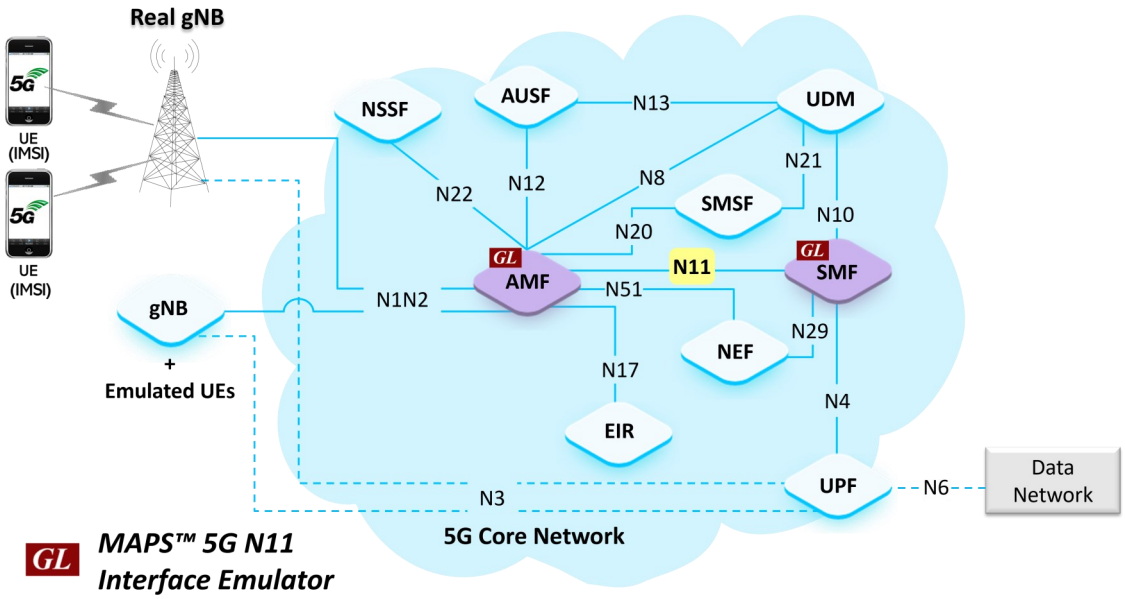
MAPS™ 5G N11 Interface Emulator



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™ emulate Session Management Function (SMF) within the 5G Core offering services to the Access and Mobility Management Function (AMF) via the Nsmf service-based N11 interface. The above network architecture represents the service-based interface, with focus on N11 between AMF and SMF. Here, any node SMF act as "NF Producer", where the specification is TS29.502 (Release 17).

The NF, SMF and AMF are the entities in 5G Core Network (5GC), which supports the following services via the Nsmf and Namf service-based N11 interface.

- **Nsmf_PDUSession:** Create SM Context, Update SM Context, Release SM Context, Notify SM Context Status and Retrieve SM Context operations
- **Namf_Communication**: N1N2 Message Transfer (UE Specific) operations based on N11 interface

Besides emulating network elements SMF and AMF functions, 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 allows user to create conformance test cases based on their test plan.

MAPS™ 5G N11 Interface Emulator supports powerful utilities such as Script Editor and Profile Editor which allows new scenarios to be created or existing scenarios to be modified using messages and parameters.

For more information, refer to MAPS™ 5G N11 Interface Emulator webpage.

GL Communications Inc.

818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878, U.S.A

(Web) www.gl.com - (V) +1-301-670-4784 (F) +1-301-670-9187 - (E-Mail) info@gl.com

Main Features

- Emulate SMF and AMF elements
- Supports Nsmf_PDUSession and Namf_Communication 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
- Generate multiple subscribers using the CSV profiles
- Automation, Remote access, and Schedulers to run tests 24/7

Testbed Configuration

The testbed setup window allows user to setup the required test configurations in N11 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 N11 interface with the supported AMF and SMF parameters.

