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# MAPS™ 5G N12 Interface Emulator

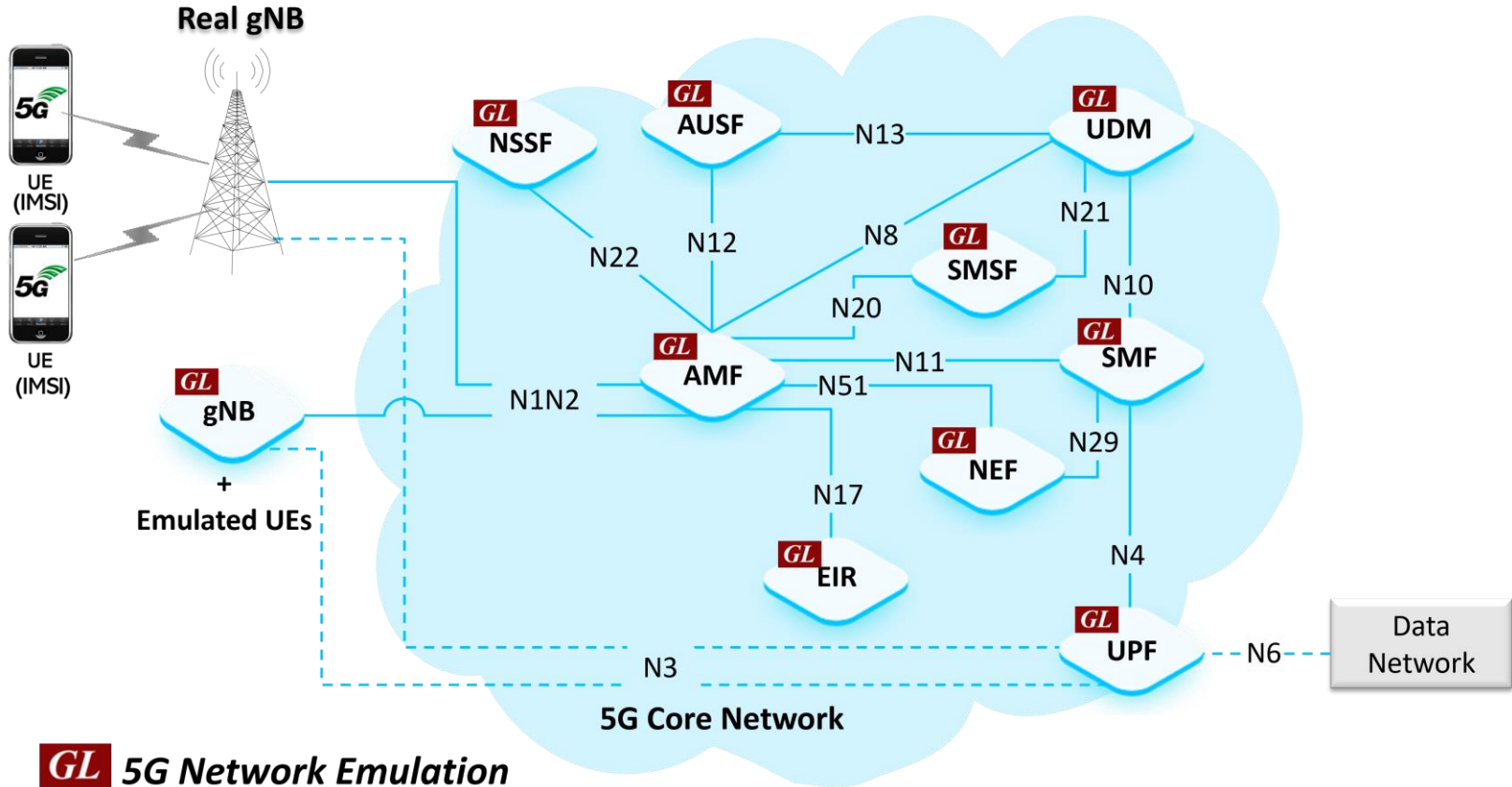
