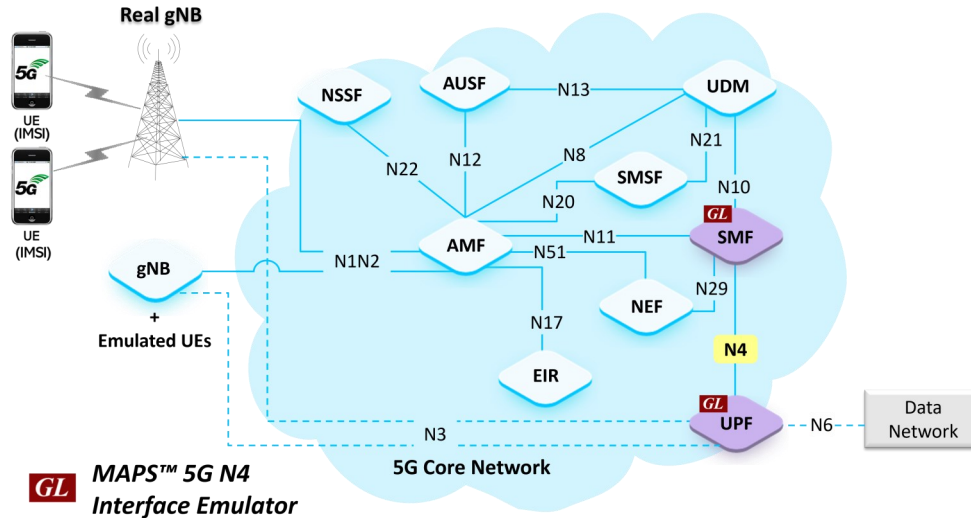


# MAPS™ 5G N4 Interface Emulator



## Overview

GL's MAPS™ 5G N4 interface can emulate PFCP (Packet Forwarding Control Protocol) signaling messages, as defined by 3GPP standards. PFCP used on the interface between the control plane and the user plane function. In the above network diagram, N4 is the reference point in the Control and User Plane Separation (CUPS) architecture. The PFCP protocol is used on N4 reference point between Session Management Function (SMF) and User Plane Function (UPF) 3GPP mobile core interfaces as specified in 3GPP TS 23.501 and 3GPP TS 23.502.

GL's MAPS™ 5G N4 interface emulator can emulate and test SMF and UPF elements. SMF in the 5G N4 interface is primarily concerned with managing the UEs PDU sessions. Its responsibilities include the establishment, modification, and release of the PDU sessions. UPF in the CUPS architecture is responsible for handling user data packet forwarding and reporting the traffic usage data to the SMF.

Besides emulating network elements SMF and UPF, 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 the test plan.

The application supports utilities such as Message Editor, Script Editor, and Profile Editor that allow new scenarios to be created or modified using messages and parameters.

For more information, visit [MAPS™ 5G N4 Interface Emulator](#) webpage.

## Main Features

- Emulate SMF and UPF elements
- Supports 5G Control Plane and User Plane
- Generates and process PFCP (valid and invalid) messages
- Supports Command Line Interface (CLI) through a client-server model, enabling users to control all features via Python APIs
- Supports various PFCP session procedures like Session Establishment, Session Modification, Session Deletion and Reporting Traffic Data Usage
- Supports GTP Traffic (GTP User Plane Data) such as, HTTP/TCP, UDP, PCAP playback scaling up to 40 Gbps per chassis
- Supports scripted call generation and automated call reception
- Supports GTP Traffic (GTP User Plane Data), HTTP traffic generation capability
- 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



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## Testbed Configuration

The testbed setup window allows user to setup the required test environment in N4 interface. The SCTP Configuration parameters consists of Source / Destination IP address, and Port numbers to be configured in MAPS™ to emulate SMF and UPF entities in N4 interface. MAPS™ can then generate and receive messages to / from valid IP Address in the 5G network. End user configuration profile used to configure MAPS™ 5G N4 with supported SMF and UPF parameters.

