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# MAPS™ 5G N21 Interface Emulator

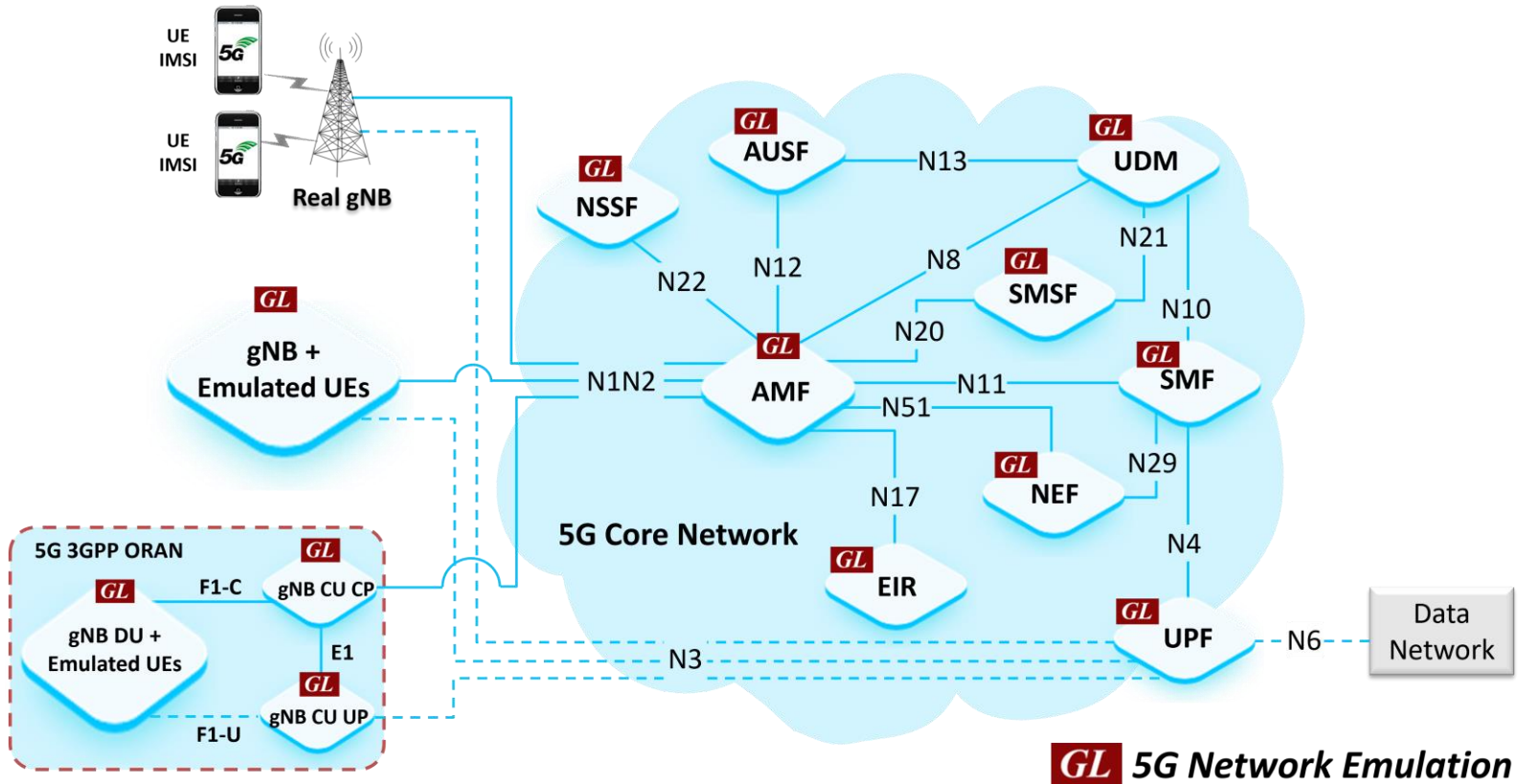
