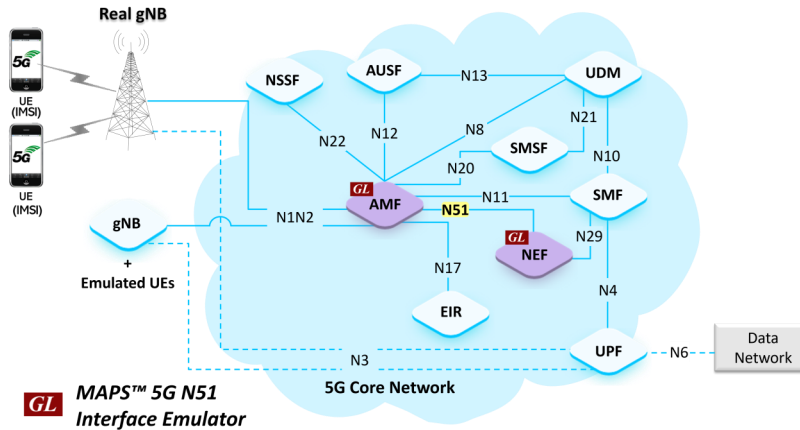# MAPS™ 5G N51 Interface Emulator

Overview

GL's MAPS™ 5G System as a service-based architecture, includes a set of Network Functions (NFs) providing services as defined in TS29.518 and TS29.522 (Release 17) specifications. The service-based interfaces use HTTP protocol with JavaScript Object Notation (JSON) as the application layer serialization protocol.

GL's MAPS™ 5G N51 emulates a Network Exposure Function (NEF) within the 5G Core, which requests services from the Access and Mobility Management Function (AMF) through the Namf service. In the above network setup, N51 acts as an interface between NEF and AMF, allowing both nodes to function as servers and clients. However, NEF primarily initiates service calls, while the AMF acts as a producer.

The NEF and AMF are the entities in 5G Core Network (5GC), which supports the following services:

- UE Subscription for notification event detection
    - Registration State Change Event
    - Connection State Change Event
    - Location Report Event
    - Presence In Area of Interest Event

Besides emulating network elements NEF and AMF functions, the application 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 N51 Interface emulator supports powerful utilities such as Script Editor and Profile Editor which allow new scenarios to be created or existing scenarios to be modified using 5G N51's JSON messages and parameters.

For more information, visit MAPS™ 5G N51 Interface Emulator webpage.

Main Features

- Emulate NEF and AMF elements
- Supports Namf_EventExposure Service
- 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
- Automation, Remote access, and Schedulers to run tests 24/7

