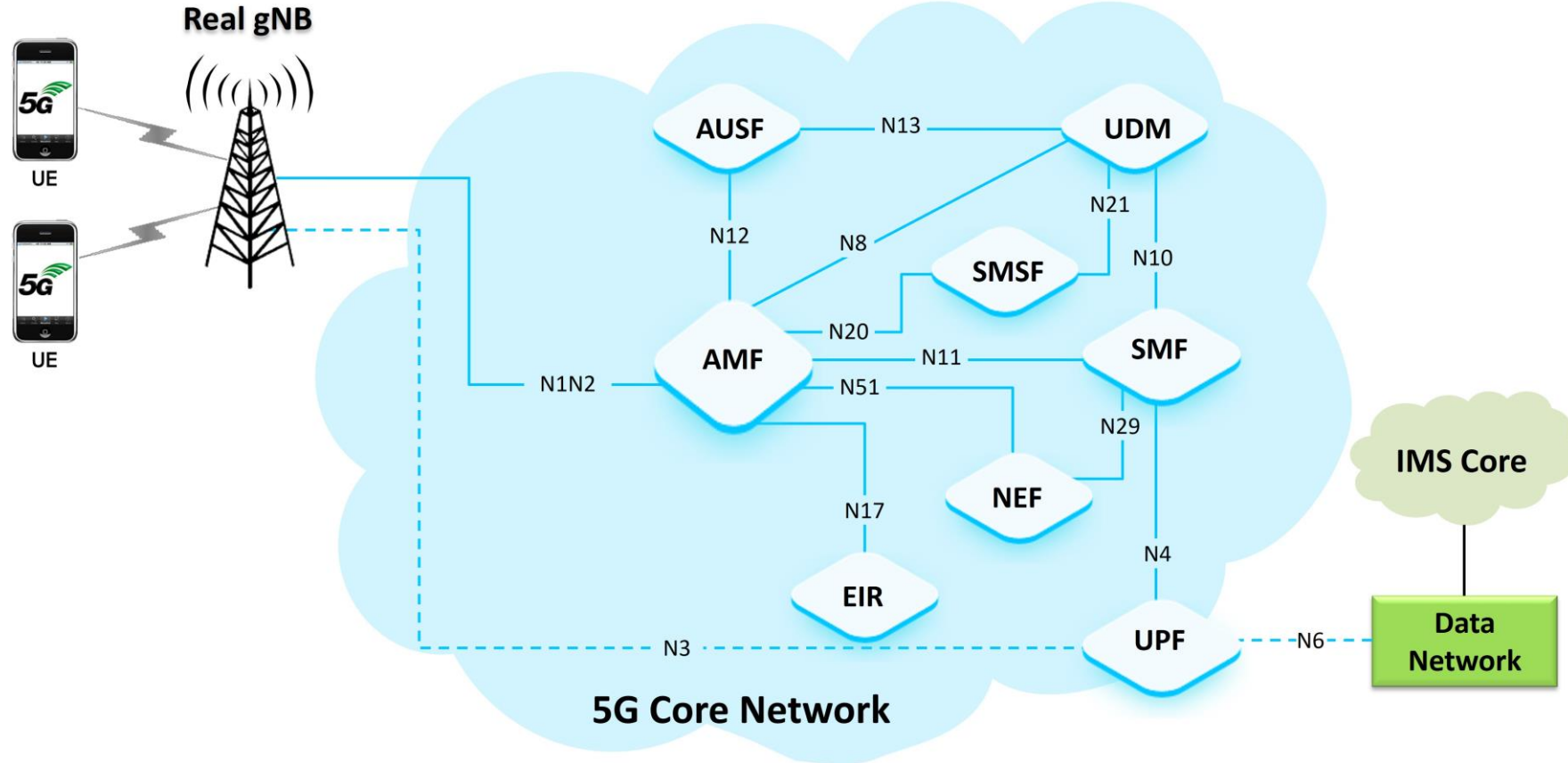

PacketScan™ 5G Protocol Analyzer



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