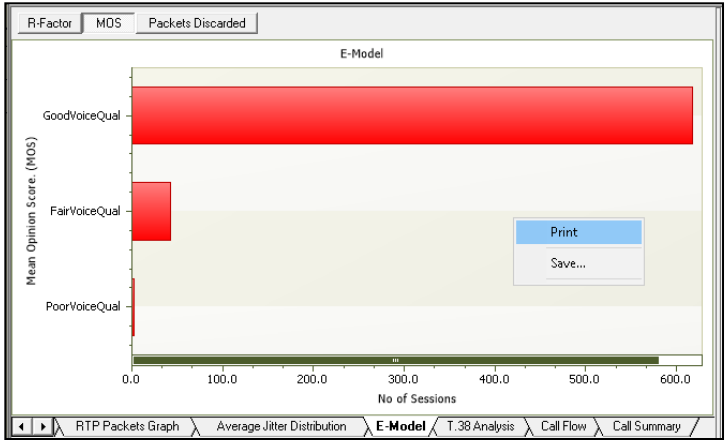
Average Jitter Distribution Graph

- Distribution of the Average Jitter values across Total Sessions



MOS Graph and R-Factor Graph

- 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

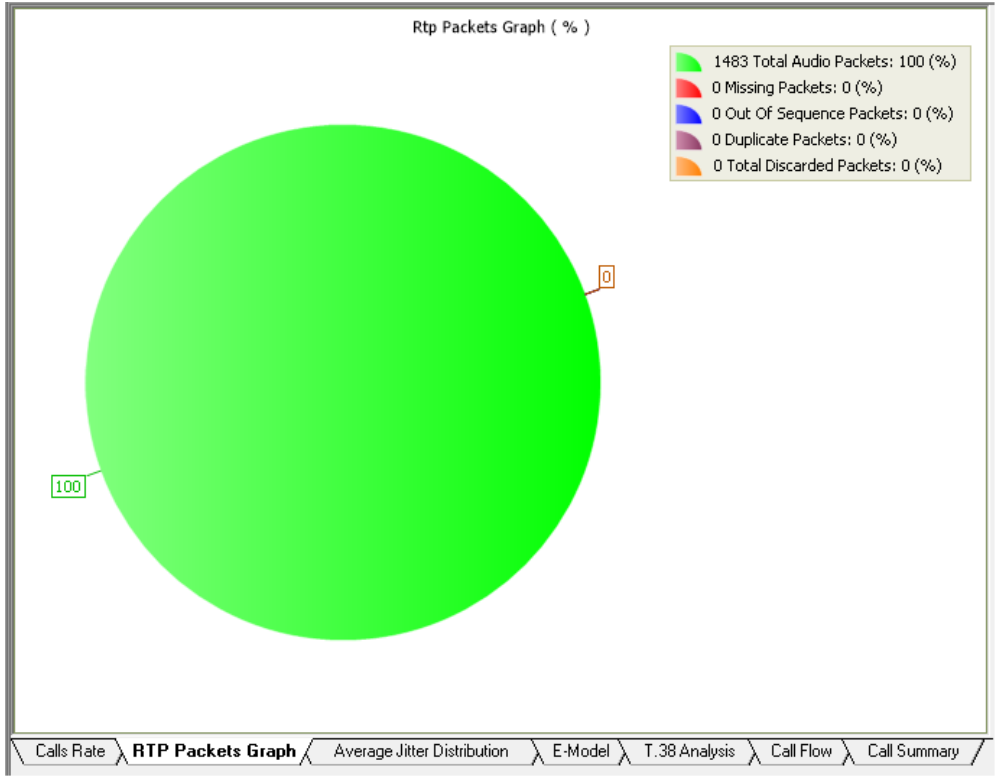


MOS

R Factor

GL Communications

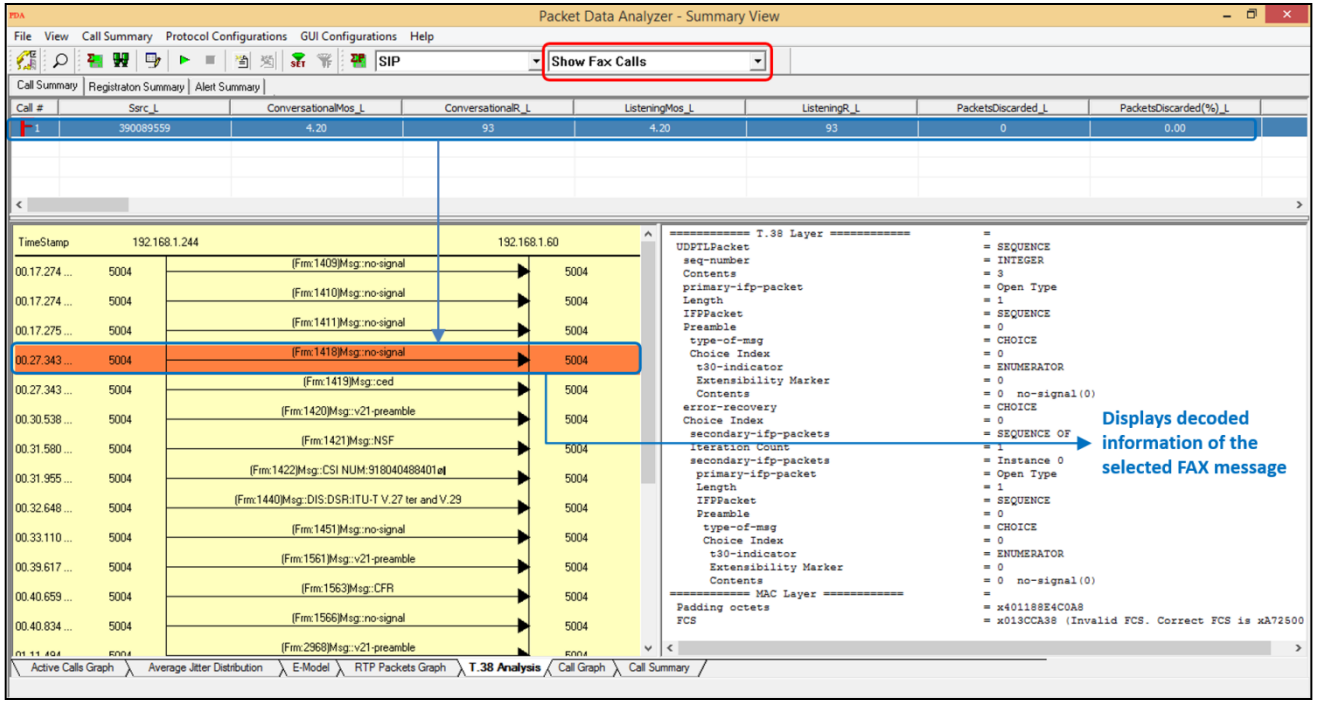
RTP Packets Graph



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

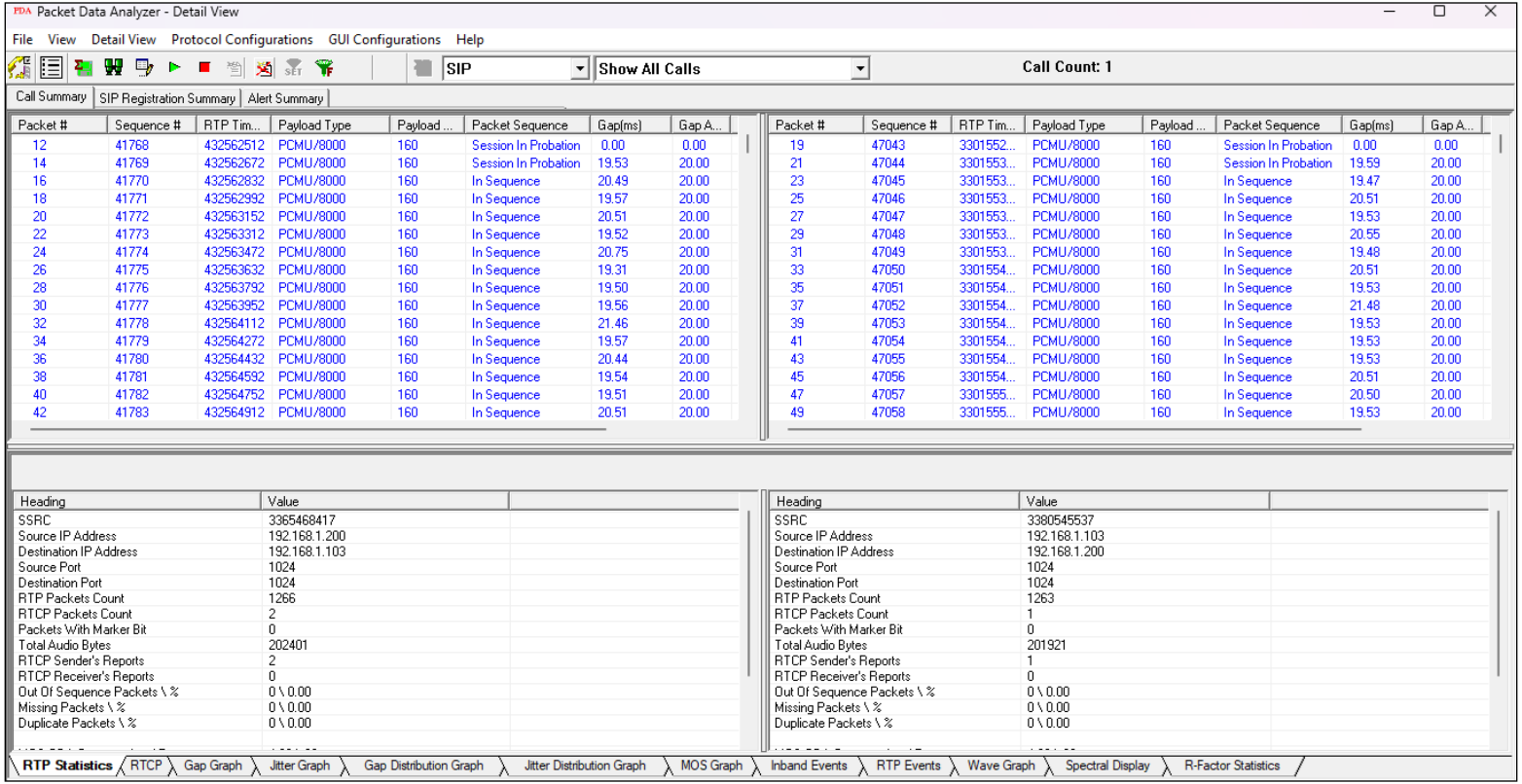
T.38 Analysis - Fax over IP

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

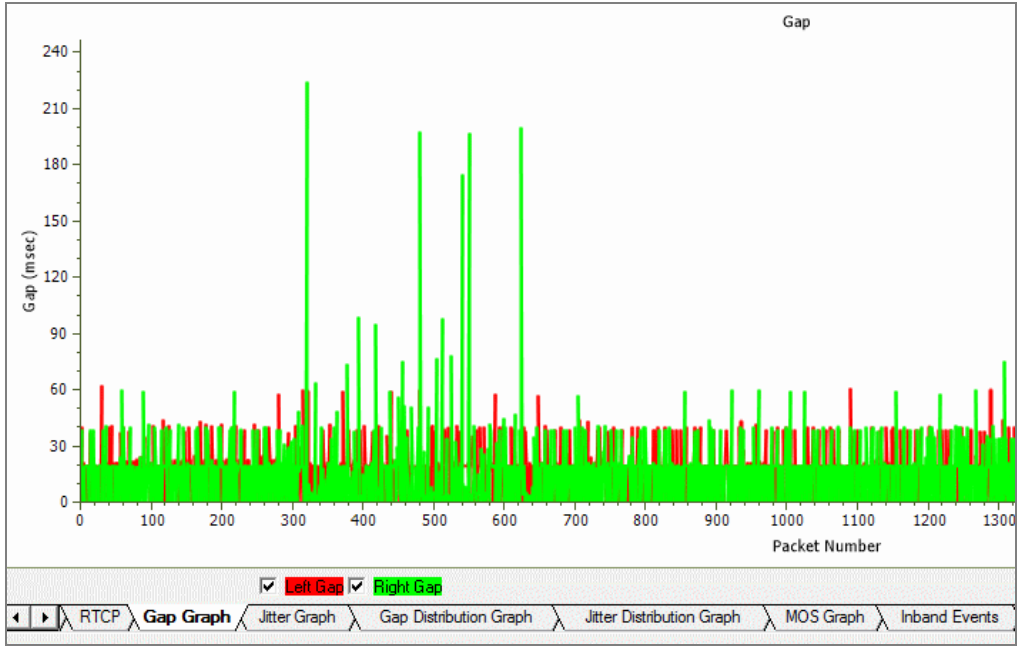


Call Detail View