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

Testbed Configuration

The testbed setup window allow users to setup the required test configurations in N51 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 51 interface with the supported NEF and AMF parameters.
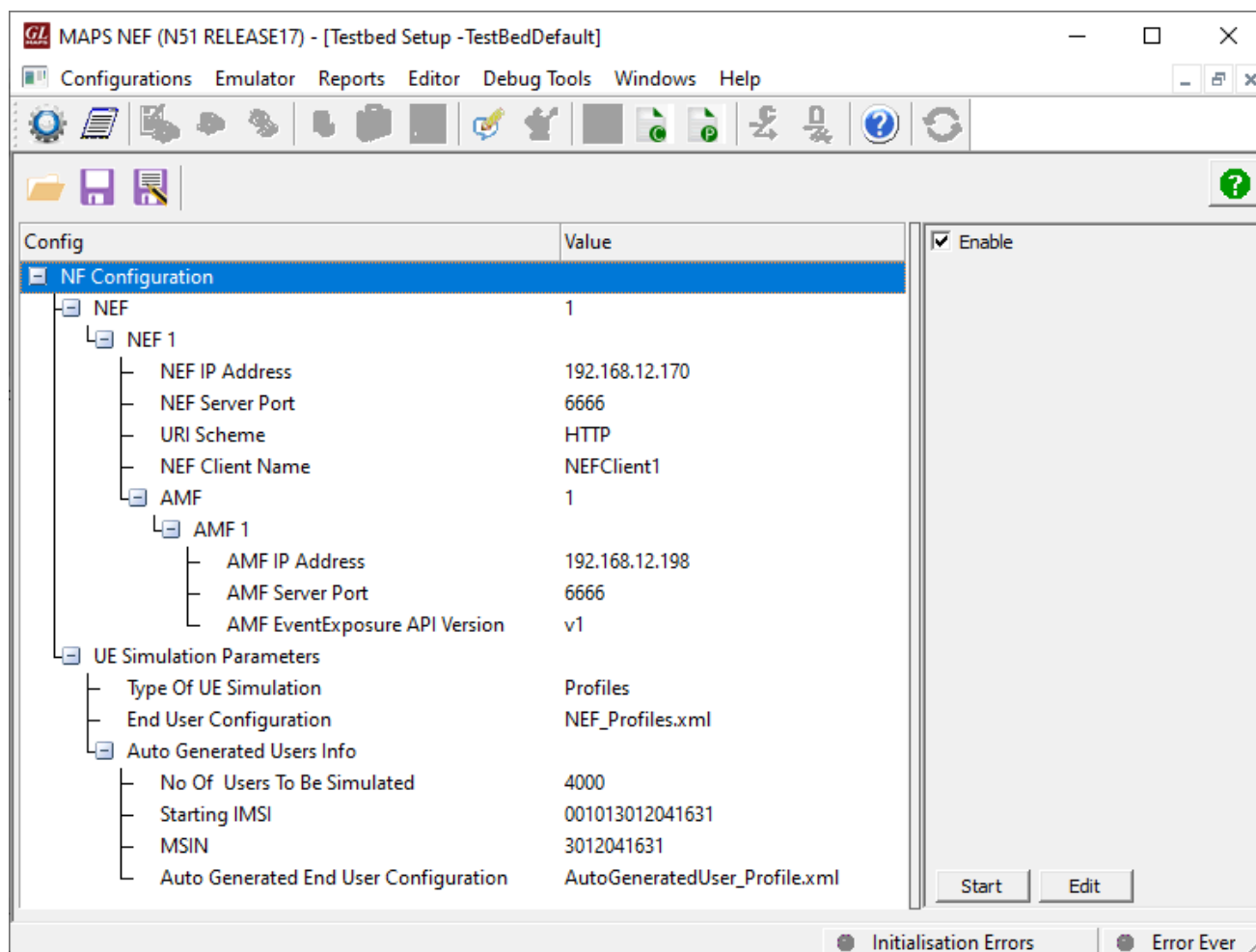

Figure: Testbed Setup

GL Communications Inc.

