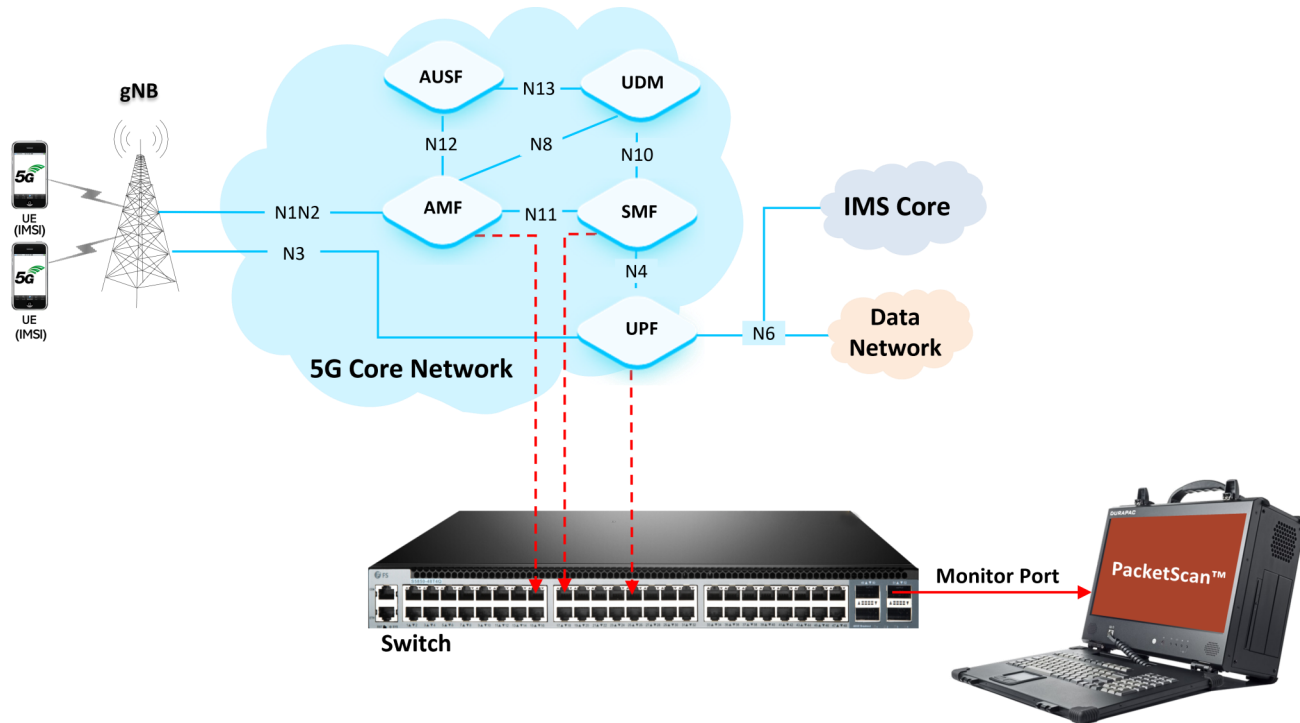


PacketScan™ 5G Protocol Analyzer



Overview

5G is a fifth generation mobile technology for cellular networks. 5G covers three main verticals namely, Enhanced Mobile Broadband (eMBB), Massive Machine Type Communications (mMTC), and Ultra Reliable Low Latency Communications (URLLC) to support a wide variety of use cases such as Smart cities, AR/VR, self-driving cars, IOT etc.

GL's [5G Protocol Analyzer](#) offers comprehensive monitoring capabilities for 5G networks. It captures, decodes, and collects statistics over the N1N2, N4, N8, N10, N11, N12, and N13 interfaces, providing valuable insights into network performance and behavior.

The 5G protocol analyzer is an optional application for [PacketScan™](#). PacketScan™ is a protocol analysis software supporting a large range of protocols and codecs. PacketScan™ is deployed on Windows® PCs and uses the host PC's network interface card to capture Ethernet / IP traffic. The PC should be connected to a network tap or a monitor port on a switch. PacketScan™ can also open packet captures offline and intelligently build call detail records, compute statistics on the calls, create graphs and ladder diagrams and more.

PacketScan™ 5G includes the [Packet Data Analysis](#) (PDA) tool allowing users to monitor live IP/TDM networks including capture, analysis, and reporting of every phone call in detail. It also provides graphical presentation of analysis, including ladder diagrams of call flows.