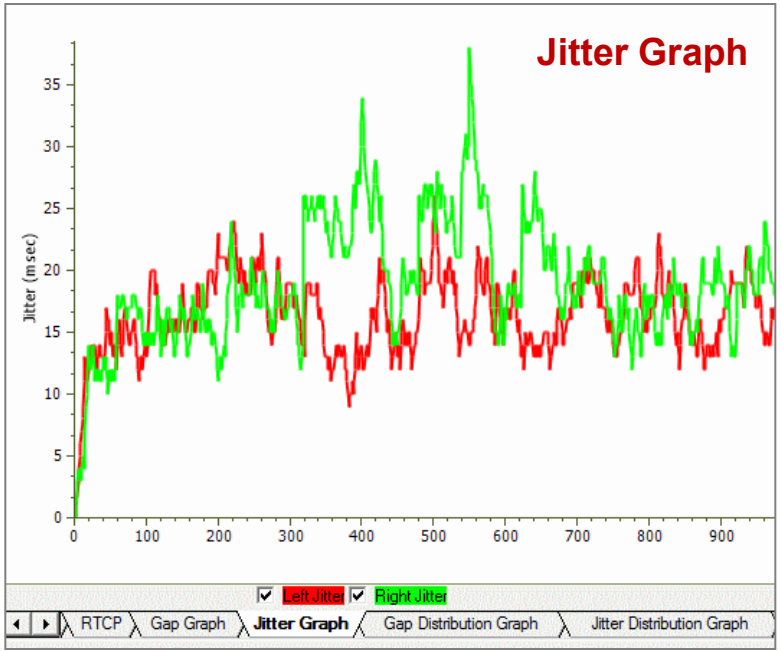
- Provides a detail look at the two (or one) RTP sessions that are part of a single call
- Left and right panes accommodate the two sessions



Gap and Jitter Graph



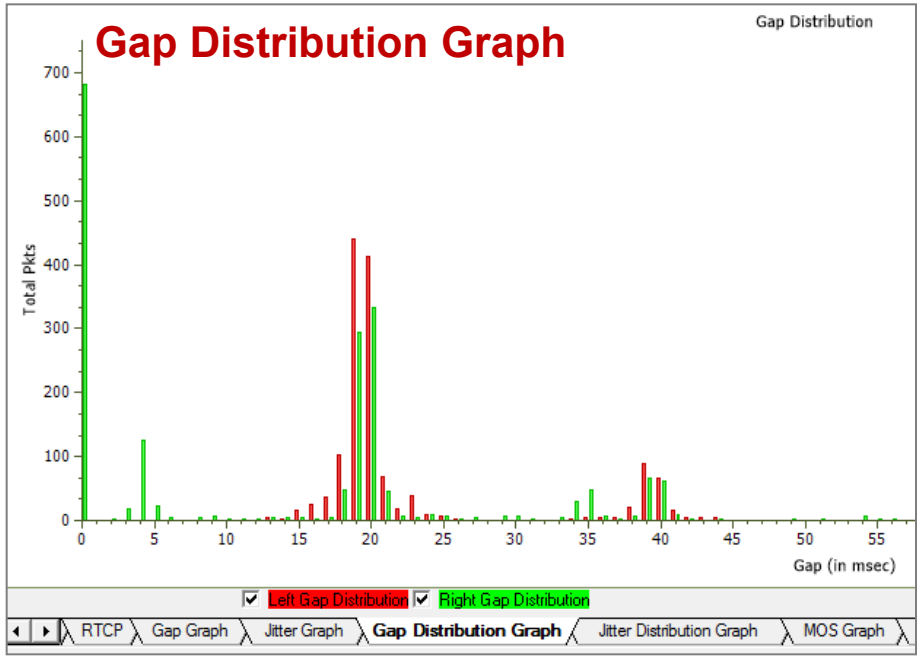
- Gap graph plots the Gap (in milliseconds) versus the packet number



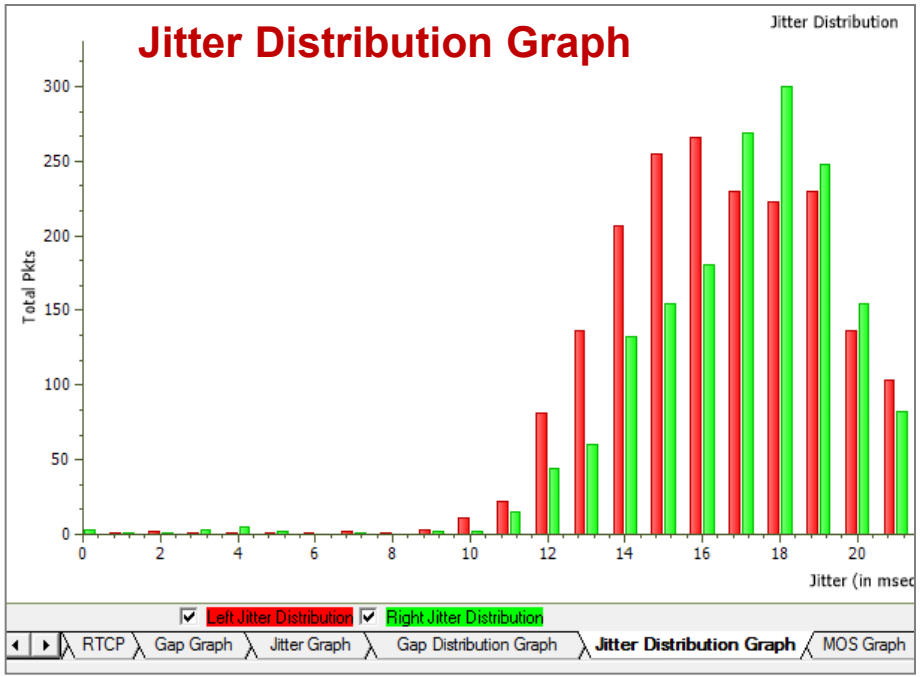
- Jitter graph plots the Jitter versus the packet number

GL Communications

Gap and Jitter Distribution Graph

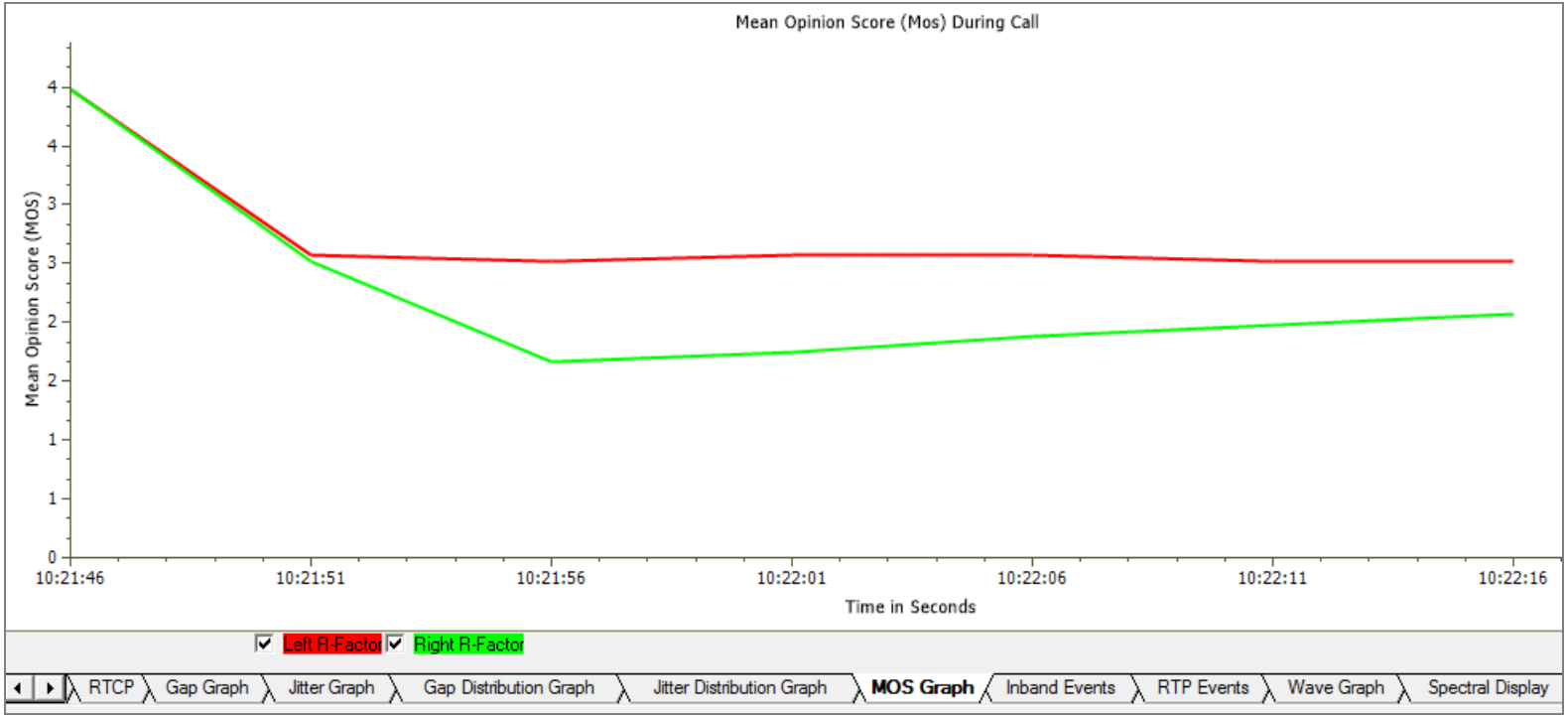


- Number of packets with a particular value of gap is plotted against the (gap) value