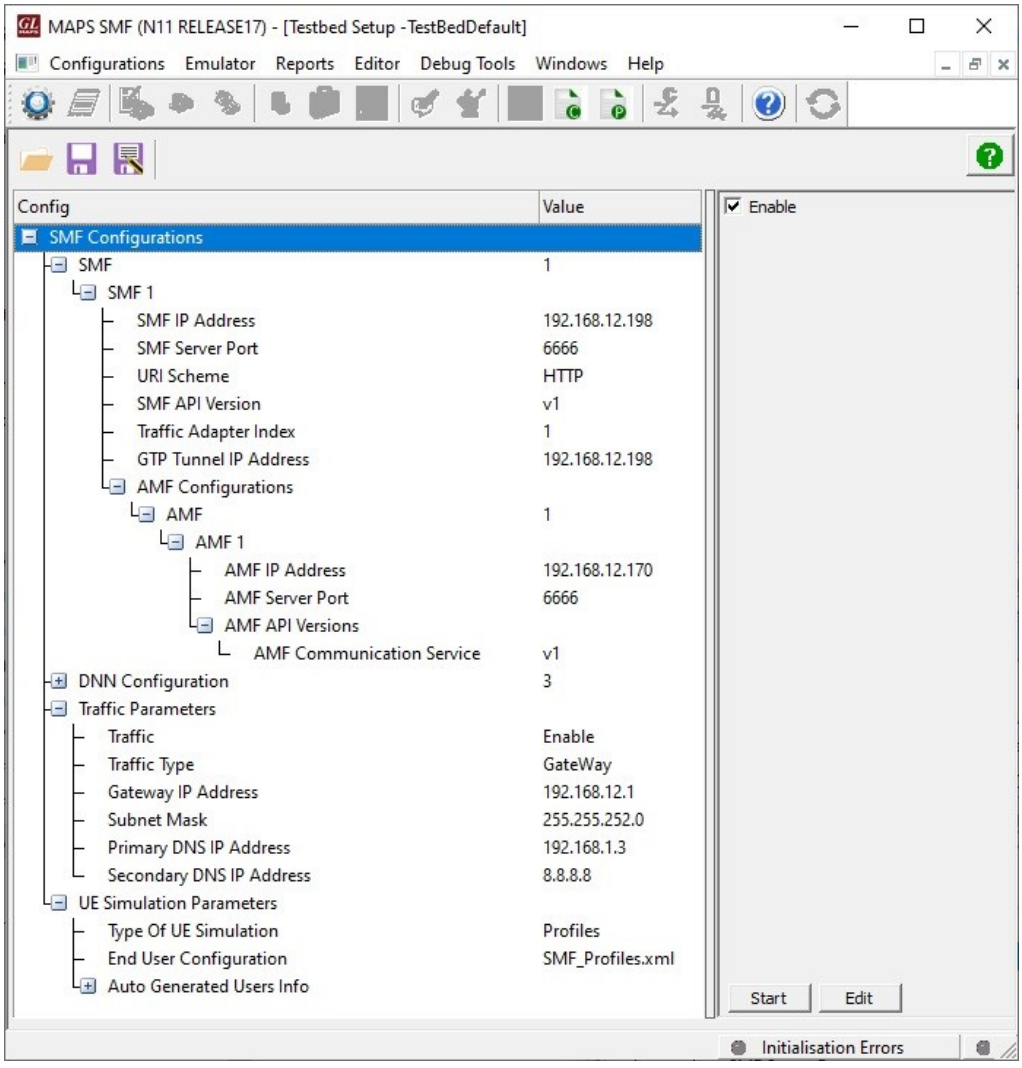


Figure: Testbed Setup

Pre-processing Tools

SCRIPT EDITOR - The script editor allows 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.

