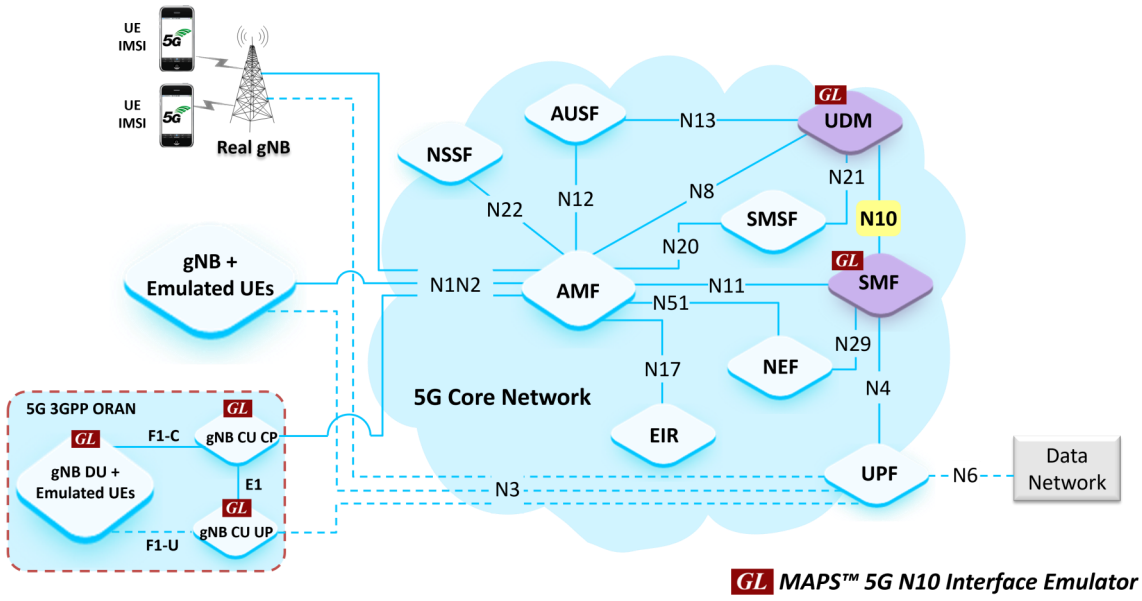
MAPS™ 5G N10 Interface Emulator



Overview

GL's MAPS™ 5G System as a service-based architecture, includes a set of Network Functions (NFs) providing services as defined in 3GPP TS 23.501 (Release 17). The service-based interfaces use HTTP/2 protocol with JavaScript Object Notation (JSON) as the application layer serialization protocol.

GL's MAPS™ 5G N51 emulates a Session Management Function (SMF) within the 5G Core, which requests services from the Unified Data Management (UDM) through the Nudm service. In the above network setup, N10 acts as an interface between UDM and SMF, allowing both nodes to function as servers and clients. However, SMF primarily initiates service calls, while the UDM acts as a producer.

The NFs, UDM and SMF are the entities in 5G Core Network (5GC), which support the following services:

- **Nudm_SubscriberDataManagement :** Get Data Retrieval, Subscribe, Modify Subscription, Unsubscribe Notification procedures
- **Nudm_UEContextManagement:** SMF Registration, Deregistration, Get and Update, UDM Initiated SMF Deregistration Notification, and UDM Initiated P-CSCF-Restoration Notification procedures

Besides emulating UDM and SMF, It also supports error tracking, regression testing, load testing. It can run pre-defined test scenarios against 5G interface test objects in a controlled and deterministic manner. Easy to use script syntax allow user to create conformance test cases based on their test plan.

MAPS™ 5G N10 Interface Emulator supports powerful utilities like Script Editor and Profile Editor which allow new scenarios to be created or existing scenarios to be modified using messages and parameters.

For more information, refer to MAPS™ 5G N10 Interface Emulator webpage.

