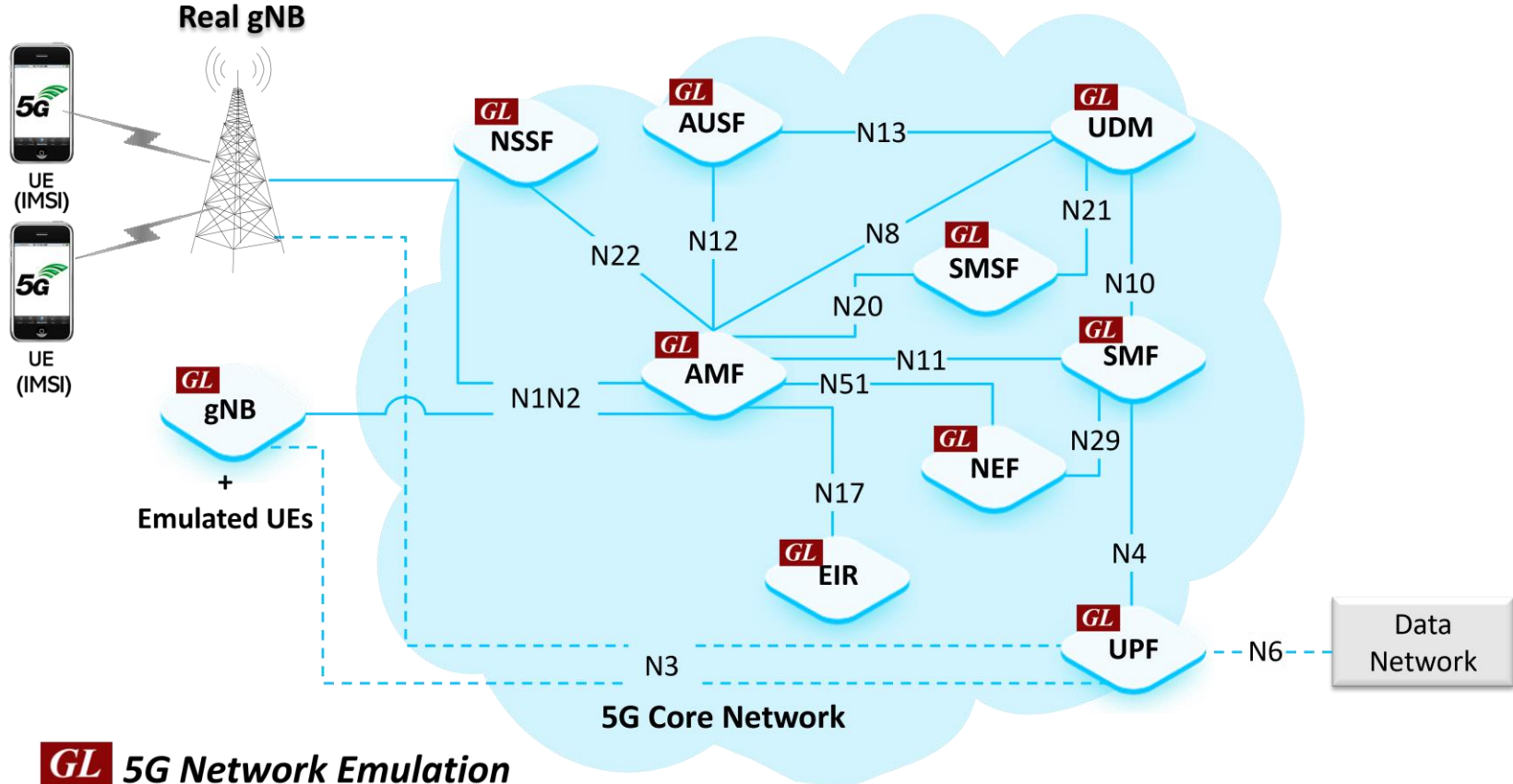

MAPS™ 5G N13 Interface Emulator



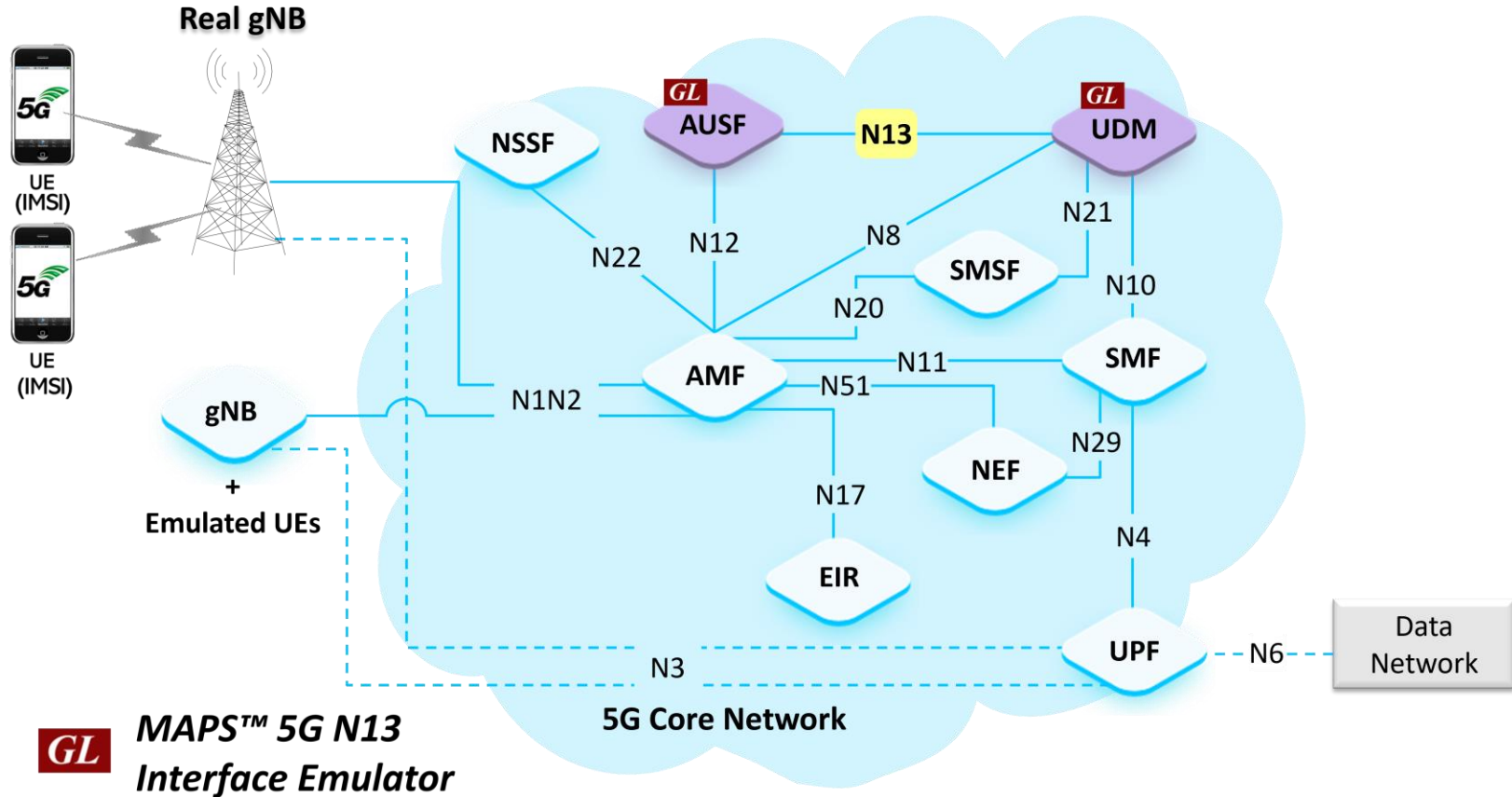
818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878
Phone: (301) 670-4784 Fax: (301) 670-9187 Email: info@gl.com
Website: <https://www.gl.com>