Pre-processing Tools

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 user to configure call instances in call generation to receive calls. The **UE_Profiles** include 5G parameters, that is required to configure multiple UEs to emulate Signaling and Traffic.
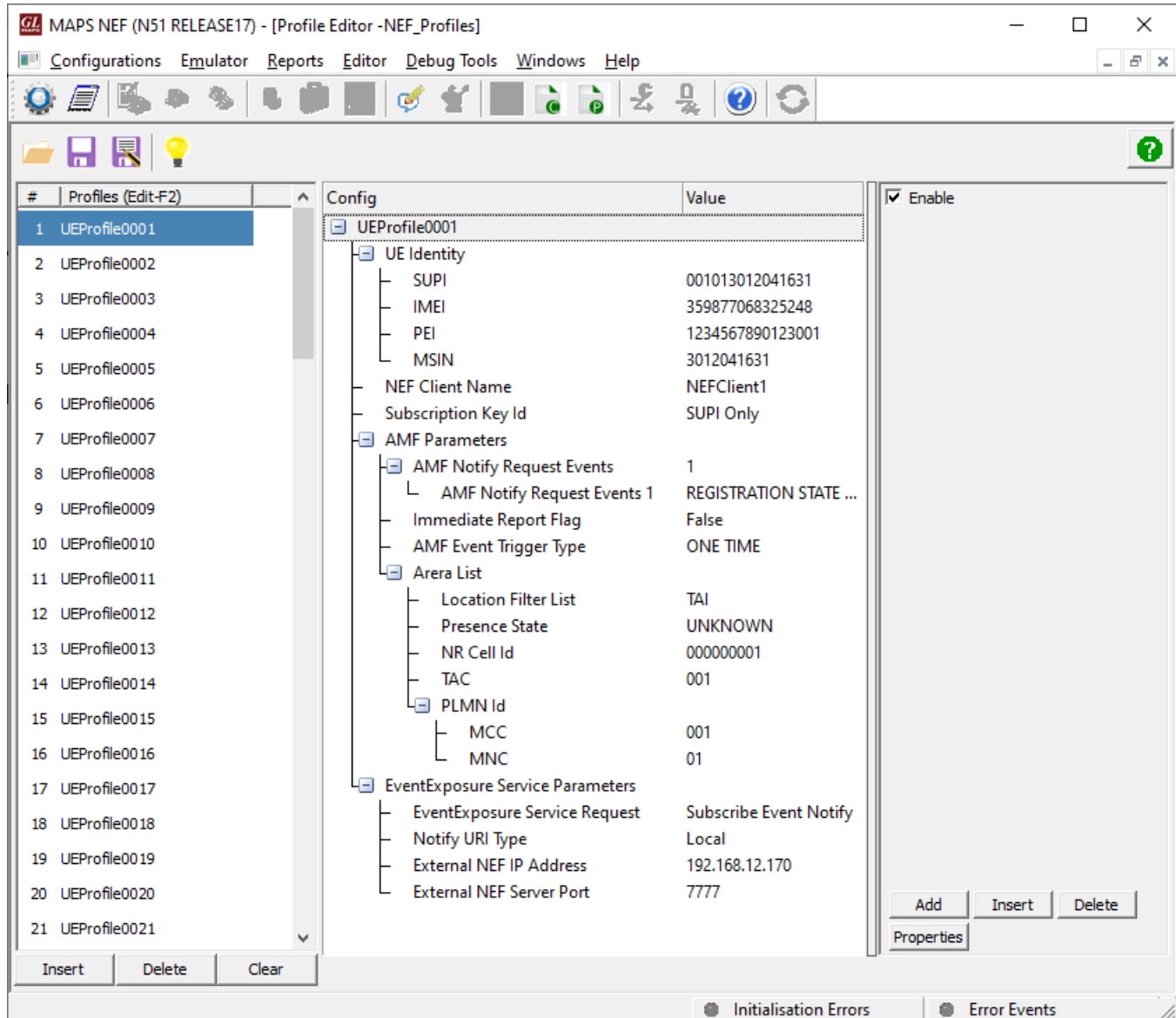

Figure: Profile Editor

GL Communications Inc.

