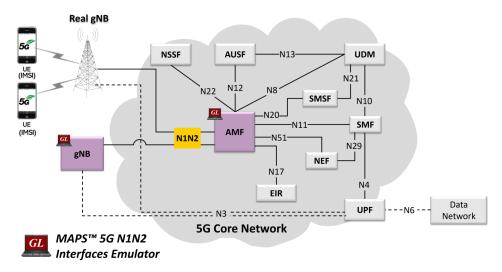
MAPS[™] 5G N1N2 (NGAP) Emulator



Overview

GL's **Message Automation & Protocol Simulation (MAPS™)** is enhanced to test 5G N1N2 interface that can emulate gNodeB (gNB), and AMF (Access and Mobility Management Function) according to 3GPP standards.

It supports Non-Access-Stratum (NAS) signaling on N1N2 interface between UE and AMF. It also supports NGAP to emulate signaling services between NG-RAN and AMF.

MAPS[™] N1N2 Interface emulator supported procedures include - NG Reset, NG Setup, Initial Context Setup, UE Context Release, Registration, De-registration, Primary authentication and key agreement procedure, Security mode control, Identification and PDU session management and SMS over NAS. The application gives the users an unlimited ability to edit NGAP/NAS message and call scenarios (message sequences).

In addition to control plane emulation the application supports generation and verification of traffic, including VoNR (Voice) calls with SIP signaling and RTP Traffic generation. It also emulates mobile traffic such as HTTP, FTP, Video by playing back real capture stateful over established TCP connection with additional licenses - Mobile Traffic Core – GTP (ETH101) and Mobile Traffic Core – Gateway (ETH102).

GL MAPS[™] is not only used for protocol validation but also for performance and capacity by emulating tens of thousands of 5G subscribers.

MAPS[™] 5G NGAP emulator supports utilities like Message Editor, Script Editor, and Profile Editor which allows new scenarios to be created or modified using 5G NGAP/N1N2 messages and parameters.

For more information, please refer to <u>MAPS[™] 5G N1N2 Interface Emulator</u> webpage.

Main Features

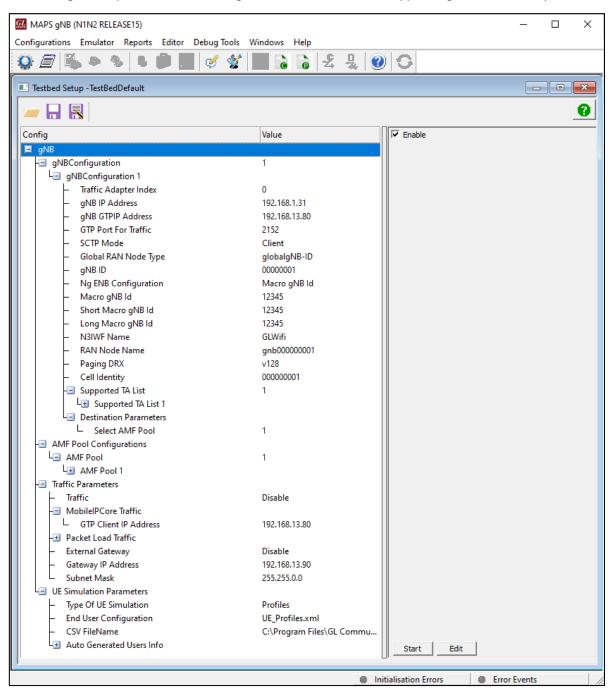
- MAPS[™] 5G N1N2 interface emulates gNodeB and AMF
- Application supports 5G Control Plane and User Plane
- Supported traffic types includes mobile data traffic such as HTTP and VoNR
- Generates and processes NGAP/NAS (valid and invalid) messages
- Includes gateway functionality to forward mobile traffic over GTP to and from external IP network
- Customization of call flow and message templates using Script and Message Editor
- Ready-to-use scripts for quick testing
- Supports scripted call generation and automated call reception
- Provides detailed Statistics and Events Status
- Emulates tens of thousands of 5G subscribers
- Automation, Remote access, and Schedulers to run tests 24/7