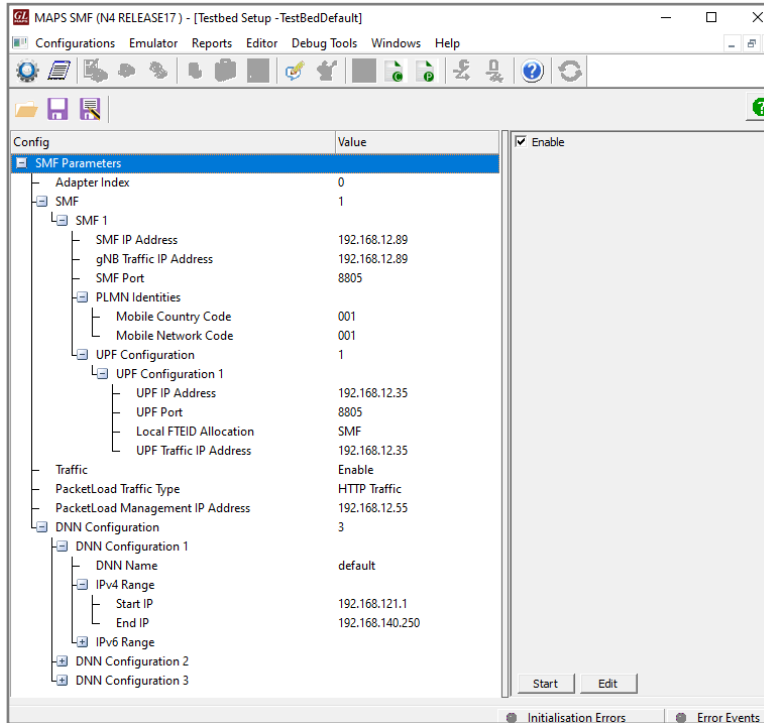


Figure: Testbed Setup

## Pre-processing Tools

**MESSAGE EDITOR** - The message editor allows user to build a template for each protocol message type. The value for each field may be changed in the message template prior to testing. The protocol fields comprises of mandatory fixed parameters, mandatory variable parameters, and optional variable parameters.