Pre-processing Tools *(Contd.)*

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.
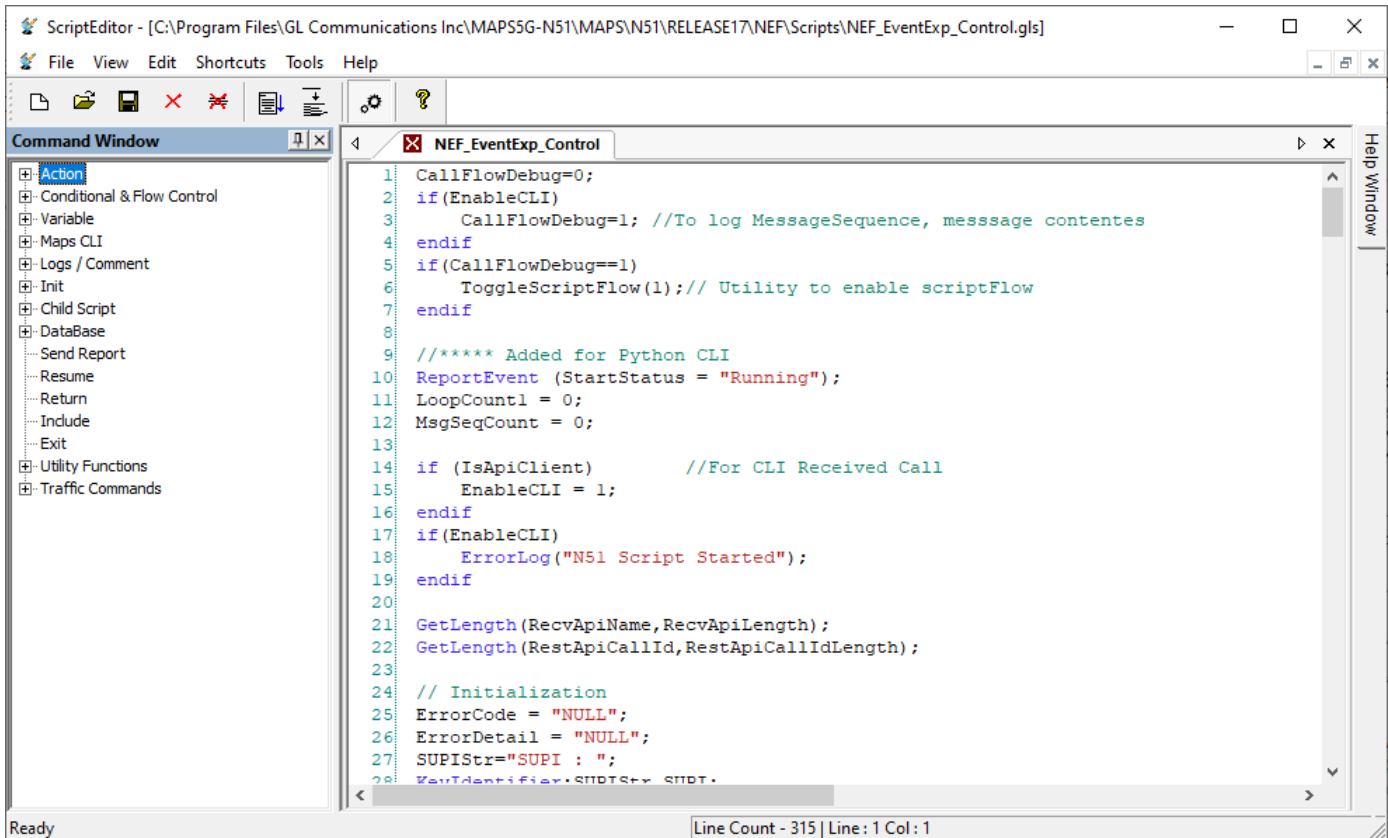
Figure: Script Editor

GL Communications Inc.