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Testbed Configuration

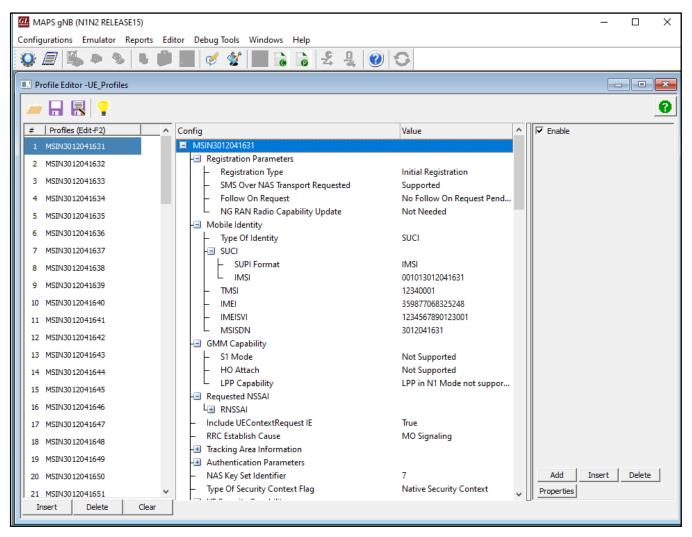
The testbed setup window allows users to setup the required test environment with SCTP configuration in N1N2 interface. SCTP configuration parameters consist of Source/Destination IP addresses, and Port numbers to configure MAPS[™] to emulate gNodeB and AMF entities in N1N2 interface. MAPS[™] can then generate and receive NGAP/NAS messages to/from valid IP address in the 5G network. End user configuration profile is used to configure MAPS[™] 5G N1N2 with supported gNodeB and AMF parameters.





Pre-processing Tools

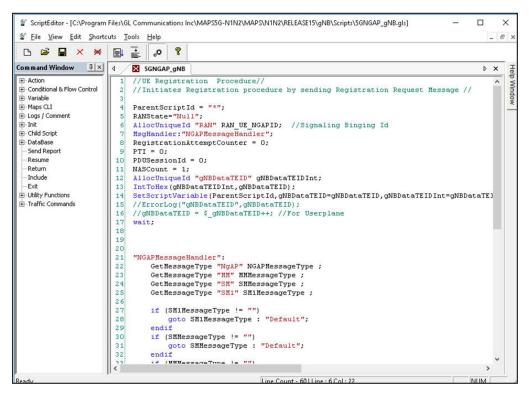
PROFILE EDITOR - This feature allows loading profile to edit the values of variables using GUI, replacing the original value of variables in the message template. An XML file defines a set of multiple profiles with varying parameter values which allows users to configure call instances in call generation to receive calls. The UE_Profiles includes 5G parameters, that is required to configure multiple UEs to emulate Signaling, Traffic, VoLTE calls. User can configure Mobile Traffic parameters, allowing emulation of offline HTTP Traffic using Mobile IP Core TCP Client Server connections.





Pre-processing Tools (Contd.)

SCRIPT EDITOR - The script editor allows user to create/edit scripts and access protocol fields as variables for the message template parameters. The script uses pre-defined message templates, to perform send and receive actions.



MESSAGE EDITOR - The message editor allows user to build a template for each protocol message type. The value for each field may be changed in the message template prior to testing. The protocol fields comprise of mandatory and optional parameters.

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- NAS	
Extended Protocol Discriminator	Registration Request = 65
Security Header Type	Registration Request = 65 Registration Accept = 66
MM Message Type	Registration Accept = 66 Registration Complete = 67
InformationElements	Registration Reject = 68
E- 5GS Registration Type and NAS Key Set Identifier	Deregistration Request (UE originating) = 69
- Registration Type	Deregistration Accept (UE originating) = 70
- Follow-On Request	Deregistration Request (UE terminated) = 71
- NAS Key Set Identifier	Deregistration Accept (UE terminated) = 72 Service Request = 76
Type of Security Context Flag (TSC)	Service Reject = 77
	Service Accept = 78
Length	Configuration Update Command = 84 Configuration Update Command = 84
====== NGAP Layer =======	
NGAP-PDU	= CHOICE
Extensibility Marker	= 0
Choice Index	= 0
ProcedureCode	= INTEGER
Contents	= 4 id-DownlinkNASTransport
procedureCriticality	= ENUMERATOR
Contents	= 0 reject(0)
Value	= Open Type
Length	= 29
Extensibility Marker	= 0
ProtocolIE-Container	= SEQUENCE OF
Iteration Count	= 3
ProtocolIE-Container	= Instance 0
ProtocolIE-ID	= INTEGER
Contents	= 10 id-AMF-UE-NGAP-ID
procedureCriticality	= ENUMERATOR
Contents	= 0 reject(0)
Value	= Open Type
Length	= 3
AMF-UE-NGAP-ID	= INTEGER