- Number of packets with a particular value of jitter is plotted against the jitter value

MOS Graph



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

Inband and Outband (RTP) Events

TimeStamp	Type	Event	On(ms)	Power(dBm)	Freq1(Hz)/Pow...	Freq2(Hz)/Pow...
00:00:00.000	IDLE		45470	0.00		
00:00:45.470	DTMF	1	80	-1.89	698/-6.01	1210/-4.01
00:00:45.550	IDLE		80	0.00		
00:00:45.630	DTMF	2	80	-1.87	698/-6.00	1337/-3.99
00:00:45.710	IDLE		80	0.00		
00:00:45.790	DTMF	3	80	-1.85	698/-5.98	147
00:00:45.870	IDLE		80	0.00		
00:00:45.950	DTMF	4	80	-1.86	771/-5.98	12
00:00:46.030	IDLE		80	0.00		
00:00:46.110	DTMF	5	80	-1.86	771/-5.98	13
00:00:46.190	IDLE		80	0.00		
00:00:46.270	DTMF	6	80	-1.87	771/-5.99	14
00:00:46.350	IDLE		80	0.00		
00:00:46.430	DTMF	7	80	-1.86	853/-5.98	12
00:00:46.509	IDLE		80	0.00		
00:00:46.590	DTMF	8	80	-1.89	853/-6.01	13
00:00:46.670	IDLE		80	0.00		

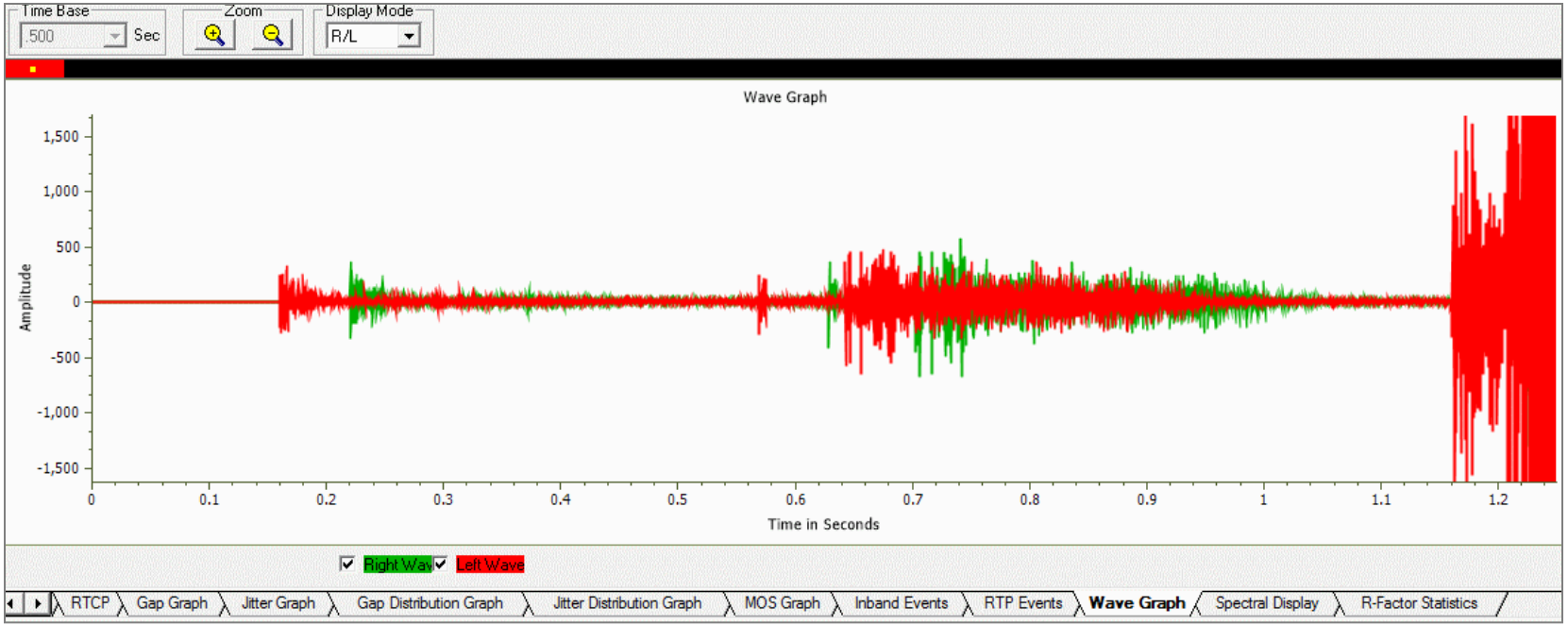
Inband Events | RTP Events | Wave Graph | Spectral Display | R-Fact

TimeStamp	Event	Volume (-dBm)	Duration (ms)
12:09:02.652	DTMF 1	6	80
12:09:02.812	DTMF 2	6	80
12:09:02.971	DTMF 3	6	80
12:09:03.132	DTMF 4	6	80
12:09:03.292	DTMF 5	6	80
12:09:03.452	DTMF 6	6	80
12:09:03.612	DTMF 7	6	80
12:09:03.772	DTMF 8	6	80
12:09:03.931	DTMF 9	6	80
12:09:04.092	DTMF 0	6	80
12:09:04.252	DTMF A	6	80
12:09:04.412	DTMF B	6	80
12:09:04.572	DTMF C	6	80
12:09:04.732	DTMF D	6	80
12:09:04.891	DTMF #	6	80
12:09:36.324	MF 1	6	80

Inband Events | RTP Events | Wave Graph | Spectral Display | R-Factor Statistics

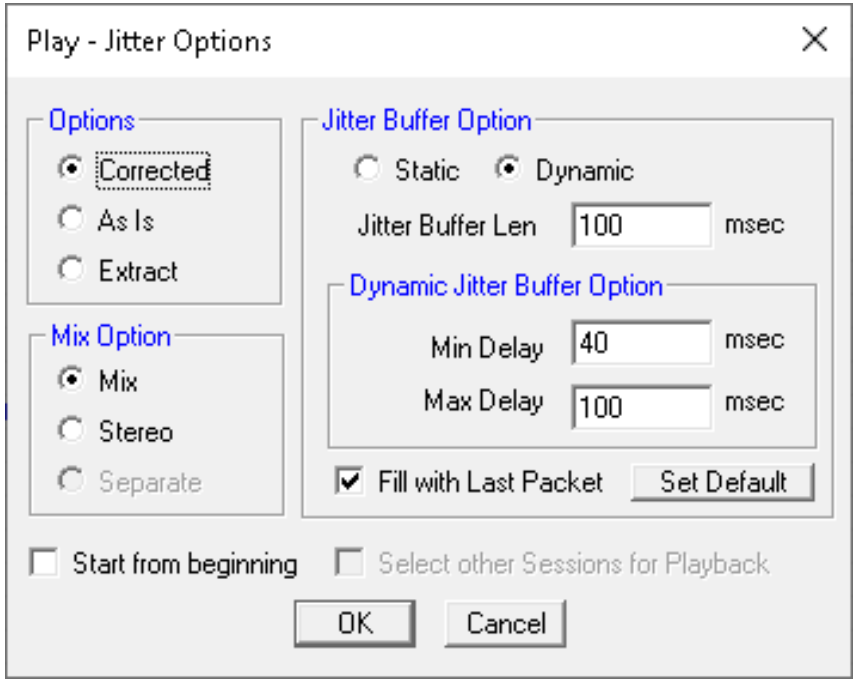
- Inband Event tab displays Inband DTMF and MF digits as they are received on selected RTP stream
- Outband (RTP) Events tab displays all Outband RTP events defined in RFC 2833 or RFC 4733