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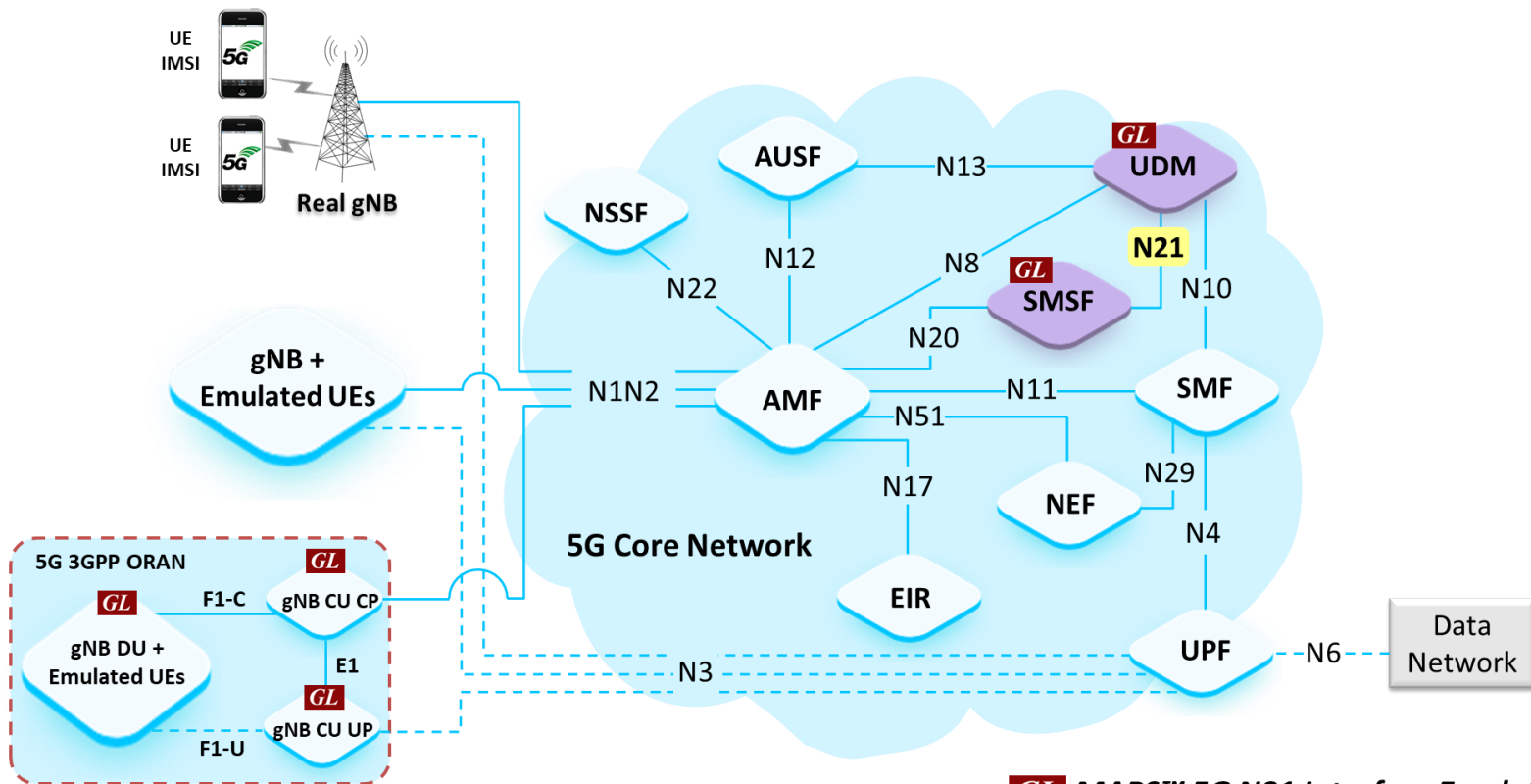


