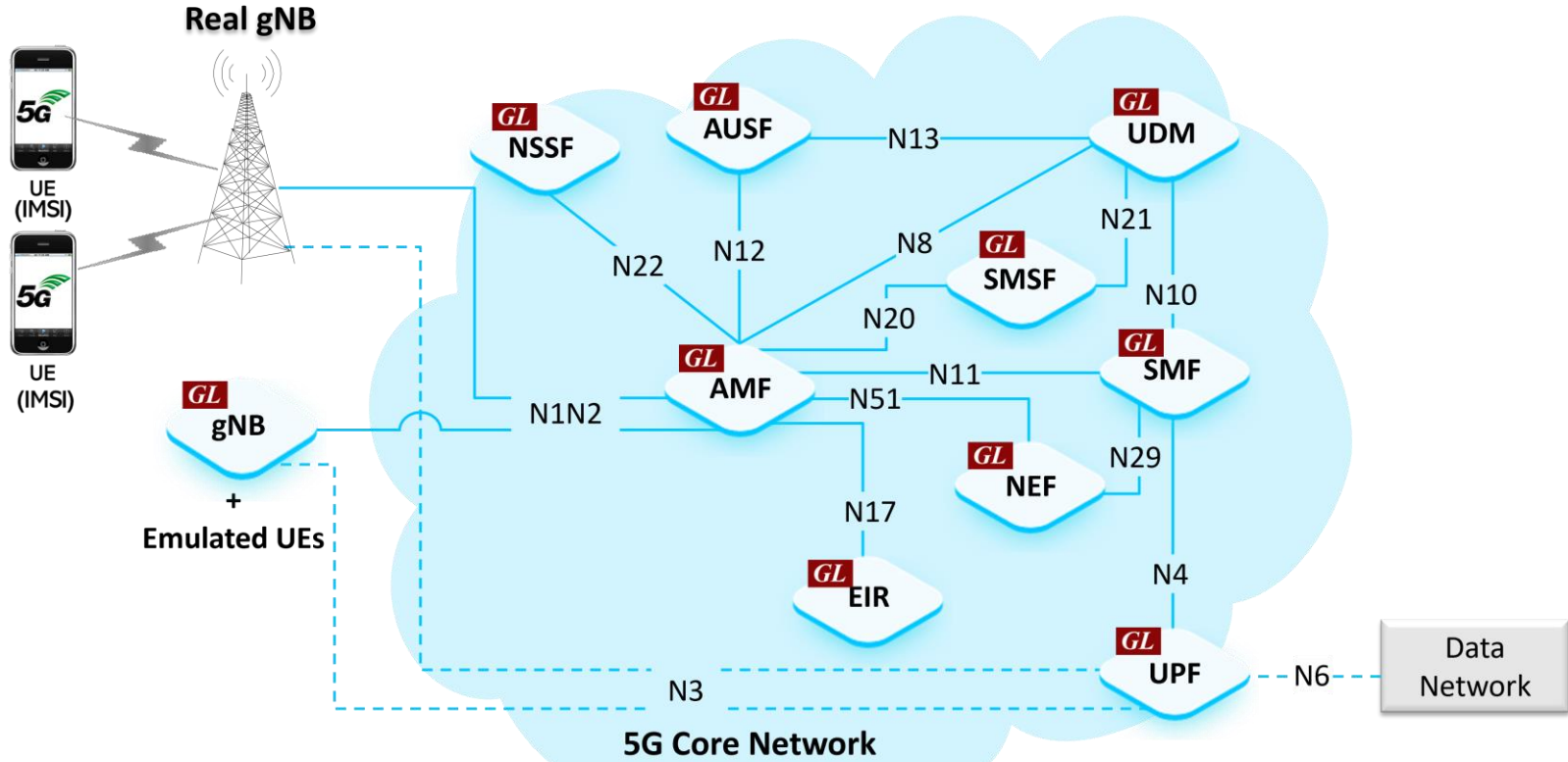

MAPS™ 5G N20 Interface Emulator



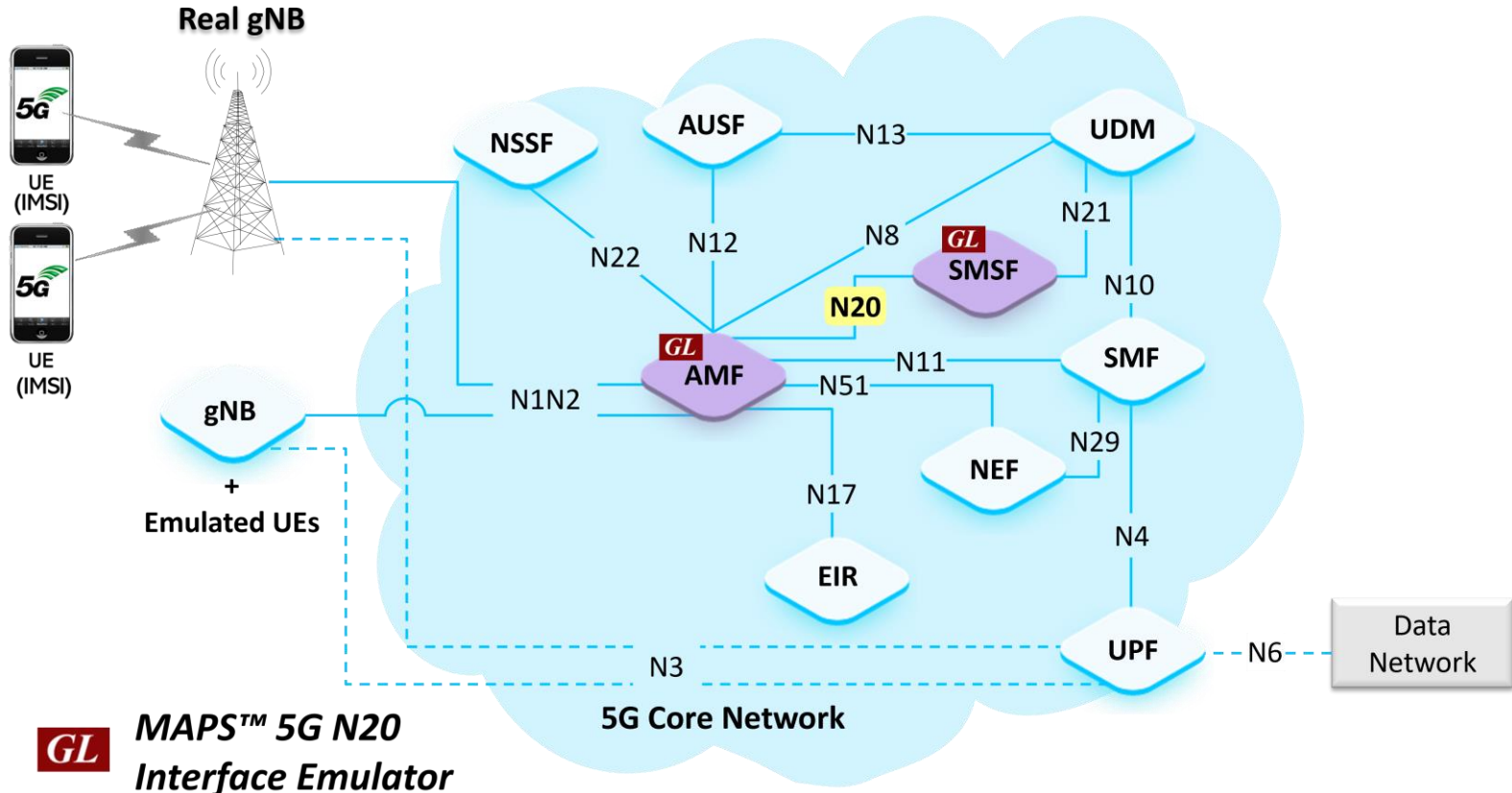
818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878
Phone: (301) 670-4784 Fax: (301) 670-9187 Email: info@gl.com
Website: <https://www.gl.com>

5G Network Diagram



GL 5G Network Emulation

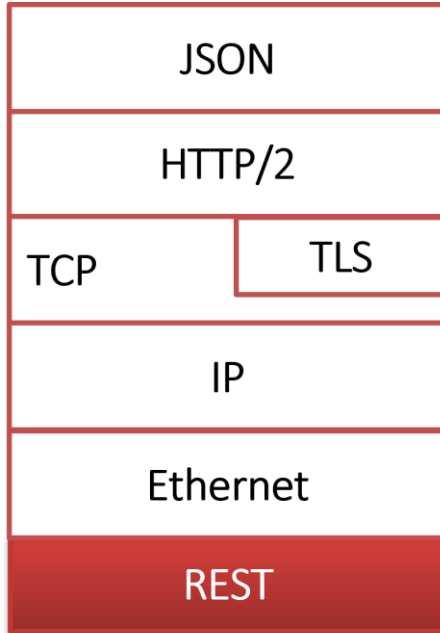
MAPS™ 5G N20 Interface Emulator



Main Features

- Emulate Short Message Service Function (SMSF) and Access and Mobility Management Function (AMF) network elements
- The following are the supported procedures:
 - Nsmsf_SMSService : Activate, Deactivate and UplinkSMS (MOSMS)
 - Namf_Communication Service : N1N2MessageTransfer(UE Specific)
- 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 transports
- Offers NF service consumer to authorize SMS and activate SMS for a service via Nsmsf service on N20 interface
- Supports scripted call generation and automated call reception
- Supports customization of call flow and message templates using Script and JSON messages
- Ready to use scripts for quick testing
- Provides Call Statistics and Events Status
- Automation, Remote access, and Schedulers to run tests 24/7