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Call Generation and Call Reception

In call generation mode, MAPS[™] is configured for the outgoing messages, while in call receive mode, it is configured to respond to the incoming messages. Tests can be configured to run once, multiple iterations and continuously. Also, allows users to create multiple entries using quick configuration feature. The editor allows to run the added scripts sequentially (order in which the scripts are added in the window) or randomly (any script from the list of added script as per the call flow requirements). The test scripts are started manually at call generation, and at the call reception, the script is automatically triggered by incoming messages.

onfigurations Emulator Reports Editor Debug Tools Windows Help	-					-
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🗀 🕂 🤮 👘 🔹						
Script Name Profile Call Info	Script Execution	Status	Events	Events Profile Result	Total Iterations	Completed Iterati
5GNGAP_UESessionControl.gls MSIN3012041631 TMSI ,0xA41C29A0,IMSI ,00101301204163		UE CONTEXT RELEASED	None	Pass	10	10
5GNGAP_UESessionControl.gls	Start		None	Unknow		0
5GNGAP_UESessionControl.gls 5GNGAP_UESessionControl.gls	Start Start		None None	Unknow Unknow		0
5GNGAP_DESessionControl.gls	Start		None	Unknow		0
5GNGAP_UESessionControl.gls	Start		None	Unknow		0
5GNGAP_UESessionControl.gls	Start		None	Unknow	n 10	0
dd Delete Insert Refresh Start Start All Stop 🔽 Stop All 🔽 Abort Ab	port All					
Save Column Width — T Show Latest						
		F	ind			
gNB 0 InitialUEMessage, Registration Request	AMF 0	NGAP				
initialuzmessage, negistration nequest	17:24:18.013000	NGAP-PDU	-1	= CH0 = 0	DICE	
DownlinkNAST ransport, Authentication Request	47.0440.007000	Extensibility Ma Choice Index	rxer	= 0		
	17:24:18.087000	InitiatingMessa	ge		UENCE	
UplinkNASTransport, Authentication Response	17:24:18.091000	ProcedureCode		= IN1	TEGER id-InitialUEM	
DownlinkNASTransport, Security Mode Command		procedureCriti	cality		MERATOR	lessage
b owniniki wa nansport, security was command	17:24:18.148000	Contents			ignore(1)	_
UplinkNASTransport, Security Mode Complete	17:24:18.152000	Value Length		= Ope = 153	en Type	
	17:24.16.132000	InitialUEMessa	ge		UENCE	
InitialContextSetupRequest, Registration Accept	17:24:18.228000	Extensibility 1		= 0		
InitialContextSetupResponse		ProtocolIE-Con Iteration Count		= SE(= 7	QUENCE OF	
	17:24:18.230000	ProtocolIE-Com	ntainer		stance 0	
UplinkNASTransport, Registration Complete	17:24:18.231000	ProtocolIE-F		= SE(= IN1	UENCE	
Unit-INACT	17.24.10.231000	ProtocolIE-	ID		Id-RAN-UE-NGA	AP-ID
UplinkNASTransport, UL NAS Transport, Session Establishment Request	17:24:18.270000	procedureCr	iticality	= ENU	MERATOR	
PDUSessionResourceSetupRequest, DL NAS Transport, Session Establishment Accept		Contents			reject(0)	
	17:24:18.347000	Value Length		= Ope = 3	en Type	
PDUSessionResourceSetupResponse	17:24:18.355000	RAN-UE-NGAP		= IN1	TEGER	
UplinkNASTransport, UL NAS Transport, Session Establishment Request		Length Dete: Contents	rminant	= 2 = 100	10	
opinikinelo manspuri, oli nelo manspuri, oessiun Establishment Hequest	17:24:18.369000	ProtocolIE-Co	ntainer		stance 1	
PDUSessionResourceSetupRequest, DL NAS Transport, Session Establishment Accept	17.04.10 447000	ProtocolIE-F	ield	= SEC	UENCE	
•	17:24:18.447000	ProtocolIE-	ID	= IN1	TEGER id-NAS-PDU	
PDUSessionResourceSetupResponse	17:24:18.455000	procedureCr:	iticality		IG-NAS-PDU MERATOR	
UplinkNASTransport, UL NAS Transport, Session Release Request		Contents		= 0	reject(0)	
opinistiko manspor, oz neko manspor, ocstor marease neguest	17:24:43.184000	Value Length		= Ope = 93	en Type	
PDUSessionResourceReleaseCommand, DL NAS Transport, Session Release Command	17:24:43.245000	NAS-PDU			TET STRING	
	17.24.43.240000	NAS-PDU			010000000597	7E004101000BF
PDUSessionResourceReleaseResponse	17:24:43.246000	ProtocolIE-Com ProtocolIE-F			stance 2 QUENCE	
UplinkNASTransport, UL NAS Transport, Session Release Complete		ProtocolIE-		= 550 = IN1		
	17:24:43.246000	Contents			l id-UserLocat	cionInformati
UplinkNASTransport, UL NAS Transport, Session Release Request	17:24:43.247000	procedureCr: Contents	iticality		MERATOR reject(0)	
	¥ 17.24.43.247000	<				>
Cripts & Message Sequence / Event Config & Script Flow /	L					