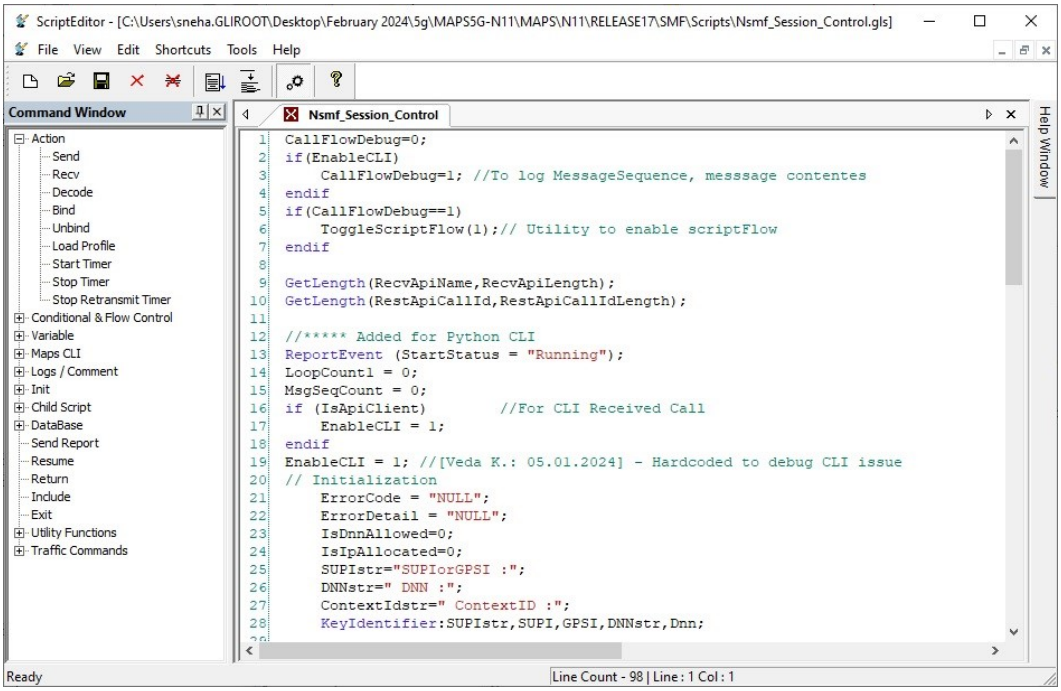


Figure: Script Editor

PROFILE EDITOR - This feature allow 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 user to configure call instances in call generation to receive calls. The **Profiles** include 5G parameters, that is required to configure the multiple UEs to emulate Signaling and Traffic.

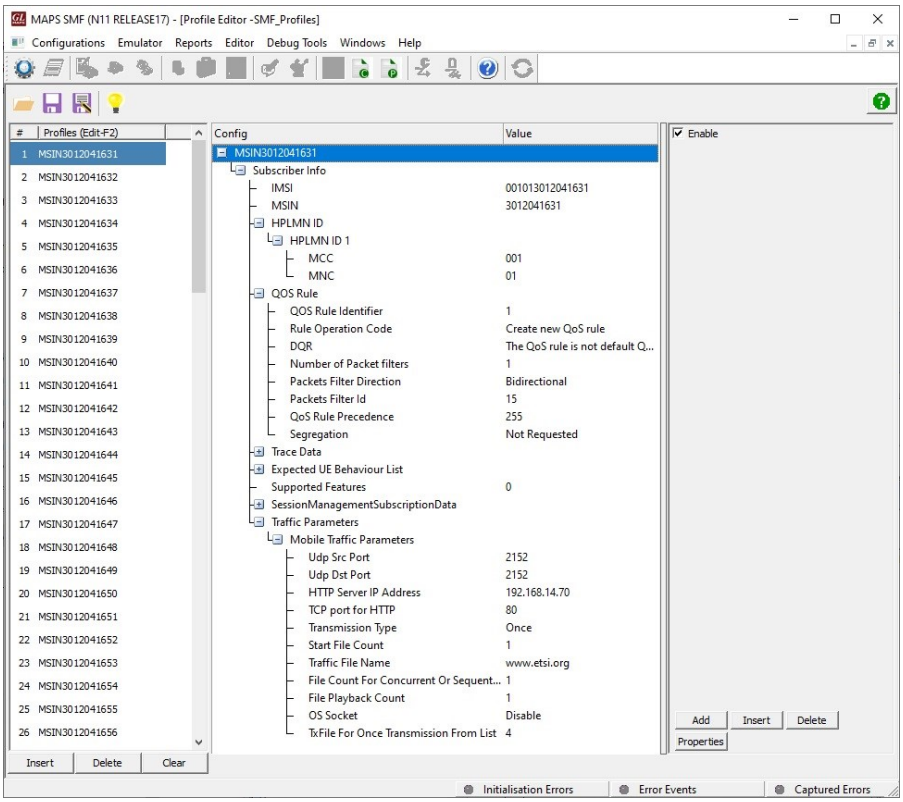


Figure: Profile Editor

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 at once, multiple iterations, and continuously. Also, allow user to create multiple entries using quick configuration feature.

The editor allows 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 the call generation and at the call reception the script is automatically triggered by incoming messages.