For more details, refer to [5G Protocol Analyzer](#) webpage.



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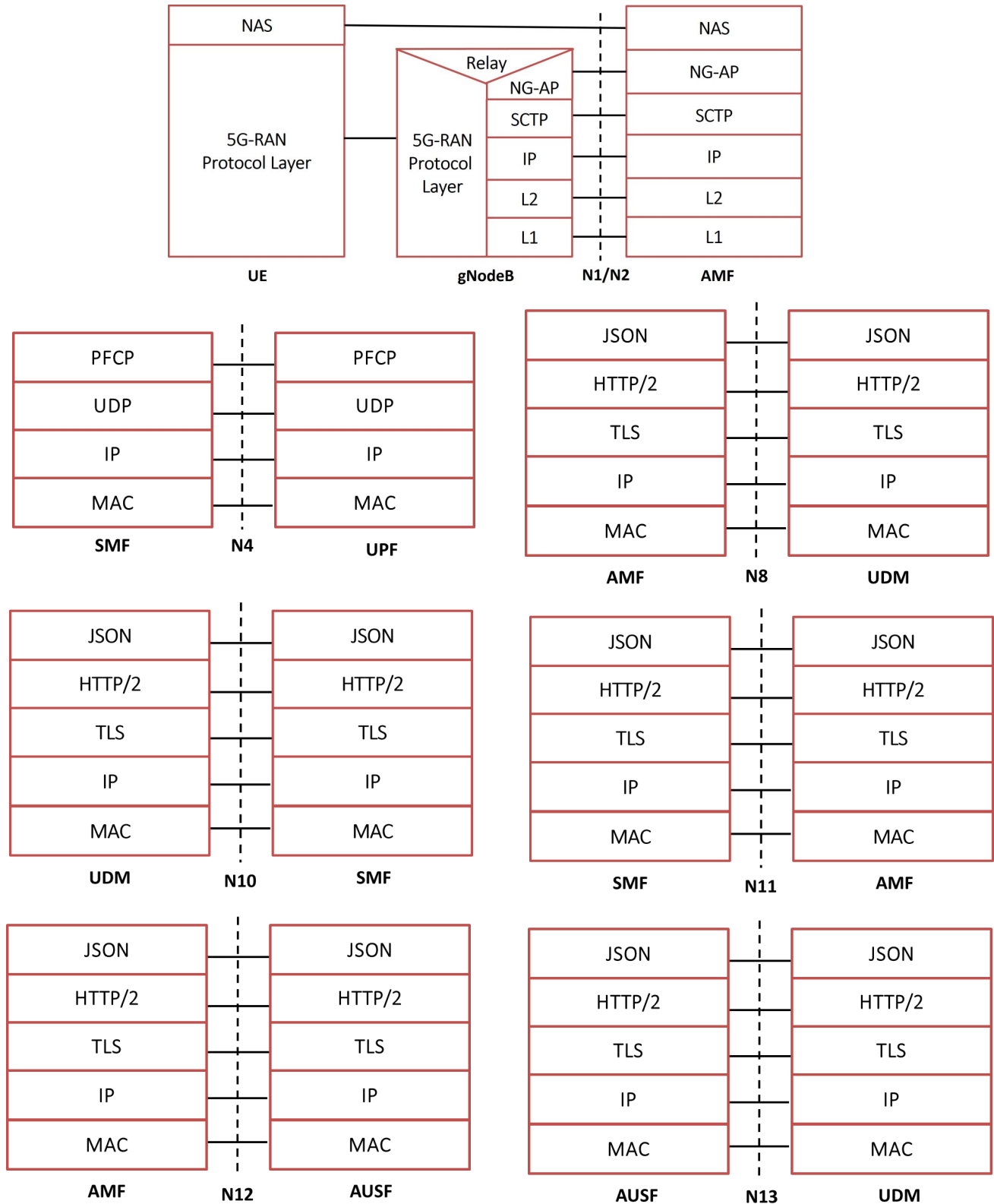
(Web) www.gl.com - (V) +1-301-670-4784 (F) +1-301-670-9187 - (E-Mail) info@gl.com