5G Network Diagram



GL 5G Network Emulation

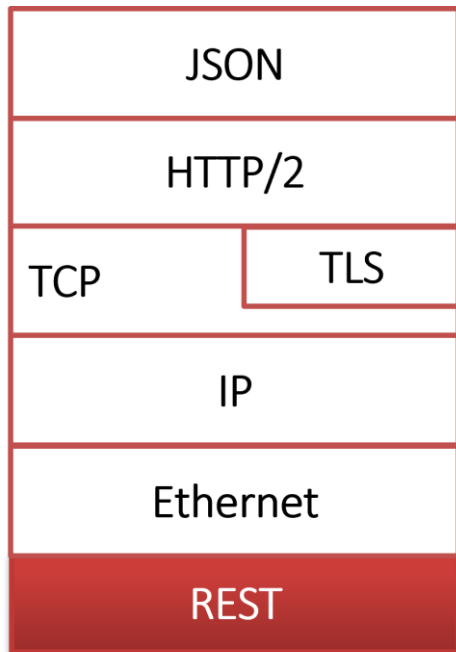
MAPS™ 5G N13 Interface



Main Features

- Emulates Authentication Server Function (AUSF) and Access and Unified Data Management (UDM) elements
- Supports Nudm_UEAuthentication Services Procedure
- Services use REST APIs based on HTTP and JSON data format
- Supports Command Line Interface (CLI) through a client-server model, enabling users to control all features via Python APIs
- Supports TLS and TCP Protocols
- 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
- Emulates Multiple Subscribers using CSV Profiles
- Automation, Remote access, and Schedulers to run tests 24/7

Protocol Stack Specification



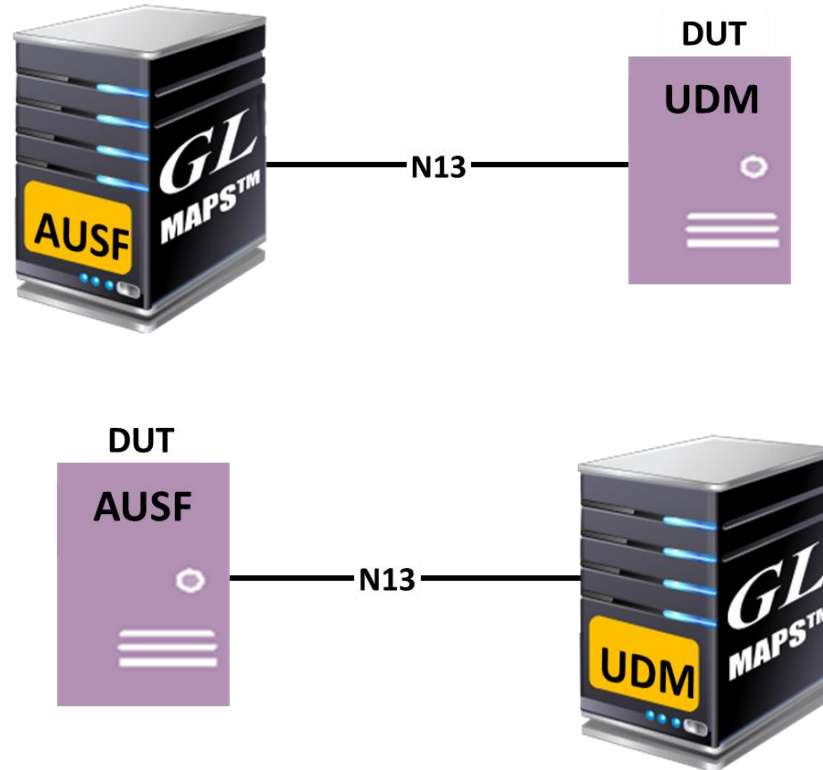
Supported Protocols	Standard / Specification Used
N13 Interface	
N13 Interface (UDM - AUSF)	TS29.509 (Release 17)
JavaScript Object Notation (JSON)	IETF RFC 8259
HTTP / 2	IETF RFC 7231 IETF RFC 7540/RFC 7541
TLS	IETF RFC 8446
TCP	IETF RFC 793
IPv4	IETF RFC 791 [5] IETF RFC 2460 [6]