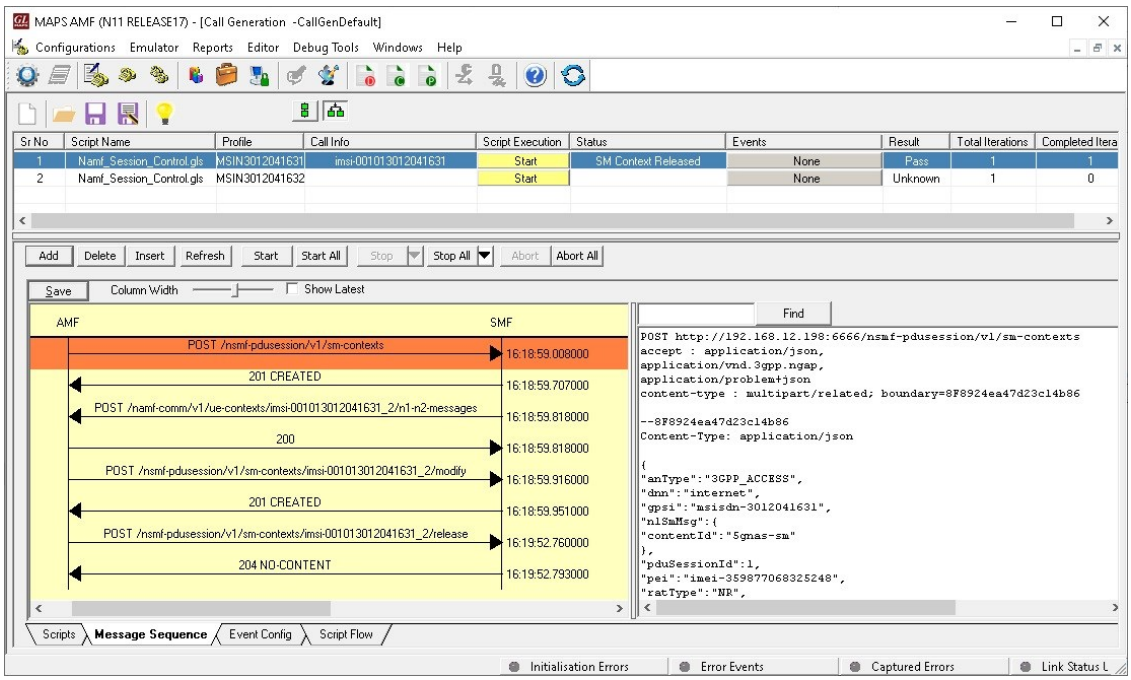


Figure: Call Generation

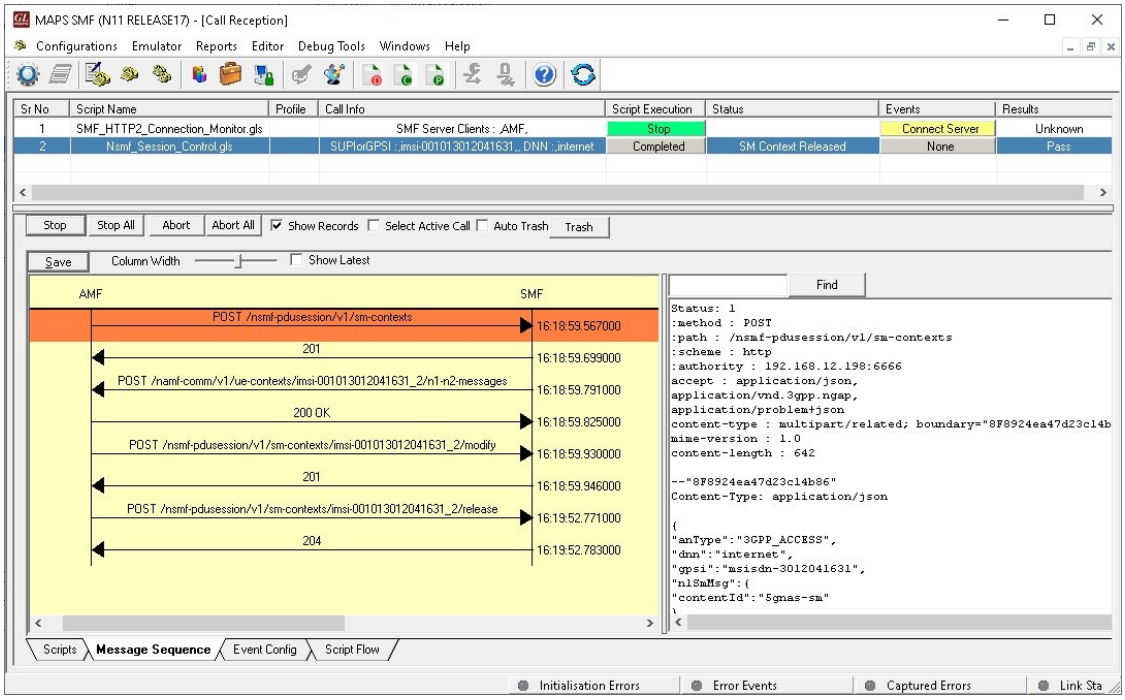


Figure: Call Reception

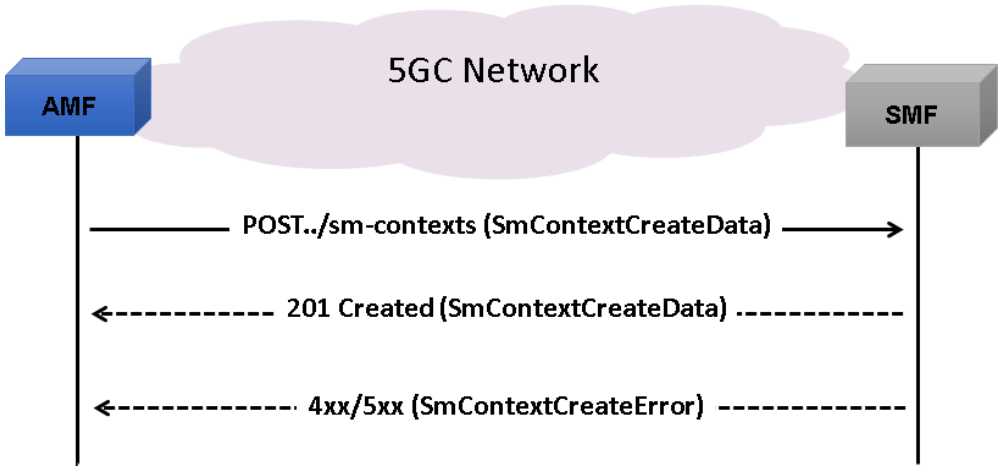
Nsmf_PDUSession Service

Create SM Context Service Operation

MAPS™ for 5G N11 interface emulate services between AMF and SMF network functions.

The **Create SM Context Service Operation** is used to create an individual SM context for a given PDU session, in the SMF, or in the V-SMF for HR roaming scenarios.

In this procedure, AMF creates an SM context using the HTTP POST method as shown below.

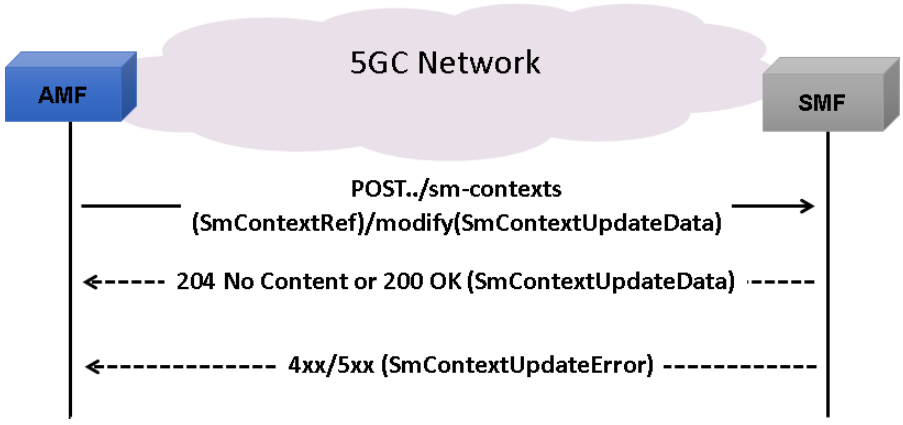


- AMF sends a POST request to the resource representing the SM contexts collection resource of the SMF
- On **Success**, "201 Created" shall be returned
- The SMF rejects the request if the UE is outside of the LADN service area
- On **Failure** or **Redirection** during a UE requested PDU Session Establishment, one of the HTTP status code is returned

Update SM Context Service Operation

The Update SM Context service operation is used to update an individual SM context and/or provide N1 or N2 SM information received from the UE or the AN, for a given PDU session, towards the SMF, or the V-SMF for HR roaming scenarios.

The NF Service Consumer (AMF) updates an individual SM context and/or provide N1 or N2 SM information to the SMF using the HTTP POST method as shown below.