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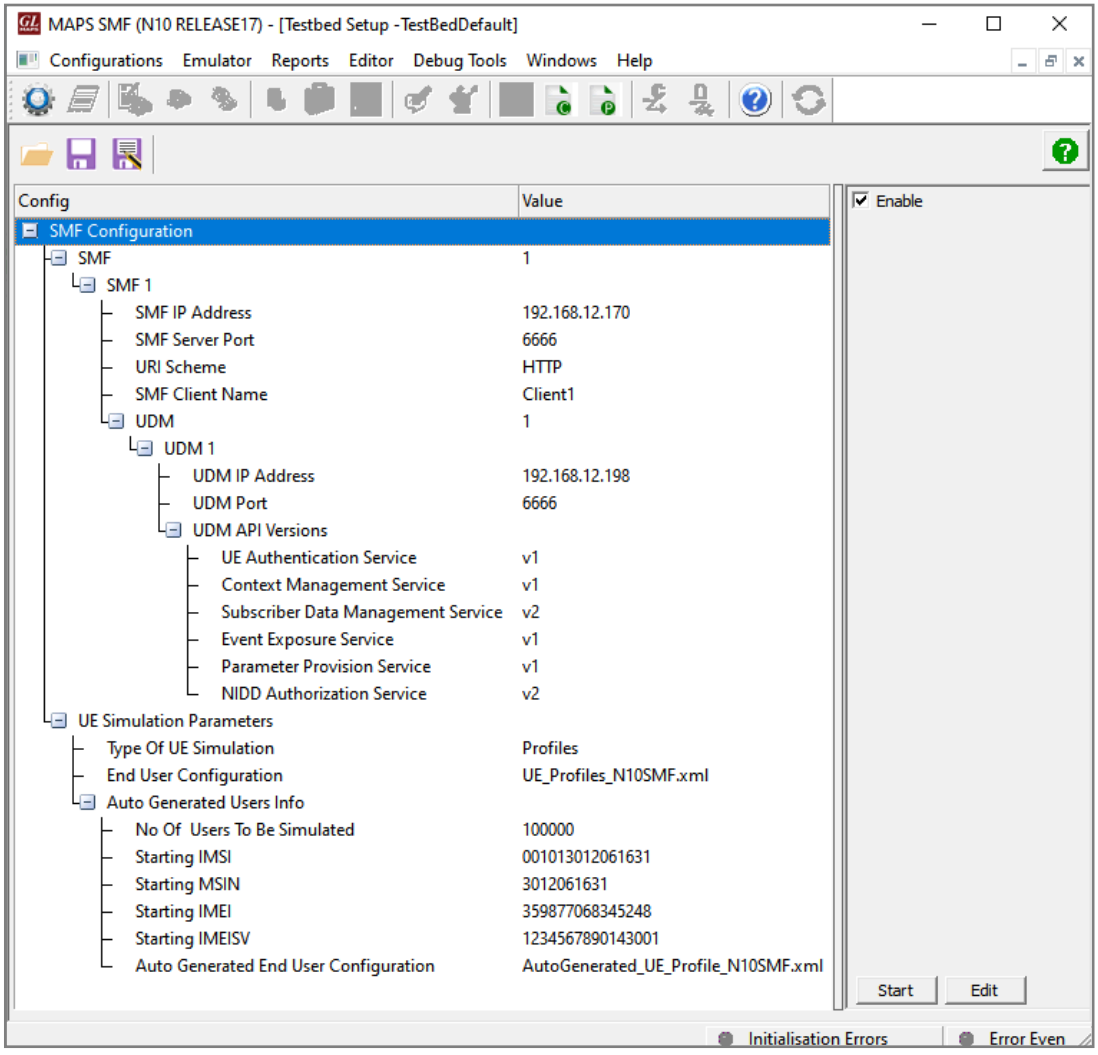
Main Features

- Emulate Unified Data Management (UDM) and Session Management Function (SMF) elements
- Supports Nudm_SubscriberDataManagement and Nudm_UEContextManagement Services
- 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 JSON Messages
- Ready-to-use scripts for quick testing
- Provides Call Statistics and Events Status
- Emulate Multiple Subscribers using CSV Profiles
- Automation, Remote access, and Schedulers to run tests 24/7