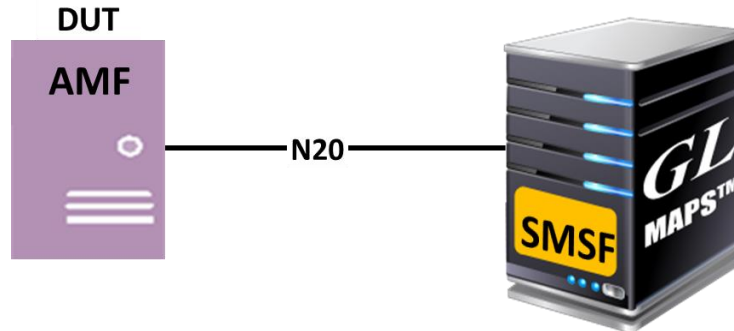
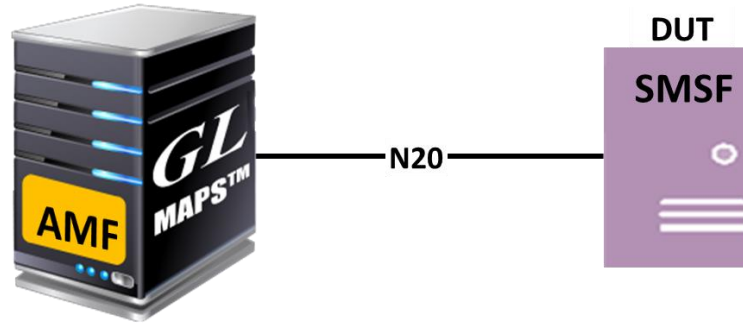
Protocol Stack Specification



Supported Protocols	Standard / Specification Used
N20 Interface	
N20 Interface (SMSF - AMF)	TS29.540 TS29.518
JavaScript Object Notation (JSON)	IETF RFC 8259
HTTP 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 N20 User Cases

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



Testbed Setup (AMF)

The screenshot shows the MAPS AMF (N20 RELEASE17) configuration window. The window title is "MAPS AMF (N20 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 a tree view showing the following structure:

- AMF Configuration
 - AMF
 - AMF 1
 - AMF IP Address: 192.168.12.89
 - AMF Serving Port: 7777
 - URI Scheme: HTTP
 - AMF Client Name: Client1
 - AMF API Versions
 - AMF Communication Service API Version: v1
 - AMF EventExposure Service API Version: v1
 - AMF MT Service API Version: v1
 - AMF Location Service API Version: v1
 - SMSF
 - SMSGF 1
 - SMSGF IP Address: 192.168.12.35
 - SMSGF Port: 7777
 - SMSGF Service API Version: v2
 - UE Simulation Parameters
 - Type Of UE Simulation: Profiles
 - End User Configuration: AMF_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 right side of the window has an "Enable" checkbox which is checked. At the bottom right, there are "Start" and "Edit" buttons. At the bottom of the window, there are two status indicators: "Initialisation Errors" and "Error Even".

Testbed Setup (SMSF)

The screenshot shows the MAPS SMSF (N20 RELEASE17) configuration window titled "[Testbed Setup - TestBedDefault]". The window contains a menu bar (Configurations, Emulator, Reports, Editor, Debug Tools, Windows, Help) and a toolbar with various icons. The main area is a configuration tree with a table of settings.

Config	Value	Enable
SMSFConfiguration		<input checked="" type="checkbox"/>
SMSF	1	
SMSF 1		
SMSF IP Address	192.168.1.31	
SMSF Server Port	7777	
URI Scheme	HTTPS	
SMS Service API Version	v2	
AMF	1	
AMF 1		
AMF IP Address	192.168.1.31	
AMF Port	7776	
AMF API Versions		
AMF Communication Service API Version	v1	
AMF EventExposure Service API Version	v1	
AMF MT Service API Version	v1	
AMF Location Service API Version	v1	
UE Simulation Parameters		
Type Of UE Simulation	Profiles	
End User Configuration	SMSF_Profiles.xml	
Auto Generated Users Info		
No Of Users To Be Simulated	4000	
Starting IMSI	001013012041631	
Auto Generated End User Configuration	AutoGeneratedUser_Profile.xml	

Buttons: Start, Edit

Status: Initialisation Errors, Error Events

Profile Editor (AMF)

MAPS AMF (N20 RELEASE17) - [Profile Editor -AMF_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
13	MSIN3012041643
14	MSIN3012041644