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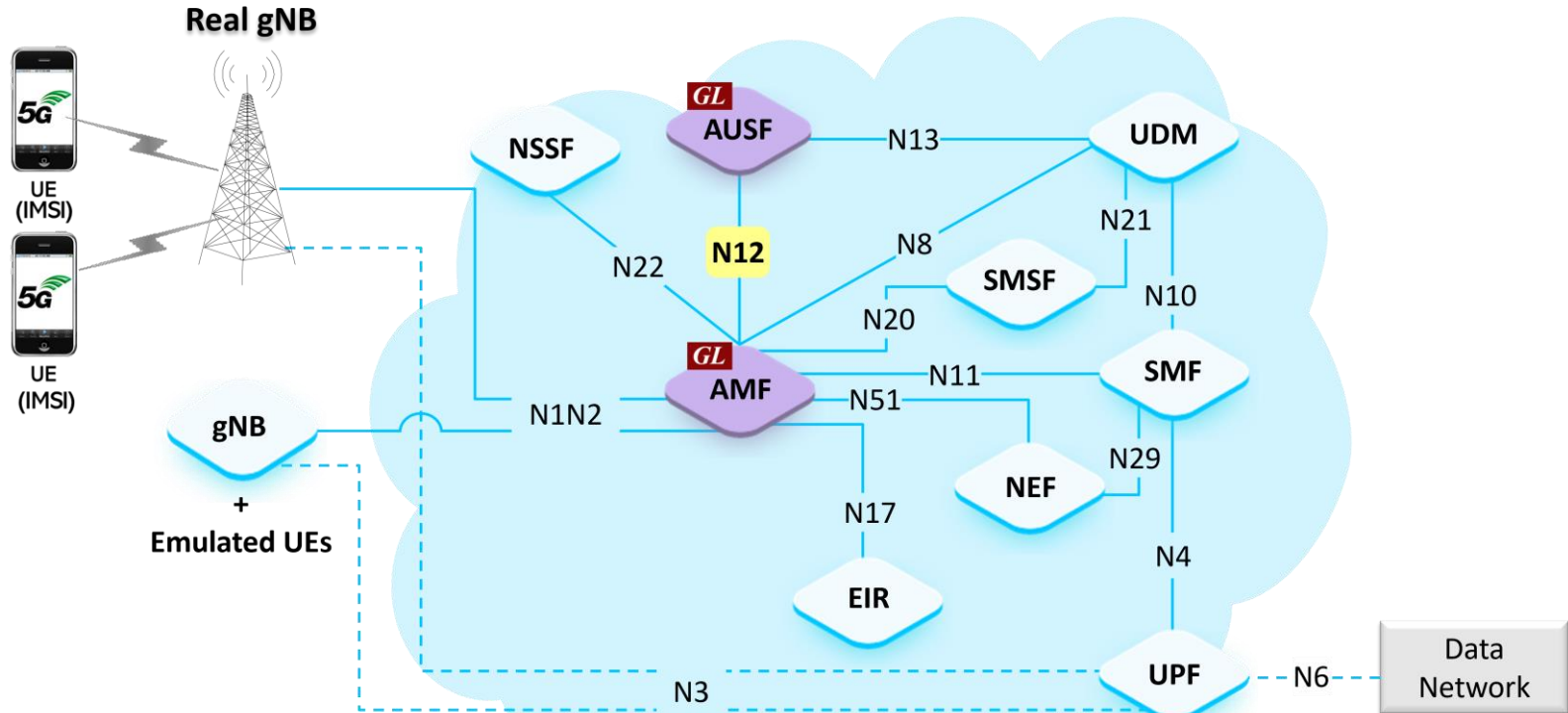
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# 5G Network Diagram