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# 5G Network Diagram



# MAPS™ 5G N21 Interface

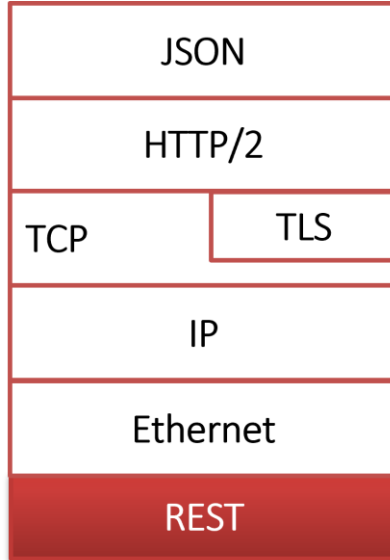


**GL** MAPS™ 5G N21 Interface Emulator

# Main Features

- Emulate Short Message Service Function (SMSF) and Unified Data Management (UDM) elements
- Supports Nudm\_SubscriberDataManagement Services (Get, Subscribe, ModifySubscription, Unsubscribe and Notification operations) and Nudm\_UEContextManagement Services (SMSF Registration and Deregistration operations)
- 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
- Supports scripted call generation and automated call reception
- Supports customization of call flow and message templates using Script and Message Editor
- Ready-to-use scripts for quick testing
- Provides Call Statistics and Events Status

# Protocol Stack



Supported Protocols	Standard / Specification Used
<b>N21 Interface</b>	
N21 Interface (UDM-SMSF)	TS29.503 (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]

# User Cases

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



# Testbed Setup (UDM)

The screenshot shows the MAPS UDM (N21 RELEASE17) configuration window. The window title is "MAPS UDM (N21 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 debugging. The main area is divided into a tree view on the left and a table on the right. The tree view shows the "UDM Configuration" folder expanded, with sub-folders for "UDM", "UDM 1", "UDM API Versions", and "UE Simulation Parameters". The table on the right lists the configuration values for each item. The "Enable" checkbox is checked. At the bottom right, there are "Start" and "Edit" buttons. At the bottom of the window, there are status indicators for "Initialisation Errors" and "Error Events".

Config	Value	Enable
UDM Configuration		<input checked="" type="checkbox"/>
UDM	1	
UDM 1		
UDM IP Address	192.168.1.31	
UDM Port	5055	
URI Scheme	HTTP	
UDM API Versions		
UE Authentication Service	v1	
Context Management Service	v1	
Subscriber Data Management Service	v2	
Event Exposure Service	v1	
Parameter Provision Service	v1	
NIDD Authorization Service	v2	
UE Simulation Parameters		
Type Of UE Simulation	Profiles	
End User Configuration	UE_Profiles_N21UDM.xml	
Auto Generated Users Info		

# Testbed Setup (SMSF)

The screenshot shows the MAPS SMSF (N21 RELEASE17) configuration window. The window title is "MAPS SMSF (N21 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 configuration area is divided into two panes. The left pane shows a tree view of the configuration, and the right pane shows the values for the selected configuration item.

Config	Value
SMSGF Configuration	
SMSGF	1
SMSGF 1	
SMSGF IP Address	192.168.1.161
SMSGF Server Port	5055
URI Scheme	HTTP
SMSGF Client Name	SMSGFClient1
UDM	1
UDM 1	
UDM IP Address	192.168.1.31
UDM Port	5055
UDM API Versions	
UE Authentication Service	v1
Context Management Service	v1
Subscriber Data Management Service	v2
Event Exposure Service	v1
Parameter Provision Service	v1
NIDD Authorization Service	v2
UE Simulation Parameters	
Type Of UE Simulation	Profiles
End User Configuration	UE_Profiles_N21SMSF.xml
Auto Generated Users Info	

The right pane shows a checkbox labeled "Enable" which is checked. At the bottom of the right pane are "Start" and "Edit" buttons.

# Profile Editor (UDM)

MAPS UDM (N21 RELEASE17) - [Profile Editor -UE\_Profiles\_N21UDM]

Configurations Emulator Reports Editor Debug Tools Windows Help

#	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			
16	MSIN3012041646			
17	MSIN3012041647			
18	MSIN3012041648			
19	MSIN3012041649			
20	MSIN3012041650			
21	MSIN3012041651			
22	MSIN3012041652			
23	MSIN3012041653			

Subscriber Info

- IMSI: 001013012041631
- IMEI: 359877068325248
- IMEISV: 1234567890123001
- MSIN: 3012041631

HPLMN ID

- MCC: 001
- MNC: 01

Expected UE Behaviour List

- Supported Features: 0
- SMS Subscribed: True
- Shared SMS Subs Datald: 0
- MT SMS Subscribed: True
- MT SMS Barring All: False
- MT SMS Barring Roaming: False
- MO SMS Subscribed: True
- MO SMS Barring All: False
- MO SMS Barring Roaming: False
- Shared SMS Management Datalds: 0

Enable or Disable Optional Procedures

- Enable Failure Procedure: False
- Failure Status Code: 404(Not Found)
- Failure Cause for 403: NO PS SUBSCRIPTION
- Failure Cause for 404: CONTEXT NOT FOUND
- Failure Cause for 422: UNPROCESSABLE REQ...