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

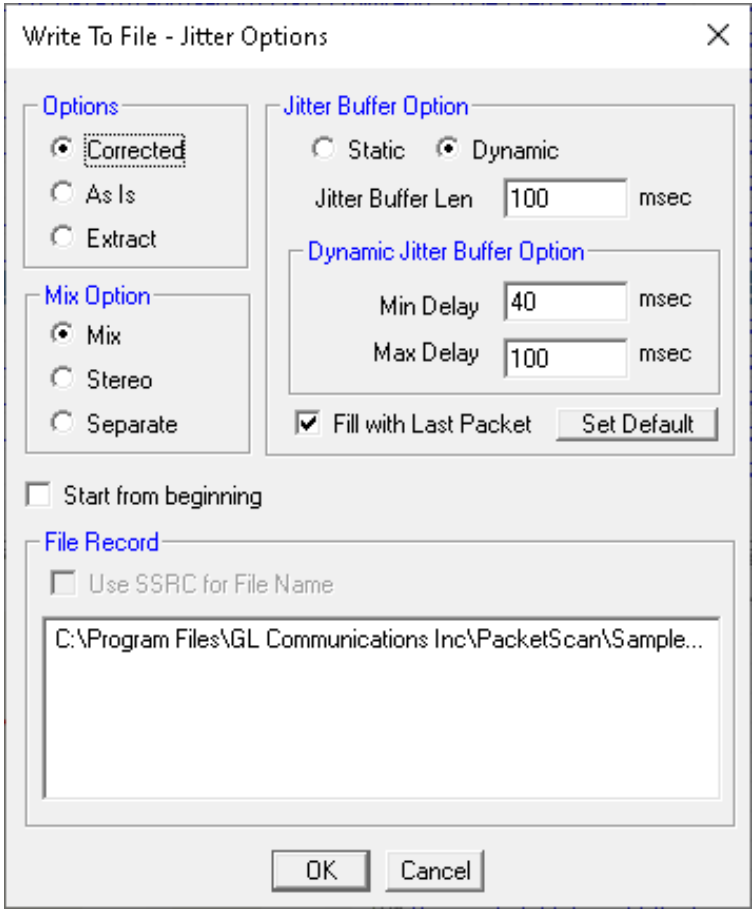
Play Audio



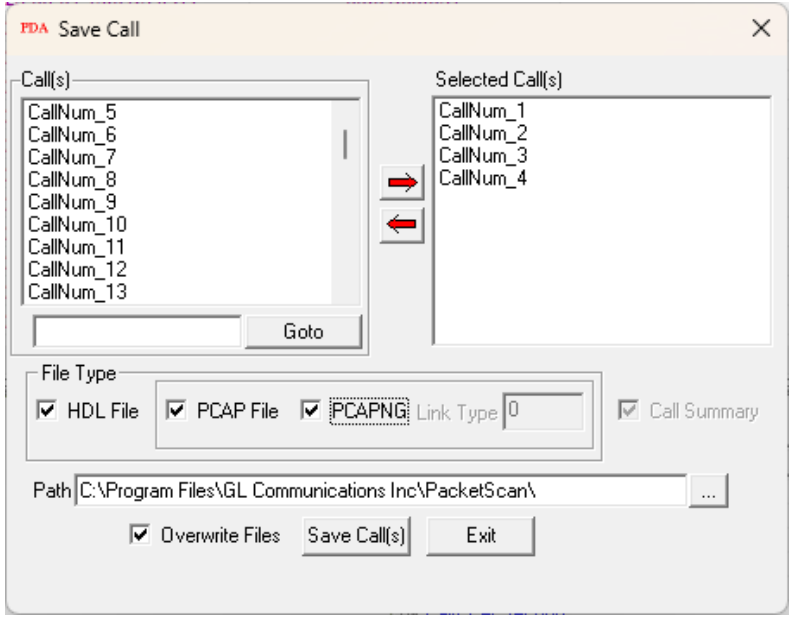
- Plays the RTP streams of a call to the PC speaker using a soundcard
- Provides a host of options such as jitter buffer settings, audio mixing, and so on to play a live call in real-time or play captured voice files

Write to File

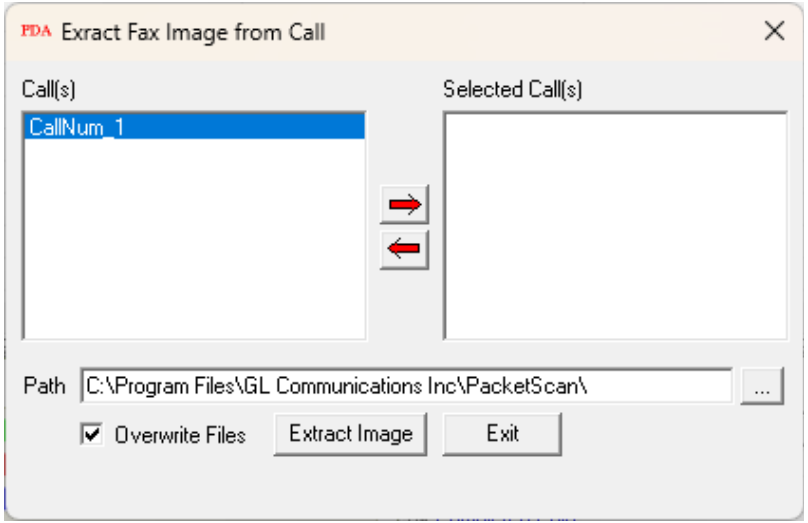
- Various options are provided to save captured calls
- Use the files with voice quality analysis software to calculate the mean opinion score of the call
- Records the RTP stream to a file in *.wav format



Save Call and Extract Fax Image

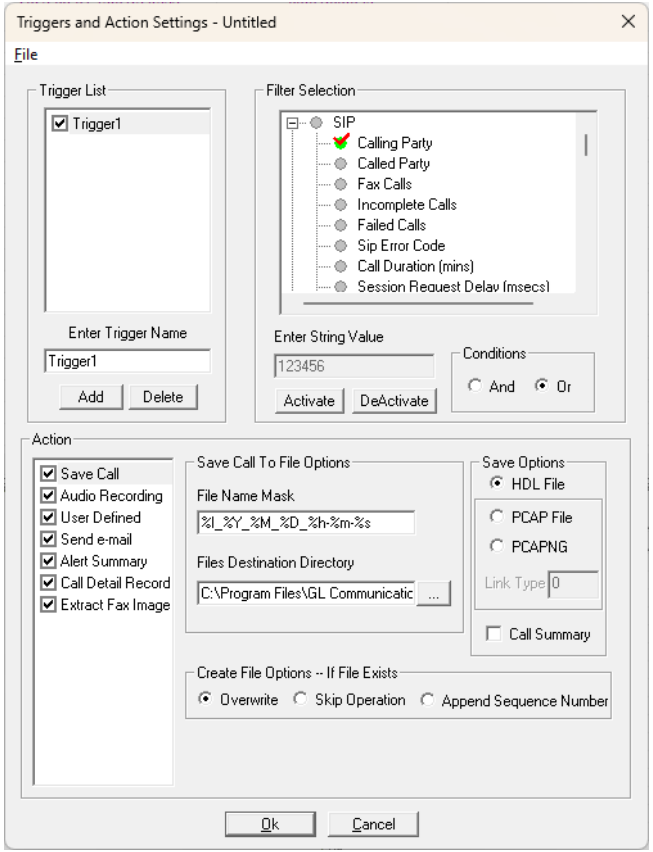


- Saves a particular call in either GL's proprietary HDL file format or Ethereal PCAP file format or PCAPNG file format
- Saves the Call Summary details including signaling and audio / fax/ video parameters for a particular call in *.rtf file
- Helps in getting data from real-time traffic locations to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



- Extracts Fax image in the TIFF format from the selected fax call

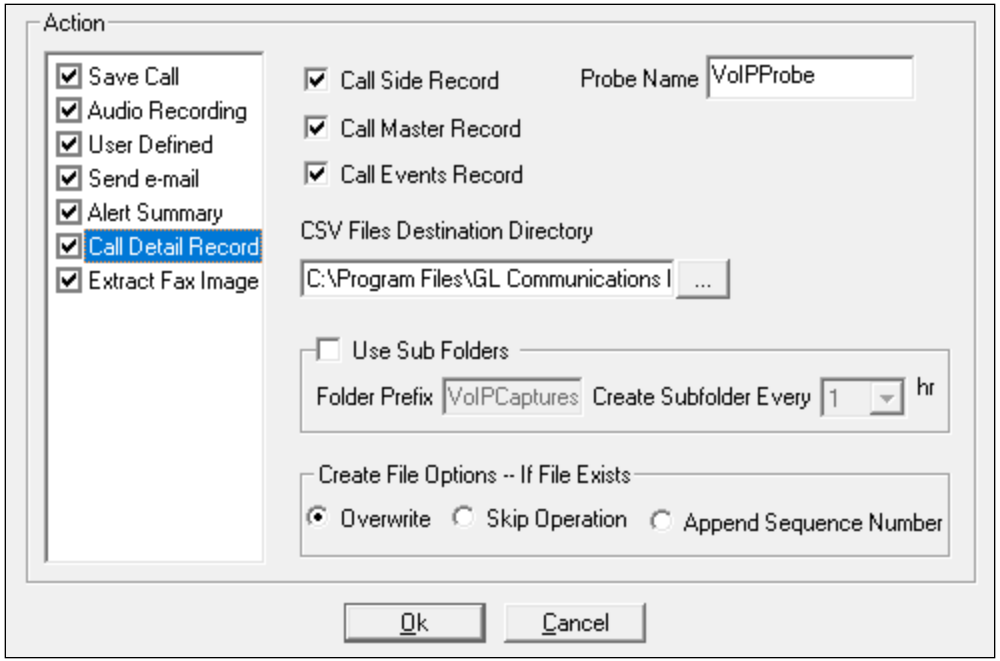
Trigger and Action Settings



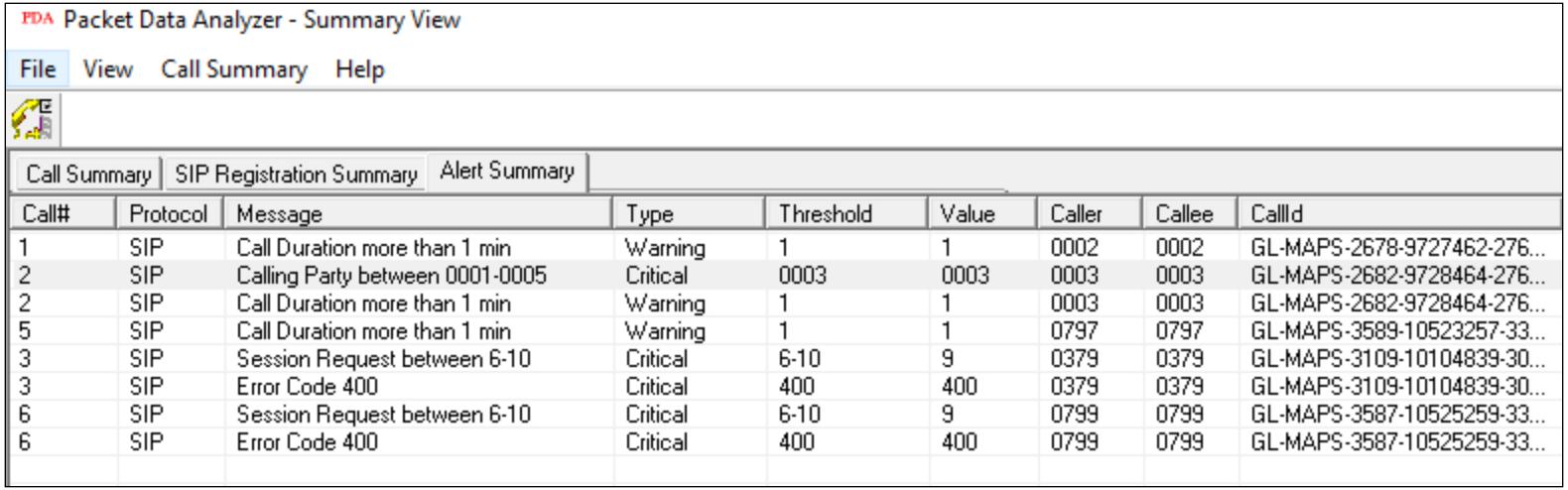
- Set the triggers and actions criteria to filter calls and perform additional actions on the completed calls
- Trigger actions on certain SIP, RTP, MEGACO, and H.323 parameters
- Triggering factors includes calling number, called number, incomplete calls, fax calls, call duration, MOS factor, sip error code, average jitter, and more
- Actions include
  - Saving call to a file -*.hdl, *.pcap, or *.pcapng
  - Recording audio to a file
  - Sending an email alert
  - Generates alerts when particular vital parameters go beyond a specified value
  - Outputs call detail records as CSV
  - Extract Fax in Tiff format