Testbed Configuration

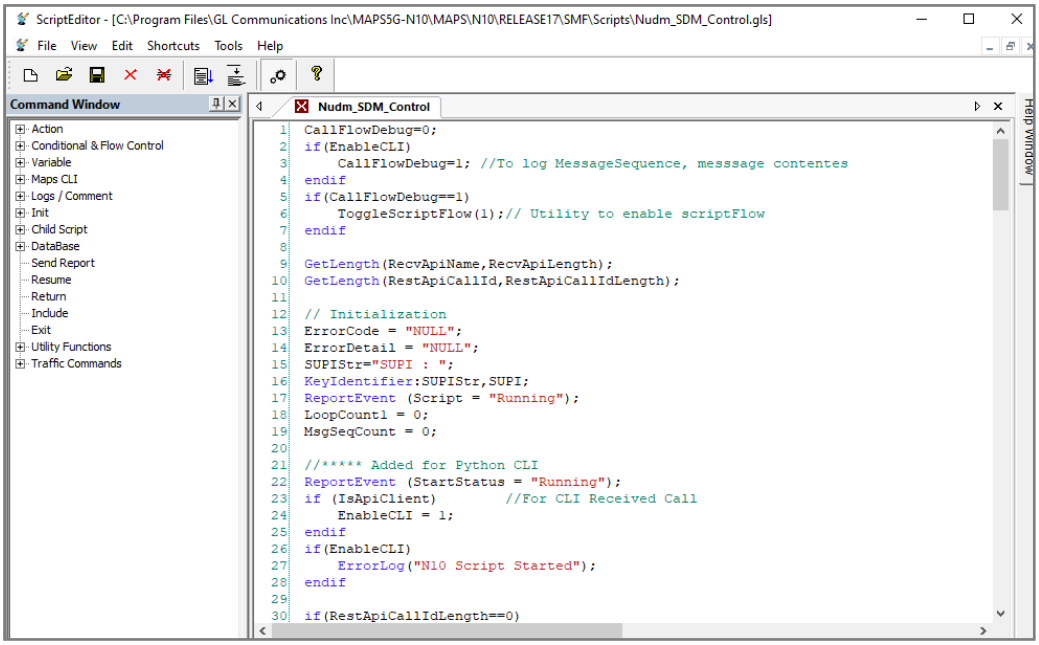
The testbed setup window allow user to setup the required test configurations in N10 interface. It includes a list of variables that are declared and assigned before starting the script. Testbed Setup defines the MAPS™ parameters which communicates with the rest of the test network. End user configuration profile is used to configure MAPS™ 5G N10 interface with the supported SMF and UDM parameters.



SMF TestBed Setup

Pre-processing Tools

SCRIPT EDITOR - The script editor allow user to create/edit scripts and access protocol fields as variables for the message template parameters. The script uses pre-defined message templates, to perform send and receive actions.



Script Editor

PROFILE EDITOR - This feature allows loading profile to edit the values of variables using GUI, replacing the original value of variables in the message template. An XML file defines a set of multiple profiles with varying parameter values which allow users to configure call instances in call generation to receive calls. These Profiles include 5G parameters, that is required to configure multiple UEs to emulate Signaling and Traffic.