Config

- MSIN3012041631
 - Mobile Identity
 - SUCI
 - IMSI: 001013012041631
 - MCC: 001
 - MNC: 01
 - MSIN: 3012041631
 - AMF Client Selection: Client1
 - SMS Call Parameters
 - SMS Character Set: Default
 - SMS Data for Default and 8 Bit Data: MAPS 5G Test MO SMS 0001
 - SMS Data for UCS2: 004D00410050002000350047002000540065007300740020004D00...
 - Destination MSIDN Number: 3012041681
 - SMSC Address Parameters
 - Destination SC: 885643722311
 - Numbering Plan: ISDN/Telephony numbering plan(REC E.164/E.163)
 - Type of Number: International number

Value

Enable

Add Insert Delete Properties

Initialisation Errors Error Events Captured Errors Link

Profile Editor (SMSF)

The screenshot displays the 'Profile Editor - SMSF_Profiles' 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 'Profiles (Edit-F2)' list shows 15 profiles. The main workspace is divided into a tree view on the left and a table on the right. The tree view shows the configuration hierarchy for the selected profile, including Mobile Identity (SUCI) and SMS Call Parameters (SMS Character Set, SMS Data for Default and 8 Bit Data, SMS Data for UCS2, SMS Calling Number, Originating SME, SMS Call Type, SMSC Address Parameters). The table on the right lists the values for these parameters. A 'Properties' panel on the far right shows the 'Enable' checkbox is checked. At the bottom, there are buttons for 'Add', 'Insert', 'Delete', and 'Properties', and a status bar with 'Initialisation Errors', 'Error Events', 'Captured Errors', and 'Lin'.

#	Profiles (Edit-F2)	Config	Value	Enable
1	MSIN3012041631	MSIN3012041631		<input checked="" type="checkbox"/>
2	MSIN3012041632			
3	MSIN3012041633			
4	MSIN3012041634			
5	MSIN3012041635			
6	MSIN3012041636			
7	MSIN3012041637			
8	MSIN3012041638			
9	MSIN3012041639			
10	MSIN3012041640			
11	MSIN3012041641			
12	MSIN3012041642			
13	MSIN3012041643			
14	MSIN3012041644			
15	MSIN3012041645			

Config	Value
Mobile Identity	
SUCI	
IMSI	001013012041631
MCC	001
MNC	01
MSIN	3012041631
SMS Call Parameters	
SMS Character Set	8 Bit Data
SMS Data for Default and 8 Bit Data	MAPS 5G Test MT SMS 0001
SMS Data for UCS2	004D00410050002000350047002000540065007300740020004D00...
SMS Calling Number	3012041681
Originating SME	995643722311
SMS Call Type	Mobile To Mobile
SMSC Address Parameters	
Originating SC	885643722311
Numbering Plan	ISDN/Telphony numbering plan(REC E.164/E.163)
Type of Number	International number

Call Generation

GL MAPS AMF (N20 RELEASE17) - [Call Generation -CallGenDefault]

Configurations Emulator Reports Editor Debug Tools Windows Help

Sr No	Script Name	Profile	Call Info	Script Executi...	Status	Events	Events Profile	Result	Total Iterations	Comp
1	Nsmsf_AMF_SMSservice_Activation.gls	MSIN3012041631	imsi-001013012041631	Start	SMSservice Activation Successful	None		Pass	1	
2	Nsmsf_AMF_Mo_SMS.gls			Start		None		Unknown	1	
3	Nsmsf_AMF_SMSservice_Deactivation.gls			Start		None		Unknown	1	

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

Save Column Width Show Latest

AMF SMSF

PUT /nsmsf-sms/v2/ue-contexts/imsi-001013012041631 11:07:37.660000

201 CREATED 11:07:37.956000

Status: 201
:status : 201
content-type : application/json
location : https://192.168.1.31:7777/nsmsf-sms/v2/ue-contexts/imsi-001013012041631
content-length : 120

```
{  
  "accessType": "3GPP_ACCESS",  
  "amfId": "9300ef7b-93ca-440a-905a-cc3f64af71e9",  
  "ratType": "NR",  
  "supi": "imsi-001013012041631"  
}
```

Scripts Message Sequence Event Config Script Flow

Initialisation Errors Error Events Captured Errors Link Status

Call Reception

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Events Profile	Results
1	SMSF_HTTP2_Connection_Monitor.gls		SMSF Server Clients :	Stop	Monitoring HTTP2 Connction STatus	Connect Server		Unknown
2	SMSF_Control.gls		imsi-001013012041631	Completed	SM Service Activated	None		Pass