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 users 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 call generation, and at the call reception the script is automatically triggered by incoming messages.
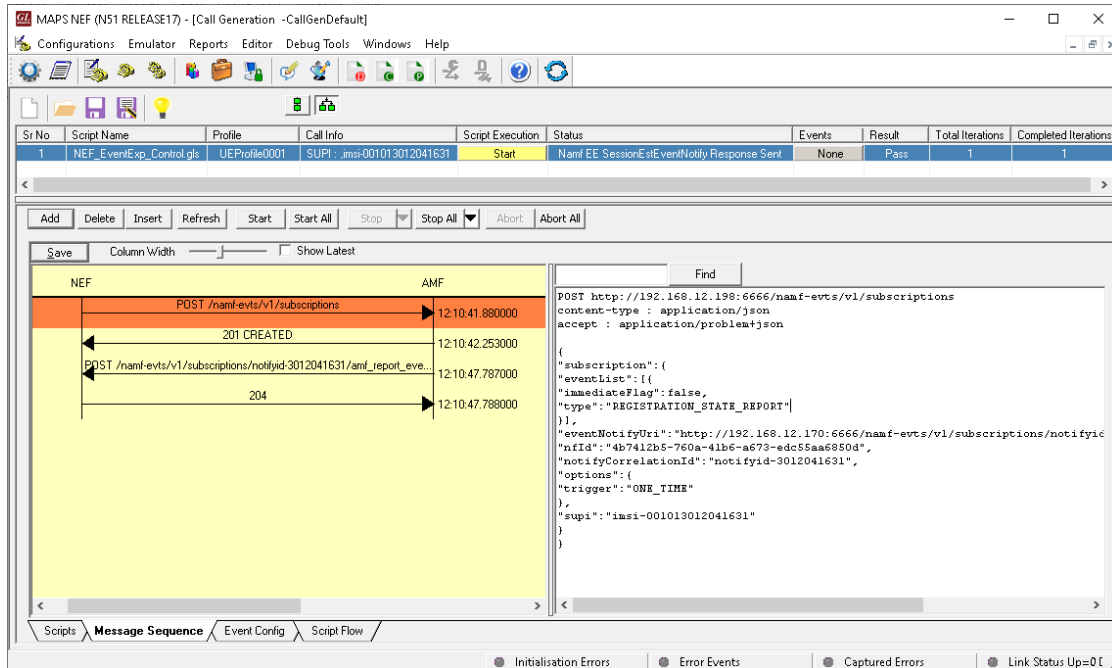
Figure: Call Generation
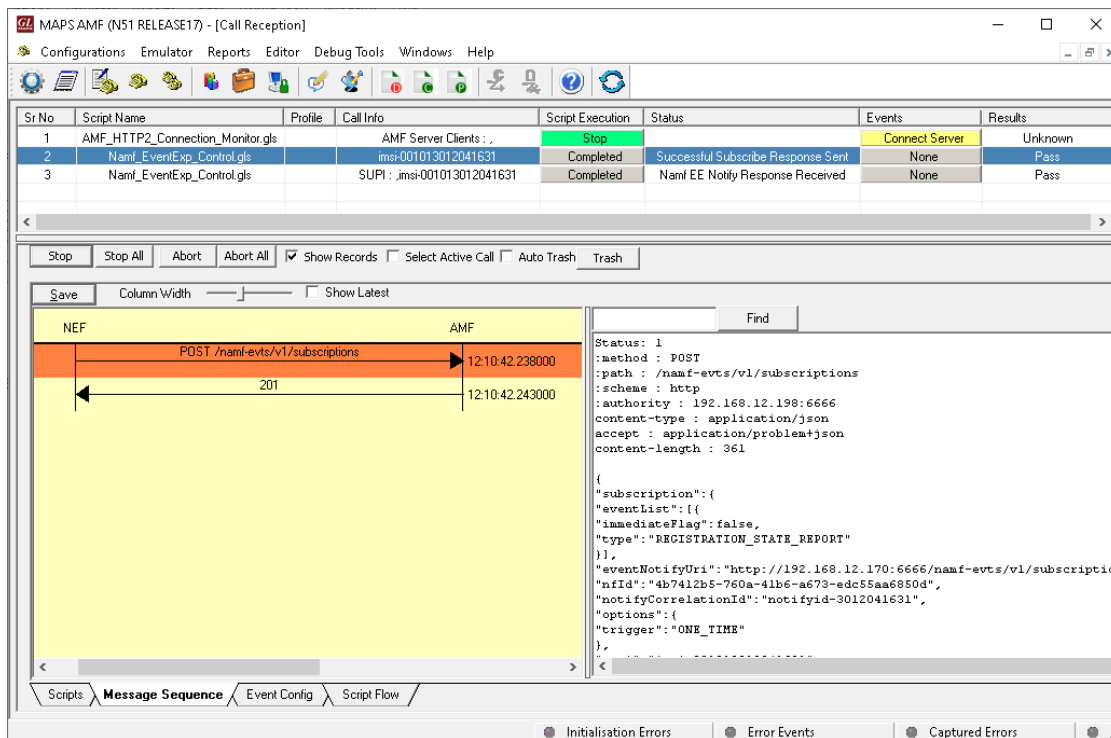
Figure: Call Reception

GL Communications Inc.