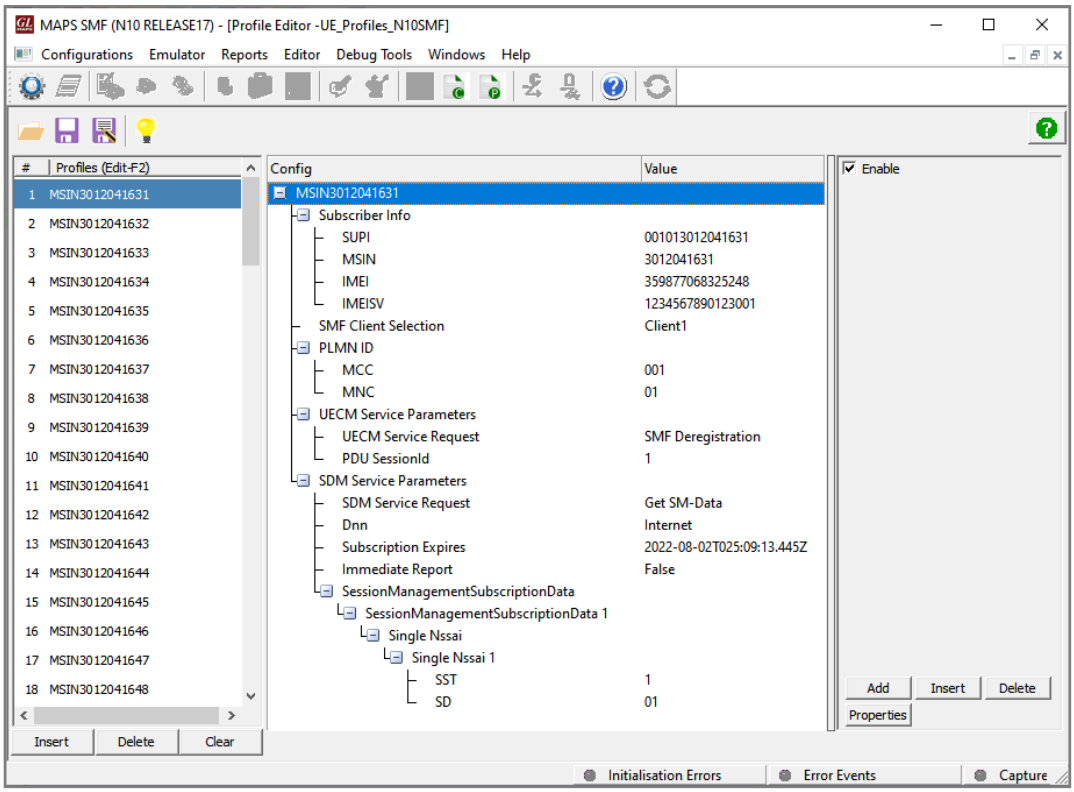


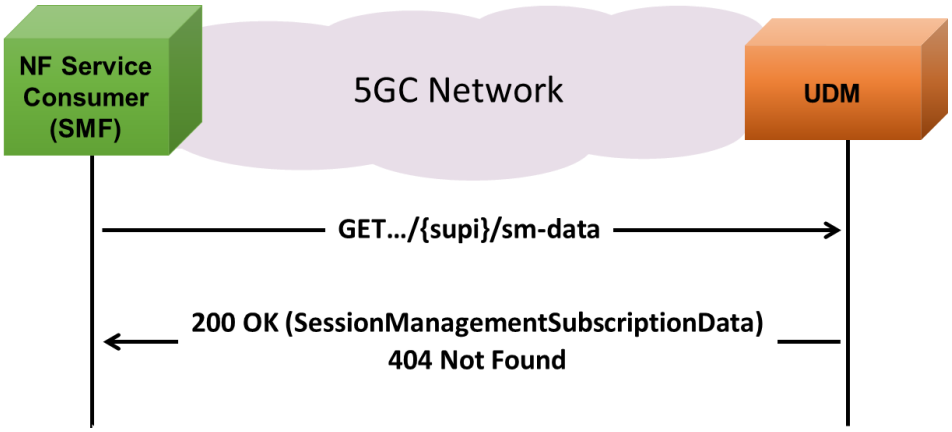
Figure: Profile Editor

Nudm_SubscriberDataManagement Service:

Session Management Subscription Data Retrieval

MAPS™ for 5G N10 interface emulate services between UDM and SMF network functions.

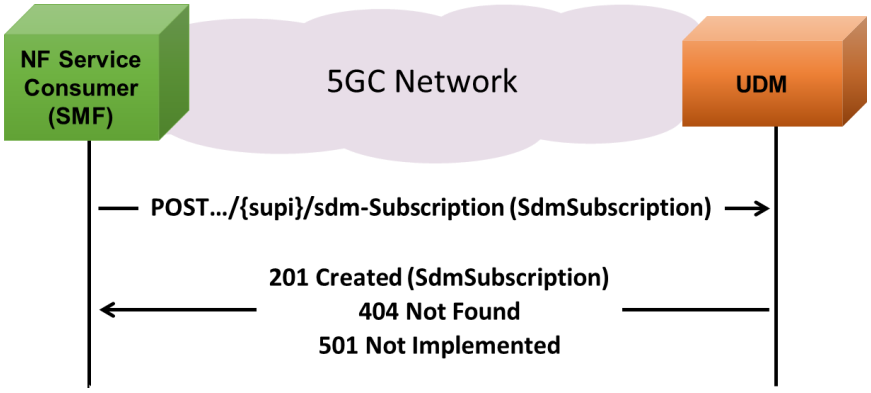
The NF service consumer (e.g. SMF) sends a request to the UDM to receive the UE's session management subscription data. The request contains the UE's identity (/{supi}), the type of the requested information (/sm-data), and query parameters (single-nssai, dnn, supported-features, plmn-id).



- The NF service consumer sends a GET request to the resource representing the UE's session management subscription data, with query parameters indicating the selected network slice /the DNN/ supported-features / plmn-id.
- On **Success**, the UDM responds with "200 OK"
- If there is no valid subscription data for the UE, or if the UE subscription data exists, but the requested session management subscription is not available, HTTP status code "404 Not Found" shall be returned.
- On **Failure**, the appropriate HTTP status code indicating the error shall be returned.

Subscription to Notifications of Data Change

The NF service consumer sends a request to the UDM to subscribe to notifications of data change. The request contains a callback URI and the URI of the monitored resource.