Figure: Call Reception



Call Generation and Call Reception (Contd.)

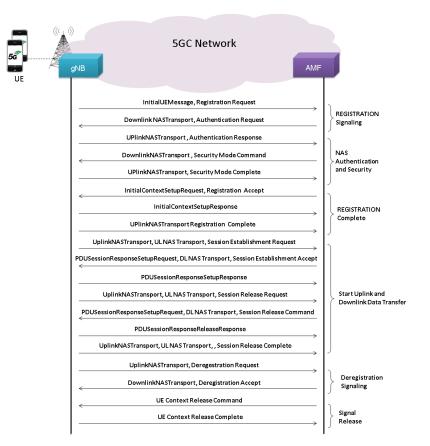
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Script Name Profile Call Info Script Execution	Status	Events	Events Profile Results	
AMFSessionControl.gls TMSI,0xA41C299E Completed	UE-CONTEXT RELEASED	None	Pass	
AMFSessionControl.gls TMSI,0xA41C299F Completed	UE-CONTEXT RELEASED	None None	Pass Pass	
AMFSessionControl.gls TMSI,0xA41C29A0 Completed	UE-CONTEXT RELEASED		Pass	
Stop All Abort Abort All Show Records Select Active Call	Auto Trash Trash Sho	w Hidden Calls		
e Column Width — Show Latest		0		
0	AMF		Find == NGAP Layer ==================	-
InitialUEMessage, Registration Request	17:24:18.05600	0 NGAP-PDU		= CHOICE
DownlinkNASTransport, Authentication Request		Chains Tay	lity Marker dex	= 0 = 0
	17:24:18.06700		dex ngMessage	= 0 = SEQUENCE
UplinkNASTransport, Authentication Response	17.04.10.10000	Procedu:	reCode	= INTEGER
	17:24:18.13000	Concento:		= 15 id-InitialUEMessage
DownlinkNASTransport, Security Mode Command	17:24:18.13300		reCriticality	= ENUMERATOR = 1 ignore(1)
 UplinkNASTransport, Security Mode Complete 		Value	-	= Open Type
Uplinkings Fransport, Security Mode Complete	17:24:18.19000			= 153
InitialContextSetupRequest, Registration Accept			UEMessage bility Marker	= SEQUENCE = 0
	17:24:18.19500		ollE-Container	= 0 = SEQUENCE OF
InitialContextSetupResponse	17:24:18.27100	Iterat:	ion Count	= 7
	17.24.10.27100	Protoco	olIE-Container	= Instance 0
UplinkNASTransport, Registration Complete	17:24:18.27300		colIE-Field ocolIE-ID	= SEQUENCE = INTEGER
Hefel MACT	-	Conte		= 85 id-RAN-UE-NGAP-ID
UplinkNASTransport, UL NAS Transport, Session Establishment Reques	17:24:18.31200		edureCriticality	= ENUMERATOR
PDUSessionResourceSetupRequest, DL NAS Transport, Session Establishment	táccent	Conte	ents	= 0 reject(0)
	17:24:18.32100	0 Value Lengt		= Open Type = 3
PDUSessionResourceSetupResponse	17:04:10 41100		UE-NGAP-ID	= INTEGER
	17:24:18.41100	Lengt	th Determinant	= 2
UplinkNASTransport, UL NAS Transport, Session Establishment Reques	t 17:24:18.41400	Conte		= 10010
PDUSessionResourceSetupRequest, DL NAS Transport, Session Establishment	-	PIOLOCI	olIE-Container colIE-Field	= Instance 1 = SEQUENCE
PD05essionHesourceSetupHequest, DL NAS Transport, Session Establishmen	17:24:18.42300		ocolIE-ID	= INTEGER
PDUSessionResourceSetupResponse		Conte		= 38 id-NAS-PDU
	17:24:18.49000		edureCriticality	= ENUMERATOR
UplinkNASTransport, UL NAS Transport, Session Release Request	17.01.40.00700	Conte Value		= 0 reject(0) = Open Type
	17:24:43.22700	Lengt		= 93
PDUSessionResourceReleaseCommand, DL NAS Transport, Session Release C	Command 17:24:43.22800	NAS-1	PDU	= OCTET STRING
		NAS-1		= x7E0161E21CEC597E004101000BF200
PDUSessionResourceReleaseResponse	17:24:43.28800		olIE-Container colIE-Field	= Instance 2 = SEQUENCE
UplinkNASTransport, UL NAS Transport, Session Release Complete		Prote	ocolIE-ID	= INTEGER
opinite inditional of the opinite of the opinite of the opinite of the opinite	17:24:43.28800			= 121 id-UserLocationInformation
UplinkNASTransport, UL NAS Transport, Session Release Request			edureCriticality	= ENUMERATOR
	17:24:43.28900	U Conte Value		= 0 reject(0) = Open Type
PDUSessionResourceReleaseCommand, DL NAS Transport, Session Release C	Command 17:24:43.28900			= 15
	11.24.45.20000	User	LocationInformation	= CHOICE
PDUSessionResourceReleaseResponse	17:24:43.34700		ce Index rLocationInformationNR	= 1 = SEOUENCE
UplinkNASTransport, UL NAS Transport, Session Release Complete		use: Exte	ensibility Marker	= SEQUENCE = 0
- operative to manopole, or taken manopole, obsolom holidase complete	17:24:43.34700	0 Pres	amble	= 00
UplinkNASTransport, Deregistration Request	.	v nR·	-CGI	= SEQUENCE
		> <		>

