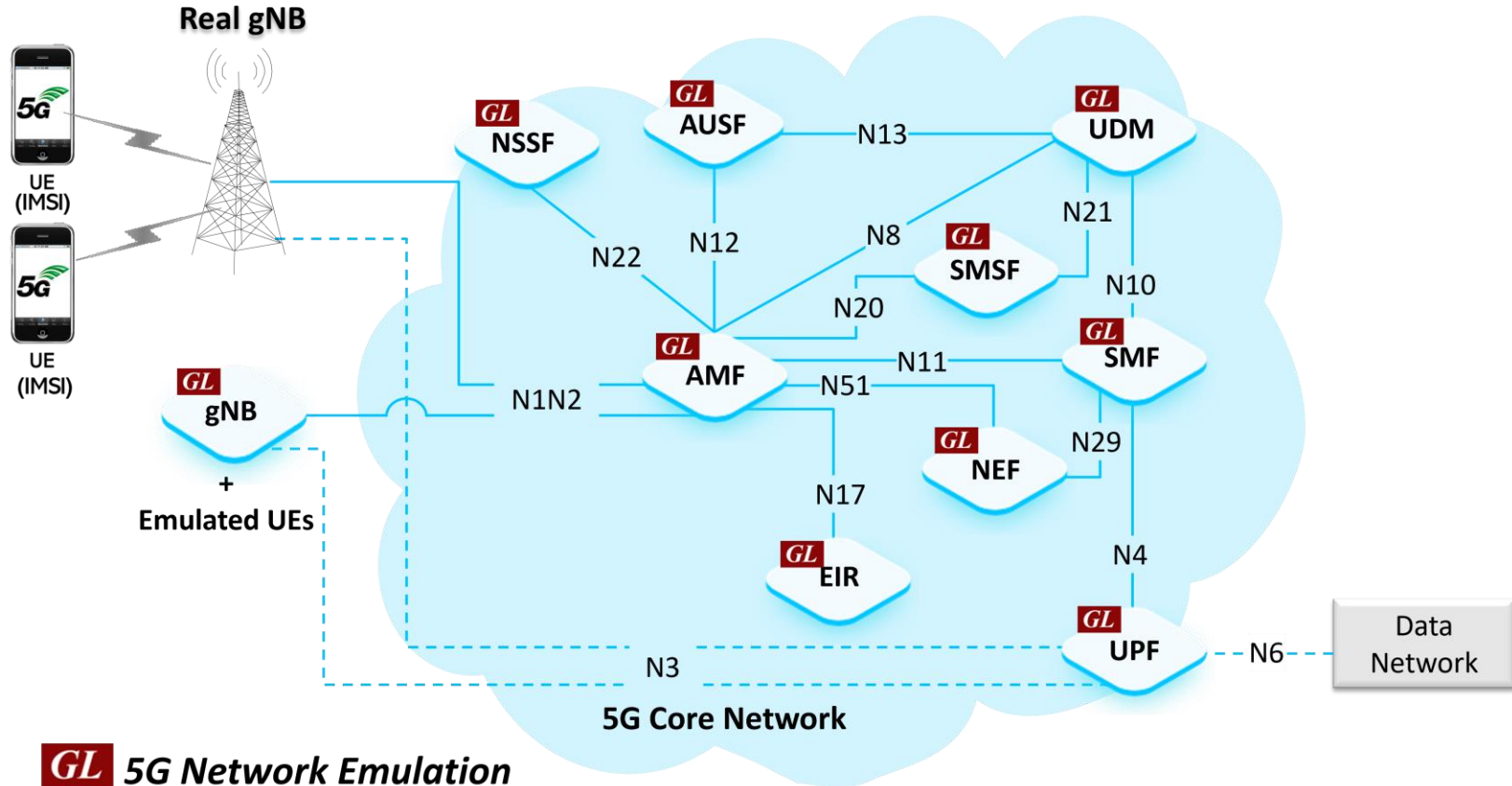

MAPS™ 5G N17 Interface Emulator



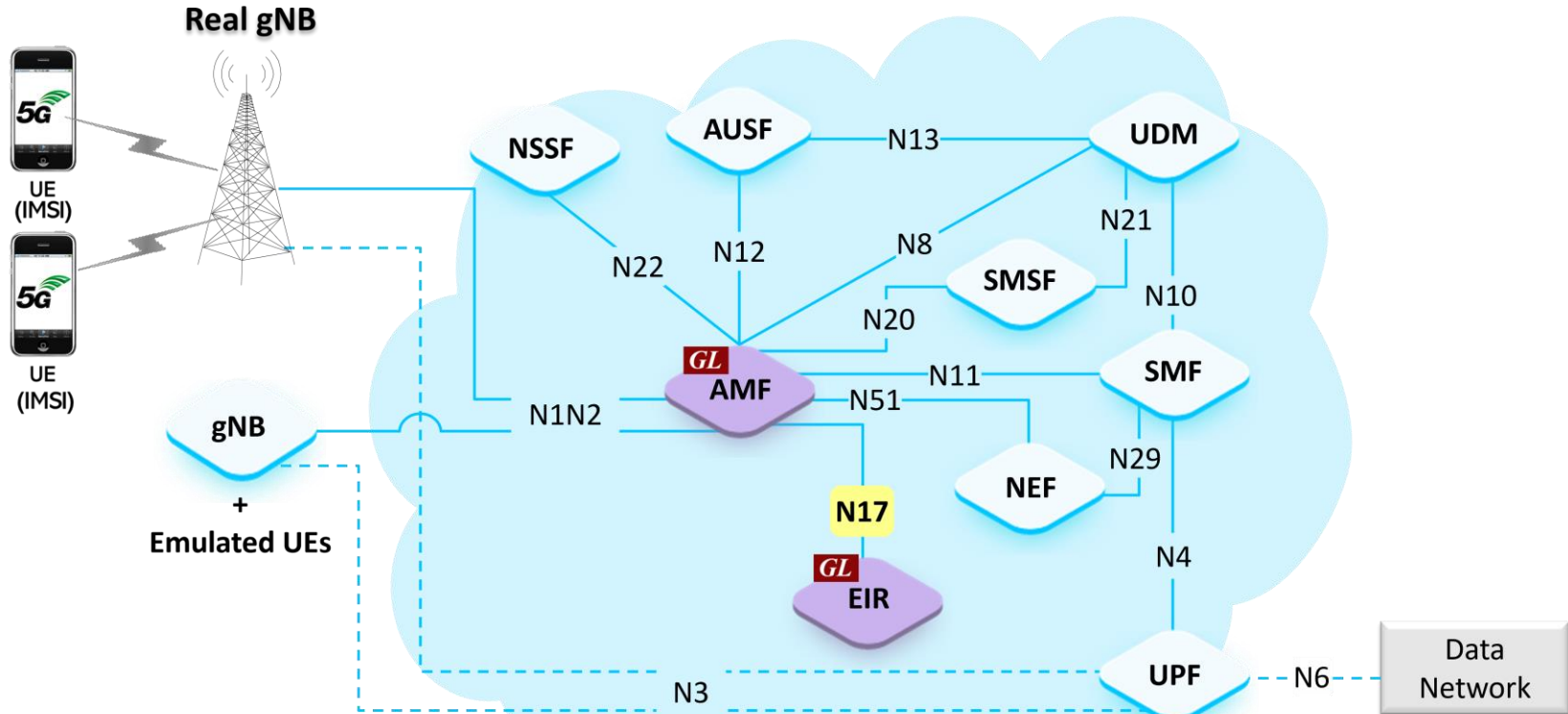
818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878
Phone: (301) 670-4784 Fax: (301) 670-9187 Email: info@gl.com
Website: <https://www.gl.com>