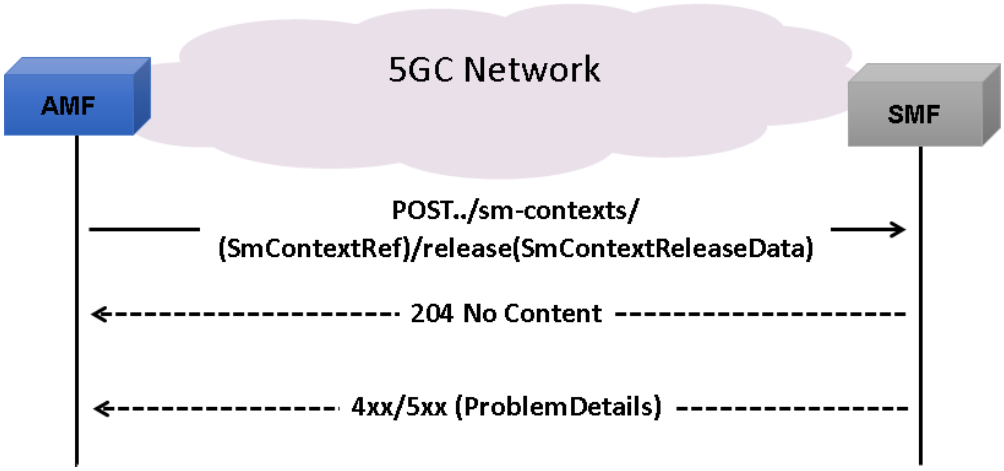
- AMF sends a POST request to the resource representing the individual SM context resource in the SMF
- On **Success**, "204 No Content" or "200 OK" is returned
- The SMF may indicate to the NF Service Consumer that it shall release EBI(s) that were assigned to the PDU session by including the releaseEbiList IE, for example when a QoS flow is released
- On **Failure**, one of the HTTP status code is returned

Nsmf_PDUSession Service (*Contd.*)

Release SM Context Service Operation:

The Release SM Context service operation is used to release the SM Context of a given PDU session, in the SMF, or in the V-SMF for HR roaming scenarios.

AMF releases the SM Context of a given PDU session using the HTTP "release" custom operation as shown below.

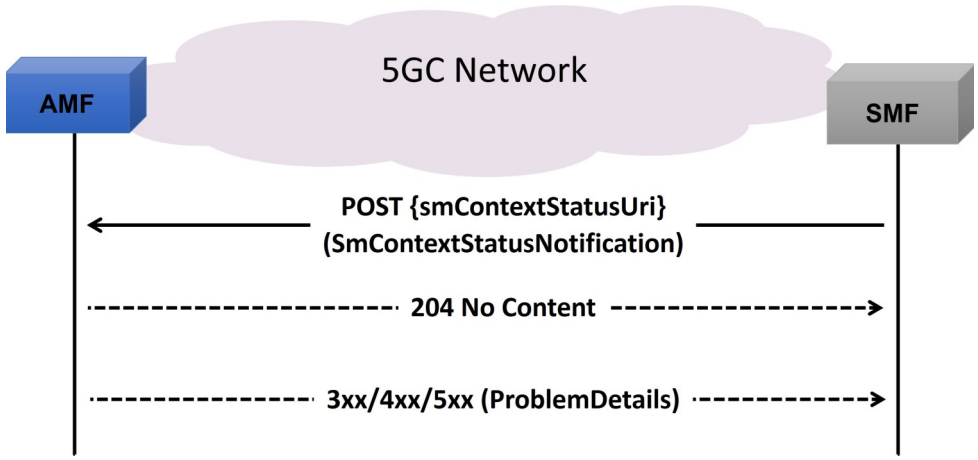


- AMF sends a POST request to the resource representing the individual SM context to be deleted
- On **Success**, the SMF returns a "204 No Content" response with an empty payload body in the POST response
- If the POST request contains a vsmfReleaseOnly indication, the V-SMF release its SM context and corresponding PDU session resource locally, i.e. without signaling towards the H-SMF
- On **Failure**, one of the HTTP status code is returned

Notify SM Context Status Service Operation

The Notify SM Context Status service operation is used by the SMF to notify the NF Service Consumer about the status of an SM context related to a PDU session in the SMF, or the V-SMF for HR roaming scenarios.

The SMF notifies the AMF using the HTTP POST method as shown below.