Call Detail Records (CSV)

- 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, 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



Alert Summary

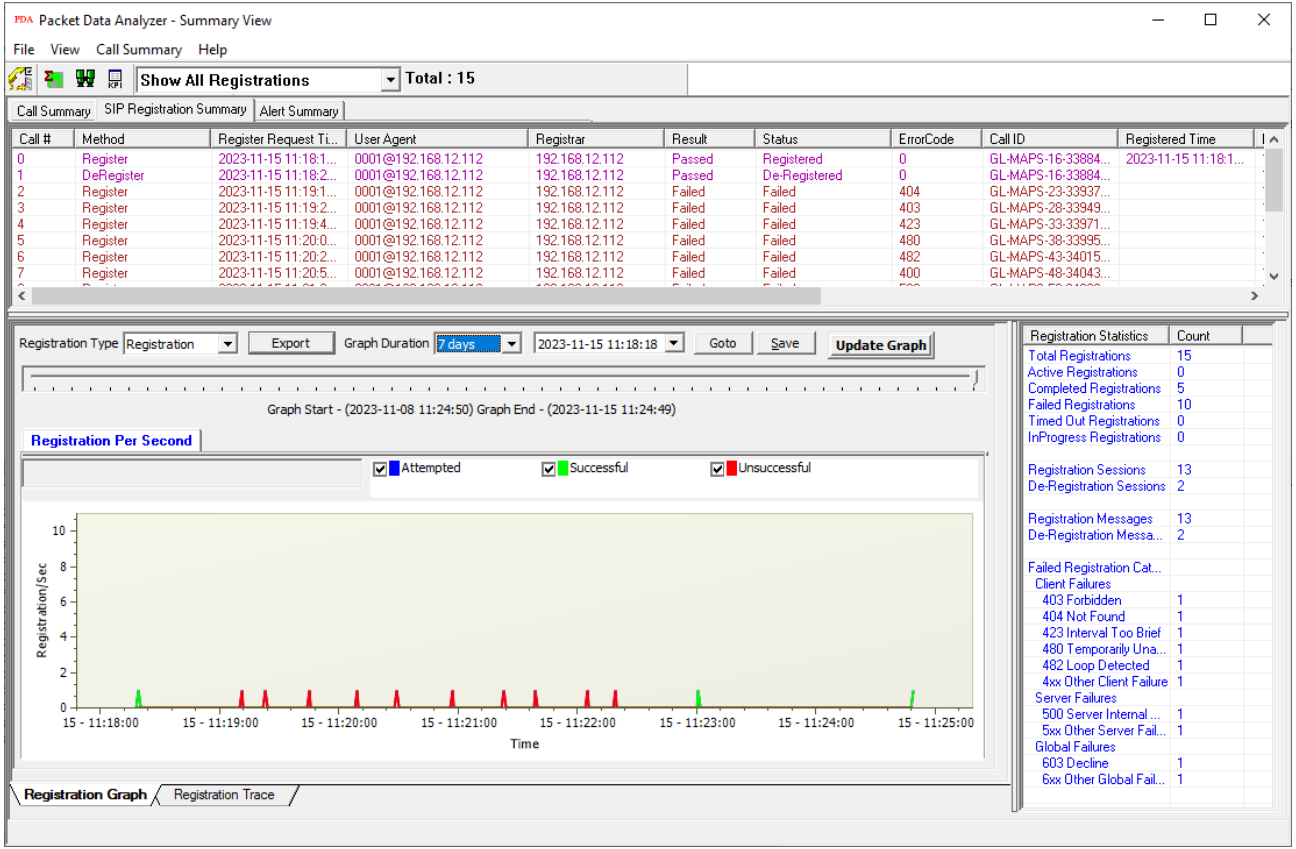


Call#	Protocol	Message	Type	Threshold	Value	Caller	Callee	CallId
1	SIP	Call Duration more than 1 min	Warning	1	1	0002	0002	GL-MAPS-2678-9727462-276...
2	SIP	Calling Party between 0001-0005	Critical	0003	0003	0003	0003	GL-MAPS-2682-9728464-276...
2	SIP	Call Duration more than 1 min	Warning	1	1	0003	0003	GL-MAPS-2682-9728464-276...
5	SIP	Call Duration more than 1 min	Warning	1	1	0797	0797	GL-MAPS-3589-10523257-33...
3	SIP	Session Request between 6-10	Critical	6-10	9	0379	0379	GL-MAPS-3109-10104839-30...
3	SIP	Error Code 400	Critical	400	400	0379	0379	GL-MAPS-3109-10104839-30...
6	SIP	Session Request between 6-10	Critical	6-10	9	0799	0799	GL-MAPS-3587-10525259-33...
6	SIP	Error Code 400	Critical	400	400	0799	0799	GL-MAPS-3587-10525259-33...

- Generates alerts when 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

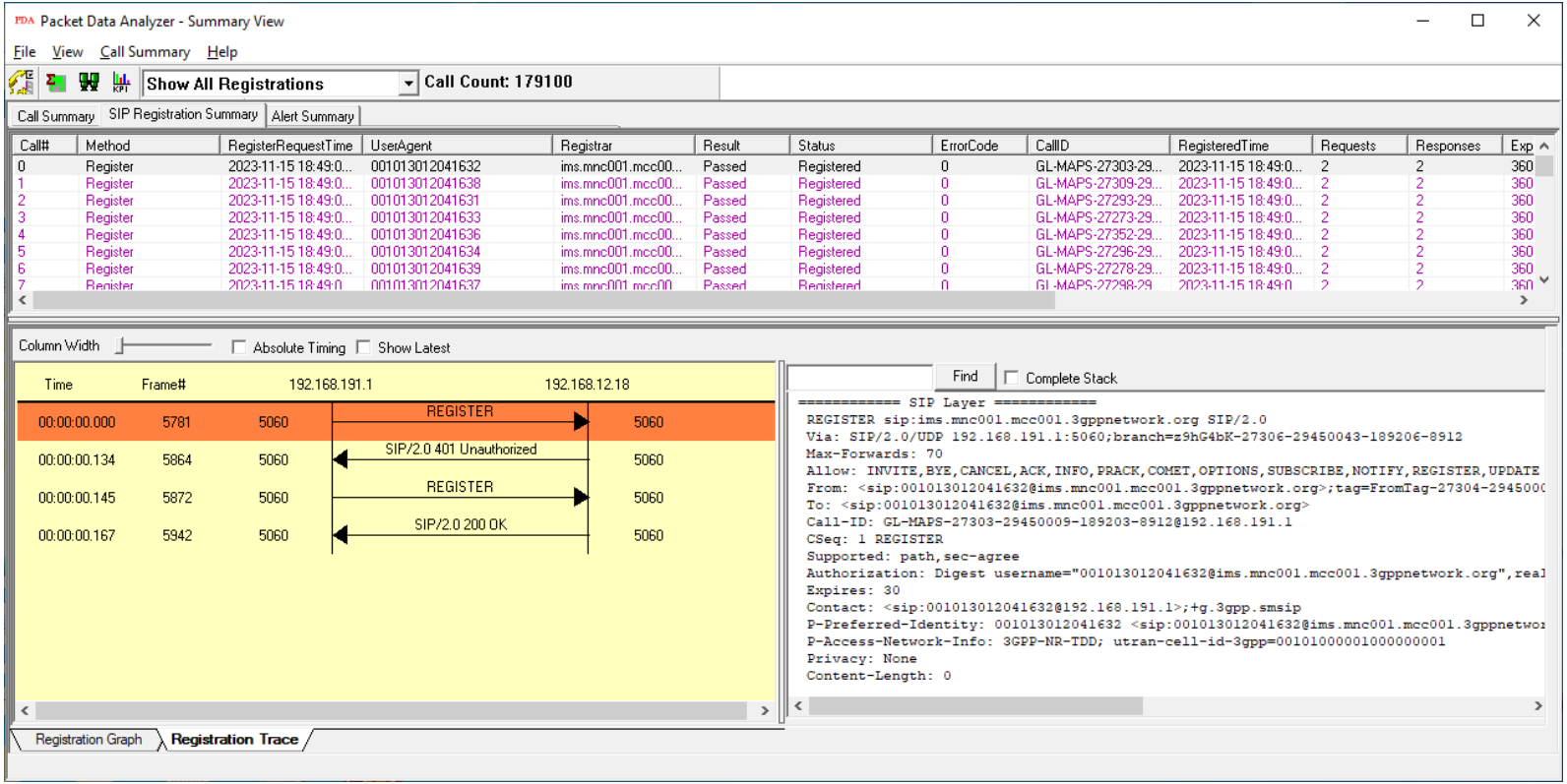
Registration Summary

- Displays the SIP registration information in a tabular format which includes user agent, registrar, registered time, status, and so on for each user agent
- Displays the active registration graph of the entire registration summary
- Provides the trace display of each registration



