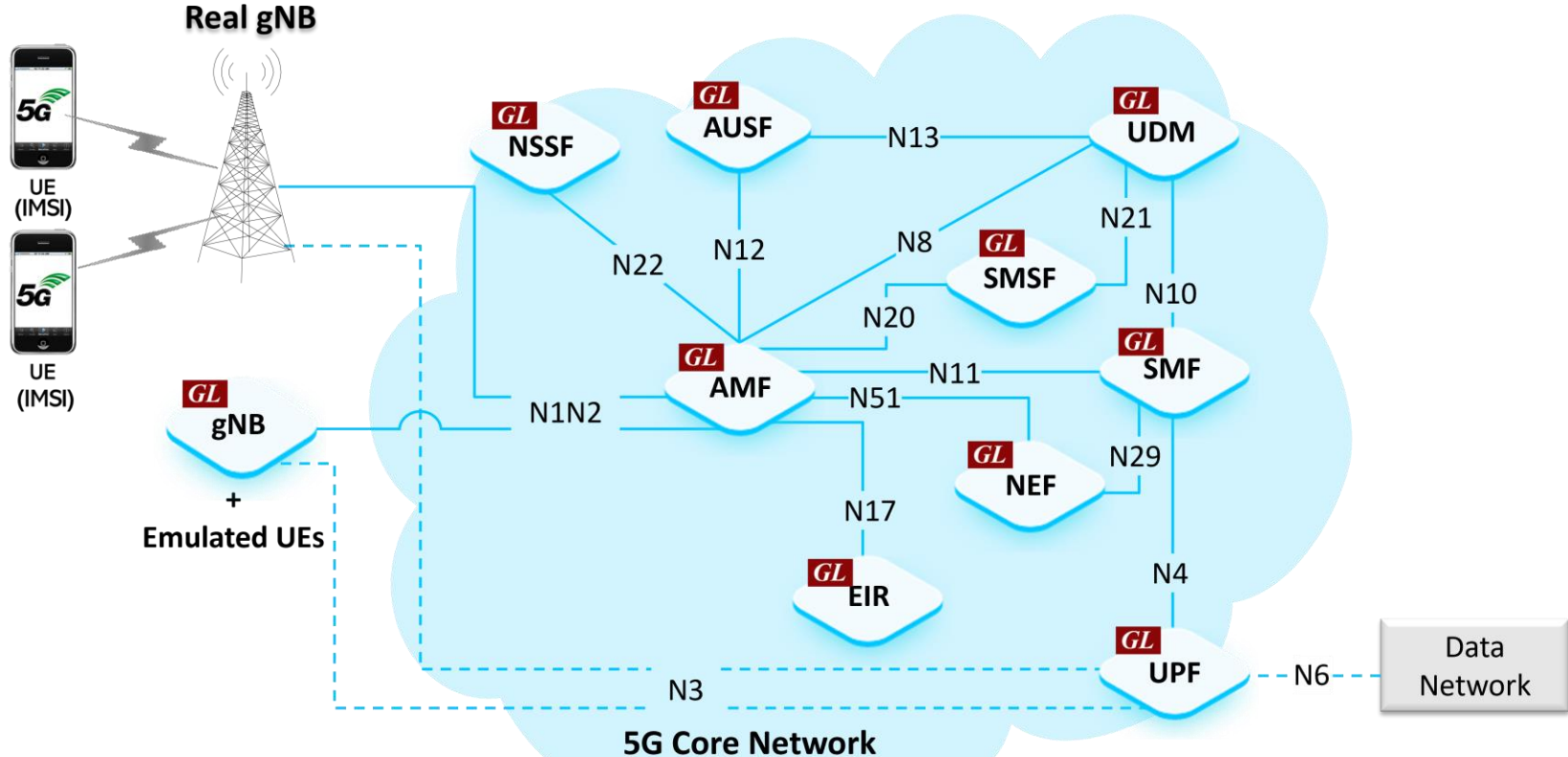

MAPS™ 5G N13 Interface Emulator



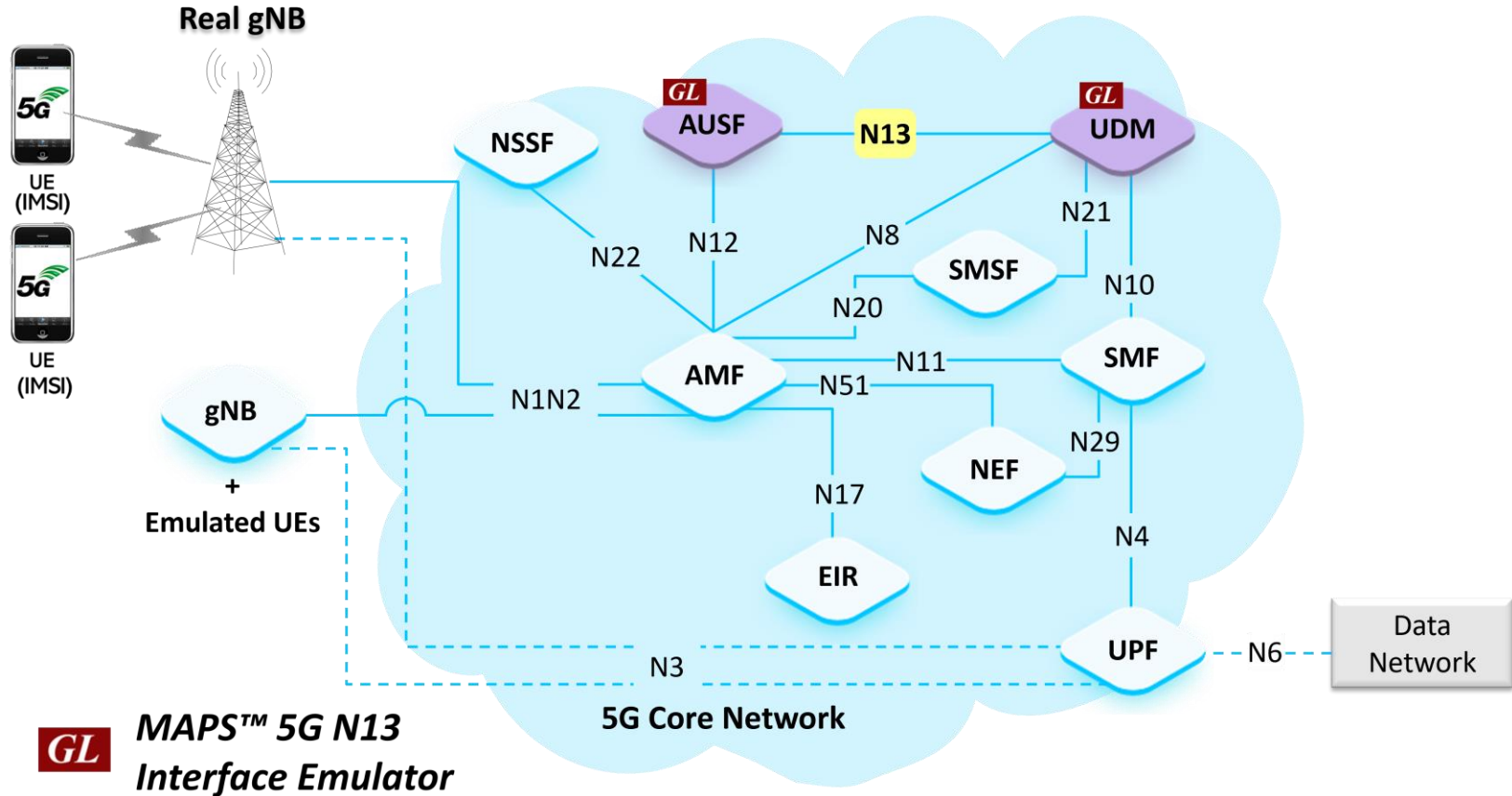
818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878
Phone: (301) 670-4784 Fax: (301) 670-9187 Email: info@gl.com
Website: <https://www.gl.com>