Main Features

- Capture, decode, and analyze calls in the 5G network
- Supported protocols include Non Access Stratum (NAS), Next Generation Application Protocol (NGAP), Packet Forwarding Control Protocol (PFCP), XnAP, SCTP, UDP, TCP, and IP
- Decode [Enhanced Common Public Radio Interface](#) (eCPRI) protocol
- Following interfaces are supported in PDA:
 - N1N2 Interface - gNodeB (also called Next Generation RAN), and AMF (Access and Mobility Management Function) nodes
 - N4 Interface - Session Management Function (SMF) and User Plane Function (UPF) elements
 - N8 Interface - Unified Data Management (UDM) and Access and Mobility Management Function (AMF)
 - N10 Interface - Unified Data Management (UDM) and Session Management Function (SMF)
 - N11 Interface - Mobility Management Function (AMF) and Session Management Function (SMF)
 - N12 Interface - Authentication Server Function (AUSF) and Access and Mobility Management Function (AMF)
 - N13 Interface - Authentication Server Function (AUSF) and User Data Management (UDM)
- Provides VoNR call statistics such as caller, callee, MOS scores, discarded packets and voice storage
- Save calls to PCAP (Wireshark® format) and in HDL (GL Proprietary format)
- PDA Packetscan™ provides a complete call flow of a 5G session
- Advanced filtering and search based on user selected 5G protocol fields
- Add any protocol field to the summary view, filtering, and search features. This flexibility allows users to monitor the specific protocol fields they need
- Trigger intelligent actions based on signaling and traffic conditions
- Displays Summary, Detail, Hex dump, Statistics, and Call Detail views
- Hex dump view displays the frame information in HEX and ASCII format, the contents of this view can also be copied to clipboard
- Statistics view displays statistics based on frame count, byte count, frames/sec, bytes/sec etc. for the entire capture data
- Call detail view displays UE information, released calls, call status, and more

Supported Protocol Stack

PacketScan™ supports below 5G stack.



5G Protocol Stack

Supported Protocol Standards

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

5G Protocol Specifications

Summary and Detail View of 5G NGAP Layer

Users can select any frame in **Summary View** to analyze and decode each 5G frame in the Detail View. The detail view of 5G call displays the following:

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

The screenshot displays the PacketScan 64-bit interface. 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 file operations, capture, and analysis. The main window is divided into two panes.

Summary View (Top Pane): A table listing captured frames. The columns are Device, Frame#, TIME (Relative), Length (Bytes), Error, Length/Protocol Type MAC, Packet Type MAC, Source IP Address IPv4, and Destination IP Address IPv4. The table shows six frames, all with a status of '0' and 'Internet IP(IPv4)' as the protocol type.

Device	Frame#	TIME (Relative)	Length (Bytes)	Error	Length/Protocol Type MAC	Packet Type MAC	Source IP Address IPv4	Destination IP Address IPv4
0	0	00:00:00.000000000	130		Internet IP(IPv4)		192.168.31.55	192.168.31.77
0	1	00:00:00.070066000	126		Internet IP(IPv4)		192.168.31.77	192.168.31.55
0	2	00:00:00.400049000	102		Internet IP(IPv4)		192.168.31.55	192.168.31.77
0	3	00:00:00.472182000	130		Internet IP(IPv4)		192.168.31.77	192.168.31.55
0	4	00:00:05.829074000	230		Internet IP(IPv4)		192.168.31.55	192.168.31.77
0	5	00:00:05.883006000	82		Internet IP(IPv4)		192.168.31.77	192.168.31.55

Detail View (Bottom Pane): A hierarchical tree view showing the decoded structure of the selected frame (Frame 0). The tree starts with '003A Payload Protocol Identifier' and 'Parameter Padding'. It then shows the 'NGAP Layer' structure, including 'InitiatingMessage (0)', 'ProcedureCode' (4 id-DownlinkNASTransport), 'procedureCriticality' (1 ignore(1)), 'DownlinkNASTransport', 'ProtocolIE-Container' (3 Items), and several 'ProtocolIE-Field' entries for 'id-AMF-UE-NGAP-ID' and 'id-RAN-UE-NGAP-ID'. The 'NAS PDU Dump' section shows the raw data and its interpretation as '5GS Mobility Management Messages'.

At the bottom of the interface, a status bar indicates 'Filter is active.', the file path 'C:\Program Files\GL Communications Inc\Pa...', and 'Idle ftr 23 of 113 395 frames'. The 'Missed Frames' count is 0.