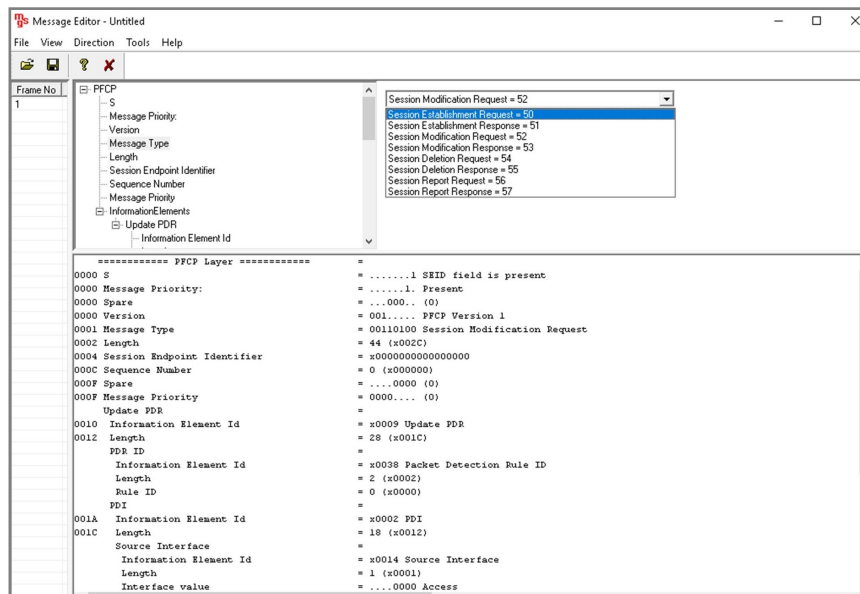


Figure: Message Editor

## Pre-processing Tools (Contd.)

**SCRIPT EDITOR** - The script editor allows the 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.

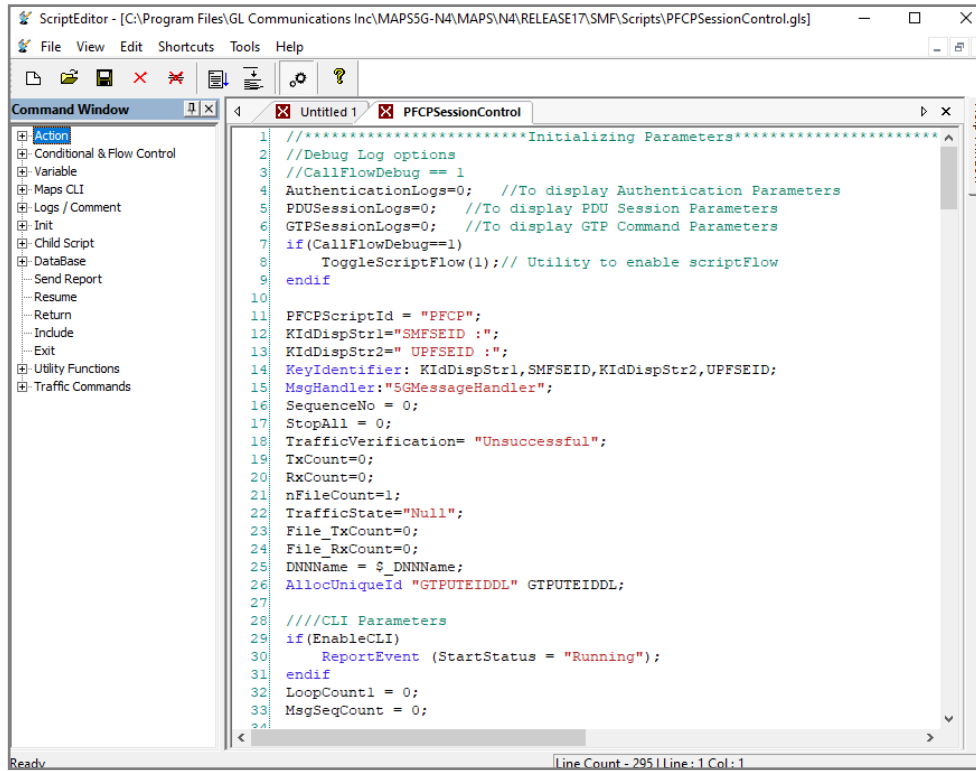


Figure: Script Editor

**PROFILE EDITOR** - The profile editor allows loading profile to edit the values of the variables using GUI, replacing the original value of the variables in the message template. An XML file defines a set of multiple profiles with varying parameter values that allow user to configure call instances in call generation and to receive calls. The MobilePCore.xml profile used during script execution includes traffic parameter settings - HTTP Server IP address, TCP port, UDP Source and Destination ports and other traffic related parameters.