Introduction

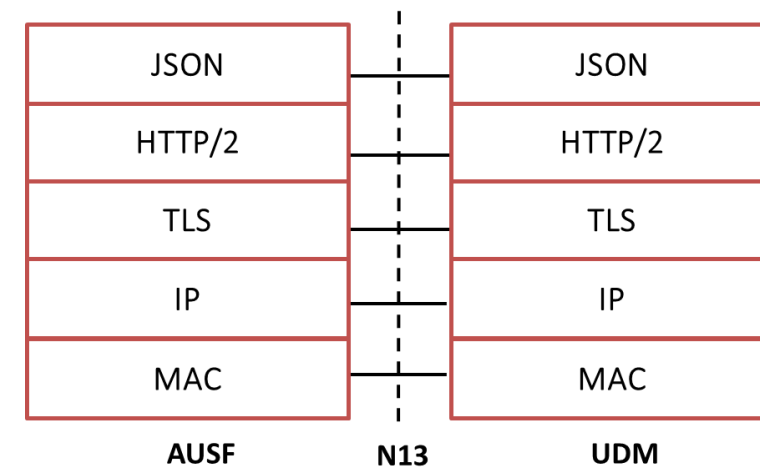
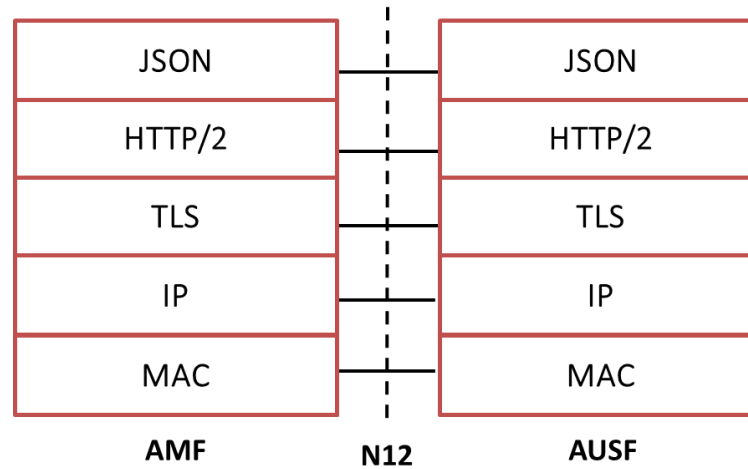