MAPS™ 5G N13 Interface Procedures

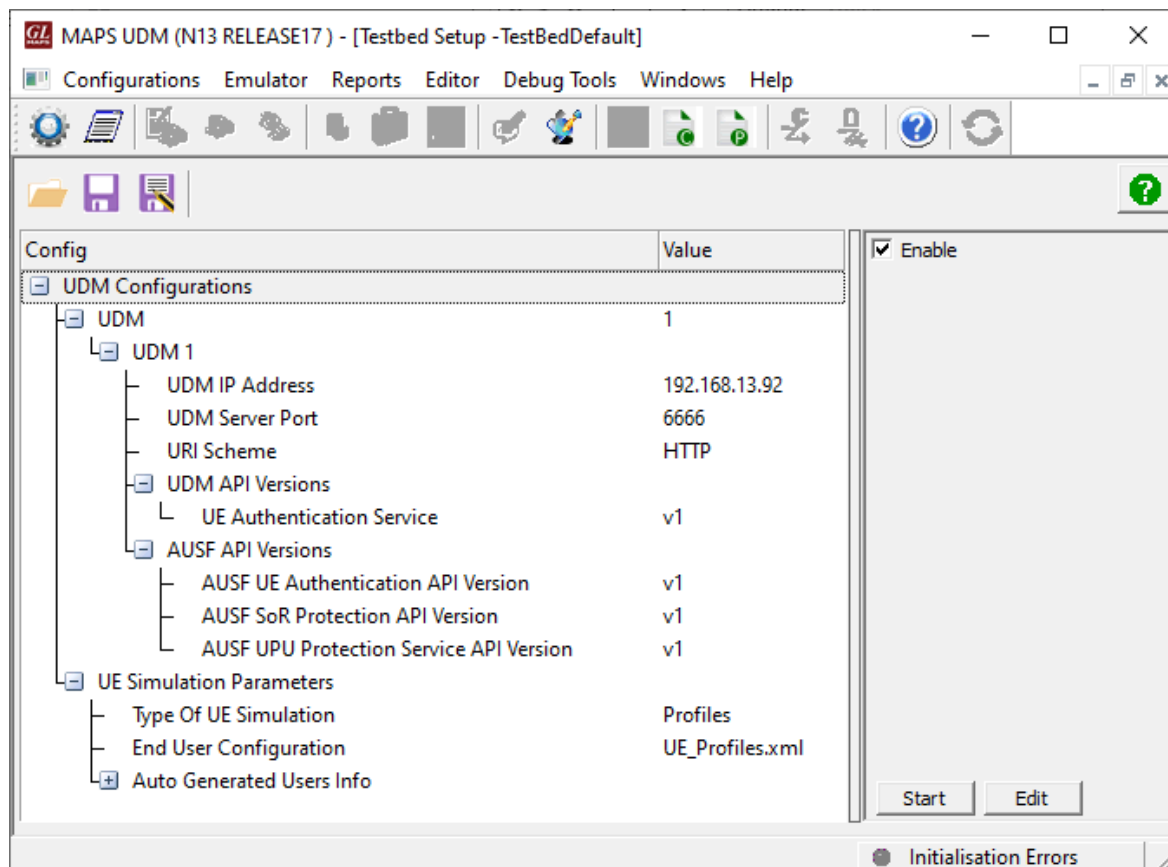
- Nudm_UEAuthentication Service
 - Authentication Information Retrieval
 - Authentication Confirmation
 - Authentication Result Removal

MAPS™ 5G N13 Use Cases

- MAPS™ can emulate any one node (AUSF/UDM) or both AUSF and UDM nodes



Testbed Setup (UDM)



Testbed Setup (AUSF)

The screenshot shows the MAPS AUSF (N13 RELEASE17) - [Testbed Setup - TestBedDefault] window. The window has a menu bar with 'Configurations', 'Emulator', 'Reports', 'Editor', 'Debug Tools', 'Windows', and 'Help'. Below the menu bar is a toolbar with various icons. The main area is divided into two panes. The left pane shows a tree view of configurations, and the right pane shows a table of values for the selected configuration.

Config

- AUSF Configurations
 - AUSF
 - AUSF 1
 - AUSF IP Address: 192.168.13.93
 - AUSF Server Port: 6665
 - URI Scheme: HTTP
 - AUSF Name: Client1
 - UDM Configuration
 - UDM
 - UDM 1
 - UDM IP Address: 192.168.13.92
 - UDM Port: 6666
 - UDM UE Authentication Service API Version: v1
 - UE Simulation Parameters
 - Type Of UE Simulation: Profiles
 - End User Configuration: UE_Profiles.xml
 - Auto Generated Users Info

Value

Config	Value
AUSF	1
AUSF 1	
AUSF IP Address	192.168.13.93
AUSF Server Port	6665
URI Scheme	HTTP
AUSF Name	Client1
UDM Configuration	
UDM	1
UDM 1	
UDM IP Address	192.168.13.92
UDM Port	6666
UDM UE Authentication Service API Version	v1
UE Simulation Parameters	
Type Of UE Simulation	Profiles
End User Configuration	UE_Profiles.xml
Auto Generated Users Info	

Enable

☒ Enable

Start **Edit**

Initialisation Errors **Error Ev**

Profile Editor (UDM)