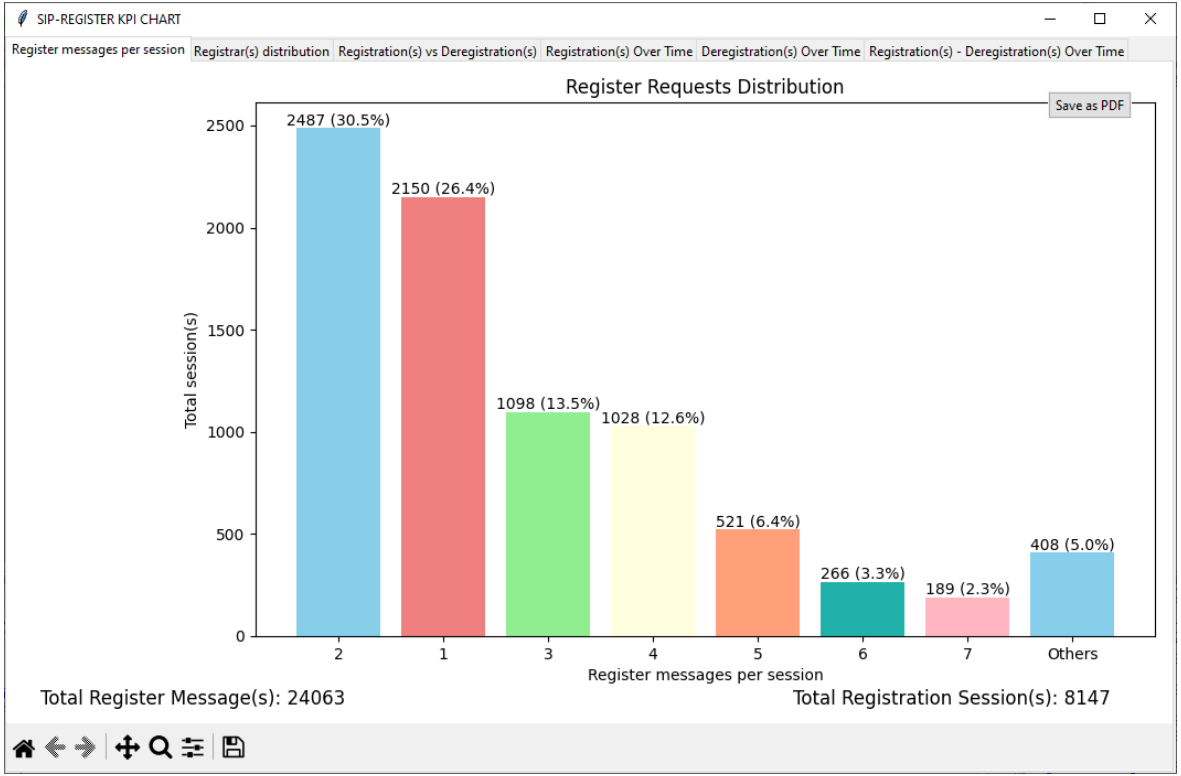
Registration Trace

- 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

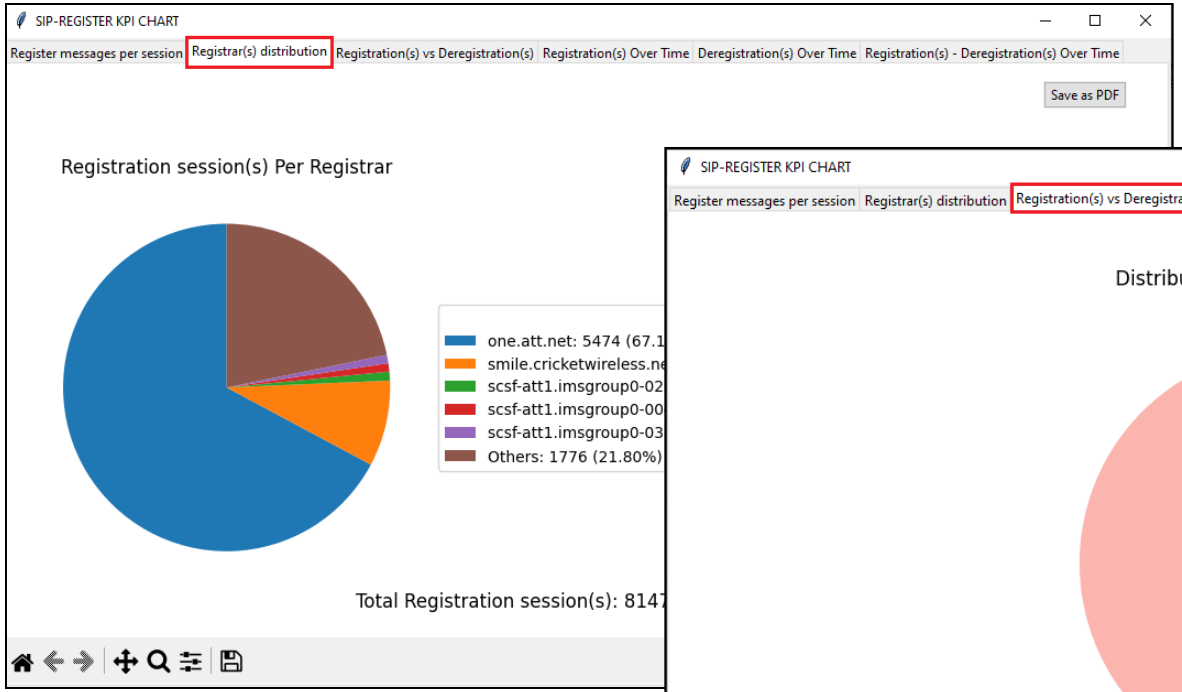


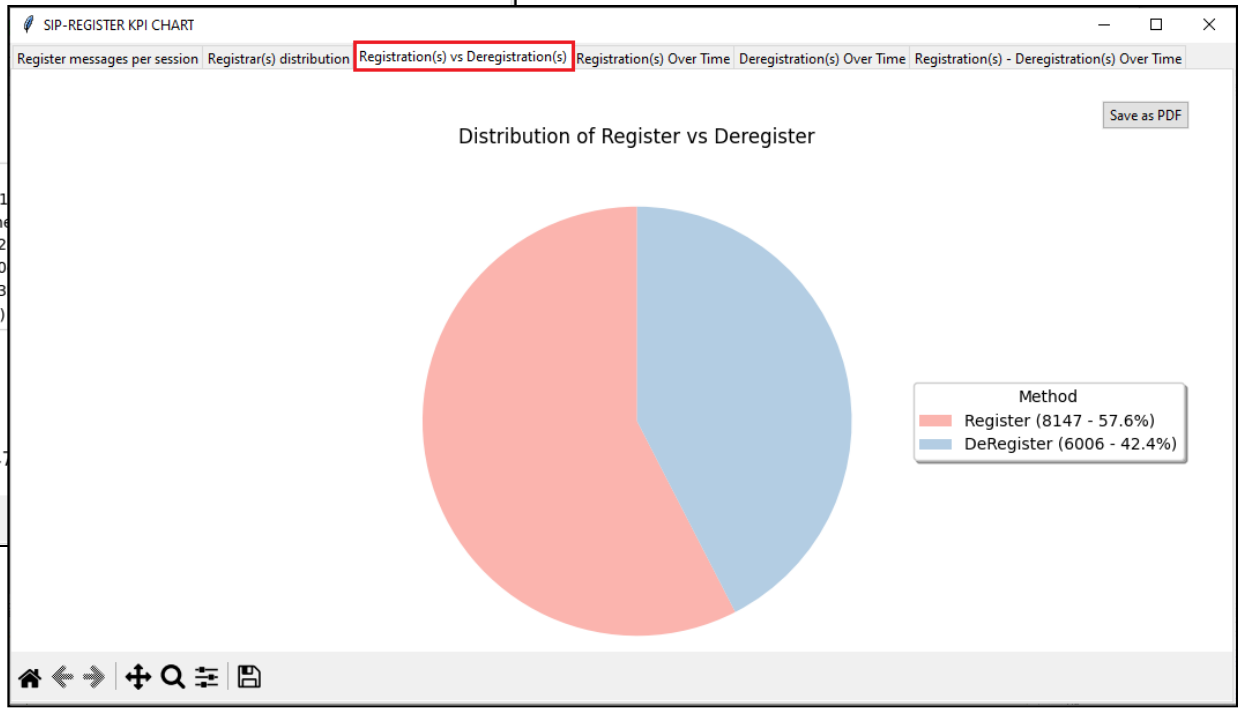
KPI Report (Registration)

- The SIP Registration Summary KPI Report includes KPIs for the following:
- **Register Messages per Session:** Shows a graph for the distribution of Register Requests
- **Registrar(s) Distribution:** Displays a graph for the number of Registration sessions per Registrar
- **Registration(s) vs Deregistration(s):** Illustrates a graph comparing the distribution of Register and Deregister counts with percentages (%)
- **Registration(s) Over Time:** Show the graphs for "Successful," "Failed," and "Total Attempts" per second
- **Deregistration(s) Over Time:** Displays a graph for "Successful" and "Total Attempts" per second
- **Registration(s) - Deregistration(s) Over Time:** Shows a graph for overall "Register & Deregister attempts," "Register & Deregister passed," and "Register & Deregister failed" attempts per second