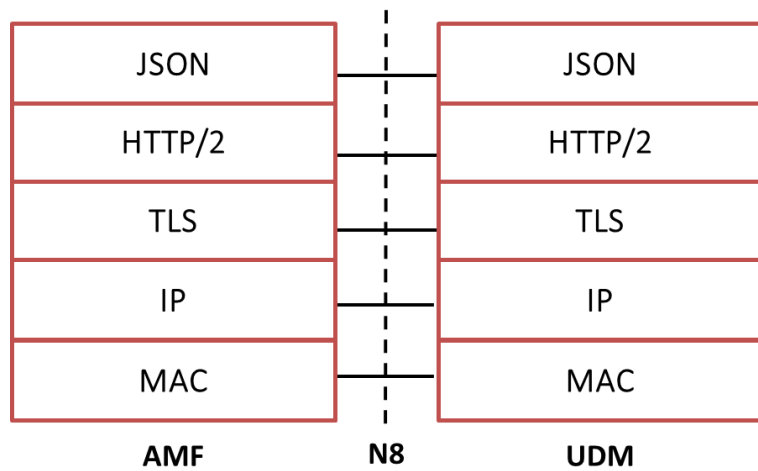
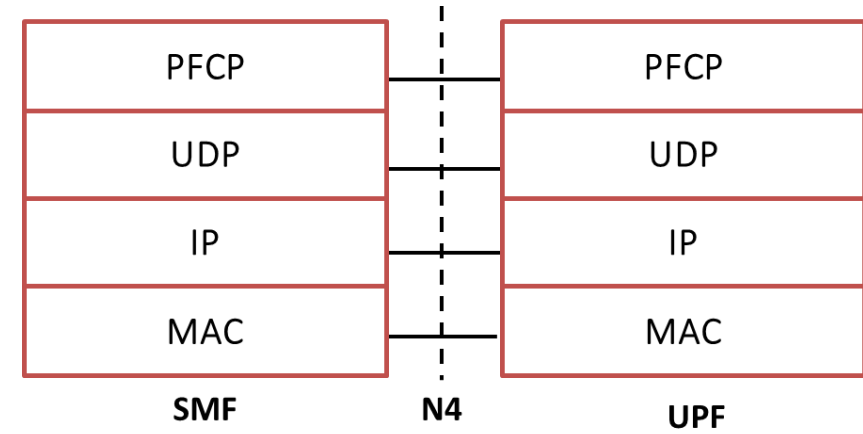
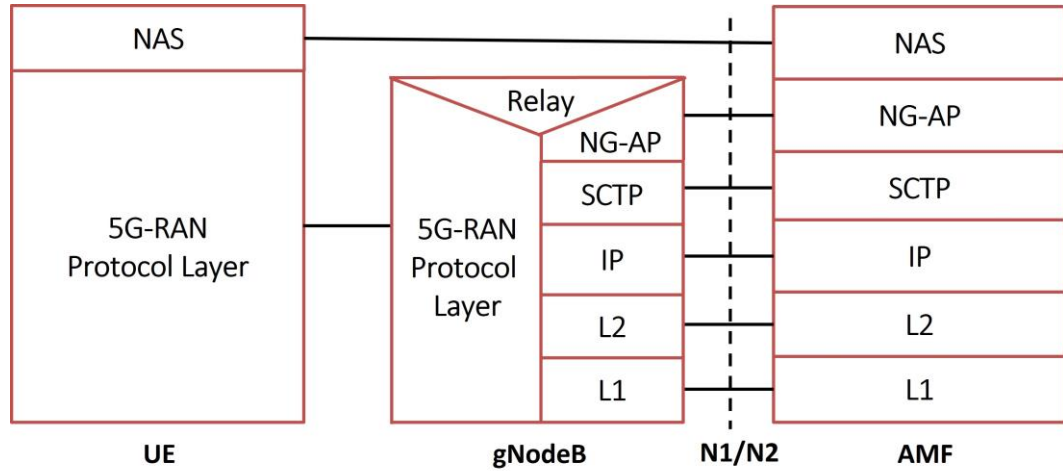