The screenshot displays the 'Profile Editor - UE_Profiles' window from the 'GL MAPS UDM (N13 RELEASE17)' application. The interface includes a menu bar (Configurations, Emulator, Reports, Editor, Debug Tools, Windows, Help) and a toolbar with various icons. On the left, a list of profiles (UEProfile0001 to UEProfile0013) is shown, with 'UEProfile0001' selected. The main area is divided into a 'Config' tree and a 'Value' column. The 'Config' tree shows a hierarchy: 'Subscriber Info' containing 'SUPI' and 'Authentication Parameters'. 'Authentication Parameters' includes 'Authentication Type', 'Algorithm Type 5G AKA', 'KEY', 'Operator Variant Parameter Type', 'OP', 'OPc', 'SQN', and 'AMF'. The 'Value' column displays the corresponding values for each parameter. On the right, there is a 'Properties' panel with an 'Enable' checkbox and buttons for 'Add', 'Insert', 'Delete', and 'Properties'. At the bottom, there are status bars for 'Initialisation Errors', 'Error Events', and 'Captured En'.

#	Profiles (Edit-F2)	Config	Value
1	UEProfile0001	UEProfile0001	
2	UEProfile0002	Subscriber Info	
3	UEProfile0003	SUPI	001013012041631
4	UEProfile0004	Authentication Parameters	
5	UEProfile0005	Authentication Type	5G_AKA
6	UEProfile0006	Algorithm Type 5G AKA	Tuak
7	UEProfile0007	KEY	00112233445566778899aabbccddeeff
8	UEProfile0008	Operator Variant Parameter Type	OPc
9	UEProfile0009	OP	0102030405060708091011121314151601...
10	UEProfile0010	OPc	01020304050607080910111213141516
11	UEProfile0011	SQN	000000000079
12	UEProfile0012	AMF	8000
13	UEProfile0013		

Profile Editor (AUSF)

MAPS AUSF (N13 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
11	UEProfile0011
12	UEProfile0012
13	UEProfile0013
14	UEProfile0014
15	UEProfile0015
16	UEProfile0016
17	UEProfile0017

Config

Config	Value
UEProfile0001	
Subscriber Info	
SUPI	001013012041631
AUSF Client Selection	Client1
PLMN ID	
MCC	001
MNC	01
Authentication Parameters	
Authentication Type	5G_AKA
Algorithm Type 5G AKA	Tuak
KEY	00112233445566778899aabbccddeeff
Operator Variant Parameter Type	OPc
OP	0102030405060708091011121314151601020...
OPc	01020304050607080910111213141516
SQN	000000000079
AMF	8000
Sync Failure	
Simulate Sync Failure	False
Re synchronization Info	
RAND	11
AUTS	2222222222222222

Enable

Add Insert Delete

Properties

Initialisation Errors Error Events Captured Errors

Call Generation

GL MAPS AUSF (N13 RELEASE17) - [Call Generation -Default]

Configurations Emulator Reports Editor Debug Tools Windows Help

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Result	Total Iterations	Completed Iterations
1	Nudm_UEAU_AUSF_Control.gls	UEProfile0001	suci-0-001-01-0-0-0-3012041631	Start	Authentication Successful	None	Pass	1	1
2	Nudm_UEAU_AUSF_Control.gls	UEProfile0002		Start		None	Unknown	1	0
3	Nudm_UEAU_AUSF_Control.gls	UEProfile0003		Start		None	Unknown	1	0
4	Nudm_UEAU_AUSF_Control.gls	UEProfile0004		Start		None	Unknown	1	0
5	Nudm_UEAU_AUSF_Control.gls	UEProfile0005		Start		None	Unknown	1	0

Add Delete Insert Refresh Start Start All Stop Stop All Abort Abort All

Save Column Width Show Latest

AUSF UDM

POST /nudm-ueau/v1/suci-0-001-01-0-0-0-3012041631/security-information/generate-auth-data 12:27:03.967000

200 OK 12:27:04.102000

POST /nudm-ueau/v1/imsi-001013012041631/auth-events 12:27:04.225000

201 CREATED 12:27:04.253000

Find

POST http://192.168.1.20:6665/nudm-ueau/v1/suci-0-001-01-0-0-0-3012041631/security-information/generate-auth-data
content-type : application/json
accept : application/json,
application/problem+json

{
 "ausfInstanceId": "501f409-7df3-4881-bb54-b6bdd9574440",
 "servingNetworkName": "5G:mnc001.mcc001.3gppnetwork.org"
}