UE Subscription Notification Procedures

Event Notification Subscription Procedure

MAPS™ for 5G N51 interface emulate services between NEF and AMF network functions. The subscribe service operation is used to create subscription to an event for one UE or group of UE's. The below image shows the NEF (as Service Consumer) sends the subscription request through HTTP POST to AMF to create new event on subscription AMF.
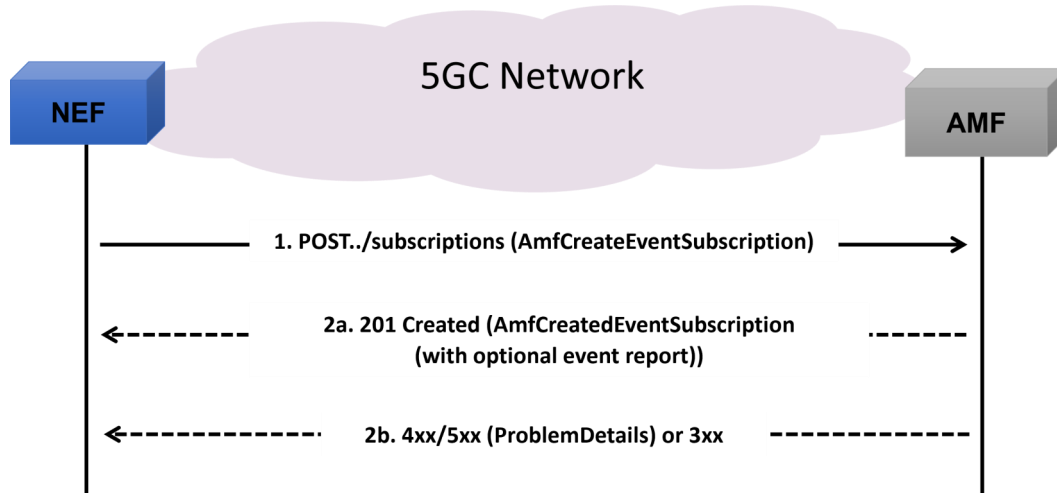
Figure: Event Notification Subscription Procedure

In this procedure, NEF sends HTTP POST request to create an event for new subscription to the AMF. On success, AMF includes a HTTP Location header to provide the location of a newly created subscription together with the status code 201 indicating the requested resource is created. On failure, HTTP status code 4xx/5xx response is returned indicating the subscription creation has failed due to application error like UE_NOT_SERVED_BY_AMF.

Unsubscribe Event Notification Procedure

The unsubscribe operation deletes the existing subscription information that is created by AMF. The below image shows that the NEF (NF Service consumer) sends unsubscribe (delete) request to the AMF.
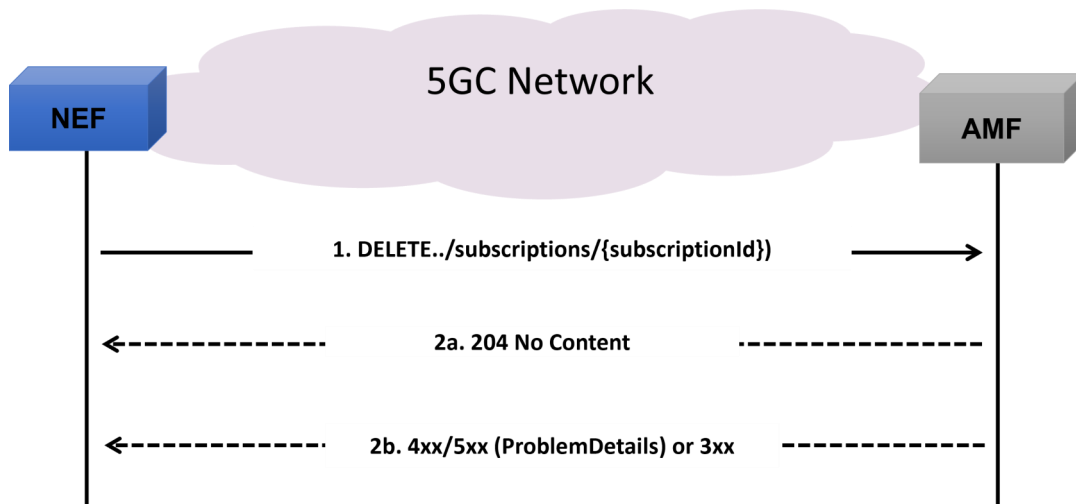
Figure: Unsubscribe Event Notification Procedure