Decode View of NGAP Layer

Detail View of 5G NAS Layer

PacketScan 64-bit

File View Capture Statistics Database Call Detail Records Configure Help

0 GoTo

Device	Frame#	TIME (Relative)	Length (Bytes)	Error	Length/Protocol Type MAC	Packet Type MAC	Source IP Address IPv4	Destination IP Address IPv4
✓ 0	0	00:00:00.000000000	130		Internet IP(Ipv4)		192.168.31.55	192.168.31.77
✓ 0	1	00:00:00.070066000	126		Internet IP(Ipv4)		192.168.31.77	192.168.31.55
✓ 0	2	00:00:00.400049000	102		Internet IP(Ipv4)		192.168.31.55	192.168.31.77
✓ 0	3	00:00:00.472182000	130		Internet IP(Ipv4)		192.168.31.77	192.168.31.55
✓ 0	4	00:00:05.829074000	230		Internet IP(Ipv4)		192.168.31.55	192.168.31.77
✓ 0	5	00:00:05.883006000	82		Internet IP(Ipv4)		192.168.31.77	192.168.31.55

0049 Value =

004A AMF-UE-NGAP-ID = 2

004B Item = 1

004B ProtocolIE-Field =

004B ProtocolIE-ID = 85 id-RAN-UE-NGAP-ID

004D procedureCriticality = 0 reject(0)

004F Value =

0050 RAN-UE-NGAP-ID = 2

0051 Item = 2

0051 ProtocolIE-Field =

0051 ProtocolIE-ID = 38 id-NAS-PDU

0053 procedureCriticality = 0 reject(0)

0055 Value =

0055 NAS-PDU =

0056 NAS PDU Dump = x7E0056000200002188821DE340CB350DB1EFA850501A484A20103AE3588D45F780000CBE535FE4F4B155

***** 5G NAS Layer *****

0056 Extended Protocol Discriminator = 01111110 5GS Mobility Management Messages

0057 Security Header Type =0000 Plain NAS message, not security protected

0058 Message Type = 01010110 Authentication Request

ngKSI =

0059 NAS Key Set Identifier =000 (0)

0059 Type of Security Context Flag (TSC) =0 Native security context (for KSIAMF)

ABBA =

005A Length = 2 (x02)

005B ABBA = x0000

Authentication Parameter RAND =

005D Information Element Id = 00100001 Authentication Parameter RAND

005E RAND Value = x88821DE340CB350DB1EFA850501A484A

Authentication Parameter AUTN =

006E Information Element Id = 00100000 Authentication Parameter AUTN

006F Length = 16 (x10)