Scripts Message Sequence Event Config Script Flow

Initialisation Errors Error Events Captured Errors Link Status Up=

Call Reception

GL MAPS UDM (N13 RELEASE17) - [Call Reception]

Configurations Emulator Reports Editor Debug Tools Windows Help

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Results
1	UDM_HTTP2_Connection_Monitor.gls		UDM Server Clients : AUSF,	Stop	Monitoring HTTP2 Connection Status	None	Unknown
2	Nudm_UEAU_Control.gls		suci-0-001-01-0-0-0-3012041631	Completed	Authentication Vectors sent	None	Pass
3	Nudm_UEAU_Control.gls		imsi-001013012041631	Completed	Authentication Vectors sent	None	Pass
4	Nudm_UEAU_Control.gls		suci-0-001-01-0-0-0-3012041632	Completed	Authentication Vectors sent	None	Pass
5	Nudm_UEAU_Control.gls		imsi-001013012041632	Completed	Authentication Vectors sent	None	Pass

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

Save Column Width ☐ Show Latest

AUSF UDM

POST /nudm-ueau/v1/suci-0-001-01-0-0-0-3012041631/security-information/generate-auth-data 13:01:30.169000

200 13:01:30.171000

Status: 1
:method : POST
:path : /nudm-ueau/v1/suci-0-001-01-0-0-0-3012041631/security-info
:scheme : http
:authority : 192.168.1.20:6665
content-type : application/json
accept : application/json,
application/problem+json
content-length : 113

```
{
  "ausfInstanceId": "7f54c042-7ff8-4a44-b377-b8e48f0b7163",
  "servingNetworkName": "5G:mnc001.mcc001.3gppnetwork.org"
}
```

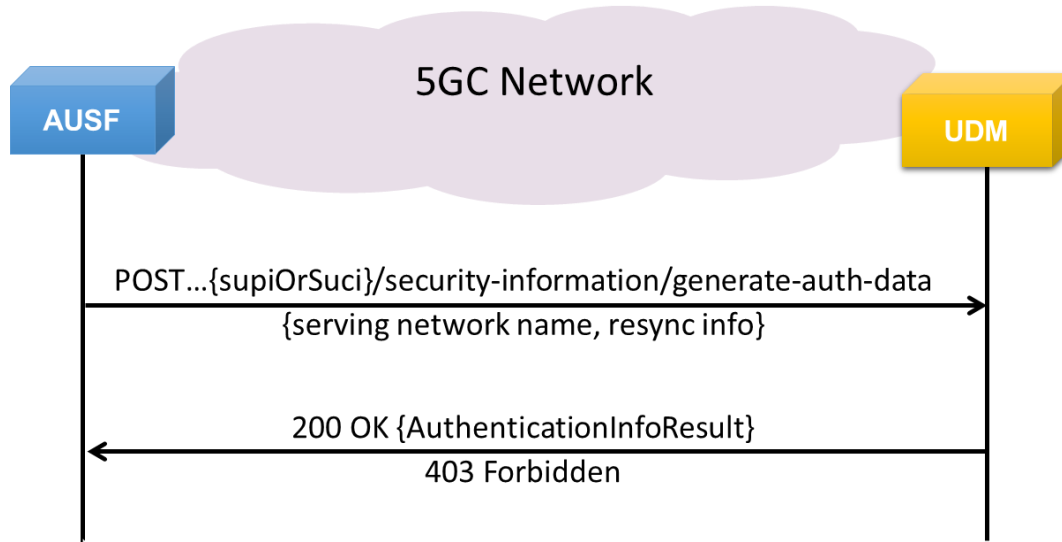
Scripts Message Sequence Event Config Script Flow