5G Network Diagram



GL 5G Network Emulation

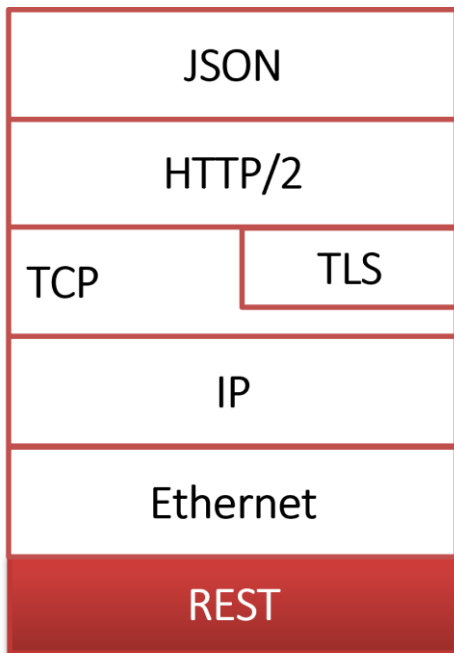
MAPS™ 5G N13 Interface



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



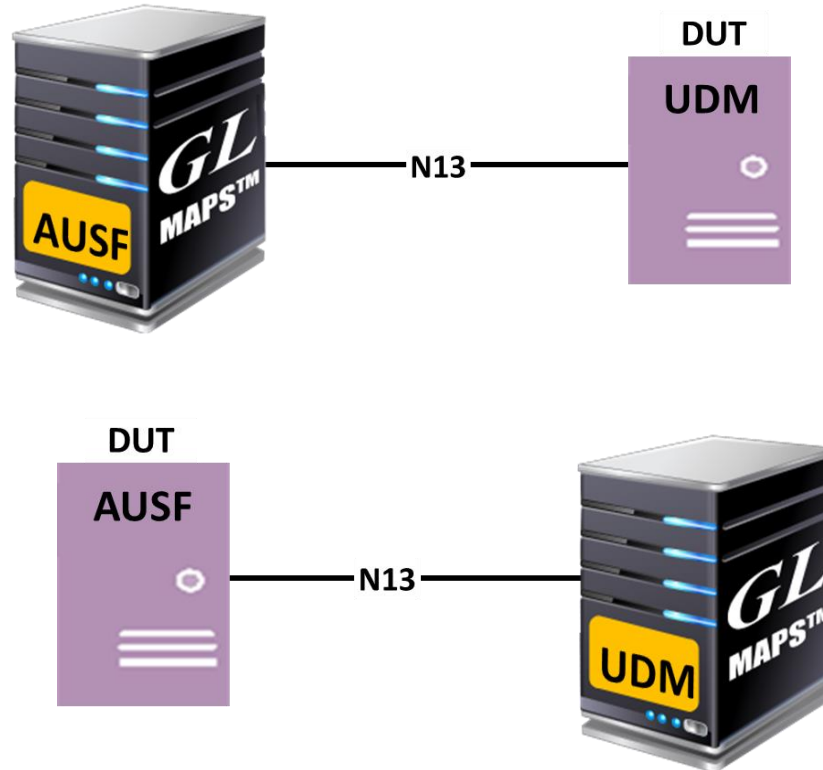
Supported Protocols	Standard / Specification Used
N13 Interface	
N13 Interface (UDM - AUSF)	TS29.509
JavaScript Object Notation (JSON)	IETF RFC 8259
HTTP / 2	IETF RFC 7231 IETF RFC 7540/RFC 7541
TLS	IETF RFC 8446
TCP	IETF RFC 793
IPv4	IETF RFC 791 [5] IETF RFC 2460 [6]

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)

The screenshot shows the MAPS UDM (N13 RELEASE17) configuration window. The window title is "MAPS UDM (N13 RELEASE17) - [Testbed Setup - TestBedDefault]". The menu bar includes "Configurations", "Emulator", "Reports", "Editor", "Debug Tools", "Windows", and "Help". The toolbar contains various icons for configuration, simulation, and help. The main area displays a tree view of configurations with a table of values and an "Enable" checkbox.