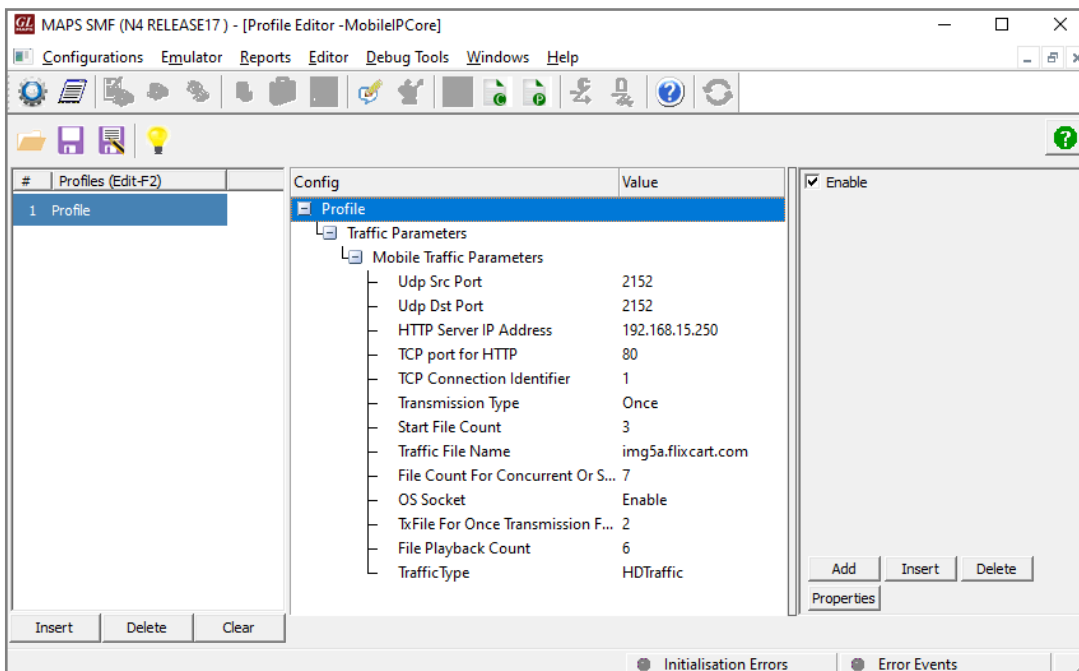


Figure: Profile Editor

## Call Generation and Call Reception

In call generation, 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, allows 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 call generation and at the call reception, the script is automatically triggered by incoming messages.