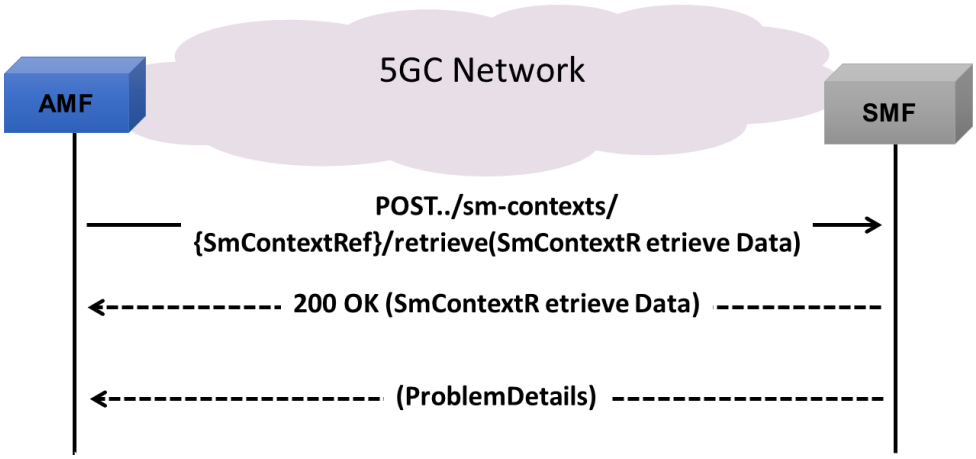
- The SMF sends a POST request to the SM Context Status callback reference provided by the NF Service Consumer during the subscription to this notification
- If the notification is triggered by PDU session handover, the notification payload contains the Cause IE with the value "PDU_SESSION_HANDED_OVER"
- On **Success**, "204 No Content" is returned
- On **Failure** or **Redirection**, one of the HTTP status code is returned

Nsmf_PDUSession Service (*Contd.*)

Retrieve SM Context Service Operation

The Retrieve SM Context service operation is used to retrieve an individual SM context, for a given PDU session, from the SMF, or from the V-SMF for HR roaming scenarios.

AMF retrieves an SM context using the HTTP POST method (retrieve custom operation) as shown below.

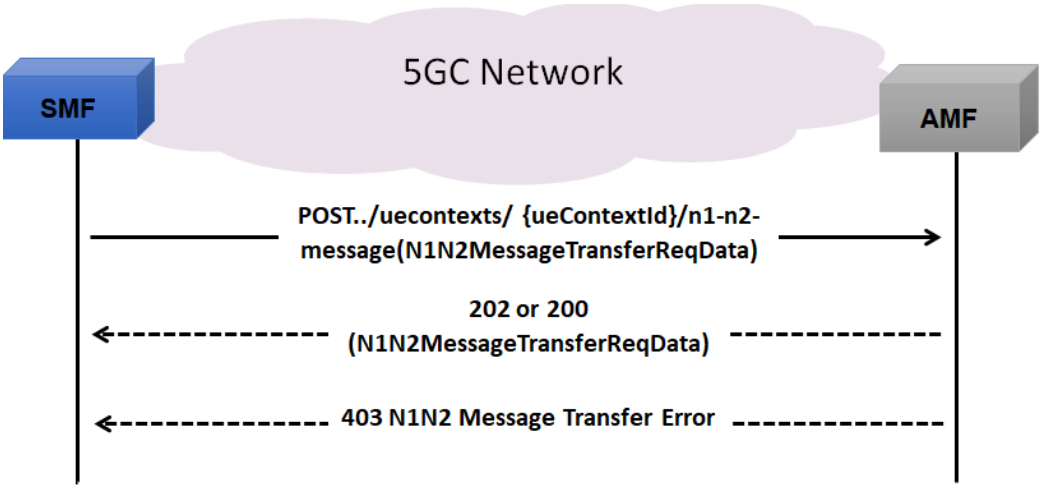


- AMF sends a POST request to the resource representing the individual SM context to be retrieved
- On **Success**, "200 OK" is returned
- If the target MME capabilities were provided in the request parameters, and if the target MME supports the non-IP PDN type, the SMF is returned
- On **Failure**, one of the HTTP status code is returned

Namf_Communication Service

The SMF uses N1N2 Message Transfer service operation to transfer N1 and/or N2 information to the UE through the AMF by following the below procedures:

- Network Triggered Service Request
- PDU Session establishment
- PDU Session modification
- PDU Session release
- Session continuity, service continuity and UP path management
- Inter NG-RAN node N2 based handover
- SMS over NAS procedures
- UE assisted and UE based positioning procedure
- Network assisted positioning procedure
- UE configuration update procedure for transparent UE policy delivery



- The SMSF sends a POST request to transfer N1 and N2 information which include a N1N2MessageTransfer Notification URI to AMF in the request message
- On **Success**, 200 OK response is received. The AMF shall set the cause IE in the N1N2MessageTransferRspData as "N1_N2_TRANSFER_INITIATED"
- On **Failure**, the appropriate HTTP status code indicating the error shall be returned and appropriate additional error information should be returned in the POST response body

Command Line Interface (CLI)

The MAPS™ 5G N11 (AMF) 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.