- PacketScan™ 5G protocol analyzer supports monitoring of 5G networks
- Captures, segregates, monitors and collects statistics on all calls over N1/N2, N4, N8, N12 and N13 interfaces of the 5G network

Main Features

- Capture, Decode, and Analysis of Calls in 5G Network
- Supported protocols – Non-Access Stratum (NAS), Next Generation Application Protocol (NGAP), Packet Forwarding Control Protocol (PFCP)
- Supported interfaces – N1N2, N4, N8, N12, and N13
- Provides VoNR call statistics such as caller, callee, MOS scores, discarded packets and voice storage
- Interested calls can be saved to PCAP and as well as GL's HDL format
- Packet Data Analyzer feature in Packetscan™ provide a complete call flow of a 5G session
- Displays Summary, Detail, Hex dump, Statistics, and Call Detail Views
- Statistics View displays statistics based on frame count, byte count, frames/sec, bytes/sec etc. for the entire capture data
- Provides a consolidated interface for all the important settings required in the analyzer. All the configuration settings done in any of these options can be saved to a file, loaded from a configuration file

Protocol Stack



Protocol Specifications

Supported Protocols	Standard / Specification
System Architecture for the 5G	3GPP TS 23.501
NG Application Protocol (NGAP)	3GPP TS 38.413
Non-Access-Stratum (NAS)	3GPP TS 24.501
GPRS Tunneling Protocol for User Plane (GTP-U)	3GPP TS 29.281
NR and NG-RAN Overall Description	3GPP TS 28.300
Packet Forwarding Control Protocol (PFCP)	3GPP TS 29.244
UDP	IETF RFC 768
IPv4	IETF RFC 791 [5]
IPv6	IETF RFC 2460 [6]
JavaScript Object Notation (JSON)	IETF RFC 8259
HTTP/2	IETF RFC 7231 IETF RFC 7540/RFC 7541
TLS	IETF RFC 8446
TCP	IETF RFC 793

Configuration Editor Settings

Configuration Editor of PacketScan Settings. C:\Program Files\GL Communications Inc\Pa...

- TCAP
- CNAM
- TCP and/or UDP
- SCTP
- PDA
- PDA Performance Log
- LTE
- UMTS
- IMS
- 5G
 - NgAP Protocol Version: Release 15 V.2
 - NAS-5G Protocol Version: Release 15 V.2

MISCELLANEOUS

IMSI MNC Digits Length	2
Enable/Disable LTE signalling processing:	<input checked="" type="checkbox"/>
Number of protocol decoder to be created:	1
Point Code Notation:	DOT
Number of frames to be processed per second in offline	0
Enable/Disable luPS signalling processing:	<input type="checkbox"/>
Enable/Disable GB signalling processing:	<input type="checkbox"/>
Active call timer:	360

5G Settings.

Apply Default Expand Collapse Exit

Real-time Analysis

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

The screenshot displays the PacketScan 64-bit application window. The top menu bar includes File, View, Capture, Statistics, Database, Call Detail Records, Configure, and Help. Below the menu is a toolbar with various icons for capture and analysis. The main window is divided into two panes.

The upper pane shows a table of captured frames:

Device	Frame#	TIME (Relative)	Length (Bytes)	Error	Length/Protocol Type	MAC	Packet Type	MAC	Source IP Address IPv4	Destination IP Address IPv4
✓ 0	54	00:00:04.071183000	60		ARP					
✓ 0	55	00:00:04.078905000	60		ARP					
✓ 0	56	00:00:04.530010000	217		Internet IP(IPv4)				192.168.12.10	239.255.255.250
✓ 0	57	00:00:04.530250000	217		Internet IP(IPv4)				192.168.12.11	239.255.255.250
✓ 0	58	00:00:04.679183000	158		Internet IP(IPv4)				192.168.13.101	192.168.13.106
✓ 0	59	00:00:04.756884000	60		ARP					
✓ 0	60	00:00:04.769177000	130		Internet IP(IPv4)				192.168.13.106	192.168.13.101
✓ 0	61	00:00:04.779202000	126		Internet IP(IPv4)				192.168.13.101	192.168.13.106

The lower pane shows a detailed protocol tree for the selected frame (Frame 58). The tree structure is as follows:

```

0030 Length = 112 (x0070)
0032 TSN = 448 (x000001C0)
0036 Stream Identifier = 0 (x0000)
0038 Stream Sequence Number = 448 (x01C0)
003A Payload Protocol Identifier = x0000003C NGAP
----- NGAP Layer -----
NGAP-PDU = CHOICE
  Extensibility Marker = 0
  Choice Index = 0
  InitiatingMessage = SEQUENCE
    ProcedureCode = INTEGER
    Contents = 15 id-InitialUEMessage
    procedureCriticality = ENUMERATOR
    Contents = 0 reject(0)
    Value = Open Type
    Length = 92
  InitialUEMessage = SEQUENCE
    Extensibility Marker = 0
    ProtocolIE-Container = SEQUENCE OF
      Iteration Count = 6
      ProtocolIE-Container = Instance 0
        ProtocolIE-Field = SEQUENCE
          ProtocolIE-ID = INTEGER
          Contents = 85 id-RAN-UE-NGAP-ID
          procedureCriticality = ENUMERATOR
          Contents = 0 reject(0)
          Value = Open Type
          Length = 2
          RAN-UE-NGAP-ID = INTEGER
          Length Determinant = 1
          Contents = 36
        ProtocolIE-Container = Instance 1
          ProtocolIE-Field = SEQUENCE
            ProtocolIE-ID = INTEGER
            Contents = 38 id-NAS-PDU
            procedureCriticality = ENUMERATOR
            Contents = 0 reject(0)
            Value = Open Type
            Length = 44
            NAS PDU = SEQUENCE
              NAS-PDU = OCTET STRING
  