Initialisation Errors Error Events Captured Errors Link Status Up

MAPS™ 5G N13 Interface Procedures

Nudm_UEAuthentication Service

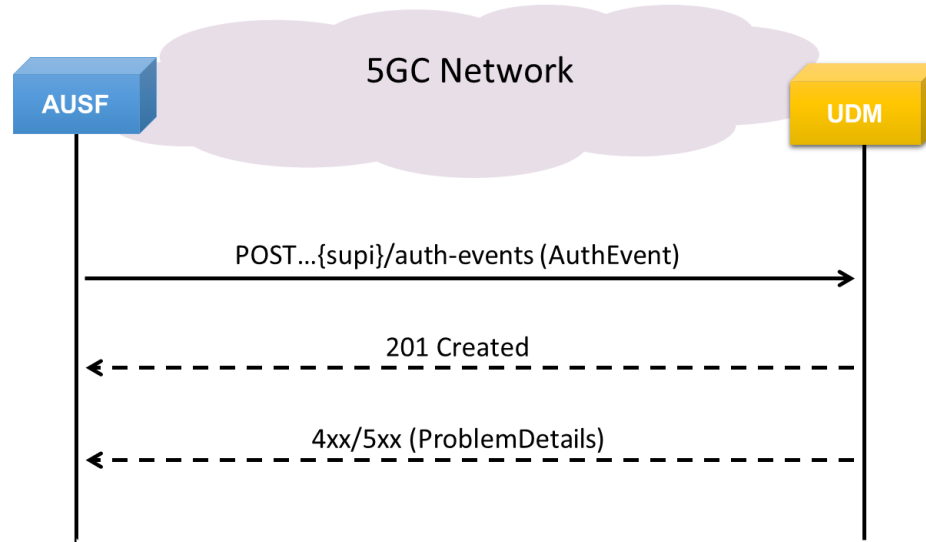
Authentication Information Retrieval



MAPS™ 5G N13 Interface Procedures (Contd.)