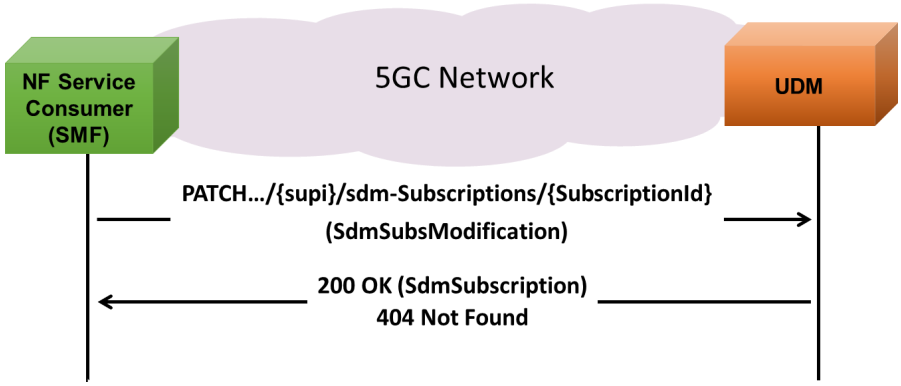


- The NF service consumer sends a POST request to the parent resources, to create a subscription as present in message body
- On **Success**, the UDM responds with "201 Created"
- If there is no valid subscription data for the UE, HTTP status code "404 Not Found" shall be returned
- If the UE subscription data exist, but the requested subscription to data change notification cannot be created. HTTP status code "501 Not Implemented" shall be returned
- On **Failure**, the appropriate HTTP status code indicating the error shall be returned

Nudm_SubscriberDataManagement Service (*Contd.*)

Modification of a Subscription to Notifications of Data Change

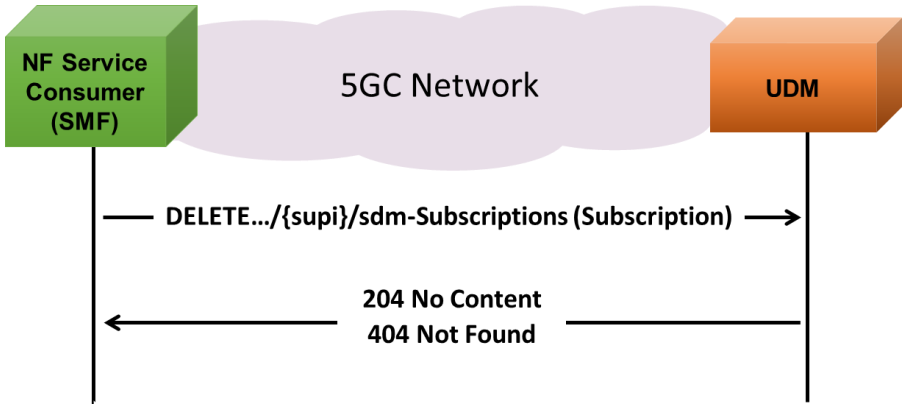
The NF service consumer sends a request to the UDM to modify a subscription to notifications of data changes. The request contains the URI previously received in the Location HTTP header of the response to the subscription.



- The NF service consumer sends a PATCH request to the resource identified by the URI previously received during subscription creation
- The NF service consumer may include "monitoredResourceUris" to replace the existing monitored resource URIs
- On **Success**, the UDM responds with "200 OK"
- If there is no valid subscription available, HTTP status code "404 Not Found" should be returned
- On **Failure**, the appropriate HTTP status code indicating the error shall be returned and appropriate additional error information should be returned in the PATCH response body

Unsubscribe to Notifications of Data Change

The NF service consumer sends a request to the UDM to unsubscribe from notifications of data changes. The request contains the URI previously received in the Location HTTP header of the response to the subscription.



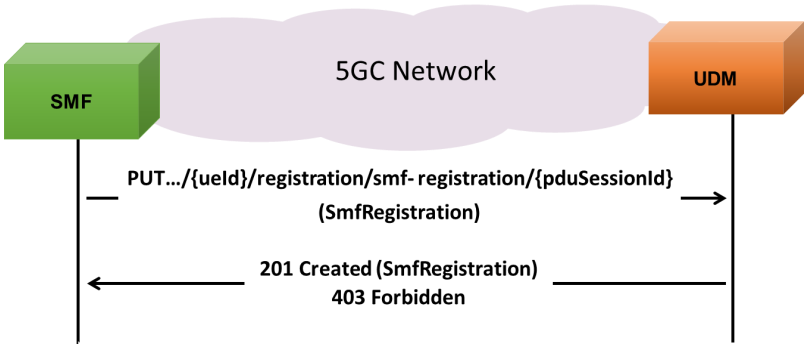
- The NF service consumer sends a DELETE request to the resource identified by the URI previously received during subscription creation
- On **Success**, the UDM responds with "204 No Content"
- If there is no valid subscription available, HTTP status code "404 Not Found" should be returned
- On **Failure**, the appropriate HTTP status code indicating the error shall be returned

Nudm_UEContextManagement Service

SMF Registration

MAPS™ for 5G N10 interface emulate services between UDM and SMF network functions.

The SMF sends a request to the UDM to create a new registration. The request contains the UE's identity (/{ueId}) which shall be a SUPI and the SMF Registration Information.