```

The status bar at the bottom indicates a Capture Rate of 0.02 Mbps, the file path C:\Program Files\GL Communications Inc\Packe, and that 10,242 frames were captured with 0 missed frames.

Detail View of 5G NAS Layer

The detail decode view of NAS Layer displays the following:

- MAC Layer
- IPv4 Layer
- SCTP Layer
- NGAP Layer
- NAS Layer

The screenshot shows the PacketScan 64-bit interface. The top part displays a table of captured packets:

Device	Frame#	TIME (Relative)	Length (Bytes)	Error	Length/Protocol Type	Packet Type	Source IP Address IPv4	Destination IP Address IPv4
✓	0	00:00:04.071183000	60		ARP			
✓	0	00:00:04.078905000	60		ARP			
✓	0	00:00:04.530010000	217		Internet IP(IPv4)		192.168.12.10	239.255.255.250
✓	0	00:00:04.530250000	217		Internet IP(IPv4)		192.168.12.11	239.255.255.250
✓	0	00:00:04.679183000	158		Internet IP(IPv4)		192.168.13.101	192.168.13.106
✓	0	00:00:04.756884000	60		ARP			
✓	0	00:00:04.769177000	130		Internet IP(IPv4)		192.168.13.106	192.168.13.101
✓	0	00:00:04.779202000	126		Internet IP(IPv4)		192.168.13.101	192.168.13.106

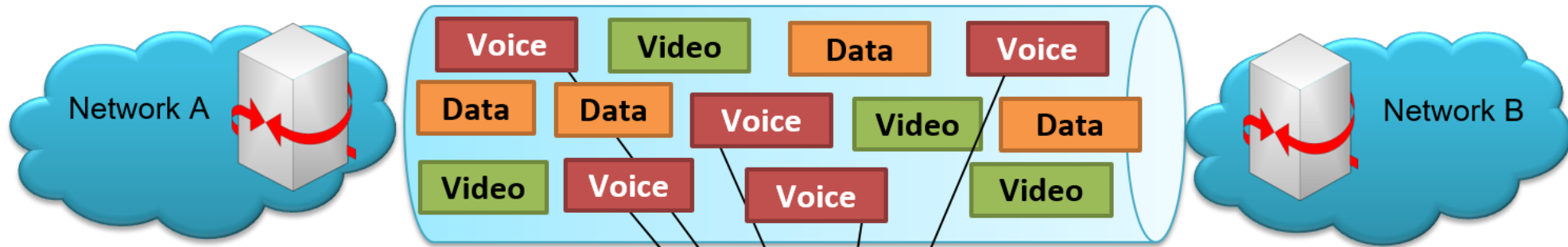
The bottom part shows the detailed decode view of the selected packet (Frame 0):

```

Contents = 0 reject(0)
Value = Open Type
Length = 1
UEContextRequest = ENUMERATOR
Extensibility Marker = 0
Contents = 0 requested(0)
===== 5G NAS Layer =====
0050 Extended Protocol Discriminator = 01111110 SGS Mobility Management Messages
0051 Security Header Type = ....0000 Plain NAS message, not security protected
0052 Message Type = 01000001 Registration Request
      5GS Registration Type and NAS Key Set Identifier =
0053 Registration Type = ....0001 Initial Registration
0053 Follow-On Request = ....0... No follow-on Request Pending
0053 NAS Key Set Identifier = .111.... (7)
0053 Type of Security Context Flag (TSC) = 0..... Native security context (for KSIAMF)
      5GS Mobile Identity =
0054 Length = 13 (x000D)
0056 Type of Identity = ....0001 SUCI
0056 SUPI Format = .000.... IMSI
0057 MCC = 001
0058 MNC = 01
005A Routing Indicator Digit = 0000
005C Protection Scheme Identifier = ....0000 Null scheme
005D Home Network Public Key Identifier = 0 (x00)
      Scheme output = 3012041631
      5GMM Capability =
0063 Information Element Id = 00010000 5GMM Capability
0064 Length = 1 (x01)
0065 S1 Mode = .....0 Not Supported
0065 HO Attach = .....0. Handover request to transfer PDU session from N1 mode to S1 mode not supported
0065 LTE Positioning Protocol (LPP) Capability = .....0... LPP in N1 mode not supported
      UE Security Capability =
0066 Information Element Id = 00101110 UE Security Capability
0067 Length = 2 (x02)
0068 SGS Encryption Algorithm 5G-EA7 = .....0 Not Supported
0068 SGS Encryption Algorithm 5G-EA6 = .....0. Not Supported
0068 SGS Encryption Algorithm 5G-EA5 = .....0... Not Supported
0068 SGS Encryption Algorithm 5G-EA4 = ....0.... Not Supported
0068 SGS Encryption Algorithm 128-5G-EA3 = ..0.... Not Supported
0068 SGS Encryption Algorithm 128-5G-EA2 = .0..... Not Supported
0068 SGS Encryption Algorithm 128-5G-EA1 = .1..... Supported
  