Trace Data

- Trace Data 1
  - Trace Reference: 001001N8AMF1
  - Trace Depth: MINIMUM
  - Ne Type List: AM

Add Insert Delete Properties

Insert Delete Clear

Initialisation Errors Error Events

# Profile Editor (SMSF)

MAPS SMSF (N21 RELEASE17) - [Profile Editor -UE\_Profiles\_N21SMSF]

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 Value

MSIN3012041631

- Subscriber Info
  - SUPI 001013012041631
  - MSIN 3012041631
  - IMEI 359877068325248
  - IMEISV 1234567890123001
- SMSF Client Name SMSFClient1
- PLMN ID
  - MCC 001
  - MNC 01
- UECM Service Request SMSF Registration for 3GPP Access
- SDM Service Request Get SMS-Mng-Data
- SDM Subscription
  - Subscription Expires 2022-08-02T025:09:13.445Z
  - Immediate Report False

Enable

Add Insert Delete

Properties

Insert Delete Clear

Initialisation Errors Error Events

# Call Generation

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Events Profile	Result	Total Iterations	Completed Iterations
1	Nudm_UECM_Control.gls	MSIN3012041631	SUPI :_imsi-001013012041631	Start	SMSF Registration for 3GPP access is successful	None		Pass	1	1
2	Nudm_SDM_Control.gls			Start		None		Unknown	1	0

Message Sequence:

```
PUT http://192.168.1.31:5055/nudm-uecm/v1/imsi-001013012041631/registrations/smsf-3gpp-content-type : application/json
accept : application/json,
application/problem+json
{
  "plmnId": {
    "mcc": "001",
    "mnc": "01"
  },
  "smsfInstanceId": "b386d0d5-3097-4d68-b99d-3ac32e557af9",
  "supportedFeatures": "0"
}
```

# Call Reception

MAPS UDM (N21 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	UDM_HTTP2_Connection_Monitor.gls		UDM Server Clients : AMF	Stop	Monitoring HTTP2 Connection Status	None		Unknown
2	Nudm_UECM_Control.gls		SUPI : imsi-001013012041631	Completed	SMSF Registration is updated	None		Pass

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

Save Column Width  Show Latest

SMSF UDM

PUT /nudm-uecm/v1/imsi-001013012041631/registrations/smsf-3gpp-access 14:55:22.267000

200 14:55:22.267000

Find

```
Status: 3
:method : PUT
:path : /nudm-uecm/v1/imsi-001013012041631/registrations/smsf-3gpp-
:scheme : http
:authority : 192.168.1.31:5055
:content-type : application/json
:accept : application/json,
application/problem+json
:content-length : 115

{
  "plmnId":{
    "mcc":"001",
    "mnc":"01"
  },
  "smsfInstanceId":"b386d0d9-3097-4d68-b99d-3ac32e557af9",
  "supportedFeatures":"0"
}
```