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

Save Column Width Show Latest

AMF SMSF

PUT /nsmf-sms/v2/ue-contexts/imsi-001013012041631 11:07:37.931000

201 11:07:37.948000

Find

```
Status: 201
content-type : application/json
location : https://192.168.1.31:7777/nsmf-sms/v2/ue-cont
{
  "accessType": "3GPP_ACCESS",
  "amfId": "9300ef7b-93ca-440a-905a-cc3f64af71e9",
  "ratType": "NR",
  "supi": "imsi-001013012041631"
}
```

Scripts Message Sequence Event Config Script Flow

Initialisation Errors Error Events Captured Errors Li

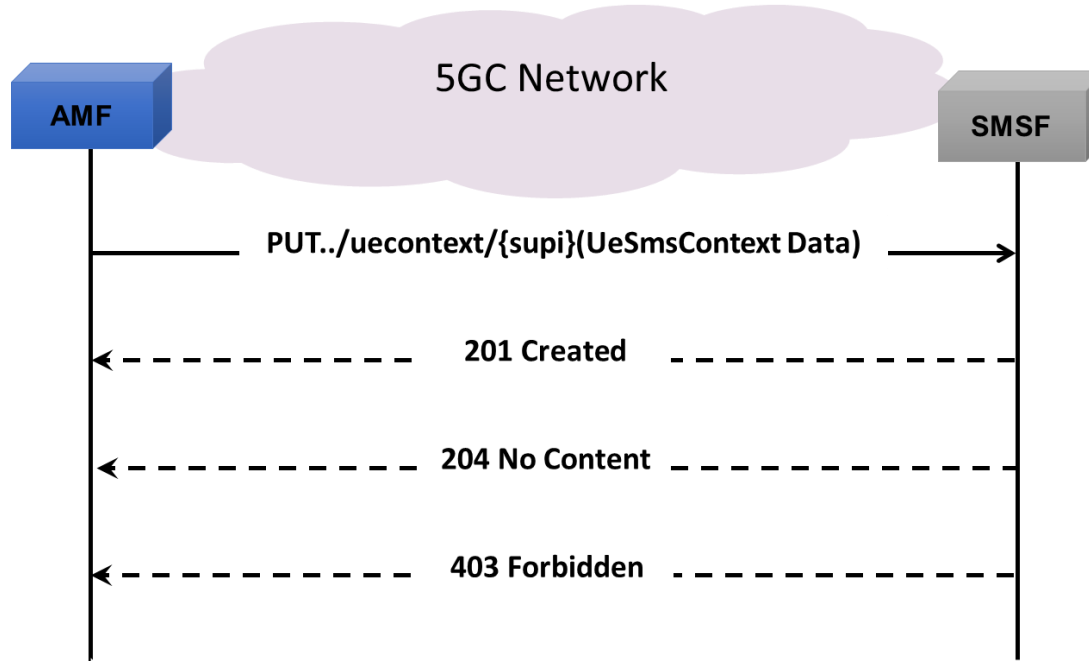
MAPS™ 5G N20 Interface Procedures

- Nsmsf procedures
 - Registration using Activate service procedure
 - De-Registration using Deactivate service procedure
 - Send SMS payload in uplink direction procedure
 - Namf_Communication Service procedure

MAPS™ 5G N20 Interface Procedures

Namf_Communication Service

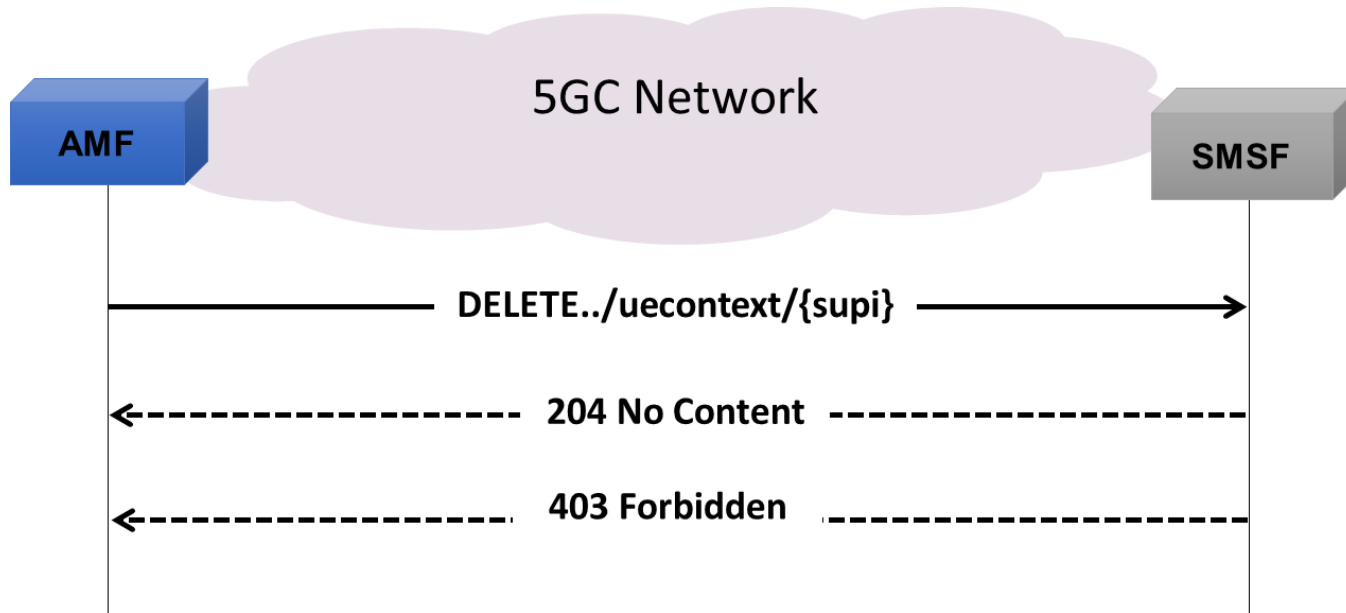
Registration using Activate service procedure