Config	Value	Enable
UDM Configurations		<input checked="" type="checkbox"/>
UDM	1	
UDM 1		
UDM IP Address	192.168.13.92	
UDM Server Port	6666	
URI Scheme	HTTP	
UDM API Versions		
UE Authentication Service	v1	
AUSF API Versions		
AUSF UE Authentication API Version	v1	
AUSF SoR Protection API Version	v1	
AUSF UPU Protection Service API Version	v1	
UE Simulation Parameters		
Type Of UE Simulation	Profiles	
End User Configuration	UE_Profiles.xml	
Auto Generated Users Info		

Buttons: Start, Edit

Initialisation Errors

Testbed Setup (AUSF)

The screenshot shows the MAPS AUSF (N13 RELEASE17) configuration tool. The window title is "MAPS AUSF (N13 RELEASE17) - [Testbed Setup - TestBedDefault]". The menu bar includes "Configurations", "Emulator", "Reports", "Editor", "Debug Tools", "Windows", and "Help". The toolbar contains various icons for configuration, saving, and help. The main area displays a tree view of configurations with a table of values. The "AUSF Configurations" folder is expanded, showing "AUSF" and "UE Simulation Parameters". The "AUSF" folder is further expanded to show "AUSF 1" and "UDM Configuration". The "AUSF 1" folder is expanded to show "AUSF IP Address", "AUSF Server Port", "URI Scheme", and "AUSF Name". The "UDM Configuration" folder is expanded to show "UDM" and "UDM 1". The "UDM 1" folder is expanded to show "UDM IP Address", "UDM Port", and "UDM UE Authentication Service API Version". The "UE Simulation Parameters" folder is expanded to show "Type Of UE Simulation", "End User Configuration", and "Auto Generated Users Info". The "Auto Generated Users Info" folder is expanded to show "Start" and "Edit" buttons. The "Enable" checkbox is checked. The status bar at the bottom shows "Initialisation Errors" and "Error Ev".

Config	Value
AUSF Configurations	
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	

Profile Editor (UDM)

The screenshot displays the MAPS UDM (N13 RELEASE17) Profile Editor window. The interface includes a menu bar (Configurations, Emulator, Reports, Editor, Debug Tools, Windows, Help), a toolbar with various icons, and a main workspace. On the left, a list of profiles is shown, with UEProfile0001 selected. The main workspace displays the configuration for UEProfile0001, including Subscriber Info (SUPI) and Authentication Parameters (Authentication Type, Algorithm Type, KEY, Operator Variant Parameter Type, OP, OPc, SQN, AMF). A right-hand panel shows the 'Enable' checkbox checked and buttons for 'Add', 'Insert', 'Delete', and 'Properties'. At the bottom, there are buttons for 'Insert', 'Delete', and 'Clear', and a status bar with 'Initialisation Errors', 'Error Events', and 'Captured En'.

#	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		
11	UEProfile0011		
12	UEProfile0012		
13	UEProfile0013		

Config	Value
Subscriber Info	
SUPI	001013012041631
Authentication Parameters	
Authentication Type	5G_AKA
Algorithm Type 5G AKA	Tuak
KEY	00112233445566778899aabbccddeeff
Operator Variant Parameter Type	OPc
OP	0102030405060708091011121314151601...
OPc	01020304050607080910111213141516
SQN	000000000079
AMF	8000

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)	Config	Value
1	UEProfile0001	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		

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

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
content-type : application/json
accept : application/json,
application/problem+json

{
  "ausfInstanceId": "5017f409-7df3-4881-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
    