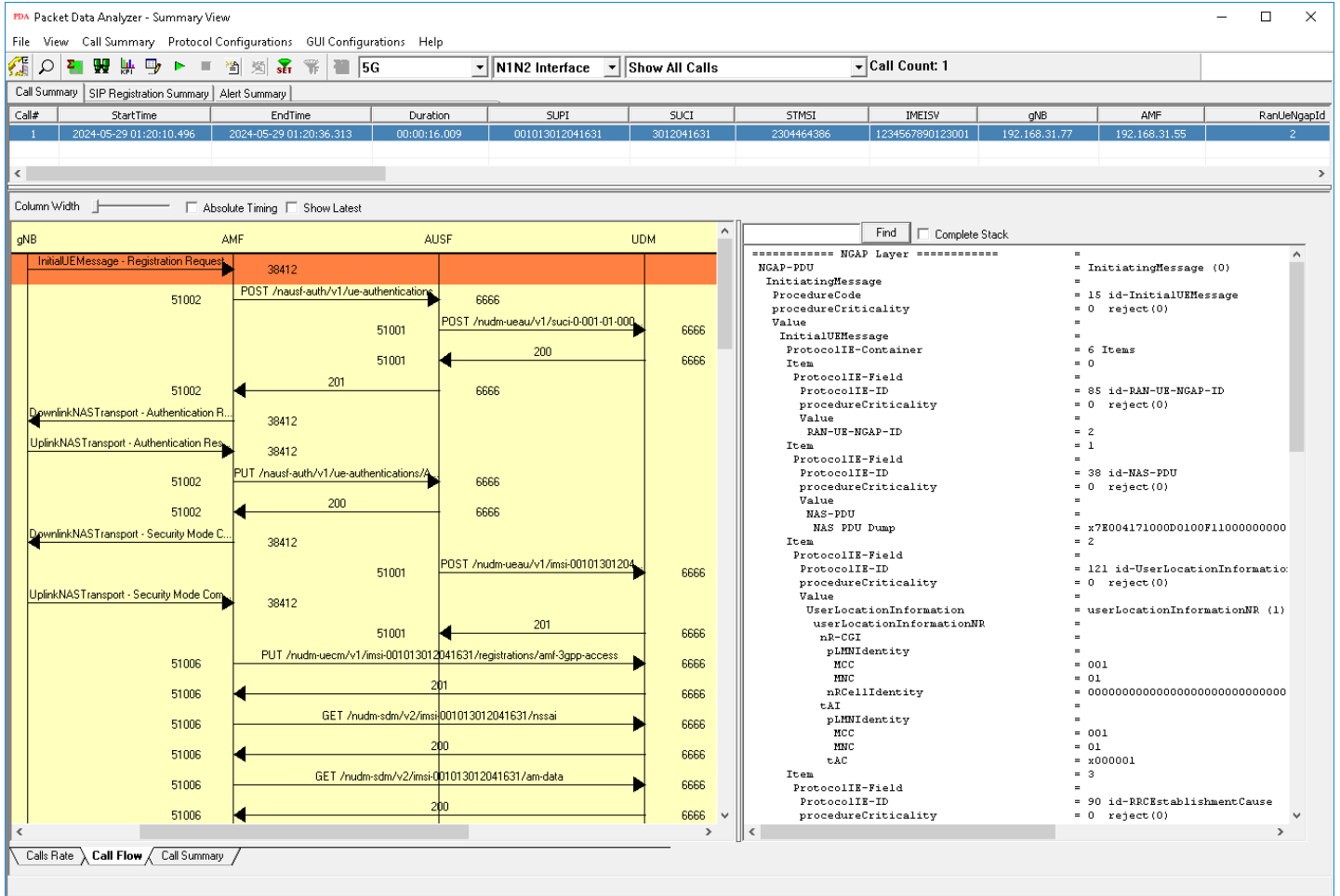
0070 AUTN Value = x3AE3588D45F780000CBE535FE4F4B155

Filter is active. C:\Program Files\GL Communications Inc\Pa Idle filtr 23 of 113 395 frames Missed Frames : 0

Decode View of 5G NAS Layer

End-to-End Call in 5G Lab Setup

Displays the message sequences of captured 5G end-to-end call. The right pane shows the decoded information of the selected N1N2 message.



5G N1N2 Call Flow

5G N4 Interface between SMF and UPF

Decodes of the selected N4 message is displayed on the right pane.

The screenshot shows the 'Packet Data Analyzer - Summary View' interface. The top menu bar includes File, View, Call Summary, Protocol Configurations, GUI Configurations, and Help. The main toolbar has icons for various functions and a dropdown menu set to '5G'. The 'Call Summary' tab is active, displaying a table of calls. The table has columns: Call#, SmfNodeId, NetworkInstance, QFI, GnbTid, GnbTunIPv4, GnbTunIPv6, UpfTid, and UpfTunIPv4. Two calls are listed: Call #1 with SmfNodeId 192.168.31.79 and UpfTid 198, and Call #2 with SmfNodeId 192.168.31.79 and UpfTid 200. Below the table, the 'Call Flow' tab is selected, showing a sequence of messages between SMF and UPF. The messages are: PFCP Session Establishment Request (SMF to UPF), PFCP Session Establishment Response (UPF to SMF), PFCP Session Modification Request (SMF to UPF), PFCP Session Modification Response (UPF to SMF), PFCP Session Deletion Request (SMF to UPF), and PFCP Session Deletion Response (UPF to SMF). The right pane displays the decoded message details for the selected PFCP Session Establishment Request, showing fields like Message Priority, Version, Message Type, Length, Session Endpoint Identifier, Sequence Number, Message Priority, Node ID, Information Element Id, Length, Node ID Type, IPv4 Address, CP F-SMID, Information Element Id, Length, and V6.

5G N4 Call Flow

5G N8 Interface between AMF and UDM

Decodes of the selected N8 message is displayed on the right pane.