MAPS™ 5G N20 Interface Procedures

Namf_Communication Service

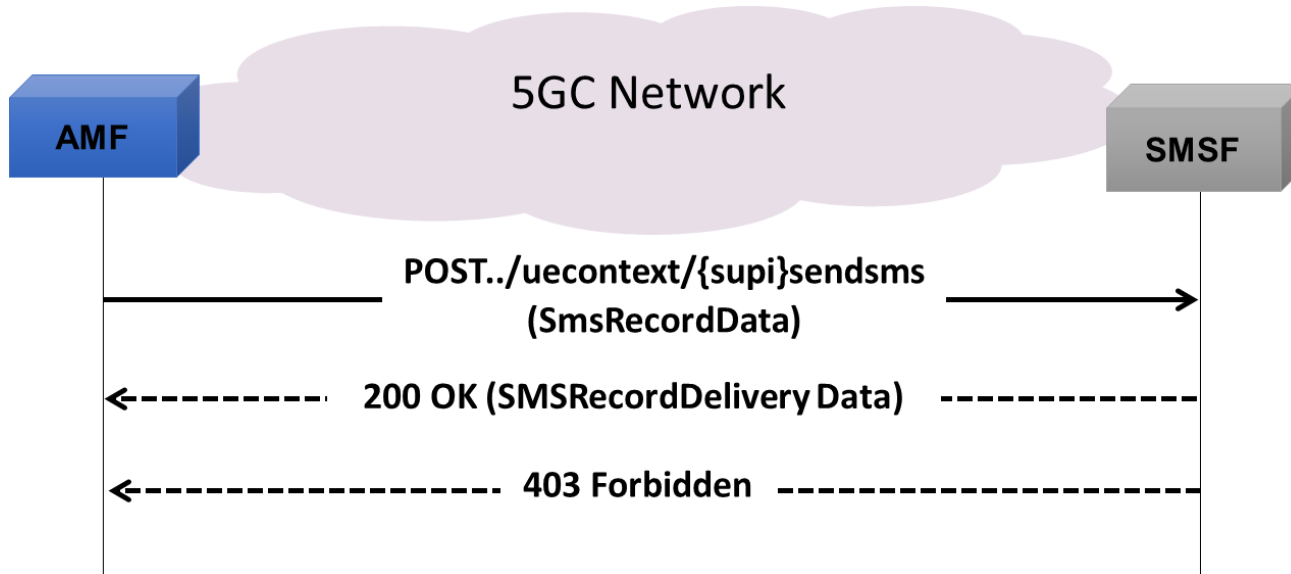
De-Registration using Deactivate service procedure