```

Find

```

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"
}
    
```

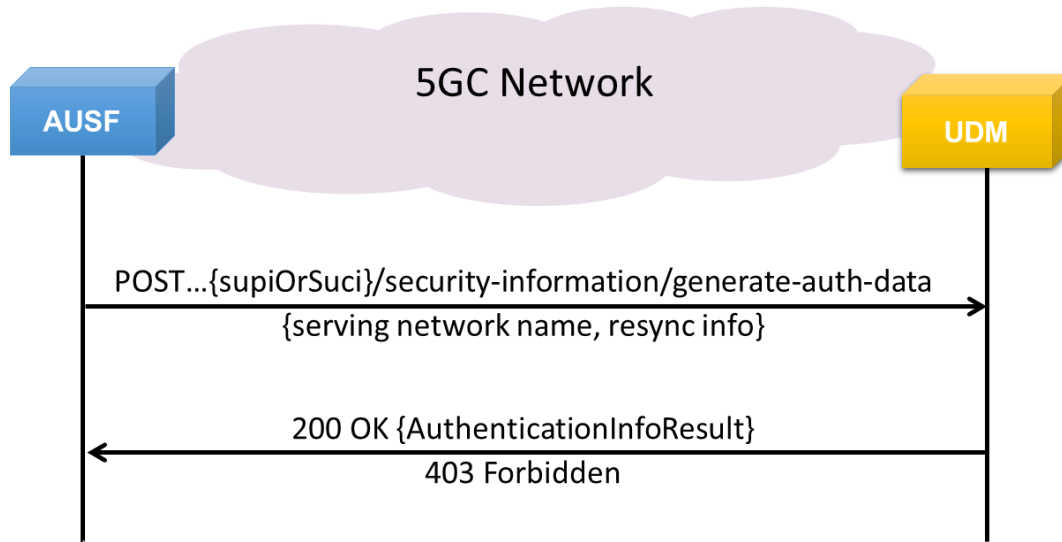
Scripts **Message Sequence** Event Config Script Flow

● Initialisation Errors ● Error Events ● Captured Errors ● Link Status Up

MAPS™ 5G N13 Interface Procedures

Nudm_UEAuthentication Service

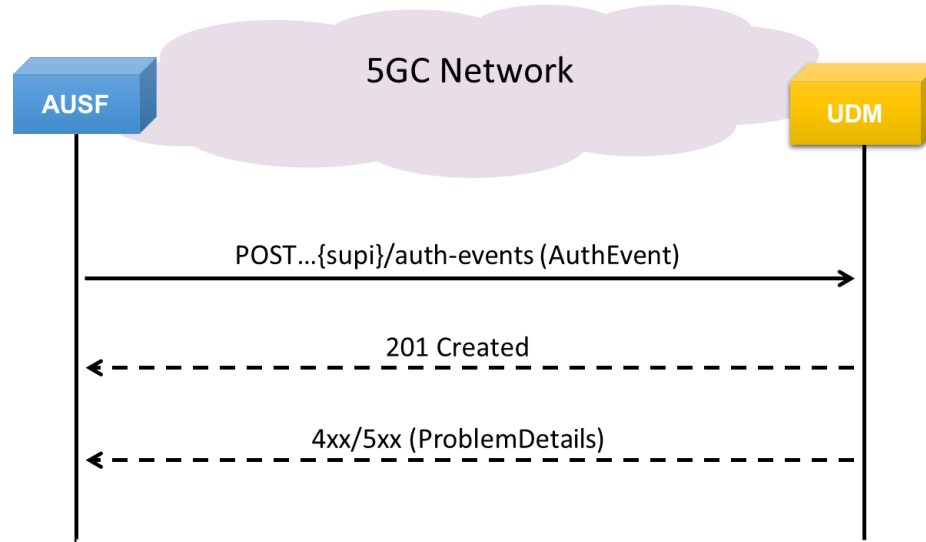
Authentication Information Retrieval



MAPS™ 5G N13 Interface Procedures (Contd.)

Nudm_UEAuthentication Service

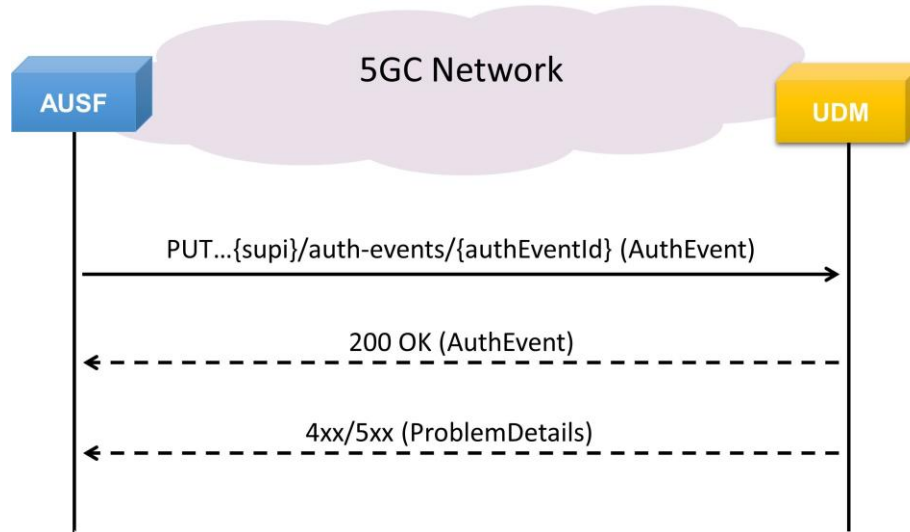
Authentication Confirmation