5G Network Diagram



GL 5G Network Emulation

MAPS™ 5G N17 Network Architecture

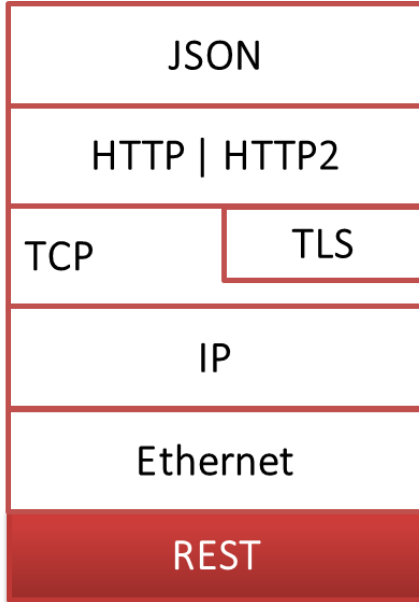


GL MAPS™ 5G N17
Interface Emulator

Main Features

- Emulate Equipment Identity Register (EIR) and Access and Mobility Management Function (AMF) network function
- Supports N5g-eir_EquipmentIdentityCheck Services via the N17 service-based interface
- Services use REST APIs based on HTTP and JSON data format
- Supports TLS and TCP transports
- Supports Command Line Interface (CLI) through a client-server model, enabling users to control all features via Python APIs
- Supports scripted call generation and automated call reception
- Supports customization of call flow and message templates using Script Editor
- Ready-to-use scripts for quick testing
- Provides Call Statistics and Events Status
- Emulate multiple Subscribers using CSV Profiles
- Automation, Remote access, and Schedulers to run tests 24/7

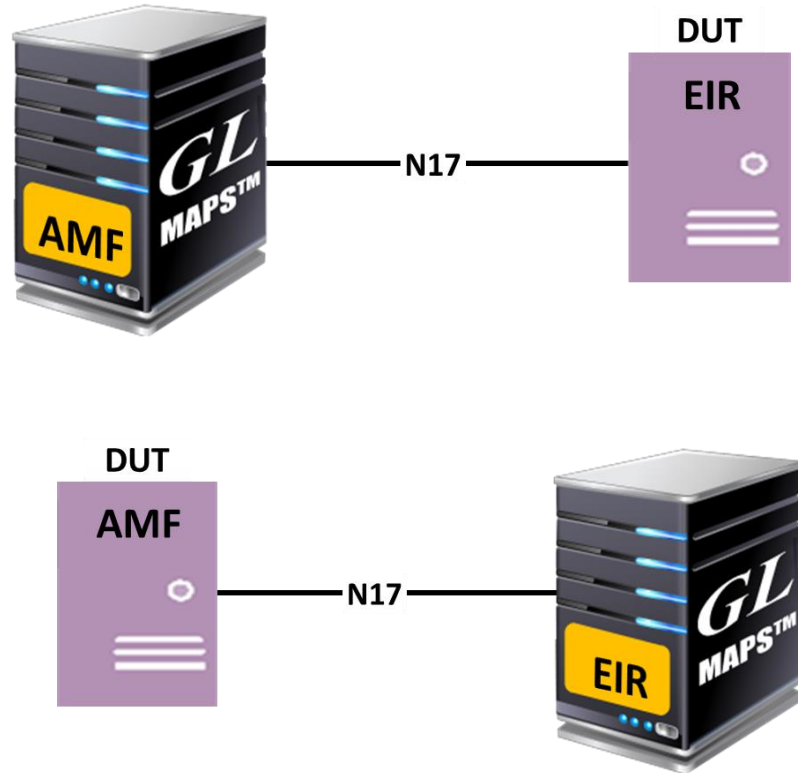
Protocol Stack Specification



Supported Protocols	Standard / Specification Used
N17 Interface (EIR)	3GPP TS 29.511 V17.2.0
JavaScript Object Notation (JSON)	IETF RFC 8259
HTTP	IETF RFC 7231
HTTP / 2	IETF RFC 7540/RFC 7541
TLS	IETF RFC 8446
TCP	IETF RFC 793
IPv4	IETF RFC 791 [5] IETF RFC 2460 [6]

MAPS™ 5G N17 Use Cases

- MAPS™ can emulate any one node (EIR/AMF) or both EIR and AMF nodes



Testbed Setup (EIR)

The screenshot shows the 'MAPS EIR (N17 RELEASE17) - [Testbed Setup - TestBedDefault]' window. The interface includes a menu bar with 'Configurations', 'Emulator', 'Reports', 'Editor', 'Debug Tools', 'Windows', and 'Help'. Below the menu is a toolbar with various icons. The main area is divided into a configuration tree and a details pane.