MAPS™ 5G N20 Interface Procedures

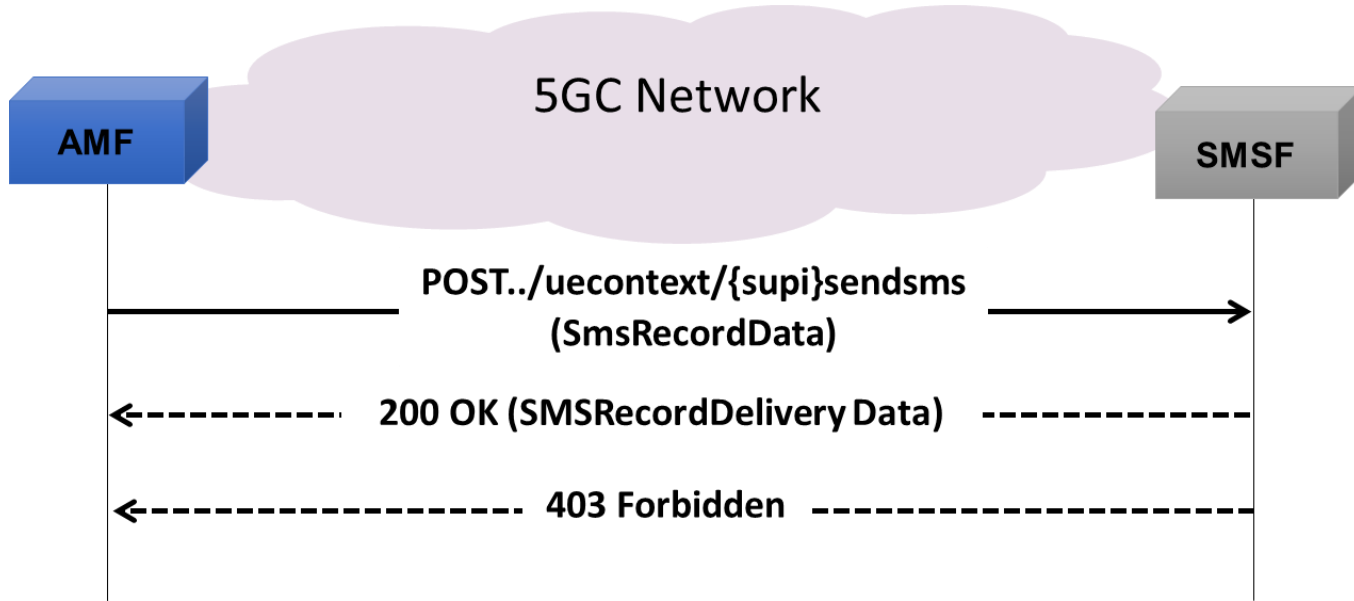
Namf_Communication Service

Send SMS payload in uplink direction procedure

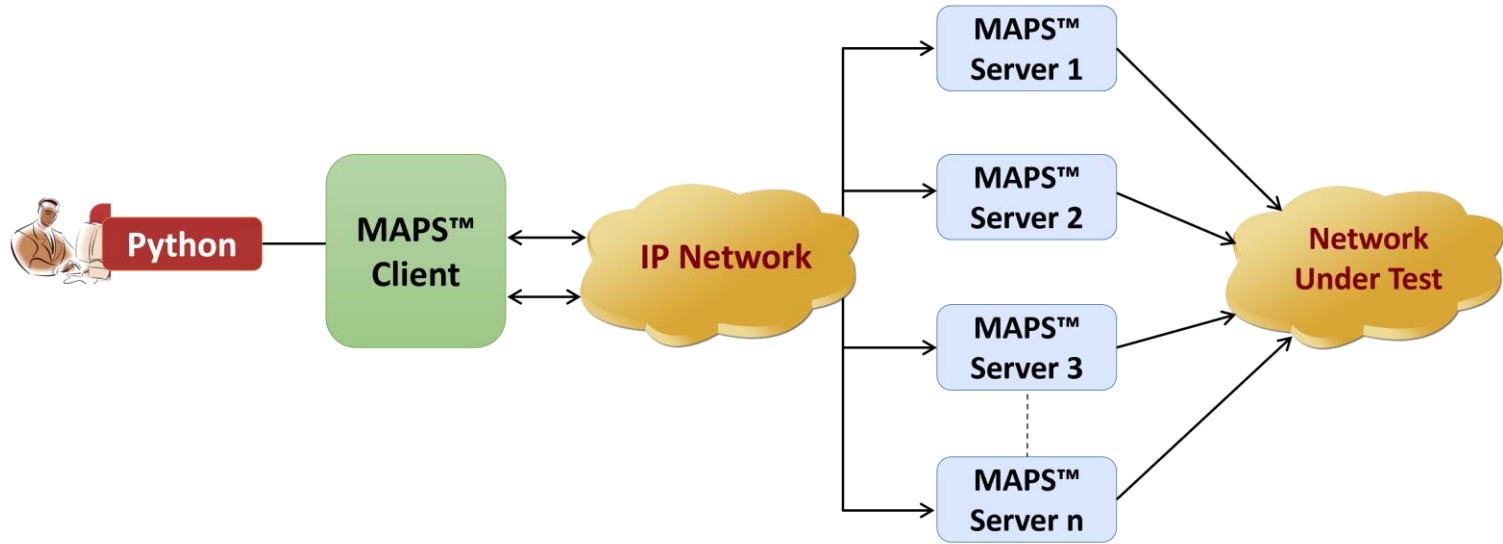


MAPS™ 5G N20 Interface Procedures

Namf_Communication 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

Python Client and MAPS™ CLI Server

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\MAPS5G-N20\MAPSCLI\PythonClie
t\examples\AMF\N20_AMF_PlaceCall.py
N20 CLI Server Connection... True
N20 Testbed Starting ... True
N20 Profile Loading... True
N20 Nsmf_AMF_SMSservice_Activation.gls Script Started... Prof:
  Profile loaded
True
====Message: Send SMSF_SMSservice Request Procedure====
N20_Call Initiation Status ...   script_name == Nsmf_AMF_SMSse
gls
service_type == SMSserviceActivation
access_type == 3GPP_ACCESS
N20_user_event= Request SMSserviceActivation
N20_status= Applied
result == 0
True
Call Response Status...  SMSservice Activation Successful
ResponseStatus =  SMSservice Activation Successful
status after sm service success=== SMSservice Activation Success:
*****   AutoSendMOSMS===== Disable
MAPS N20 MsgCount: 1
```

MAPS™ CLI Server

```
CLI MapsCLI AMF (N20 RELEASE17)
File Edit View
View Latest Command
1 :: 2024-1-19 17:03:40.108000 : Start TestBedDefault.xml # "_TypeOfUESimulation"="XML";
1 :: 2024-1-19 17:03:43.631000 : LoadProfile "AMF_Profiles.xml"
1 :: 2024-1-19 17:03:43.851000 : StartScript 1 "Nsmf_AMF_SMSservice_Activation.gls" "MSIN3012041631" 1 = "IMSI"="(binarystring)001013012041631,"AccessType"="3GPP_ACCESS","CallFlowDebug"=1,"EnableCLI"=1;
1 :: 2024-1-19 17:03:44.279000 : UserEvent 1 "Request SMSserviceActivation";
1 :: 2024-1-19 17:03:44.933000 : UserEvent 1 "GetCallStatus";
1 :: 2024-1-19 17:03:45.045000 : UserEvent 1 "Initiate UPLinkSMS";
1 :: 2024-1-19 17:03:55.229000 : UserEvent 1 "Request SMSserviceDeactivation";