Scripts **Message Sequence** Event Config Script Flow

Initialisation Errors Error Events Captured Errors Lin

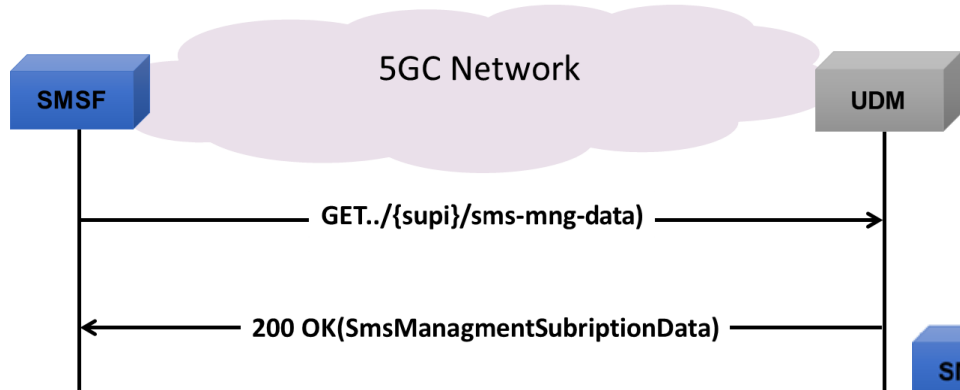
# MAPS™ 5G N21 Interface Procedures

- **Nudm\_SubscriberDataManagement Service**
  - SMS Management Subscription Data Retrieval
  - Subscription to Notifications of Data Change
  - Unsubscribe to Notifications of Data Change
  - Modification of a Subscription to Notifications of Data Change
- **Nudm\_UEContextManagement Service**
  - SMSF Registration for 3GPP Access
  - SMSF Registration for Non 3GPP Access
  - SMSF Deregistration for 3GPP Access
  - SMSF Deregistration for Non 3GPP Access

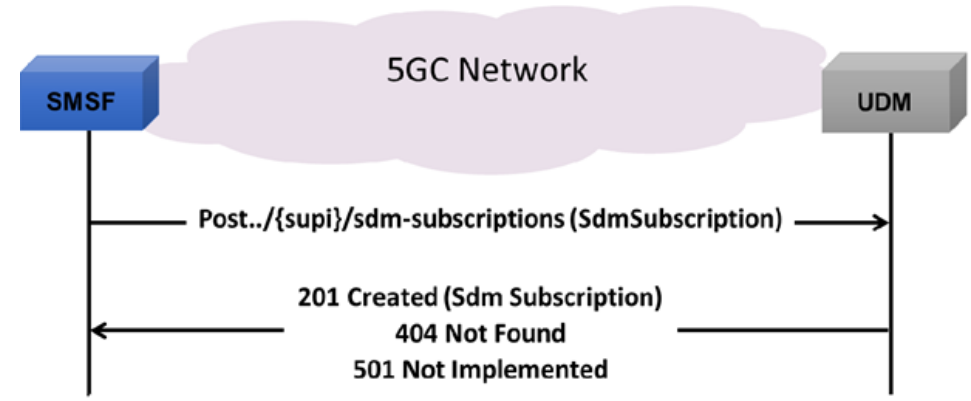
# MAPS™ 5G N21 Interface Procedures

## Nudm\_SubscriberDataManagement Service

### SMS Management Subscription Data Retrieval



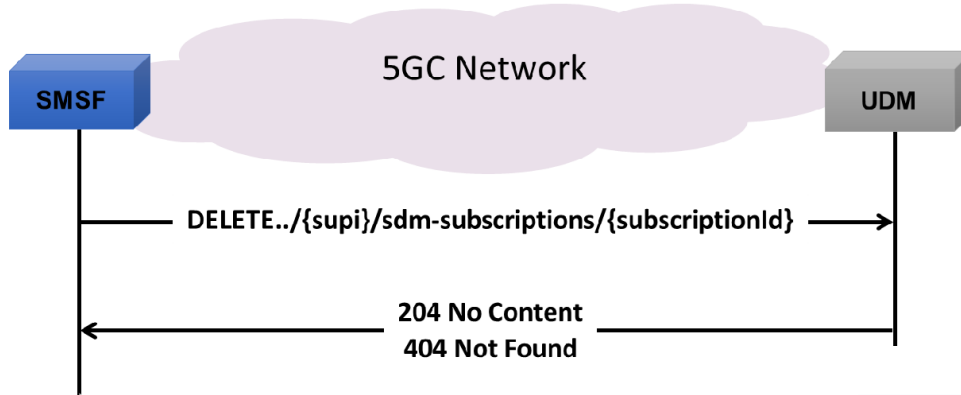
### Subscription to Notifications of Data Change