**GL** 5G Network Emulation

# MAPS™ 5G N12 Interface

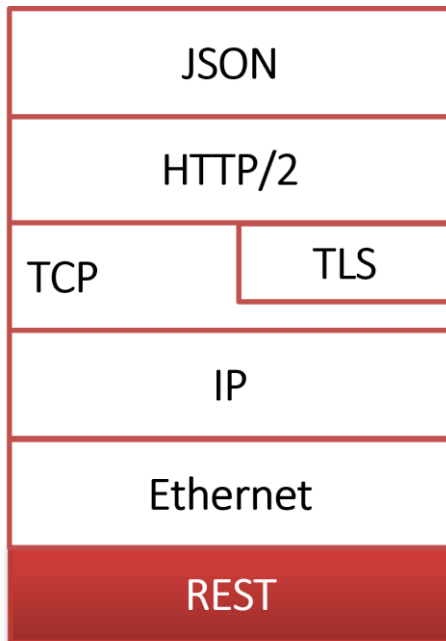


**MAPS™ 5G N12**  
*Interface Emulator*

# Main Features

- Emulate Authentication Server Function (AUSF) and Access and Mobility Management Function (AMF) elements
- Supports AKA (Authentication and Key Agreement) and Authentication Result Removal with 5G AKA method services via the Nausf service-based N12 interface
- Services use REST APIs based on HTTP and JSON data format
- Supports TLS and TCP transports
- Supports scripted call generation and automated call reception
- Supports customization of call flow and message templates to create valid and invalid scenarios
- Ready-to-use scripts for quick testing
- Provides Call Statistics and Events Status
- Supports Command Line Interface (CLI) through a client-server model, enabling users to control all features via Python APIs
- Automation, Remote access, and Schedulers to run tests 24/7

# Protocol Stack Specification



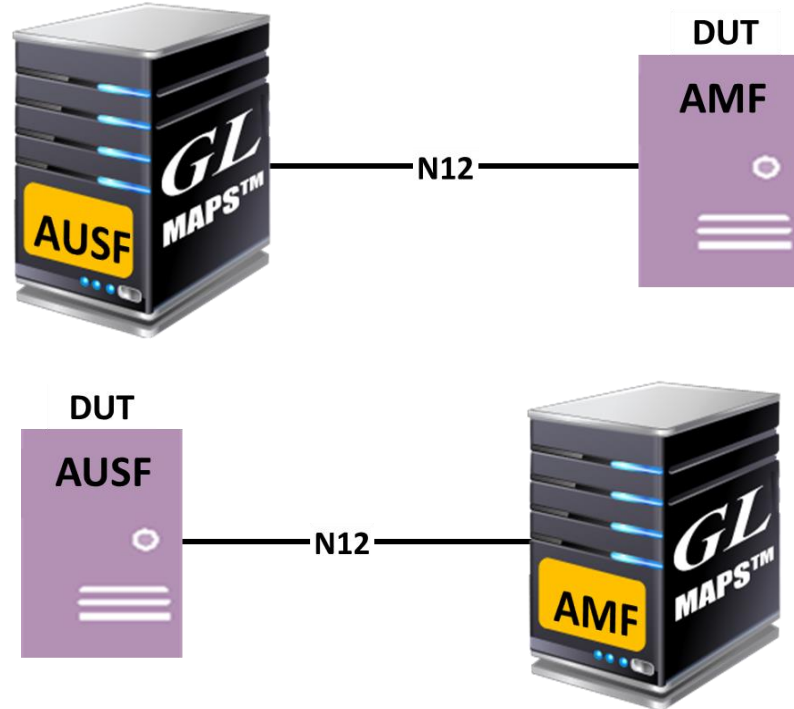
Supported Protocols	Standard / Specification Used
<b>N12 Interface</b>	
N12 Interface (AUSF - AMF)	TS29.509
JavaScript Object Notation (JSON)	IETF RFC 8259
HTTP/2	IETF RFC 7231 IETF RFC 7540/RFC 7541
TLS	IETF RFC 8446
TCP	IETF RFC 793
IPv4	IETF RFC 791 [5] IETF RFC 2460 [6]