1 :: 2024-1-19 17:03:55.341000 : UserEvent 1 "GetCallStatus";
1 :: 2024-1-19 17:04:05.529000 : UserEvent 1 "GetMessageCount";
1 :: 2024-1-19 17:04:05.641000 : UserEvent 1 "GetLastReceivedMessage";
ServerLog:errCode = 0,errString =No error for ClientId =1
1 :: 2024-1-19 17:04:08.083000 : StopScript 1
2 :: 2024-1-19 17:04:09.615000 : Start TestBedDefault.xml # "_TypeOfUESimulation"="XML";
2 :: 2024-1-19 17:04:09.724000 : LoadProfile "AMF_Profiles.xml"
2 :: 2024-1-19 17:04:09.931000 : StartScript 1 "Nsmf_AMF_SMSservice_Activation.gls" "MSIN3012041631" 1 = "IMSI"="(binarystring)001013012041631,"AccessType"="3GPP_ACCESS","CallFlowDebug"=1,"EnableCLI"=1;
2 :: 2024-1-19 17:04:10.489000 : UserEvent 1 "Request SMSserviceActivation";
2 :: 2024-1-19 17:04:10.696000 : UserEvent 1 "GetCallStatus";
2 :: 2024-1-19 17:04:10.696000 : UserEvent 1 "GetMessageCount";
2 :: 2024-1-19 17:04:10.821000 : UserEvent 1 "GetLastReceivedMessage";
ServerLog:errCode = 0,errString =No error for ClientId =2
2 :: 2024-1-19 17:04:17.400000 : StopScript 1
3 :: 2024-1-19 17:04:20.686000 : Start TestBedDefault.xml # "_TypeOfUESimulation"="XML";
3 :: 2024-1-19 17:04:20.798000 : LoadProfile "AMF_Profiles.xml"
3 :: 2024-1-19 17:04:21.022000 : StartScript 1 "Nsmf_AMF_SMSservice_Activation.gls" "MSIN3012041631" 1 = "IMSI"="(binarystring)001013012041631,"AccessType"="3GPP_ACCESS","CallFlowDebug"=1,"EnableCLI"=1;
3 :: 2024-1-19 17:04:21.454000 : UserEvent 1 "Request SMSserviceActivation";
3 :: 2024-1-19 17:04:21.562000 : UserEvent 1 "GetCallStatus";
3 :: 2024-1-19 17:04:21.674000 : UserEvent 1 "GetMessageCount";
3 :: 2024-1-19 17:04:21.786000 : UserEvent 1 "GetLastReceivedMessage";
3 :: 2024-1-19 17:04:51.989000 : UserEvent 1 "GetMessageInfo" # "Index"=0;
ServerLog:errCode = 0,errString = connection has been gracefully closed for ClientId =3
3 :: 2024-1-19 17:04:52.196000 : StopScript 1
```

Thank you