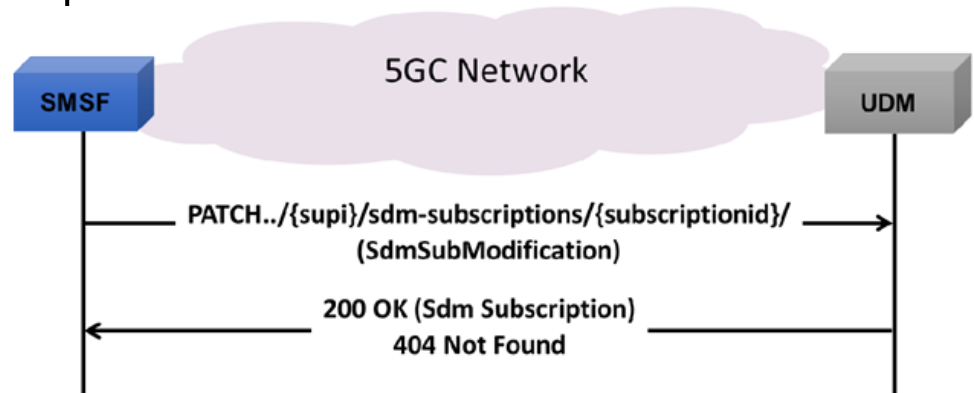
# MAPS™ 5G N21 Interface Procedures (Contd.)

## Nudm\_SubscriberDataManagement Service

### Unsubscribe to Notifications of Data Change



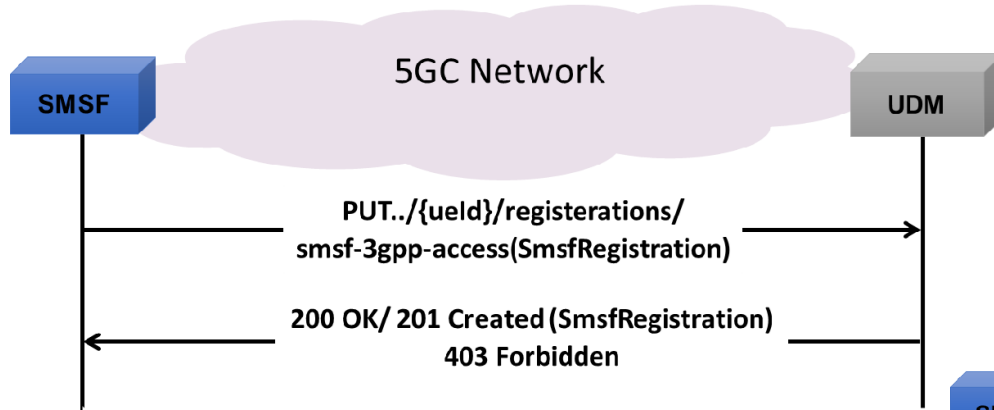
### Modification of a Subscription to Notifications of Data Change



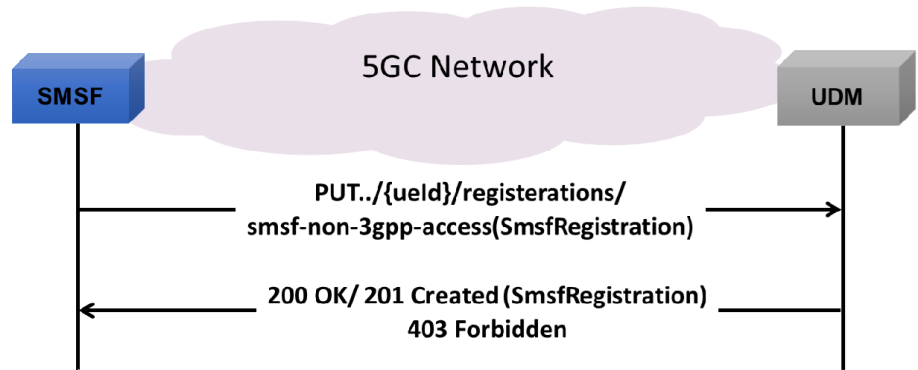
# MAPS™ 5G N21 Interface Procedures (Contd.)