Config	Value	
EIR Configurations		<input checked="" type="checkbox"/> Enable
EIR	1	
EIR 1		
N5g EIR IP Address	192.168.1.227	
N5g EIR Port	6666	
URI Scheme	HTTP	
N5g EIR API Version	v1	
NRF		
UE Simulation Parameters		
Type Of UE Simulation	Profiles	
End User Configuration	UE_Profiles.xml	
Auto Generated Users Info		

Buttons: Start, Edit

Initials: []

Testbed Setup (AMF)

The screenshot shows the MAPS AMF (N17 RELEASE17) configuration window. The title bar reads "MAPS AMF (N17 RELEASE17) - [Testbed Setup - TestBedDefault]". The menu bar includes "Configurations", "Emulator", "Reports", "Editor", "Debug Tools", "Windows", and "Help". The toolbar contains various icons for configuration, execution, and help.

The main configuration area is titled "Config" and displays a tree view of the configuration structure. The "AMF" node is selected, and its details are shown in a table below. The table has two columns: "Config" and "Value".

Config	Value
AMF	1
AMF 1	
AMF IP Address	192.168.12.28
URI Scheme	HTTP
AMF Name	AMF001
EIR	1
EIR 1	
N5g EIR IP Address	192.168.1.29
N5g EIR Port	6666
N5g EIR API Version	v1
UE Simulation Parameters	
Type Of UE Simulation	Profiles
End User Configuration	UE_Profiles.xml
Auto Generated Users Info	
No Of Users To Be Simulated	4000
Starting IMSI	001013012041631
Starting IMEI	359877068325248
Auto Generated End User Configuration	AutoGeneratedUser_Profile.xml

On the right side of the configuration area, there is a checkbox labeled "Enable" which is checked. At the bottom of the configuration area, there are two buttons: "Start" and "Edit".

The status bar at the bottom of the window shows "Initialisation Errors" and "Er".

Profile Editor (EIR)

MAPS EIR (N17 RELEASE17) - [Profile Editor - UE_Profiles]

Configurations Emulator Reports Editor Debug Tools Windows Help

Profiles (Edit-F2)

#	Profiles (Edit-F2)
1	UEProfile0001
2	UEProfile0002
3	UEProfile0003
4	UEProfile0004
5	UEProfile0005
6	UEProfile0006
7	UEProfile0007
8	UEProfile0008
9	UEProfile0009
10	UEProfile0010

Config

Config	Value
UEProfile0001	
Subscriber Info	
IMEI	359877068325248
IMEISV	1234567890123001
IMSI	001013012041631
MSISDN	3012041631
Equipment Status	WHITELISTED

Enable

Add Insert Delete

Properties

Initialisation Errors Error Events Cap

Profile Editor (AMF)

MAPS AMF (N17 RELEASE17) - [Profile Editor -UE_Profiles]

Configurations Emulator Reports Editor Debug Tools Windows Help

Profiles (Edit-F2)

#	Profiles (Edit-F2)	Config	Value
1	UEProfile0001	UEProfile0001	
2	UEProfile0002		
3	UEProfile0003		
4	UEProfile0004		
5	UEProfile0005		
6	UEProfile0006		
7	UEProfile0007		
8	UEProfile0008		
9	UEProfile0009		
10	UEProfile0010		

Subscriber Info

- IMEI: 359877068325248
- IMEISV: 1234567890123001
- IMSI: 001013012041631
- MSISDN: 3012041631
- AMF Client: AMF001
- Include SUPI or GPSI Equipment Check Request: Include SUPI

Enable

Add Insert Delete

Properties

Initialisation Errors Error Events Ca

Global Configuration

MAPS EIR (N17 RELEASE17) - [Global Configuration -Globalprofile]

Configurations Emulator Reports Editor Debug Tools Windows Help

Config Value

- Global Configuration
 - Equipment Status for Auto Generated Users WHITELISTED

Enable

Apply Edit

Initialisation Errors

Call Generation

The screenshot displays the 'Call Generation' interface in the GL MAPS AMF (N17 RELEASE17) application. The main window title is 'GL MAPS AMF (N17 RELEASE17) - [Call Generation - CallGenDefault]'. The menu bar includes 'Configurations', 'Emulator', 'Reports', 'Editor', 'Debug Tools', 'Windows', and 'Help'. The toolbar contains various icons for file operations and execution.