Nudm_UEAuthentication Service

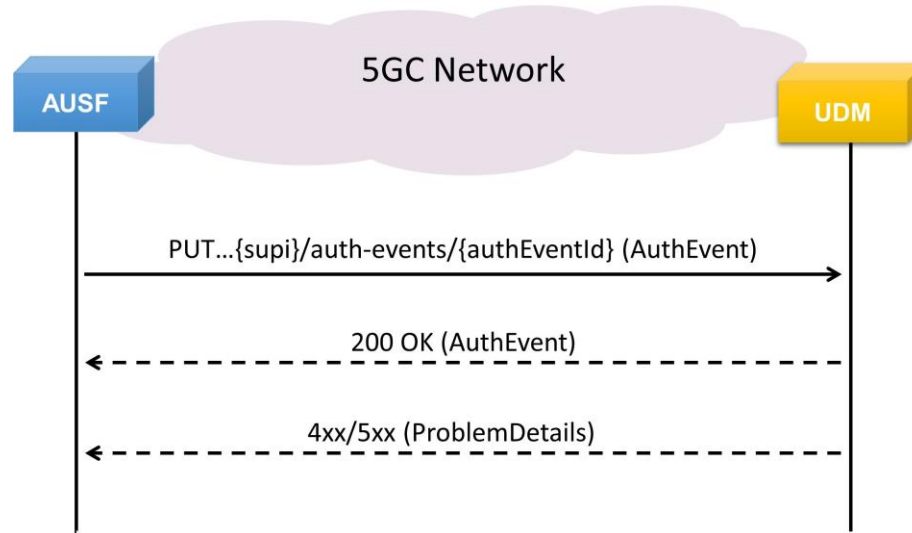
Authentication Confirmation



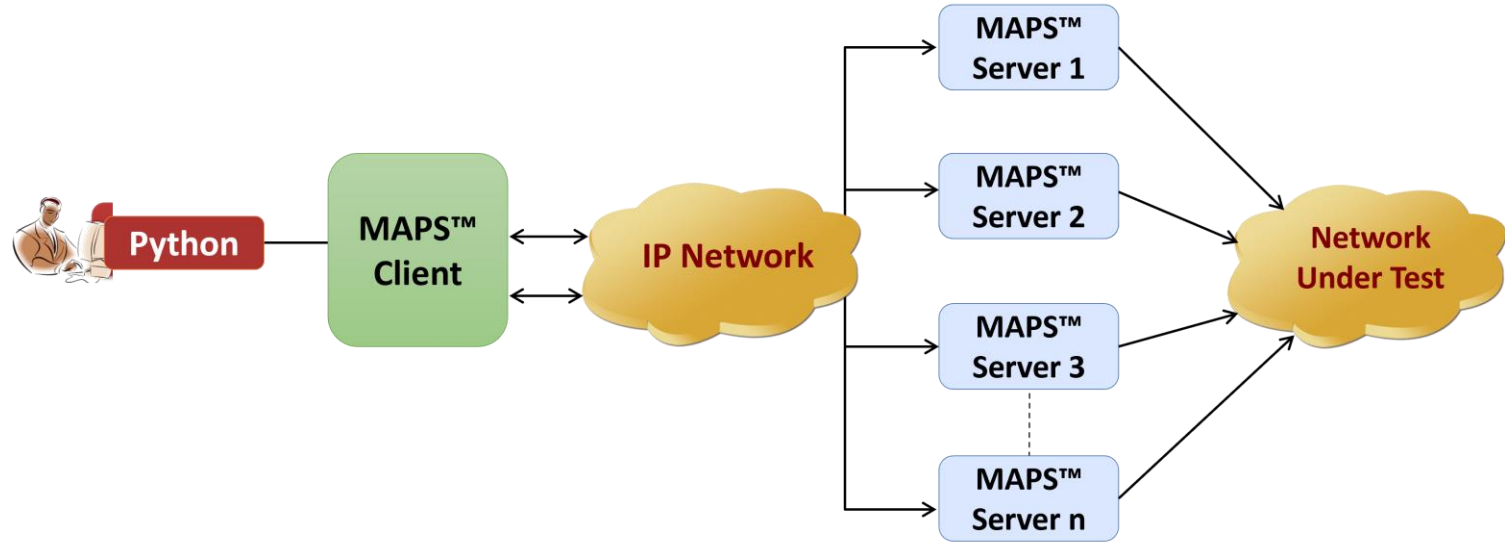
MAPS™ 5G N13 Interface Procedures (Contd.)

Nudm_UEAuthentication Service

Authentication Result Removal



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 3.7.5 Shell
File Edit Shell Debug Options Window Help
Python 3.7.5 (tags/v3.7.5:5c02a39a0b, Oct 15 2019, 00:11:34) [MSC v.1916 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: C:\Program Files\GL Communications Inc\MAPSS5G-N13\MAPSCLI\PythonClient\examples\AUSF\N13
_PlaceCall.py
N13 Server Connection... True
N13 Testbed Starting ... True
N13 Profile Loading... True
N13 Nudm_UEAU_AUSF_Control.gls Script Started...
Starting N13 script True
Authentication Request Initiation ... nudm_authenticate_request entered
event_args = []
Auth Request Status = Applied
True
Authentication Response Status... Request
ConfirmationResponse = Authentication Success
MAP MsgCount: 4
***** MAP Message Flow *****
Time Stamp          Route
msg_count== 4
19:16:35.546        ->
y-information/generate-auth-data
19:16:35.572        <-
19:16:35.695        ->
19:16:35.714        <-
Stopping Script... True
N13 Server Disconnecting... True
>>>
```

MAPS™ CLI Server

```
CLI MapsCLI AUSF (N13 RELEASE17)
File Edit View
View Latest Command
1:: 2024-1-25 19:16:20.039000 : Start "TestBedDefault.xml" # "_AUSF[0].AUSF[0].AUSFIPAddress"="192.168.12.7", "_TypeOfUESimulation"="XML", "_DefaultProfile"="UE_Profiles.xml";
1:: 2024-1-25 19:16:22.794000 : LoadProfile "UE_Profiles.xml"
1:: 2024-1-25 19:16:24.977000 : StartScript 1 "Nudm_UEAU_AUSF_Control.gls" "UEProfile0001" 1 # "TMSI"="(binarystring)001013012041632,"AuthenticationAlgType"="Tuak","CallFlowDebug"=1,"EnableCLI"=1;
1:: 2024-1-25 19:16:35.041000 : UserEvent 1 "Nudm_UE_Authentication";
1:: 2024-1-25 19:16:35.153000 : UserEvent 1 "GetCallStatus";
1:: 2024-1-25 19:16:36.799000 : UserEvent 1 "GetMessageCount";
1:: 2024-1-25 19:16:36.910000 : UserEvent 1 "GetMessageInfo" # "Index"=0;
1:: 2024-1-25 19:16:37.020000 : UserEvent 1 "GetMessageInfo" # "Index"=1;
1:: 2024-1-25 19:16:37.130000 : UserEvent 1 "GetMessageInfo" # "Index"=2;
1:: 2024-1-25 19:16:37.240000 : UserEvent 1 "GetMessageInfo" # "Index"=3;
1:: 2024-1-25 19:16:37.352000 : StopScript 1;
ServerLog:errCode = 0,errString = connection has been gracefully closed for ClientId =1
```

Thank you