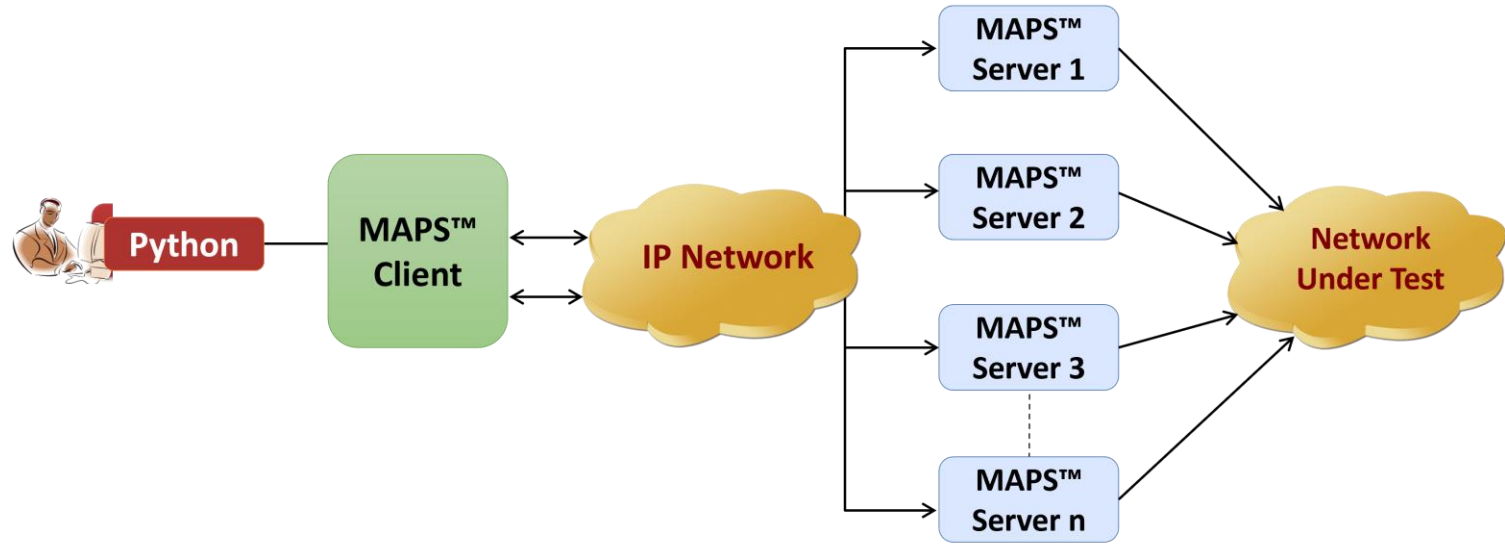
MAPS™ 5G N13 Interface Procedures (Contd.)

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\MAPSSG-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;
2 1:: 2024-1-25 19:16:35.041000 : UserEvent 1 "Nudm_UE_Authentication";
1:: 2024-1-25 19:16:35.153000 : UserEvent 1 "GetCallStatus";
2 1:: 2024-1-25 19:16:36.799000 : UserEvent 1 "GetMessageCount";
1:: 2024-1-25 19:16:36.910000 : UserEvent 1 "GetMessageInfo" # "Index"=0;
2 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