```

At the bottom of the interface, the status bar shows: Capture Rate: 0.02 Mbps, C:\Program Files\GL Communications Inc\Packe Captured 11 586 frames, Missed Frames: 0.

Wirespeed Filtering



Wirespeed lossless capture and filter

- Filtering can be based on the following:

- Pattern match
- Protocol information
- Frame size

Hardware Filter

Capture Filter

View Filter

- Checksum errors

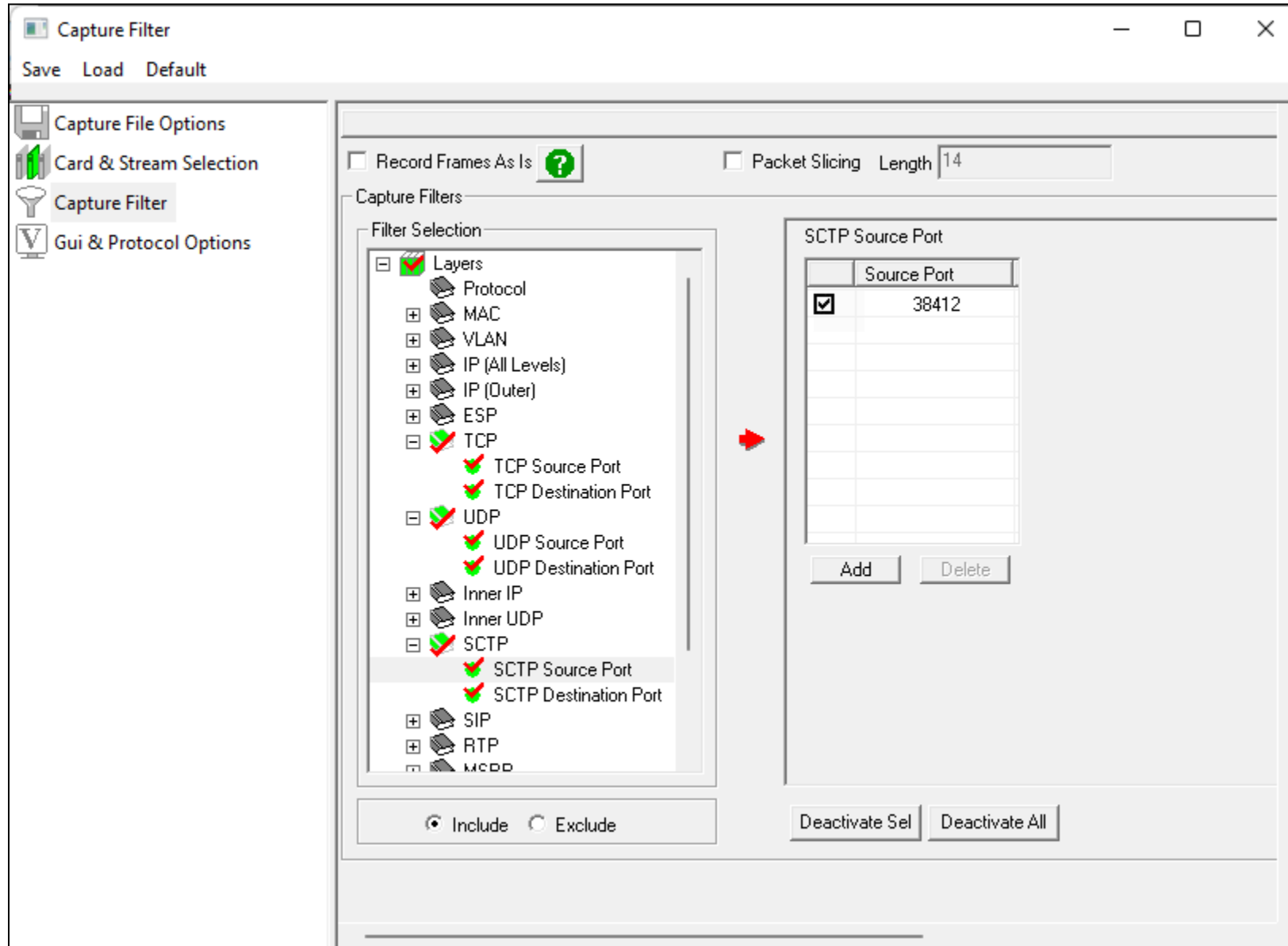
- Port number

- IP address and address ranges

Voice



Real-time Capture Filter



Packet Data Analyzer (PDA) – 5G N1N2 Call Graph

- Displays the message sequences of captured 5G calls
- Decodes of the selected N1N2 message is displayed on the right pane

PDA Packet Data Analyzer - Summary View

File View Call Summary Protocol Configurations GUI Configurations Help

5G N1N2 Interface Show All Calls

Call Summary | Registrar Summary | Alert Summary

Call #	StartTime	AmfUeNgapId	RrcEstablishmentCause	NrCellIdentity	Tac	AmfSetID	AmfRegionID	Amfpointer	Mcc	Mnc	RegistrationType	EndTime	RegistrationResult