## Nudm\_UEContextManagement Service

### SMSF Registration for 3GPP Access



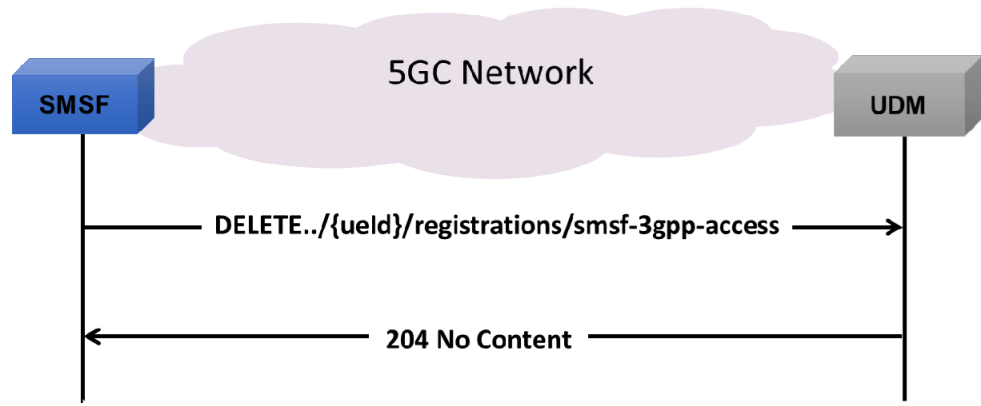
### SMSF Registration for Non 3GPP Access



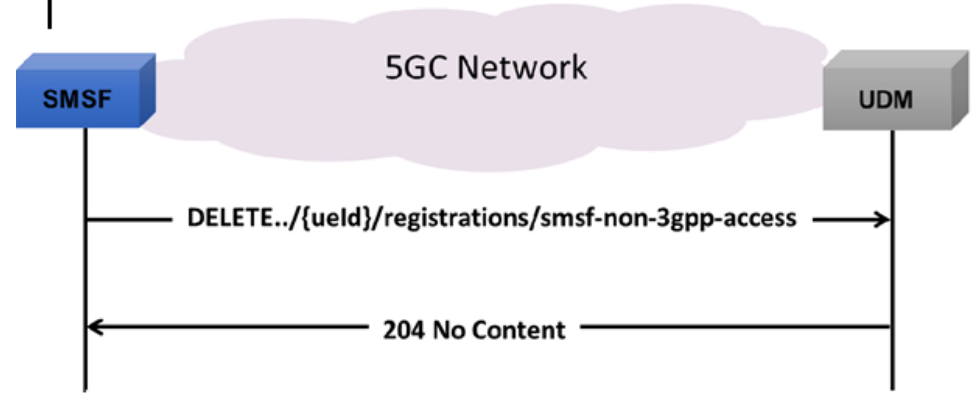
# MAPS™ 5G N21 Interface Procedures (Contd.)