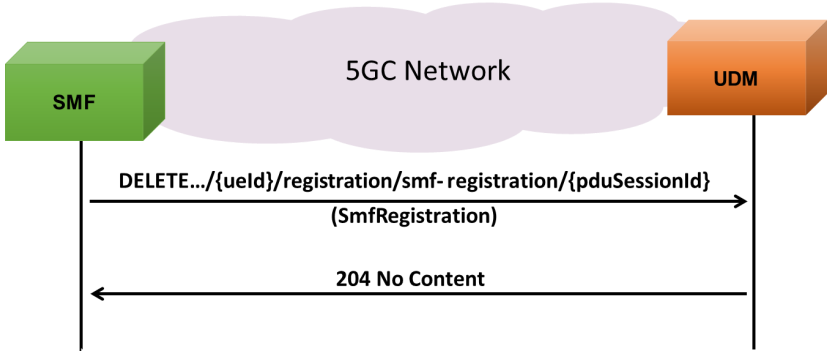
- The SMF sends a PUT request to the resource .../{ueId}/registrations/smf-registrations/{pduSessionId}, to create an SMF Registration as present in the message body
- The UDM responds with "201 Created"
- If the operation cannot be authorized due to e.g UE does not have required subscription data, access barring or roaming restrictions, HTTP status code "403 Forbidden" should be returned
- On **Failure**, the appropriate HTTP status code indicating the error shall be returned and appropriate additional error information should be returned in the PUT response body

Nudm_UEContextManagement Service

SMF deregistration

MAPS™ for 5G N10 interface emulate services between UDM and SMF network functions.

The SMF sends a request to the UDM to deregister an individual SMF registration. The request contains the UE's identity (/{ueId}) which shall be a SUPI and the PDU Session ID (/{pduSessionId}.

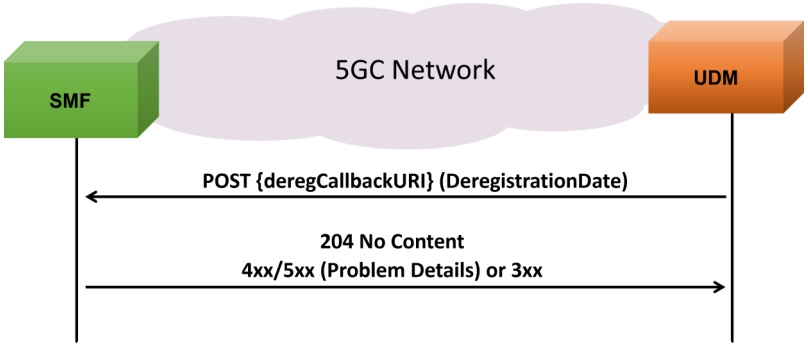


- The SMF sends a DELETE request to the resource representing the individual SMF registration that is to be deregistered
- The UDM responds with "204 No Content"
- On **Failure**, the appropriate HTTP status code indicating the error shall be returned and appropriate additional error information should be returned in the DELETE response body

Nudm_UEContextManagement Service (*Contd.*)

UDM Initiated SMF Deregistration

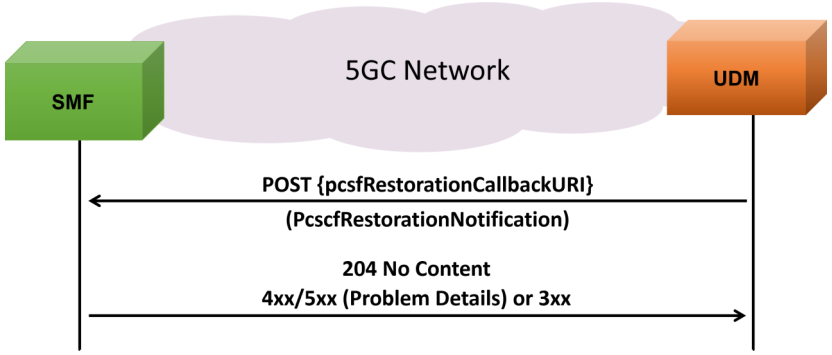
The UDM initiates deregistration procedures for a registered user toward the SMF of the old PDU session when a new PDU session is established with the same ID from a different SMF. This occurs during the SM Context Transfer procedure or when duplicated PDU sessions exist in the network (e.g., the AMF fails to release the old PDU session before creating a new one with the same ID). In the registration procedure, the SMF sends the deregCallbackUri URI and Deregistration Data to the UDM for UDM-initiated notifications.