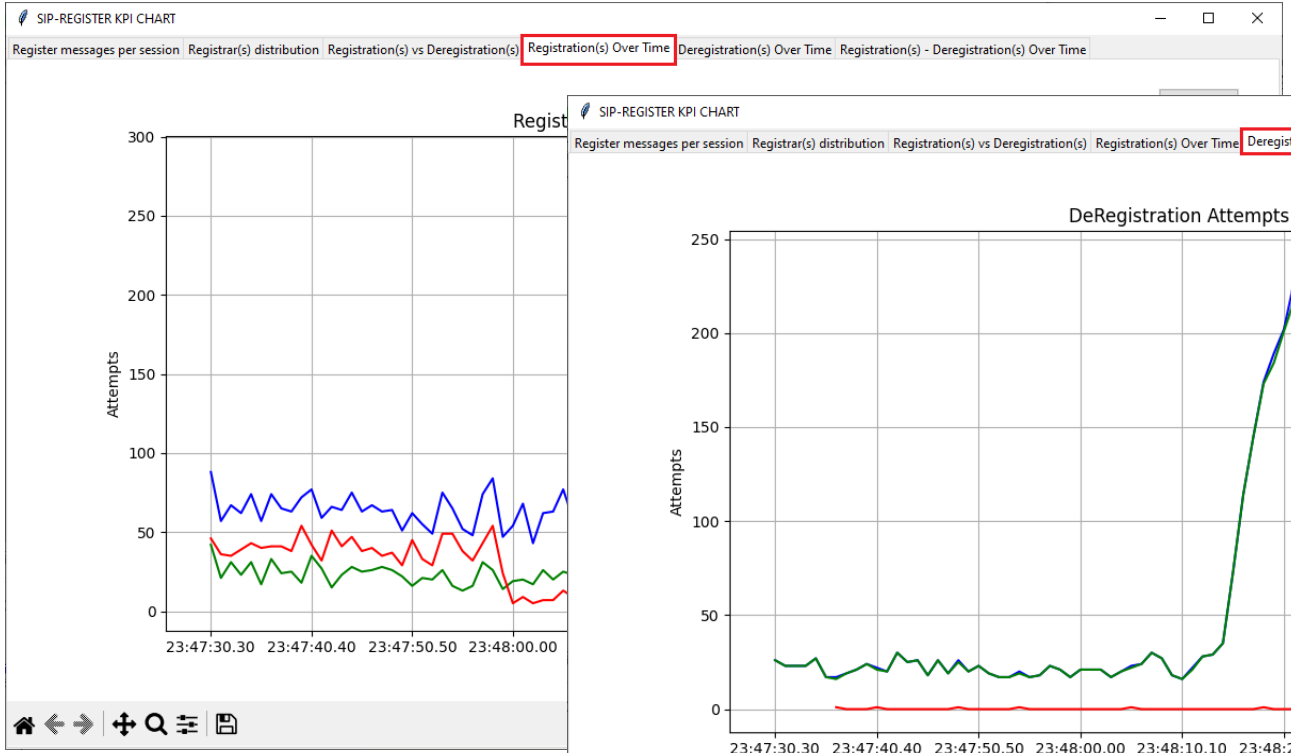


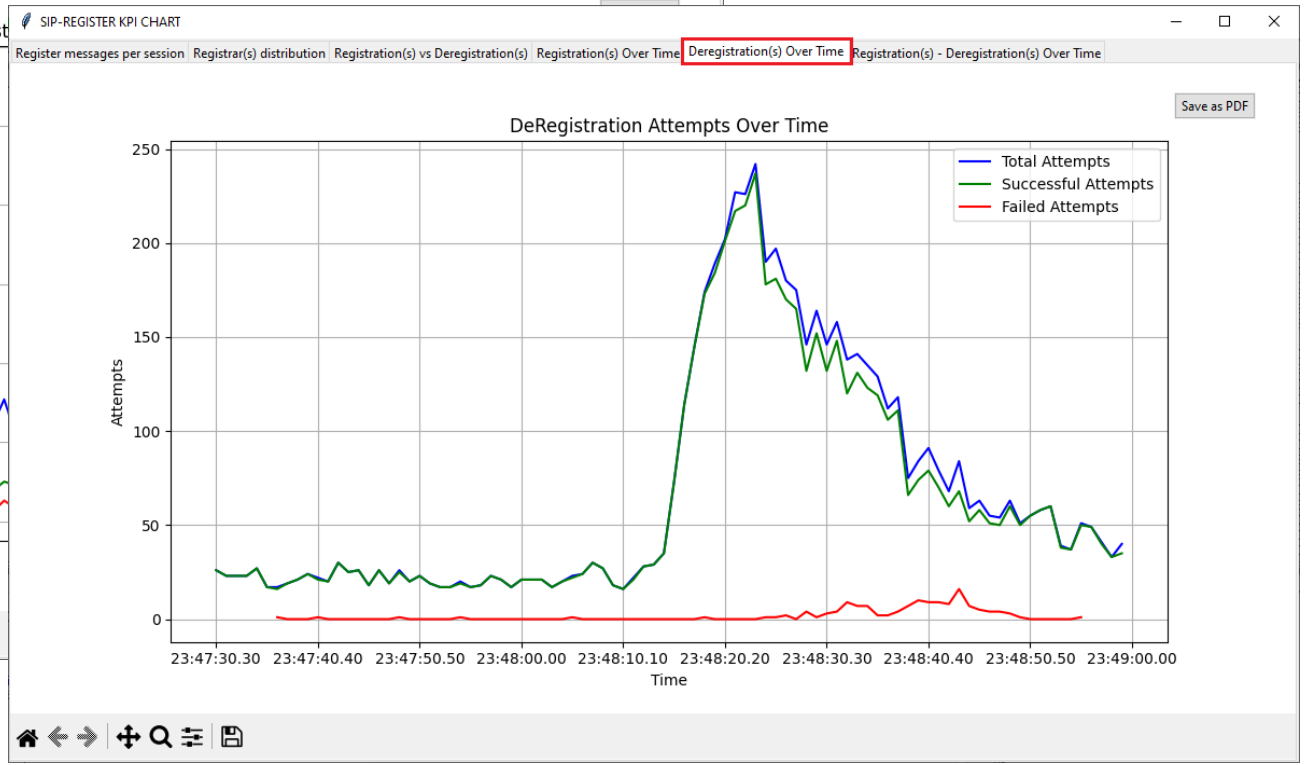
Registrar(s) Distribution, Registration vs Deregistration KPIs