# MAPS™ 5G N12 Interface Procedures

- Nausf\_UEAuthentication (Authentication and Key Agreement)
- Authentication Result Removal with 5G AKA method

# MAPS™ 5G N12 User Cases

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



# Testbed Setup (AUSF)

The screenshot shows the MAPS AUSF (N12 RELEASE17) configuration window. The title bar reads "MAPS AUSF (N12 RELEASE17) - [Testbed Setup - TestBedDefault]". The menu bar includes "Configurations", "Emulator", "Reports", "Editor", "Debug Tools", "Windows", and "Help". The toolbar contains various icons for file operations and system functions. The main area is divided into a tree view on the left and a configuration table on the right.

Config	Value
<b>AUSFConfigurations</b>	
<b>AUSF</b>	1
<b>AUSF 1</b>	
AUSF IP Address	192.168.12.37
AUSF Port	6666
URI Scheme	HTTP
AUSF UE Authentication API Version	v1
AUSF SoR Protection API Version	v1
AUSF UPU Protection Service API Version	v1
<b>UE Simulation Parameters</b>	
Type Of UE Simulation	Profiles
End User Configuration	UE_Profiles.xml
<b>Auto Generated Users Info</b>	
No Of Users To Be Simulated	4000
Starting IMSI	001013012041631
Auto Generated End User Configuration	AutoGeneratedUser_Profile.xml

On the right side of the configuration table, there is a checkbox labeled "Enable" which is checked. Below the table, there are "Start" and "Edit" buttons. At the bottom of the window, there are status indicators for "Initialisation Errors" and "Err".



# Testbed Setup (AMF)

The screenshot displays the configuration interface for MAPS AMF (N12 RELEASE17). The window title is "MAPS AMF (N12 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 divided into a tree view on the left and a details pane on the right. The tree view shows the following structure:

- AMFConfigurations
  - AMF
    - AMF 1
      - AMF IP Address: 192.168.12.35
      - URI Scheme: HTTP
      - AMF Client Name: AMFClient1
      - AUSF Parameters
        - AUSF
          - AUSF 1
            - AUSF IP Address: 192.168.12.37
            - AUSF Port: 6666
            - AUSF UE Authentication 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
      - MSIN: 3012041631
      - Auto Generated End User Configuration: AutoGeneratedUser\_Profile.xml

The details pane on the right shows a checked "Enable" checkbox. At the bottom of the details pane are "Start" and "Edit" buttons.

At the bottom of the window, there are two status indicators: "Initialisation Errors" and "Error Events".

# Profile Editor (AUSF)

MAPS AUSF (N12 RELEASE17) - [Profile Editor -UE\_Profiles]

Configurations Emulator Reports Editor Debug Tools Windows Help

Profiles (Edit-F2)

#	Profiles (Edit-F2)
1	MSIN3012041631
2	MSIN3012041632
3	MSIN3012041633
4	MSIN3012041634
5	MSIN3012041635
6	MSIN3012041636
7	MSIN3012041637
8	MSIN3012041638
9	MSIN3012041639
10	MSIN3012041640
11	MSIN3012041641
12	MSIN3012041642

Config

Config	Value
MSIN3012041631	
Subscriber Info	
SUPI	001013012041631
Authentication Parameters	
Authentication Type	5G_AKA
Algorithm Type 5G AKA	Tuak
KEY	00112233445566778899aabbccddeeff
Operator Variant Parameter Type	OPc
OP	01020304050607080910111213141516010203040...
OPc	01020304050607080910111213141516
SQN	000000000079
AMF	8000

Enable

Add Insert Delete

Properties

Initialisation Errors Error Events Captured Errors

# Profile Editor (AMF)

MAPS AMF (N12 RELEASE17) - [Profile Editor -UE\_Profiles]

Configurations Emulator Reports Editor Debug Tools Windows Help

Profiles (Edit-F2)