The main area features a table with the following data:

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Result	Total Iterations	Completed Iterations
1	N5g-eir_AMF_Control.gls	UEProfile0002	359877068325249	Start	WHITELISTED	None	Pass	1	1
2	N5g-eir_AMF_Control.gls	UEProfile0003		Start		None	Unknown	1	0
3	N5g-eir_AMF_Control.gls	UEProfile0004		Start		None	Unknown	1	0
4	N5g-eir_AMF_Control.gls	UEProfile0005		Start		None	Unknown	1	0

Below the table is a control bar with buttons: 'Add', 'Delete', 'Insert', 'Refresh', 'Start', 'Start All', 'Stop', 'Stop All', 'Abort', and 'Abort All'. Below this is another control bar with 'Save', 'Column Width', and 'Show Latest' options.

The main display area shows a message sequence diagram between 'AMF' and 'EIR'. The AMF sends a GET request to the EIR: 'GET /n5g-eir-eic/v1/equipment-status?pei=imei-359877068325249&gpsi=msisdn-3012041632'. The EIR responds with '200 OK'. The response body is shown in a text area on the right:

```
Status: 200
:status : 200
content-type : application/json
content-length : 24

{
  "status": "WHITELISTED"
}
```

At the bottom of the window, there are tabs for 'Scripts', 'Message Sequence', 'Event Config', and 'Script Flow'. The 'Message Sequence' tab is currently selected. The status bar at the very bottom shows 'Initialisation Errors', 'Error Events', 'Captured Errors', and 'Link Status Up=...'.

Call Reception

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Results
1	EIR_HTTP2_Connection_Monitor.gls		EIR Server Clients : ,AMF,	Stop	Monitoring HTTP2 Connection Status	None	Unknown
2	N5g-eir_Control.gls		imei-359877068325248	Completed	WHITELISTED	None	Pass
3	N5g-eir_Control.gls		imei-359877068325249	Completed	WHITELISTED	None	Pass

Stop Stop All Abort Abort All Show Records Select Active Call Auto Trash Trash

Save Column Width Show Latest

AMF EIR

GET /n5g-eir-eic/v1/equipment-status 12:44:56.405000

200 12:44:56.406000

Find

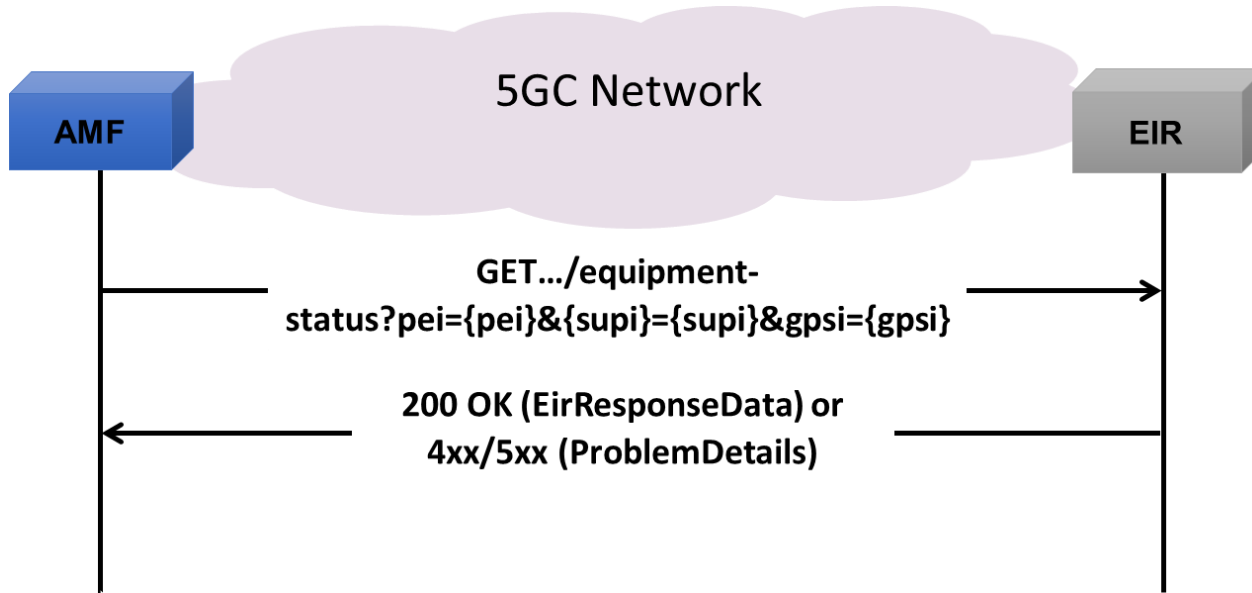
```
Status: 0
:method : GET
:path : /n5g-eir-eic/v1/equipment-status?pei=imei-359877068325248
:scheme : http
:authority : 192.168.12.29:6666
accept : application/json,
application/problem+json
```