The screenshot shows the 'Packet Data Analyzer - Summary View' interface. The top menu bar includes File, View, Call Summary, Protocol Configurations, GUI Configurations, and Help. The main toolbar has icons for various functions and a dropdown menu set to '5G'. The 'Call Summary' tab is active, displaying a table of calls. The table has columns: Call#, NfInstanceId, ServiceName, DNN, APIRoot, Method, OperationId, SubscriptionId, and SUPI. Three calls are listed: Call #1 with NfInstanceId f617ee4-7ee8-464a-b67c-8355e... and Method PUT, Call #2 with NfInstanceId nudm-sdm and Method GET, and Call #3 with NfInstanceId nudm-sdm and Method GET. Below the table, the 'Call Flow' tab is selected, showing a sequence of messages between AMF and UDM. The messages are: PUT /nudm-uecm/v1/imsi-001013012041631/registrations (AMF to UDM) and 201 Created (UDM to AMF). The right pane displays the decoded message details for the selected PUT message, showing fields like method, path, scheme, authority, content-type, accept, content-length, and the JSON body containing registration details.

5G N8 Call Flow

5G N10 Interface between SMF and UDM

Decodes of the selected N10 message is displayed on the right pane.

Packet Data Analyzer - Summary View

File View Call Summary Protocol Configurations GUI Configurations Help

5G N10 (smf-udm) Show All Calls Call Count: 10

Call#	NfInstanceId	SUPI	APIRoot	Method	OperationId	ServiceName	Version	StartTime	EndTime
1	f84f2235-6c02-4364-8dc1-f7dd8df...	imsi-001013012041631	http://192.168.31.53:6666	PUT	GetSmfRegistration	nudm-uecm	v1	2024-05-29 01:20:21.999	2024-05-29 01:20:22.316
2	f84f2235-6c02-4364-8dc1-f7dd8df...	imsi-001013012041631	http://192.168.31.53:6666	GET	GetSmData	nudm-sdm	v2	2024-05-29 01:20:22.352	2024-05-29 01:20:22.352
3	f84f2235-6c02-4364-8dc1-f7dd8df...	imsi-001013012041631	http://192.168.31.53:6666	POST	Subscribe	nudm-sdm	v2	2024-05-29 01:20:22.352	2024-05-29 01:20:22.352

Column Width Absolute Timing Show Latest

Time	Frame#	SMF	UDM
00.00.000	30249	51001	6666
00.00.291	30274	51001	6666

Find Complete Stack

```

:method: PUT
:path: /nudm-uecm/v1/imsi-001013012041631/registrations/smf-registrations/1
:scheme: http
:authority: 192.168.31.53:6666
:content-type: application/json
:accept: application/json, application/problem+json
:content-length: 281

=====JSON=====
{"deregCallbackUri": "http://192.168.31.79:6667/nudm-uecm/v1/imsi-001013012041631/r
"dnn": "ims"
"pduSessionId": 1
"plmnId": {"mcc": "001"
"mnc": "01"
"singleNssai": {"sd": "01"
"sst": 1}
"smfInstanceId": "f84f2235-6c02-4364-8dc1-f7dd8df1aee3"}
  
```

Calls Rate Call Flow Call Summary

5G N10 Call Flow

5G N11 Interface between AMF and SMF

Decodes of the selected N11 message is displayed on the right pane.

Packet Data Analyzer - Summary View

File View Call Summary Protocol Configurations GUI Configurations Help

5G N11 (amf-smf) Show All Calls Call Count: 8

Call#	SUPI	MCC	MNC	sNssai-sd	sNssai-sst	ServingNFID	PDUSessionID	PDUSessionType	SSC-Mo
1	imsi-001013012041631	001	01	01	1	617eea4-7ee8-464a-b67c-8355e05f4b36	1	IPv4	1
2	imsi-001013012041631				1		49	IPv4	
3	imsi-001013012041631					617eea4-7ee8-464a-b67c-8355e05f4b36		IPv4	

Column Width Absolute Timing Show Latest

Time	Frame#	AMF	SMF
00.00.000	30148	51005	6666
00.02.235	30343	51005	6666

Find Complete Stack

```

:method: POST
:path: /nsmf-pdusession/v1/smf-contexts
:scheme: http
:authority: 192.168.31.79:6666
:accept: application/json, application/vnd.3gpp.ngap, application/problem+json
:content-type: multipart/related; boundary="cac45f25820d774ff331"
:mime-version: 1.0
:content-length: 676

=====JSON=====
{"anType": "3GPP_ACCESS"
"dnn": "ims"
"gsi": "msisd-3012041631"
"n1SmMsg": {"contentId": "n1smg"}
"pduSessionId": 1
"pei": "imeisv-1234567890123001"
"ratType": "NR"
"requestType": "INITIAL_REQUEST"
"requestId": "cac45f25820d774ff331"
  
```

Calls Rate Call Flow Call Summary

5G N11 Call Flow

5G N12 Interface between AMF and AUSF

Decodes of the selected N12 message is displayed on the right pane.