#	Profiles (Edit-F2)	Config	Value	Enable
1	UEProfile0001	UEProfile0001		<input checked="" type="checkbox"/>
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			

Subscriber Info

- SUPI: 001013012041631
- AMF Client Name: AMFClient1

PLMN ID

- MCC: 001
- MNC: 01

Authentication Parameters

- Algorithm Type 5G AKA: Tuak
- KEY: 001122334455667788...
- Operator Variant Parameter Type: OPc
- OP: 010203040506070809...
- OPc: 010203040506070809...
- SQN: 000000000079
- AMF: 8000

Sync Failure

- Simulate Sync Failure: False
- Re synchronization Info
  - RAND: 1111111111111111...
  - AUTS: 22222222222222

Buttons: Add, Insert, Delete, Properties

Initialisation Errors Error Events

# Call Generation

GL MAPS AMF (N12 RELEASE17) - [Call Generation - CallGenDefault]

Configurations Emulator Reports Editor Debug Tools Windows Help

Sr ...	Script Name	Profile	Call Info	Script Execu...	Status	Events	Events Profile	Result
1	Nausf_AMF_UEAuthentication_Request.gls	UEProfile0001	suci-0-001-01-0-0-0-3012041631	Start	Authentication Successful	None		Pass
2	Nausf_AMF_UEAuthentication_Request.gls	UEProfile0002		Start		None		Unknown
3	Nausf_AMF_UEAuthentication_Request.gls	UEProfile0003		Start		None		Unknown

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

Save Column Width Show Latest

AMF AUSF

POST /nausf-auth/v1/ue-authentications 16:19:10.834000

201 CREATED 16:19:10.859000

PUT /nausf-auth/v1/ue-authentications/AuthCtx\_001013012041631/5g-ak 16:19:10.861000

200 OK 16:19:10.883000

Find

```
POST http://192.168.12.37:6666/nausf-auth/v1/ue-authentications
content-type : application/json
accept : application/3gppHal+json,
application/problem+json

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

Scripts Message Sequence Event Config Script Flow

Initialisation Errors Error Events Captured Errors Link Status Up=0 C

# Call Reception

GL MAPS AUSF (N12 RELEASE17) - [Call Reception]

Configurations Emulator Reports Editor Debug Tools Windows Help

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Events Profile	Results
1	AUSF_HTTP2_Connection_Monitor.gls		AUSF Server Clients : AMF	Stop	Monitoring HTTP2 Connection Status	None		Unknown
2	Nausf_Control.gls		suci-0-001-01-0-0-0-3012041631	Completed	Authentication Vectors sent	None		Pass
3	Nausf_Control.gls		AuthCtx_001013012041631	Completed	5G_AKA_ConfirmationResponseSent	None		Pass

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

Save Column Width  Show Latest

AMF AUSF

POST /nausf-auth/v1/ue-authentications 16:19:10.849000

201 16:19:10.850000

Find

```
Status: 1
:method : POST
:path : /nausf-auth/v1/ue-authentications
:scheme : http
:authority : 192.168.12.37:6666
:content-type : application/json
:accept : application/3gppHal+json,
application/problem+json
:content-length : 103