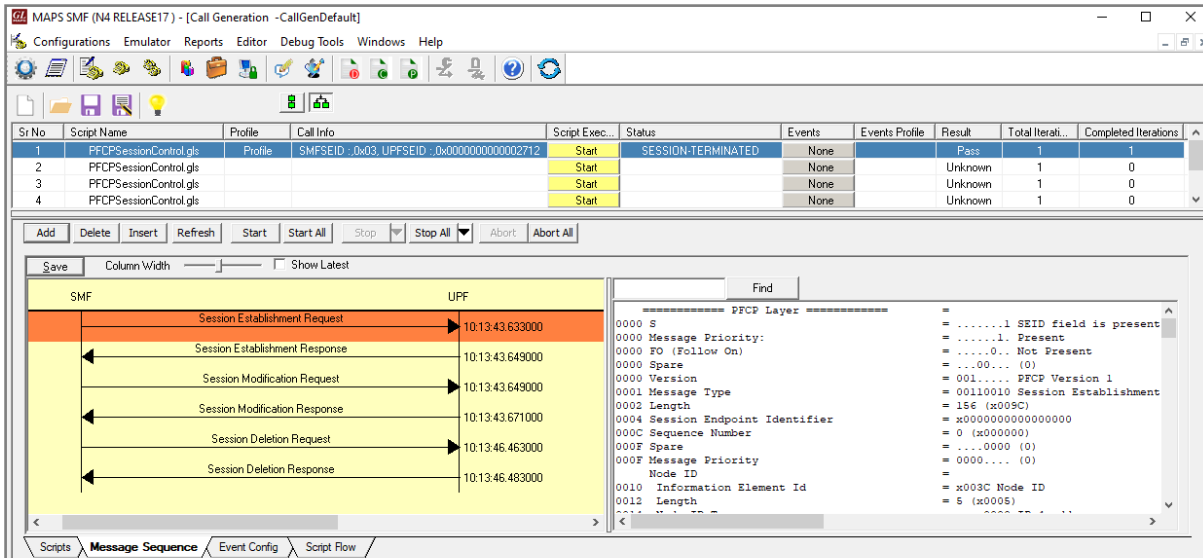


Figure: Call Generation

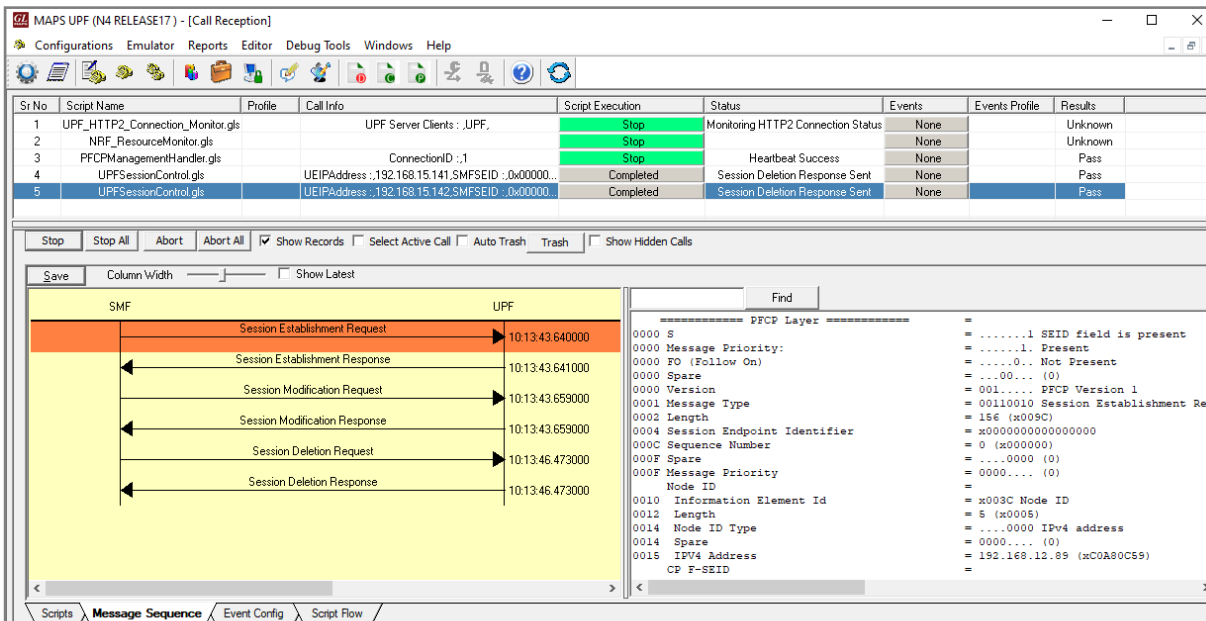


Figure: Call Reception

## Emulation of 5G N4 Signaling Procedure

The below call flow shows the messages flow between SMF and UPF that are emulated using MAPS™ application.

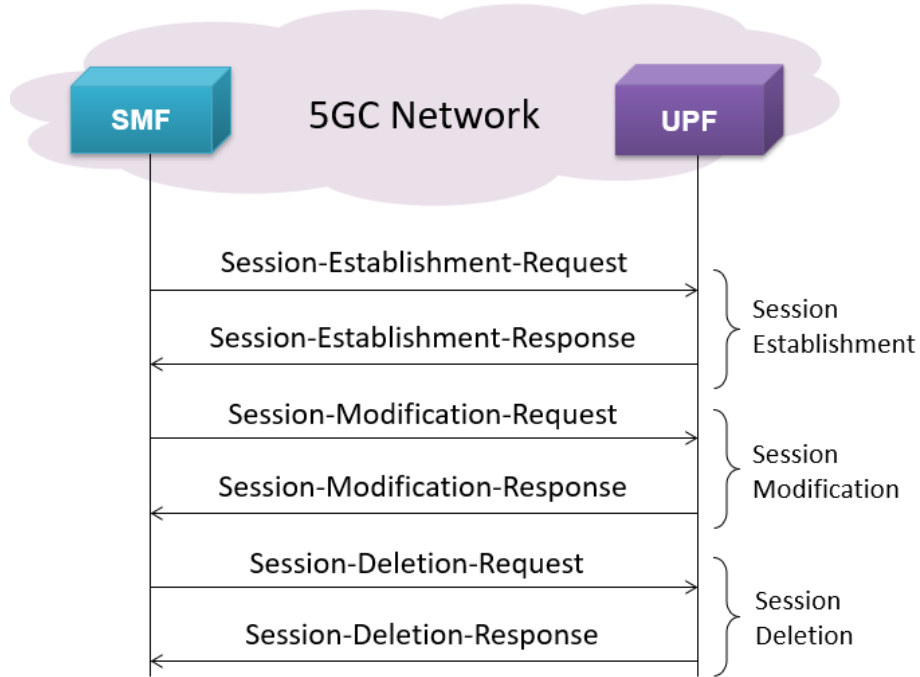
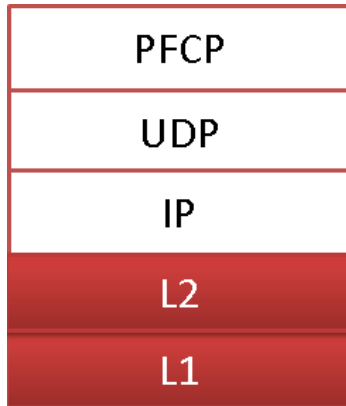