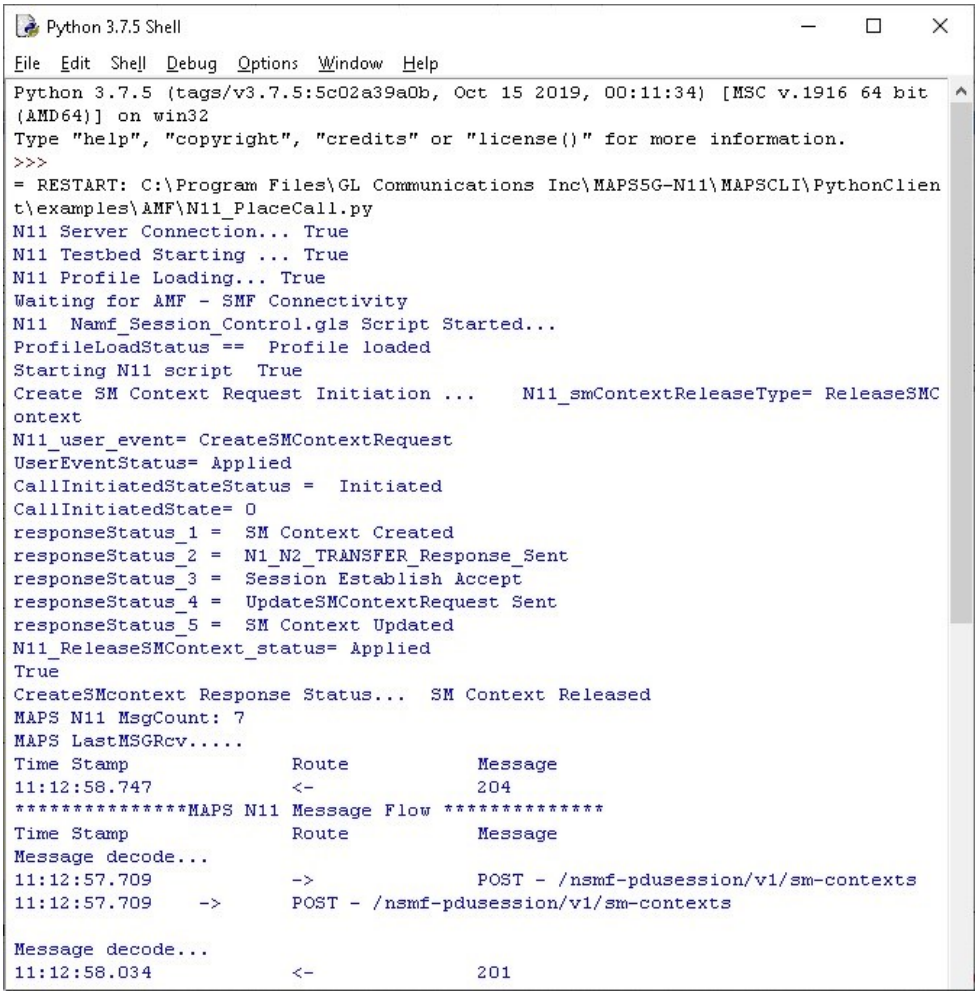
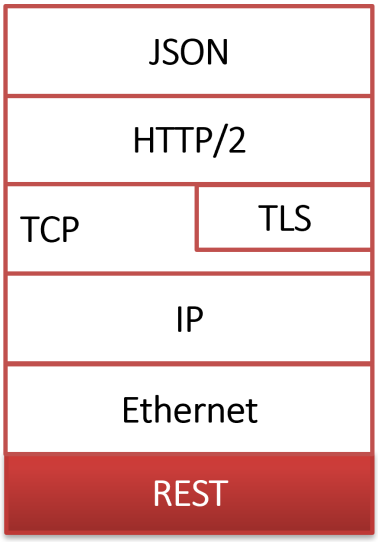


Figure: Sample Python Client

Figure: MAPS™ CLI Server

Supported Protocols and Specifications



Supported Protocols	Standard/ Specification
N11 Interface (SMF - AMF)	TS29.502 (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
PKS505	MAPS™ 5G N11 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)
PKS502	MAPS™ 5G N17 Interface Emulator
PKS503	MAPS™ 5G N8 Interface Emulator (Requires PKS502)
PKS504	MAPS™ 5G N10 Interface Emulator (Requires PKS502)
PKS506	MAPS™ 5G N12 Interface Emulator (Requires PKS502)
PKS507	MAPS™ 5G N13 Interface Emulator (Requires PKS502)
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™

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.

GL Communications Inc.
818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878, U.S.A
(Web) www.gl.com - (V) +1-301-670-4784 (F) +1-301-670-9187 - (E-Mail) info@gl.com