- The UDM recieves a POST request to the deregCallbackUri provided by the SMF during registration
- On success, the SMF responds with a “204 No Content” message.
- When an SMF receives a deregistration notification, it releases the PDU session without sending a SM Context Status Notification to the SMF. For a PDU session with I-SMF or V-SMF, the SMF sends a Status Notification to the I-SMF or V-SMF, indicating the release of the PDU session due to duplicated PDU sessions
- On Failure, the appropriate HTTP status code indicating the error shall be returned

UDM Initiated P-CSCF-Restoration

The UDM informs the registered AMF or SMF that P-CSCF restoration is required. The request includes the pcscfRestorationCallbackUri (a specific address) and information about P-CSCF Restoration received by the UDM during registration.



- The UDM sends a POST request to the pcscfRestorationCallbackUri provided by SMF during the registration
- On success, the AMF or SMF responds with "204 No Content"
- In case of failure, the appropriate HTTP status code indicating the error is returned

Call Generation and Reception

In call generation mode, MAPS™ is configured for the outgoing messages, while in call receive mode, it is configured to respond to the incoming messages. Tests can be configured to run once, multiple iterations and continuously. Also, allow user to create multiple entries using quick configuration feature.

The editor allow to run the added scripts sequentially (order in which the scripts are added in the window) or randomly (any script from the list of added script as per the call flow requirements).

The test scripts are started manually at call generation, and at the call reception the script is automatically triggered by incoming messages.