Figure: 5G N4 Signaling Call Flow

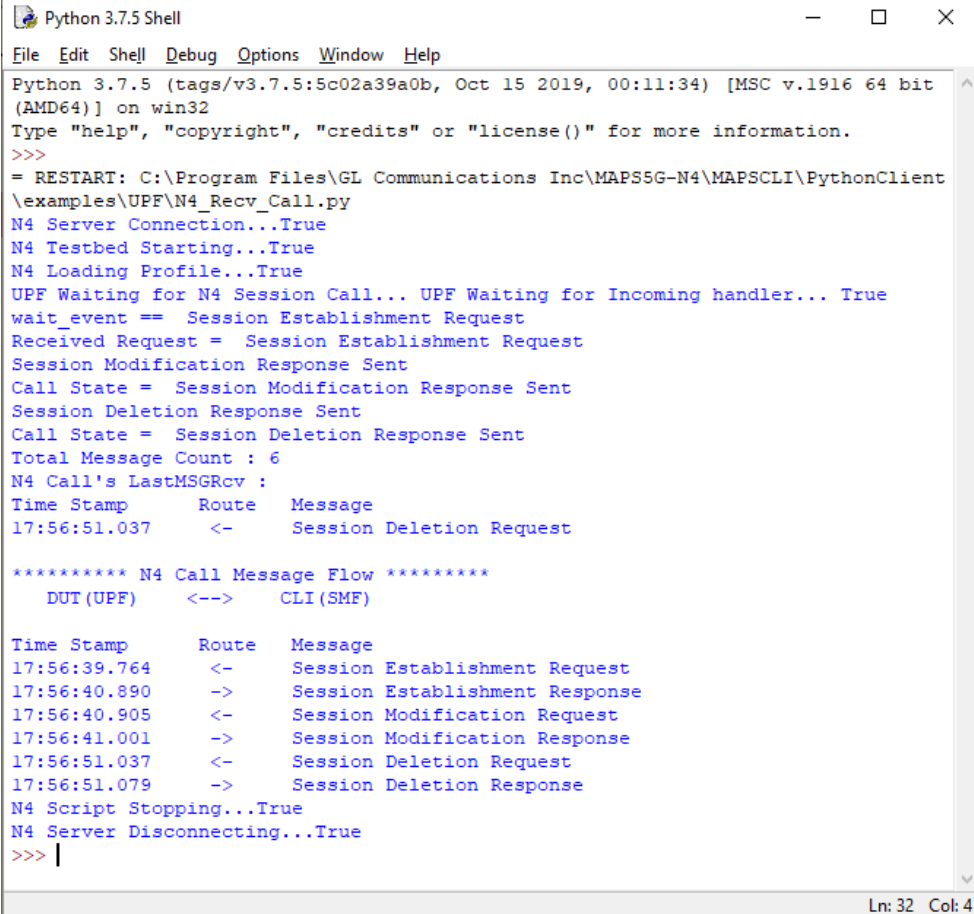
## Supported Protocols and Specifications



Supported Protocols	Standard / Specification
N4 Interface (SMF - UPF)	TS29.244
PFCP	3GPP TS 29.244
UDP	IETF RFC 768
IPv4	IETF RFC 791 IETF RFC 2460

## Command Line Interface (CLI)

The MAPS™ 5G N4 (UPF) 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 such as send digits/file/tones, detect digits/file/tones, dial, originate call, terminate call, start and stop traffic. Users can also generate and receive calls through commands. This client application is distributed along with MAPS™ Server application.