1	2023-01-25 11:28:33.449	76	mo-Signalling	1	1	1	2	63	001	01	Initial Registration	2023-01-25 11:28:47.854	ACCEPTED
2	2023-01-25 11:28:37.052	77	mo-Signalling	1	1	1	2	63	001	01	Initial Registration	2023-01-25 11:28:47.654	ACCEPTED
3	2023-01-25 11:28:37.752	78	mo-Signalling	1	1	1	2	63	001	01	Initial Registration	2023-01-25 11:28:47.954	ACCEPTED
4	2023-01-25 11:28:41.453	81	mo-Signalling	1	1	1	2	63	001	01	Initial Registration	2023-01-25 11:28:47.854	ACCEPTED
5	2023-01-25 11:28:41.453	80	mo-Signalling	1	1	1	2	63	001	01	Initial Registration	2023-01-25 11:28:47.854	ACCEPTED
6	2023-01-25 11:28:41.453	83	mo-Signalling	1	1	1	2	63	001	01	Initial Registration	2023-01-25 11:28:47.854	ACCEPTED
7	2023-01-25 11:28:41.453	79	mo-Signalling	1	1	1	2	63	001	01	Initial Registration	2023-01-25 11:28:47.954	ACCEPTED
8	2023-01-25 11:28:41.453	82	mo-Signalling	1	1	1			001	01	Initial Registration	2023-01-25 11:28:41.553	REJECTED
9	2023-01-25 11:28:41.453	84	mo-Signalling	1	1	1			001	01	Initial Registration	2023-01-25 11:28:41.541	REJECTED
10	2023-01-25 11:28:41.453	85	mo-Signalling	1	1	1	2	63	001	01	Initial Registration	2023-01-25 11:28:47.754	ACCEPTED