Scripts **Message Sequence** Event Config Script Flow

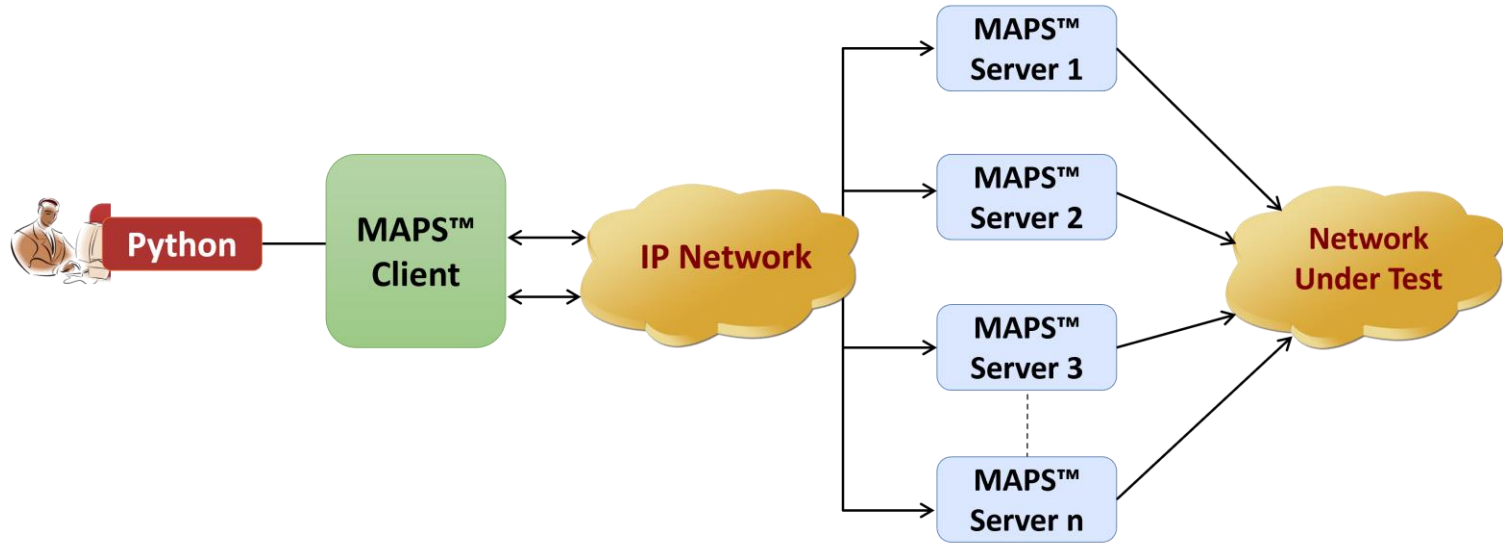
Initialisation Errors Error Events Captured Errors L