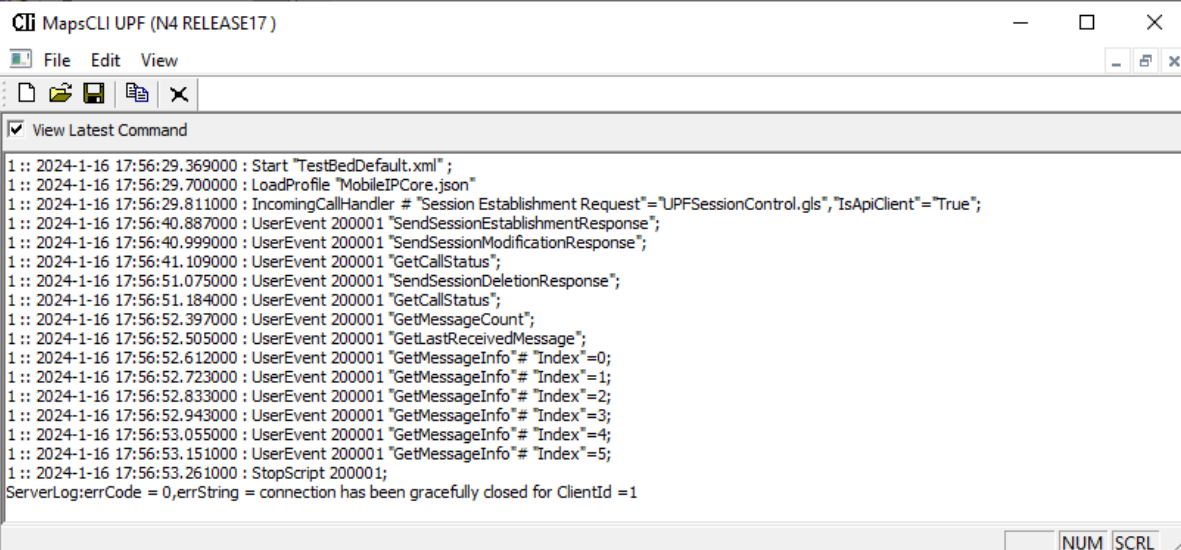


```
Python 3.7.5 Shell
File Edit Shell Debug Options Window Help
Python 3.7.5 (tags/v3.7.5:5c02a39a0b, Oct 15 2019, 00:11:34) [MSC v.1916 64 bit
(AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: C:\Program Files\GL Communications Inc\MAPS5G-N4\MAPSCLI\PythonClient
\examples\UPF\N4_Recv_Call.py
N4 Server Connection...True
N4 Testbed Starting...True
N4 Loading Profile...True
UPF Waiting for N4 Session Call... UPF Waiting for Incoming handler... True
wait_event == Session Establishment Request
Received Request = Session Establishment Request
Session Modification Response Sent
Call State = Session Modification Response Sent
Session Deletion Response Sent
Call State = Session Deletion Response Sent
Total Message Count : 6
N4 Call's LastMSGRCV :
Time Stamp      Route      Message
17:56:51.037    <-        Session Deletion Request

***** N4 Call Message Flow *****
      DUT (UPF)  <-->  CLI (SMF)

Time Stamp      Route      Message
17:56:39.764    <-        Session Establishment Request
17:56:40.890    ->        Session Establishment Response
17:56:40.905    <-        Session Modification Request
17:56:41.001    ->        Session Modification Response
17:56:51.037    <-        Session Deletion Request
17:56:51.079    ->        Session Deletion Response
N4 Script Stopping...True
N4 Server Disconnecting...True
>>> |
```