## Nudm\_UEContextManagement Service

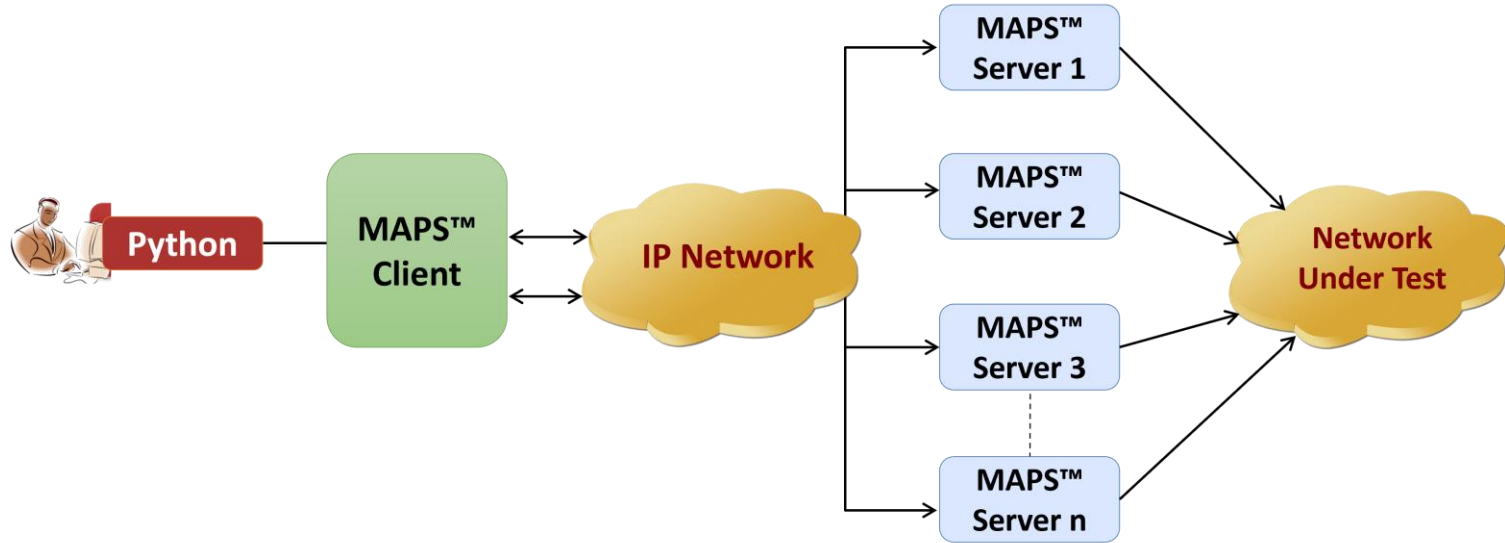
### SMSF Deregistration for 3GPP Access



### SMSF Deregistration for Non 3GPP Access



# 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 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-N21\MAPSCLI\PythonClient\examples\SMSF\N21_PlaceCall.py
N21 Server Connection... True
N21 Testbed Starting ... True
N21 Profile Loading... True
N21 Nudm_UECM_Control.gls Script Started... ProfileLoadStatus == Profile loaded
Starting N21 script True
Call Initiation Status ... SMSF_Registration_3GPPAccess :
True
Call Response Status... SMSF Registration for 3GPP access is successful
ResponseStatus = SMSF Registration for 3GPP access is successful
3gpp or non 3gpp
N21 MsgCount: 2
***** N21 Message Flow *****
Time Stamp          Route          Message
12:55:22.073        ->              PUT - /nudm-uecm/v1/imsi-001013012041631/registrations/smsf-3gpp-access
12:55:22.073        ->              PUT - /nudm-uecm/v1/imsi-001013012041631/registrations/smsf-3gpp-access
{"plmnId":{"mcc":"001","mnc":"01"},"smsfInstanceId":"6a8aaef4-0173-4f31-b8fd-5de79f94b658","supportedFeatures":"0"}
12:55:22.092        <-              200
12:55:22.092        <-              200
{"plmnId":{"mcc":"001","mnc":"01"},"smsfInstanceId":"6a8aaef4-0173-4f31-b8fd-5de79f94b658","supportedFeatures":"0"}
Stopping Script... True
N21 Server Disconnecting... True
>>>
```

```
CLI MapsCLI SMSF (N21 RELEASE17)
File Edit View
View Latest Command
1:: 2024-1-22 12:56:57.486000 : Start "TestBedDefault.xml" # "_TypeOfUESimulation"="XML", "_DefaultProfile"="UE_Profiles.xml";
1:: 2024-1-22 12:57:00.213000 : LoadProfile "UE_Profiles.xml"
1:: 2024-1-22 12:57:02.413000 : StartScript 1 "Nudm_UECM_Control.gls" "UEProfile0001" 1 # "IMSI"=(binarystring)001013012041631,"AccessType"="3GPP_ACCESS","CallFlowDebug"=1,"EnableCLI"=1;
1:: 2024-1-22 12:57:02.637000 : UserEvent 1 "Nudm_UECM_3gppSmsRegistration_Request";
1:: 2024-1-22 12:57:03.287000 : UserEvent 1 "GetCallStatus";
1:: 2024-1-22 12:57:04.385000 : UserEvent 1 "GetMessageCount";
1:: 2024-1-22 12:57:06.565000 : UserEvent 1 "GetMessageInfo" # "Index"=0;
1:: 2024-1-22 12:57:08.643000 : UserEvent 1 "GetMessageInfo" # "Index"=1;
1:: 2024-1-22 12:57:08.754000 : StopScript 1;
ServerLoggerCode = 0,errString = connection has been gracefully closed for ClientId = 1
```

**Thank you**