Figure: Call Reception

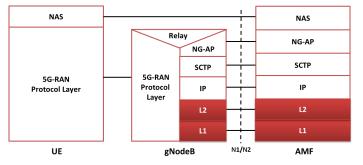


Emulation of 5G N1N2 Signaling Procedure

The below 5G N1N2 signaling procedure indicates the messages flow between gNodeB (gNB) and AMF, which are emulated using MAPS[™] application.



Supported Protocols and Specifications



Supported Protocols	Standard / Specification
N1N2 Interface (gNB - AMF)	TS24.501
System Architecture for the 5G	3GPP TS 23.501
Non-Access-Stratum (NAS)	3GPP TS 24.501
NG Application Protocol (NGAP)	3GPP TS 38.413
SCTP	RFC 4960
GPRS Tunneling Protocol for User Plane (GTP-U)	3GPP TS 29.281



Buyer's Guide

Item No	Product Description
<u>PKS500</u>	MAPS [™] 5G N1N2 Interface Emulator
ETH101	Mobile Traffic Core - GTP
<u>ETH102</u>	Mobile Traffic Core - Gateway
Item No	Related Software
<u>PKS305</u>	MAPS [™] 5G Multi-Interface Emulation
<u>PKS501</u>	MAPS [™] 5G N4 Interface Emulator
<u>PKS502</u>	MAPS™ 5G N17 Interface Emulator
<u>PKS503</u>	MAPS™ 5G N8 Interface Emulator (Requires PKS502)
<u>PKS504</u>	MAPS™ 5G N10 Interface Emulator (Requires PKS502)
<u>PKS505</u>	MAPS™ 5G N11 Interface Emulator (Requires PKS502)
<u>PKS506</u>	MAPS™ 5G N12 Interface Emulator (Requires PKS502)
<u>PKS507</u>	MAPS™ 5G N13 Interface Emulator (Requires PKS502)
<u>PKS508</u>	MAPS™ 5G N20 Interface Emulator (Requires PKS502)
<u>PKS509</u>	MAPS™ 5G N21 Interface Emulator (Requires PKS502)
<u>PKS510</u>	MAPS™ 5G N22 Interface Emulator (Requires PKS502)
<u>PKS511</u>	MAPS™ 5G N29 and N51 Interface Emulator (Requires PKS502)

For complete list of MAPS[™] products, please refer to <u>Message Automation & Protocol Simulation (MAPS[™])</u> webpage.

For more details on supported MAPS[™] 5G interfaces, refer to <u>5G Core (5GC) Network Test Solution</u> webpage.



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