Column Width Absolute Timing Show Latest

Time	Frame#	192.168.13.101	192.168.13.106
00.00.000	24	38412	38412
		InitialUEMessage - Registration Request	
00.00.088	25	38412	38412
		DownlinkNASTransport - Authentication Request	
00.00.100	26	38412	38412
		UplinkNASTransport - Authentication Response	
00.00.188	28	38412	38412
		DownlinkNASTransport - Security Mode Command	
00.00.200	30	38412	38412
		UplinkNASTransport - Security Mode Complete	
00.00.288	31	38412	38412
		InitialContextSetup - Registration Accept	
00.00.300	33	38412	38412
		InitialContextSetupRes	
00.00.300	34	38412	38412
		UplinkNASTransport - Registration Complete	
00.00.400	37	38412	38412
		UplinkNASTransport - UL NAS Transport - Session Establishment	
00.00.488	39	38412	38412
		PDUSessionResourceSetup - DL NAS Transport - Session Establishment	
00.00.500	40	38412	38412
		PDUSessionResourceSetupRes	
00.00.600	44	38412	38412
		UplinkNASTransport - UL NAS Transport - Session Establishment	
00.00.688	48	38412	38412
		PDUSessionResourceSetup - DL NAS Transport - Session Establishment	
00.00.800	53	38412	38412
		PDUSessionResourceSetupRes	
00.10.302	179	38412	38412
		UplinkNASTransport - UL NAS Transport - Session Release	
00.10.391	187	38412	38412
		PDUSessionResourceRelease - DL NAS Transport - Session Release	
00.10.401	194	38412	38412
		PDUSessionResourceReleaseRes	
00.10.401	199	38412	38412
		UplinkNASTransport - UL NAS Transport - Session Release Complete	

Find Complete Stack

```

===== NGAP Layer =====
NGAP-PDU = CHOICE
Extensibility Marker = 0
Choice Index = 0
InitiatingMessage = SEQUENCE
ProcedureCode = INTEGER
Contents = 16 id-InitialUEMessage
procedureCriticality = ENUMERATOR
Contents = 0 reject(0)
Value = Open Type
Length = 92
InitialUEMessage = SEQUENCE
Extensibility Marker = 0
ProtocolIE-Container = SEQUENCE OF
Iteration Count = 6
ProtocolIE-Container = Instance 0
ProtocolIE-Field = SEQUENCE
ProtocolIE-ID = INTEGER
Contents = 85 id-RAN-UE-NGAP-ID
procedureCriticality = ENUMERATOR
Contents = 0 reject(0)
Value = Open Type
Length = 2
RAN-UE-NGAP-ID = INTEGER
Length Determinant = 1
Contents = 79
ProtocolIE-Container = Instance 1
ProtocolIE-Field = SEQUENCE
ProtocolIE-ID = INTEGER
Contents = 38 id-NAS-PDU
procedureCriticality = ENUMERATOR
Contents = 0 reject(0)
Value = Open Type
Length = 44
NAS-PDU = SEQUENCE
NAS-PDU = OCTET STRING
Length Determinant = 43
Contents = x7E004101000D0100F110000000003214061C
ProtocolIE-Container = Instance 2
ProtocolIE-Field = SEQUENCE
ProtocolIE-ID = INTEGER
    
```

Active Calls Graph Call Graph Call Summary

Thank you