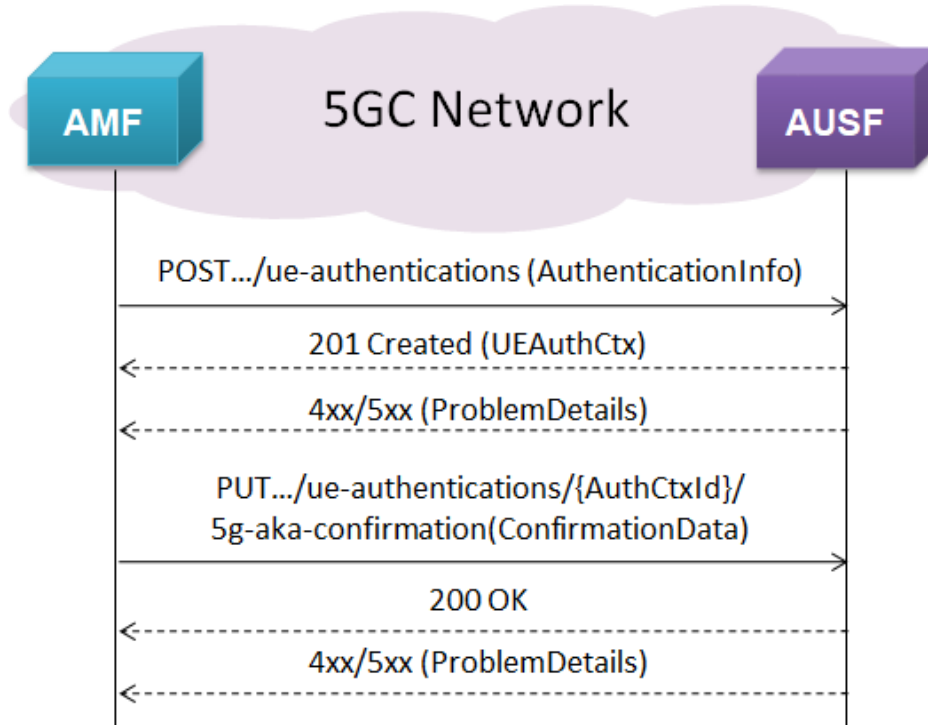
{
  "servingNetworkName": "5G:mnc001.mcc001.3gppnetwork.org",
  "supiOrSuci": "suci-0-001-01-0-0-0-3012041631"
}
```

Scripts Message Sequence Event Config Script Flow

Initialisation Errors Error Events Captured Errors Link Status Up=0 Dow

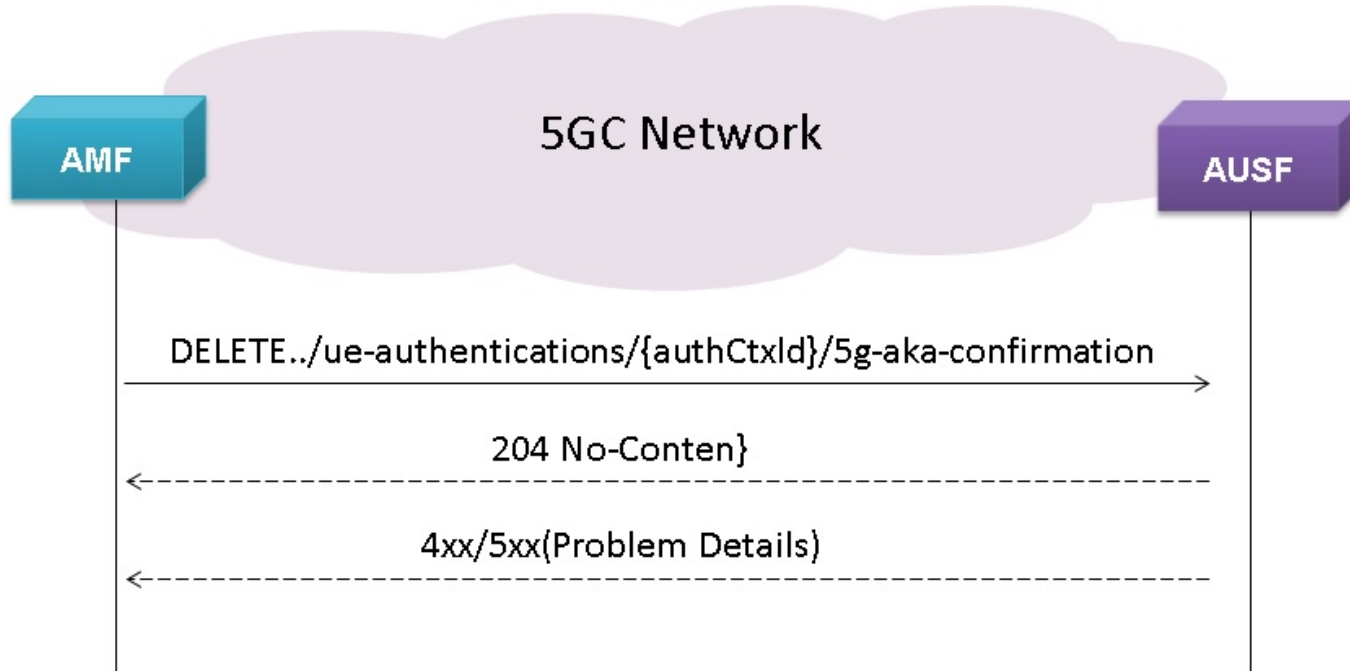
# MAPS™ 5G N12 Interface Procedures

## UE Authentication Service

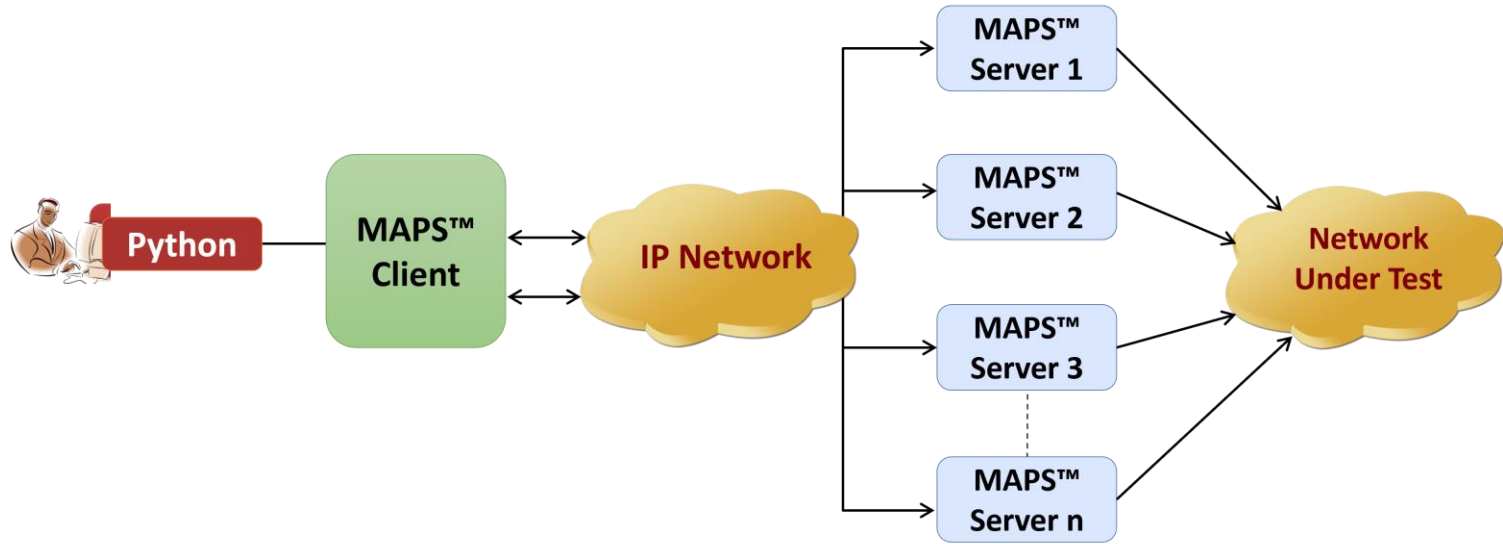


# MAPS™ 5G N12 Interface Procedures (Contd.)

## Authentication Result Removal with 5G AKA Method



# 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
{"$gAuthData":{"auth":"67C1E0025C3E80003DFD7B20037D500D","$links":{"$g-aka":{"href":"http_001013012041631/$g-aka-confirmation"},"authType":"5G_AKA
18:00:21.848        ->             PUT - /nausf-auth/
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**