In this procedure, NEF sends a HTTP DELETE request to the AMF requesting to delete the existing subscription information. On success, "204 No Content" returned indicating the subscription ID is successfully deleted. On failure, HTTP status code 4xx/5xx response is returned due to application error.

GL Communications Inc.

UE Subscription Notification Procedures (*Contd.*)

Event Notification Procedure

The Notify service is used by NEF from AMF to notify any event(s) for one UE, group of UE(s) or any UE when certain event included in the subscription has taken place.
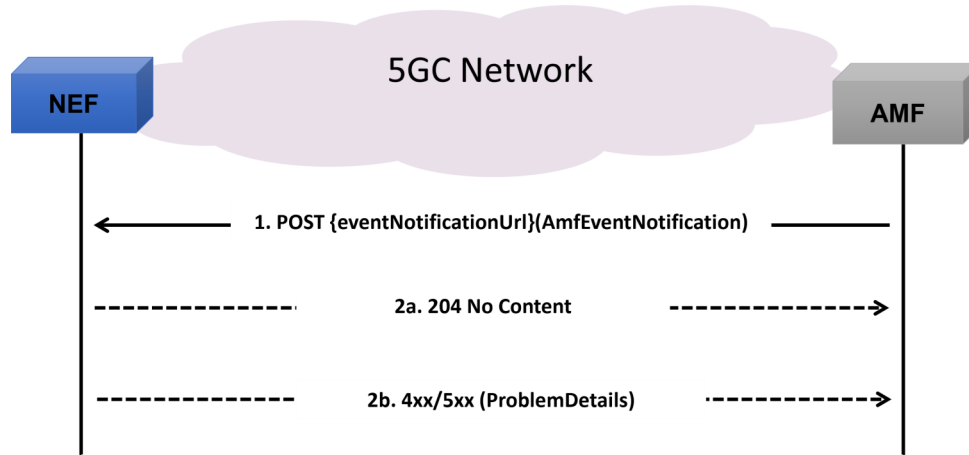

Figure: Event Notification Procedure

In this procedure, the AMF sends a HTTP POST request to the NEF towards the notification on occurrence of event within the subscription. On success, the "204 No Content" is returned. On failure, HTTP status code 4xx/5xx response is returned due to application error.

The Event Notification includes the following event types.

- Registration State Change Event
- Connection State Change Event
- Location Report Event
- Presence In Area of Interest Event