MAPS™ 5G N17 Interface Procedure

N5g-EIR_EquipmentIdentityCheck Service



MAPS™ API Architecture



- API wraps our proprietary scripting language in standard languages familiar to the user:
 - Python
- Clients and Servers support a “Many-to-Many” relationship, making it very easy for users to develop complex test cases involving multiple signaling protocols

CLI/API Support

Python Client

```
Python 3.7.9 Shell
File Edit Shell Debug Options Window Help
Type "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: C:\Program Files\GL Communications Inc\MAPS5G-N12\MAPSCLI\PythonClient\examples\AMF\N12_PlaceCall.py
N12 Server Connection... True
N12 Testbed Starting ... True
N12 Profile Loading... True
N12 Nausf_AMF_UEAuthentication_Request.gls Script Started...
Starting N12 sScript True
Authentication Request Initiation ... True
Authentication Response Status... Authentication Successful
ConfirmationResponse = Authentication Successful
MAP MsgCount: 4
***** MAP Message Flow *****
Time Stamp          Route          Message
18:00:21.826        ->             POST - /nausf-auth/v1/ue-authentications
18:00:21.826    ->             POST - /nausf-auth/v1/ue-authentications
{"servingNetworkName": "5G:mnc001.mcc001.3gppnetwork.org", "supiOrSuci": "suci-0-001-01-0-0-3012041631"}
18:00:21.846        <-            201
18:00:21.846    <-            201
{"$gAuthData": {"auth": "67C1E0025C3E80003DFD7B20037D500D", "cli": "CLI MapsCLI AMF (N12 RELEASE17)", "links": {"$g-aka": {"href": "http://001013012041631/5g-aka-confirmation"}}, "authType": "5G_AKA"}, "resStar": "7C10FC59A44E0771A4E9967B4EE53988"}
18:00:21.848        ->             PUT - /nausf-auth/v1/ue-authentications
on
18:00:21.848    ->             PUT - /nausf-auth/v1/ue-authentications
{"resStar": "7C10FC59A44E0771A4E9967B4EE53988"}
18:00:21.867        <-            200
18:00:21.867    <-            200
{"authResult": "AUTHENTICATION_SUCCESS", "kseaf": "A7F691225E", "imsi": "001013012041631"}
Stopping Script... True
N12 Server Disconnecting... True
```

MAPS™ CLI Server

```
CLI MapsCLI AMF (N12 RELEASE17)
File Edit View
View Latest Command
1:: 2024-1-9 18:00:06.656000 : Start "TestBedDefault.xml" # "_AMF[0].AUSFIP[0].AUSFIPAddress"="192.168.12.35", "_TypeOfUESimulation"="XML", "_DefaultProfile"="UE_Profiles.xml";
1:: 2024-1-9 18:00:09.400000 : LoadProfile "UE_Profiles.xml"
1:: 2024-1-9 18:00:11.702000 : StartScript 1 "Nausf_AMF_UEAuthentication_Request.gls" "UEProfile0001" 1 # "IMSI"=(binarystring)001013012041631,"AuthenticationAlgType"="Tuak","CallFlowDebug"=1
1:: 2024-1-9 18:00:21.822000 : UserEvent 1 "UE_Authentication";
1:: 2024-1-9 18:00:21.932000 : UserEvent 1 "GetCallStatus";
1:: 2024-1-9 18:00:23.031000 : UserEvent 1 "GetMessageCount";
1:: 2024-1-9 18:00:23.142000 : UserEvent 1 "GetMessageInfo" # "Index"=0;
1:: 2024-1-9 18:00:23.252000 : UserEvent 1 "GetMessageInfo" # "Index"=1;
1:: 2024-1-9 18:00:23.474000 : UserEvent 1 "GetMessageInfo" # "Index"=2;
1:: 2024-1-9 18:00:23.577000 : UserEvent 1 "GetMessageInfo" # "Index"=3;
1:: 2024-1-9 18:00:23.680000 : StopScript 1;
ServerLog:errCode = 0,errString = connection has been gracefully closed for ClientId = 1
```


Thank you