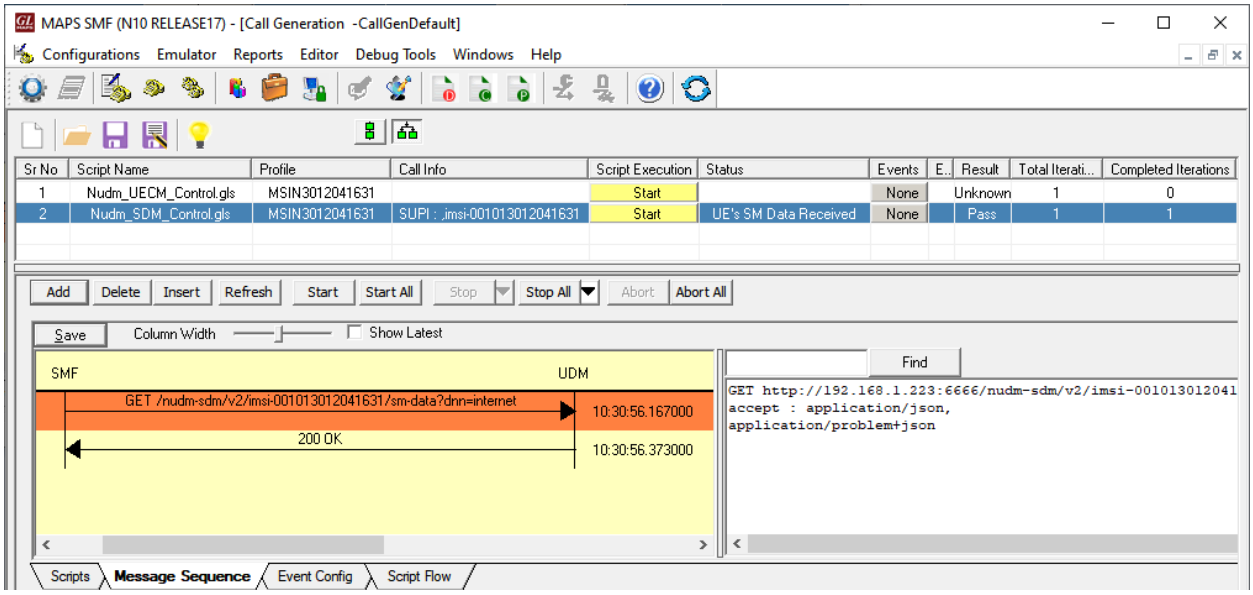


Figure: Call Generation

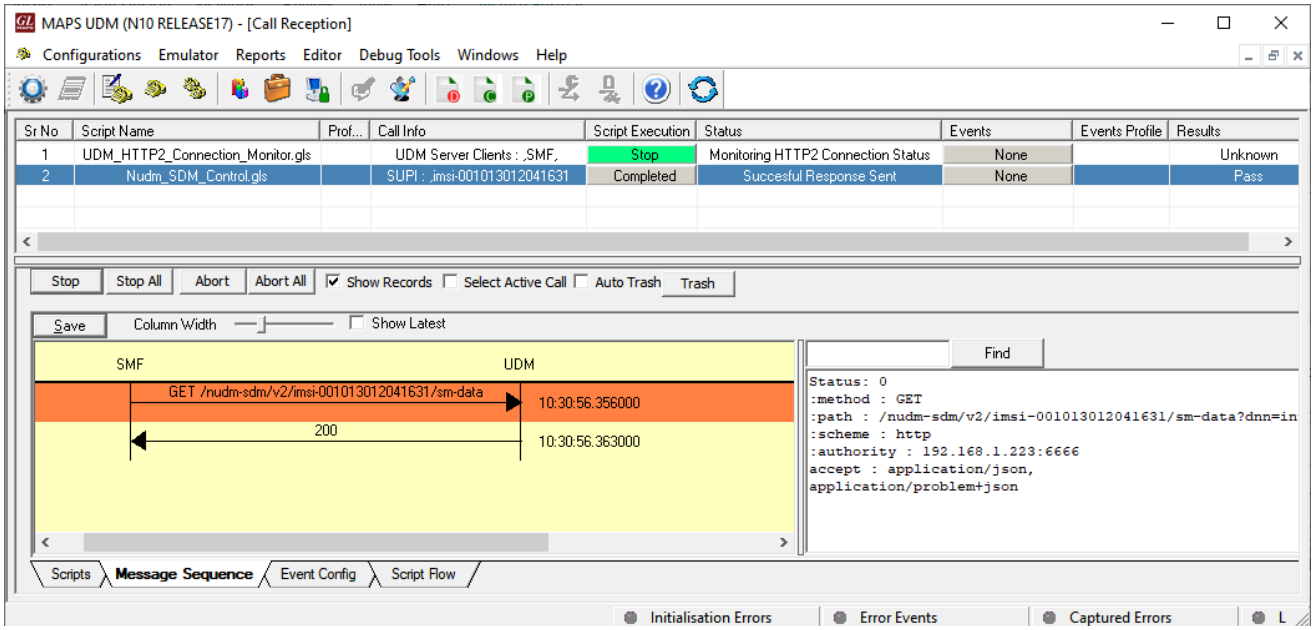


Figure: Call Reception

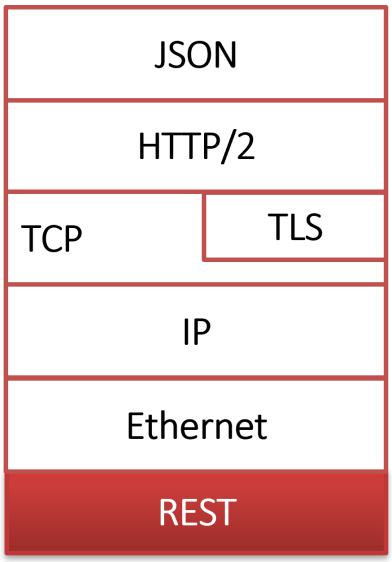
Command Line Interface (CLI)

The MAPS™ 5G N10 (SMF) can be configured as a CLI server application for remote control via command-line clients, including Python. These clients can execute various functions remotely, such as initiating the testbed setup, loading scripts, profiles, and applying user events like call generation, termination, and traffic control. Users can generate and receive calls using commands.

Figure: Sample Python Client

Figure: MAPS™ CLI Server

Supported Protocols and Specifications



Supported Protocols	Standard/ Specification
N10 Interface (UDM - SMF)	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]

Buyer's Guide

Item No	Product Description
PKS504	MAPS™ 5G N10 Interface Emulator
PKS305	MAPS™ 5G Multi-Interface Emulation

Item No	Related Software
PKS500	MAPS™ 5G N1/N2 Interface Emulator
PKS501	MAPS™ 5G N4 Interface Emulator
PKS502	5G service-based Emulation (Prerequisite base license for all service-based (Open API) interface emulations)
PKS503	MAPS™ 5G N8 Interface Emulator (Requires PKS502)
PKS505	MAPS™ 5G N11 Interface Emulator (Requires PKS502)
PKS506	MAPS™ 5G N12 Interface Emulator (Requires PKS502)
PKS507	MAPS™ 5G N13 Interface Emulator (Requires PKS502)
PKS502	MAPS™ 5G N17 Interface Emulator
PKS508	MAPS™ 5G N20 Interface Emulator (Requires PKS502)
PKS509	MAPS™ 5G N21 Interface Emulator (Requires PKS502)
PKS510	MAPS™ 5G N22 Interface Emulator (Requires PKS502)
PKS511	MAPS™ 5G N29 Interface Emulator (Requires PKS502)
PKS511	MAPS™ 5G N51 Interface Emulator (Requires PKS502)
PKS170	CLI Support for MAPS™

Note: PCs which include GL hardware/software require Intel or AMD processors for compliance.

For complete list of MAPS™ products, refer to Message Automation & Protocol Simulation (MAPS™) webpage.

For more details on supported MAPS™ 5G interfaces, refer to 5G Core (5GC) Network Test Solution webpage.

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