Registration State Change Event

A NEF sends a HTTP Post request to the AMF to get notified about the changes related to the registration state of a UE or a group of UEs, and AMF sends a notification for updated registration state.
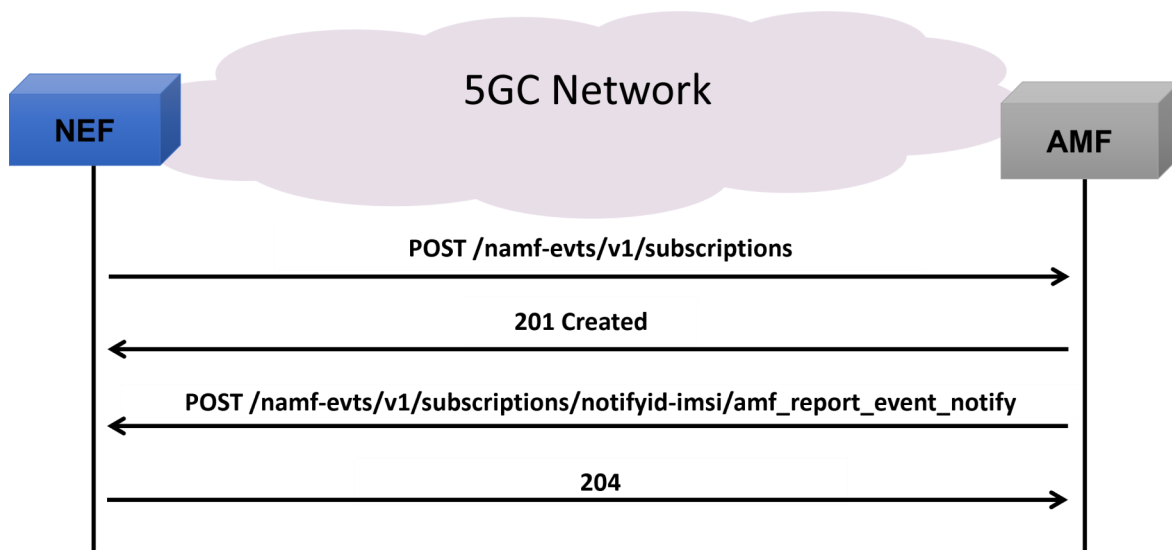
Figure: Registration State Change Event

◈ **GL Communications Inc.**

Command Line Interface (CLI)

MAPS™ 5G N51 (NEF) can be configured as CLI server application, to enable remote controlling of the application through command-line based clients. Supporting clients include Python. Clients can remotely perform all functions such as start testbed setup, load scripts, profiles, apply user events such as originate call, terminate call, start and stop traffic. Users can also generate and receive calls through commands.

Figure: Sample Python Client

Figure: MAPS™ CLI Server

GL Communications Inc.

Supported Protocols and Specifications

```
┌─────────────────────────────┐
│            JSON             │
├─────────────────────────────┤
│           HTTP/2            │
├───────────────┬─────────────┤
│  TCP          │    TLS      │
├───────────────┴─────────────┤
│             IP              │
├─────────────────────────────┤
│          Ethernet           │
├─────────────────────────────┤
│            REST             │
└─────────────────────────────┘
```
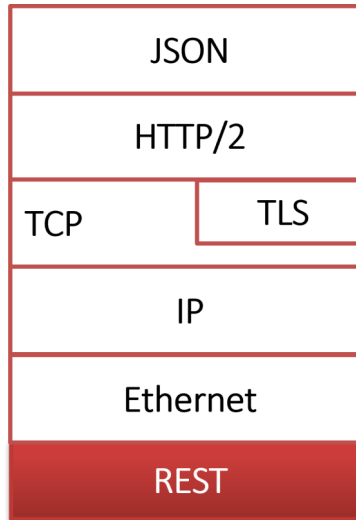
Supported Protocols	Standard / Specifications
N51 Interface (NEF-AMF)	TS29.518 (Release 17) TS29.522 (Release 17)
JavaScript Object Notation (JSON)	IETF RFC 8259
HTTP/2	IETF RFC 7540
TCP/TLS	IETF RFC 793
IPv4	IETF RFC 791 [5] IETF RFC 2460 [6]

GL Communications Inc.

Buyer's Guide

Item No	Product Description
PKS511	MAPS™ 5G N51 Interface Emulator (Requires PKS502)
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)
PKS504	MAPS™ 5G N10 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 Emulation (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)
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.