Packet Data Analyzer - Summary View

File View Call Summary Protocol Configurations GUI Configurations Help

5G N12 (amf-ausf) Show All Calls Call Count: 2

Call#	SUCI	ResStar	AuthResult	Kseaf	APIRoot	Method	OperationId	AuthCtxtId
1	suci-0-001-01-0000-0-0-3012041631				http://192.168.31.78:6666	POST	ue-authentications	AuthCtxt_001013012041631
2	suci-0-001-01-0000-0-0-3012041631	DE40291D09D87886A24505CED7...	AUTHENTICATION_SUCCESS	5415B009A30D73A4148AA...	http://192.168.31.78:6666	PUT	5g-aka-confirmation	AuthCtxt_001013012041631

Column Width Absolute Timing Show Latest

Time	Frame#	AMF	AUSF
00.00.000	29384	51002	6666
00.00.963	29428	51002	6666

Find Complete Stack

```

:method: POST
:path: /nausf-auth/v1/ue-authentications
:scheme: http
:authority: 192.168.31.78:6666
:content-type: application/json
:accept: application/3gpphal+json, application/problem+json
:content-length: 106

=====JSON=====
{"servingNetworkName": "5G:mnc001.mcc001.3gppnetwork.org"
"supiOrSuci": "suci-0-001-01-0000-0-0-3012041631"}
  
```

Calls Rate Call Flow Call Summary

5G N12 Call Flow

5G N13 Interface between AUSF and UDM

Decodes of the selected N13 message is displayed on the right pane.

Packet Data Analyzer - Summary View

File View Call Summary Protocol Configurations GUI Configurations Help

5G N13 (ausf-udm) Show All Calls Call Count: 2

Call#	SUPI	AuthEventSuccess	AuthEventTimestamp	AuthEventId	APIRoot	Method	OperationId
1					http://192.168.31.53:6666	POST	GenerateAuthData
2	imsi-001013012041631	true	2024-05-29T01:20:13-05:00	authEventId-001013012041631-d...	http://192.168.31.53:6666	POST	ConfirmAuth

Column Width Absolute Timing Show Latest

Time	Frame#	AUSF	UDM
00.00.000	29418	51001	6666
00.00.186	29425	51001	6666

Find Complete Stack

```

:method: POST
:path: /nudm-ueau/v1/suci-0-001-01-0000-0-0-3012041631/security-information/generat
:scheme: http
:authority: 192.168.31.53:6666
:content-type: application/json
:accept: application/json, application/problem+json
:content-length: 113

=====JSON=====
{"ausfInstanceId": "dd8517ce-3529-4359-8693-5bbcd227a20a"
"servingNetworkName": "5G:mnc001.mcc001.3gppnetwork.org"}
  
```

Calls Rate Call Flow Call Summary

5G N13 Call Flow

Buyer's Guide

Item No	Product Description
PKV112	5G Analyzer (Optional with PacketScan™)
PKV113	Offline 5G Analyzer (Optional with Offline PacketScan™ and NetSurveyorWeb™)
PKV100	PacketScan™ (Real-time and Offline)
PKV101	PacketScan™ - Offline
PKV120	PacketScan™ HD – High Density IP Traffic Analyzer w/ 4x1GigE
PKV301	LAN Switch w/ Mirror Port
PKV104	FaxScan™ - Decodes Fax images in TIFF format from PCAP files
PCD103	AMR Codec for PacketScan™
PCD104	EVRC Codec for PacketScan™
PCD105	EVRC-B Codec for PacketScan™
PCD106	EVRC-C Codec for PacketScan™
PKV170	NetSurveyorWeb™ (Network Surveillance Software) for IP Network

Note: PCs which include GL hardware/software require Intel or AMD processors for compliance.

For more details, refer to [5G Protocol Analyzer](#) webpage.



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