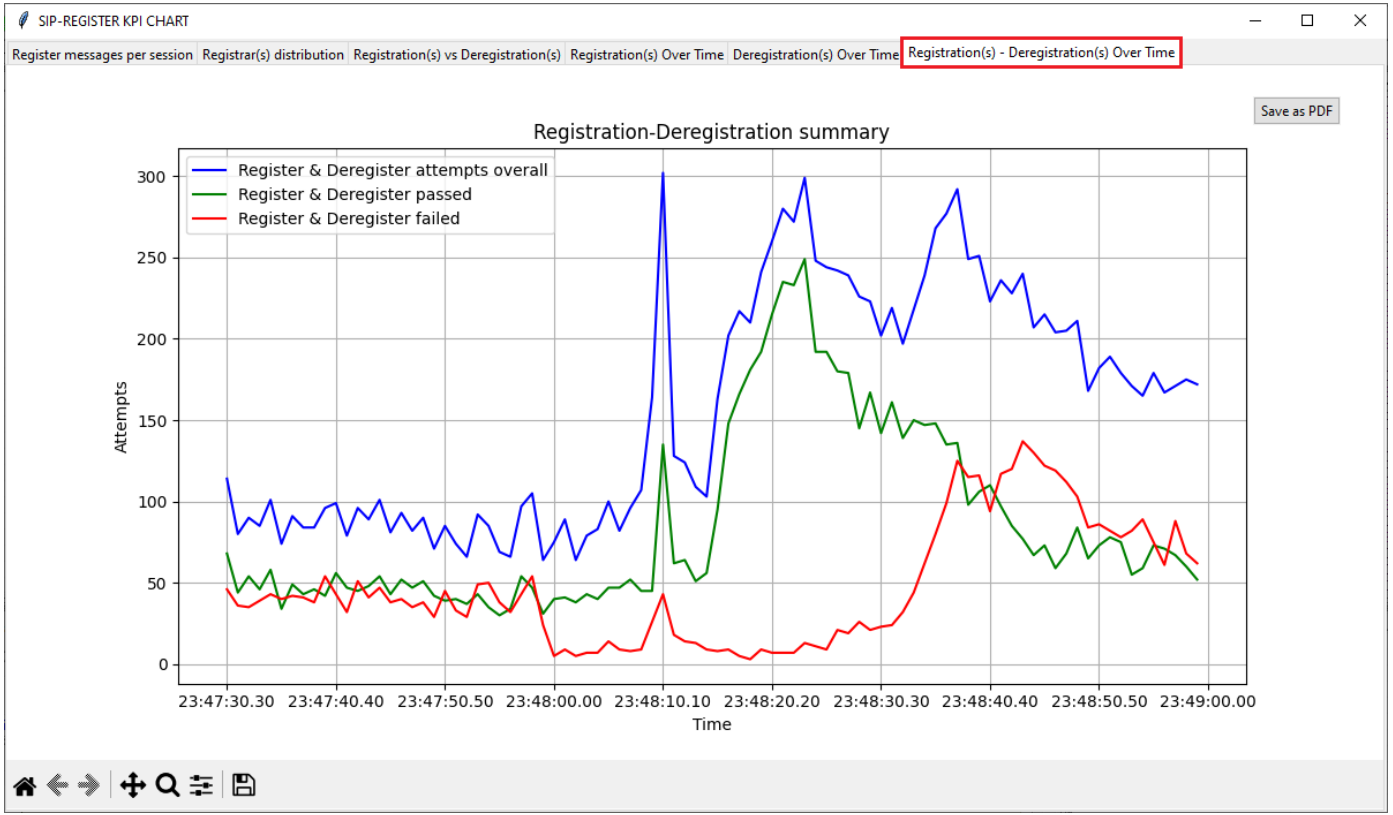


Registration(s) over Time, Deregistration over Time KPIs



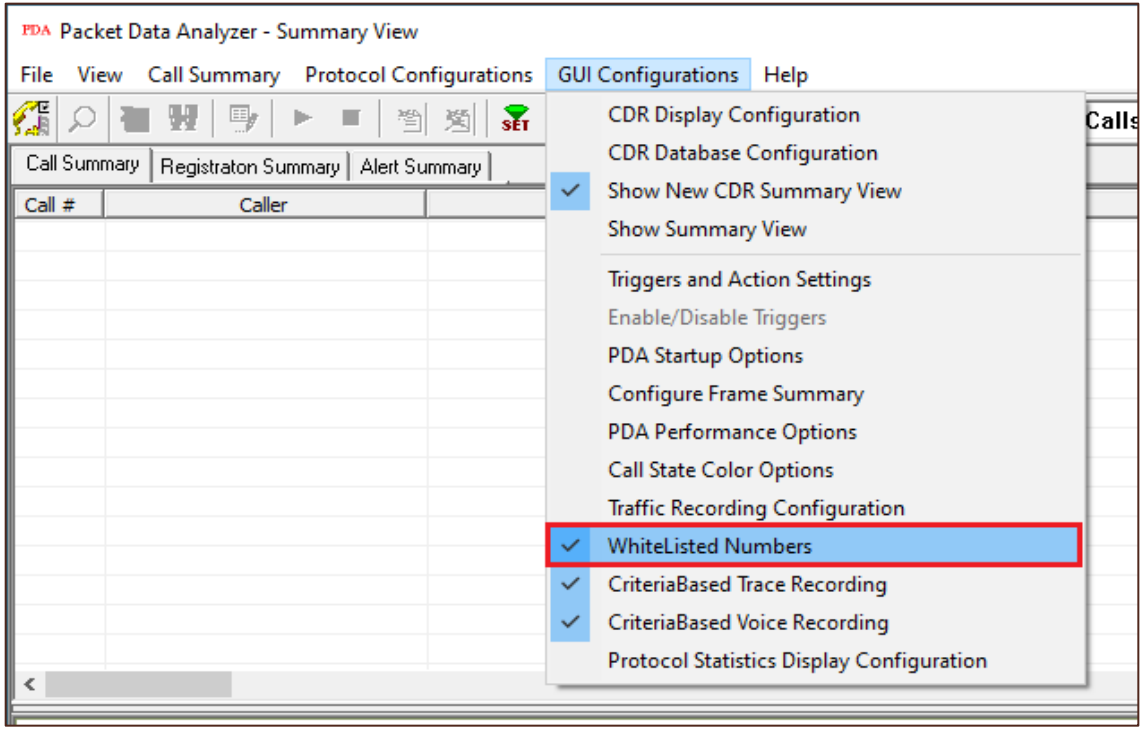


Registration(s)-Deregistration(s) over Time KPI



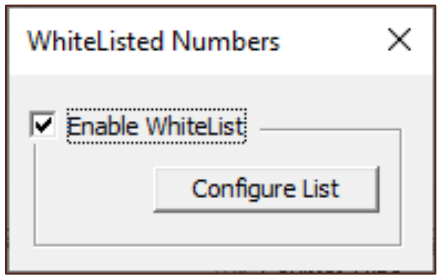
Whitelist Configuration

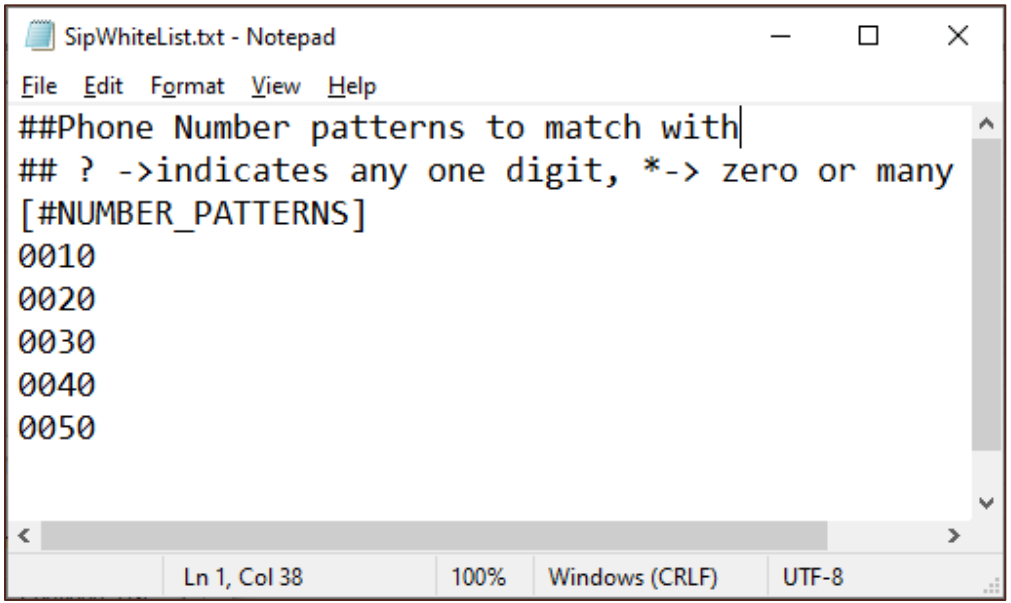
- On the **PDA** main window, click on **GUI Configurations** → **WhiteListed Numbers** to configure Whitelist number



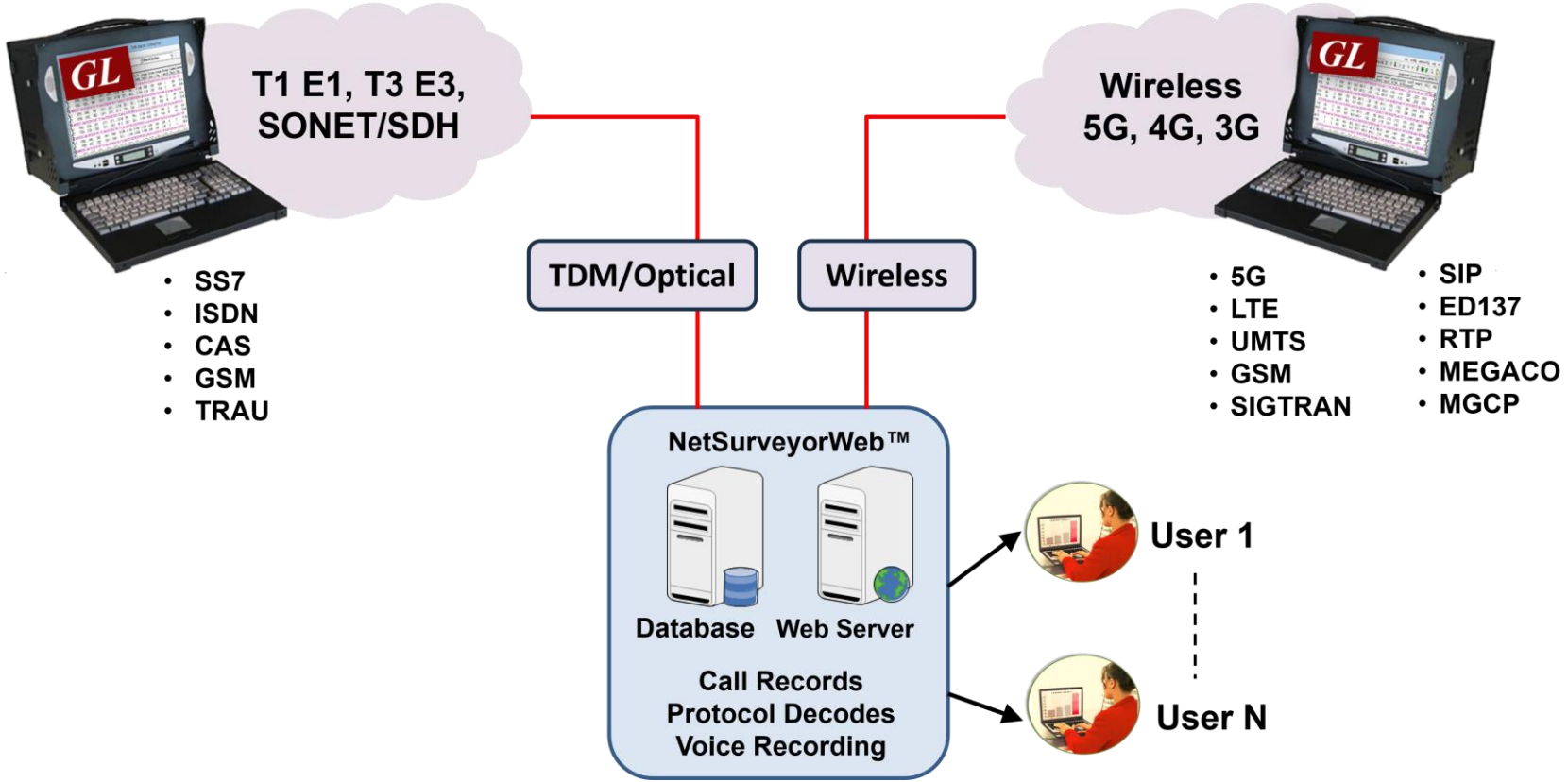
Whitelist Configuration (Contd.)

- Check the **Enable WhiteList** option and click on **Configure List**. This will invoke **SIPWhiteList.txt** in the Notepad application
- Enter the **SIP Caller** or **Callee** Number
- The following numbers should be added in the **SipWhiteList.txt** file
  - 0010
  - 0020
  - 0030
  - 0040
  - 0050
- **Save** and **Close** the file

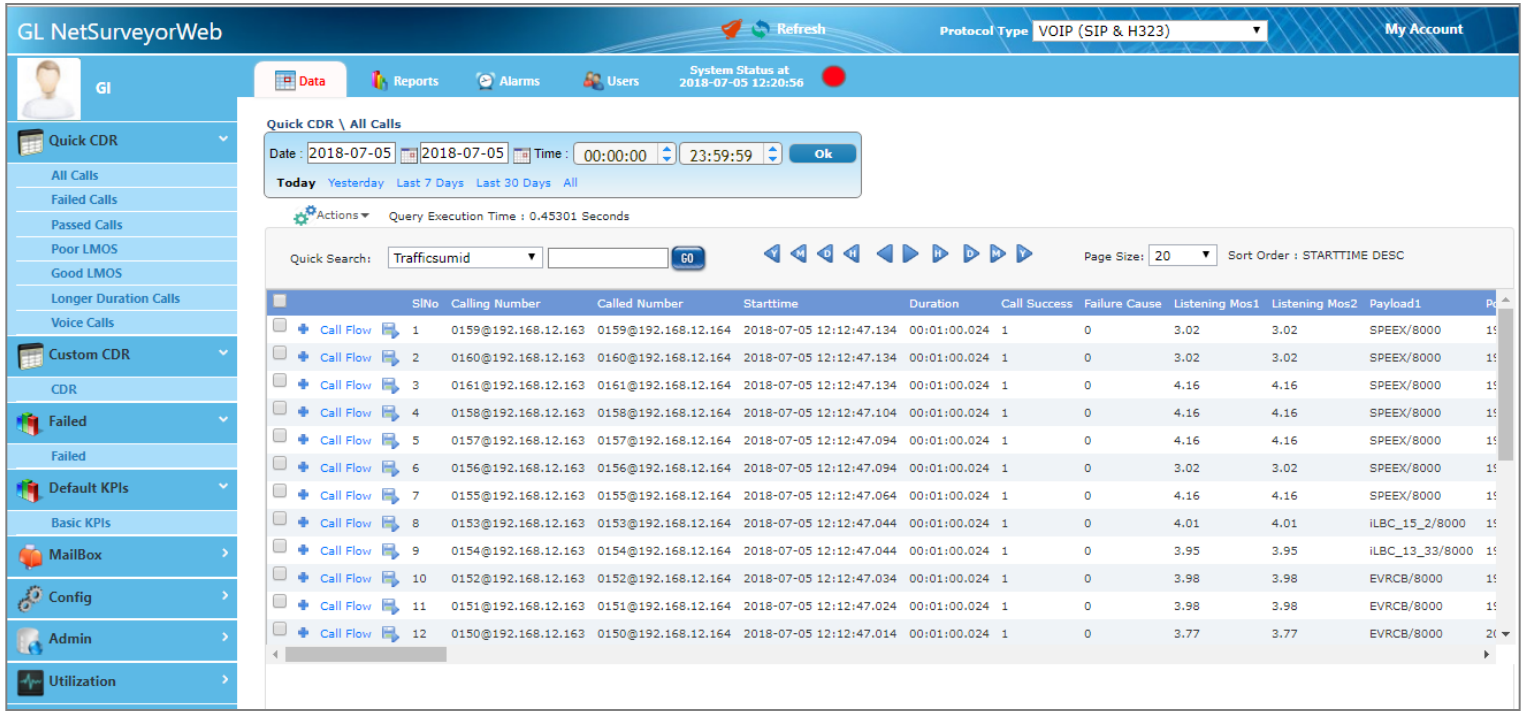




NetSurveyorWeb™ - Network Surveillance System



NetSurveyorWeb™ Main GUI



- Multiple PacketScan™ probes can be used for network monitoring, with call detail reports exported to a central data base
- Results can be accessed remotely using NetSurveyorWeb™, a simple web browser-based application

GL Communications

Thank you