Figure: Sample Python Client



```
CLI MapsCLI UPF (N4 RELEASE17)
File Edit View
View Latest Command
1:: 2024-1-16 17:56:29.369000 : Start "TestBedDefault.xml";
1:: 2024-1-16 17:56:29.700000 : LoadProfile "MobileIPCore.json"
1:: 2024-1-16 17:56:29.811000 : IncomingCallHandler # "Session Establishment Request"="UPFSessionControl.gls","IsApiClient"="True";
1:: 2024-1-16 17:56:40.887000 : UserEvent 200001 "SendSessionEstablishmentResponse";
1:: 2024-1-16 17:56:40.999000 : UserEvent 200001 "SendSessionModificationResponse";
1:: 2024-1-16 17:56:41.109000 : UserEvent 200001 "GetCallStatus";
1:: 2024-1-16 17:56:51.075000 : UserEvent 200001 "SendSessionDeletionResponse";
1:: 2024-1-16 17:56:51.184000 : UserEvent 200001 "GetCallStatus";
1:: 2024-1-16 17:56:52.397000 : UserEvent 200001 "GetMessageCount";
1:: 2024-1-16 17:56:52.505000 : UserEvent 200001 "GetLastReceivedMessage";
1:: 2024-1-16 17:56:52.612000 : UserEvent 200001 "GetMessageInfo" # "Index"=0;
1:: 2024-1-16 17:56:52.723000 : UserEvent 200001 "GetMessageInfo" # "Index"=1;
1:: 2024-1-16 17:56:52.833000 : UserEvent 200001 "GetMessageInfo" # "Index"=2;
1:: 2024-1-16 17:56:52.943000 : UserEvent 200001 "GetMessageInfo" # "Index"=3;
1:: 2024-1-16 17:56:53.055000 : UserEvent 200001 "GetMessageInfo" # "Index"=4;
1:: 2024-1-16 17:56:53.151000 : UserEvent 200001 "GetMessageInfo" # "Index"=5;
1:: 2024-1-16 17:56:53.261000 : StopScript 200001;
ServerLog:errCode = 0,errString = connection has been gracefully closed for ClientId = 1
NUM SCRL
```

Figure: MAPS™ CLI Server

## Buyer's Guide

Item No	Product Description
<a href="#">PKS501</a>	MAPS™ 5G N4 Interface Emulator
<a href="#">ETH101</a>	Mobile Traffic Core - GTP
<a href="#">ETH102</a>	Mobile Traffic Core - Gateway

Item No	Related Software
<a href="#">PKS305</a>	MAPS™ 5G Multi-Interface Emulation
<a href="#">PKS500</a>	MAPS™ 5G N1N2 Interface Emulator
<a href="#">PKS502</a>	MAPS™ 5G Service based Emulator (Pre-requisite base license for all service based (Open API) interface emulations)
<a href="#">PKS503</a>	MAPS™ 5G N8 Interface Emulator (Requires PKS502)
<a href="#">PKS504</a>	MAPS™ 5G N10 Interface Emulator (Requires PKS502)
<a href="#">PKS505</a>	MAPS™ 5G N11 Interface Emulator (Requires PKS502)
<a href="#">PKS506</a>	MAPS™ 5G N12 Interface Emulator (Requires PKS502)
<a href="#">PKS507</a>	MAPS™ 5G N13 Interface Emulator (Requires PKS502)
<a href="#">PKS502</a>	MAPS™ 5G N17 Interface Emulator (Requires PKS502)
<a href="#">PKS508</a>	MAPS™ 5G N20 Interface Emulator (Requires PKS502)
<a href="#">PKS509</a>	MAPS™ 5G N21 Interface Emulator (Requires PKS502)
<a href="#">PKS510</a>	MAPS™ 5G N22 Interface Emulator (Requires PKS502)
<a href="#">PKS511</a>	MAPS™ 5G N29 Interface Emulator (Requires PKS502)
<a href="#">PKS511</a>	MAPS™ 5G N51 Interface Emulator (Requires PKS502)
<a href="#">PKS170</a>	CLI Support for MAPS™

For complete list of MAPS™ products, refer [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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