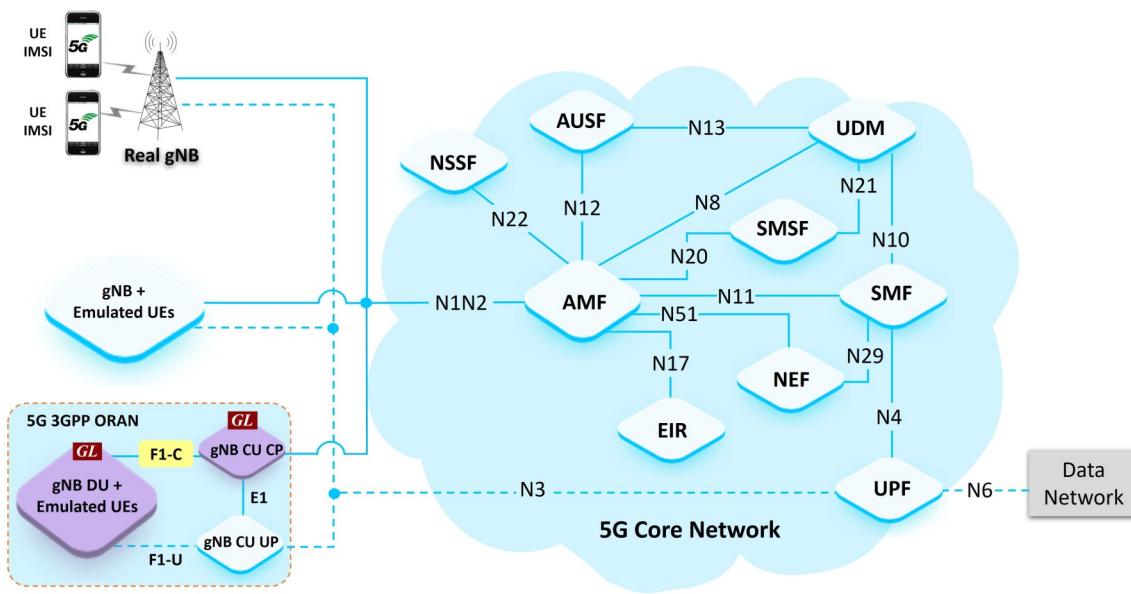


# MAPS™ 5G ORAN F1 Interface Emulator



## Overview

GL's **Message Automation & Protocol Simulation (MAPS™)** tests the **5G ORAN F1AP interface**, emulating both **gNB Central Unit (CU)** and **gNB Distributed Unit (DU)** in compliance with 3GPP TS 38.473 specification. The F1 interface connects CU and DU through F1-C (Control Plane) and F1-U (User Plane), enabling functional split and efficient midhaul communication in 5G ORAN architecture.

The MAPS™ F1AP Interface Emulator supports key 5G midhaul procedures such as UE Context Setup, Bearer Management, and RRC Message Forwarding, ensuring reliable and standards-compliant operation. Users can emulate either gNB CU or gNB DU network elements to test real-world signaling scenarios across both planes.

In addition to control-plane signaling, the application supports user-plane packet emulation using GL's **Mobile Traffic Core – GTP (ETH101)** and **Mobile Traffic Core – Gateway (ETH102)** licenses. This enables end-to-end midhaul traffic generation, verification, and performance analysis between CU and DU.

MAPS™ 5G ORAN F1AP is a versatile tool for functional testing, regression testing, load testing, and fault insertion, allowing engineers to validate performance, interoperability, and QoS handling without requiring live RAN equipment. The platform includes powerful utilities such as Message Editor, Script Editor, and Profile Editor, enabling users to customize signaling procedures, simulate configurations, and verify 5G ORAN midhaul operations.

For more information, visit [MAPS™ 5G ORAN F1 Interface Emulator](#) webpage.

## Main Features

- MAPS™ 5G ORAN F1AP interface emulates gNB Central Unit (CU) and Distributed Unit (DU)
- Supports 5G F1-C (Control Plane) and F1-U (User Plane) procedures
- Generates and processes valid and invalid F1AP messages for protocol compliance testing
- Supports GTP-U traffic tunneling for end-to-end user-plane emulation
- Provides fault insertion and impairment simulation for robustness and negative testing
- Ready-to-use scripts for quick and repeatable F1 interface testing
- Customizable call flow and message templates using Script, Message, and Profile Editors
- Supports automated call generation, reception, and scheduling for 24/7 remote testing
- Performs performance, load, functional, and regression testing of CU and DU nodes
- Supports SCTP over IP transport layer testing with configurable association parameters
- Simulates large-scale midhaul environments for interoperability, training, and R&D testing



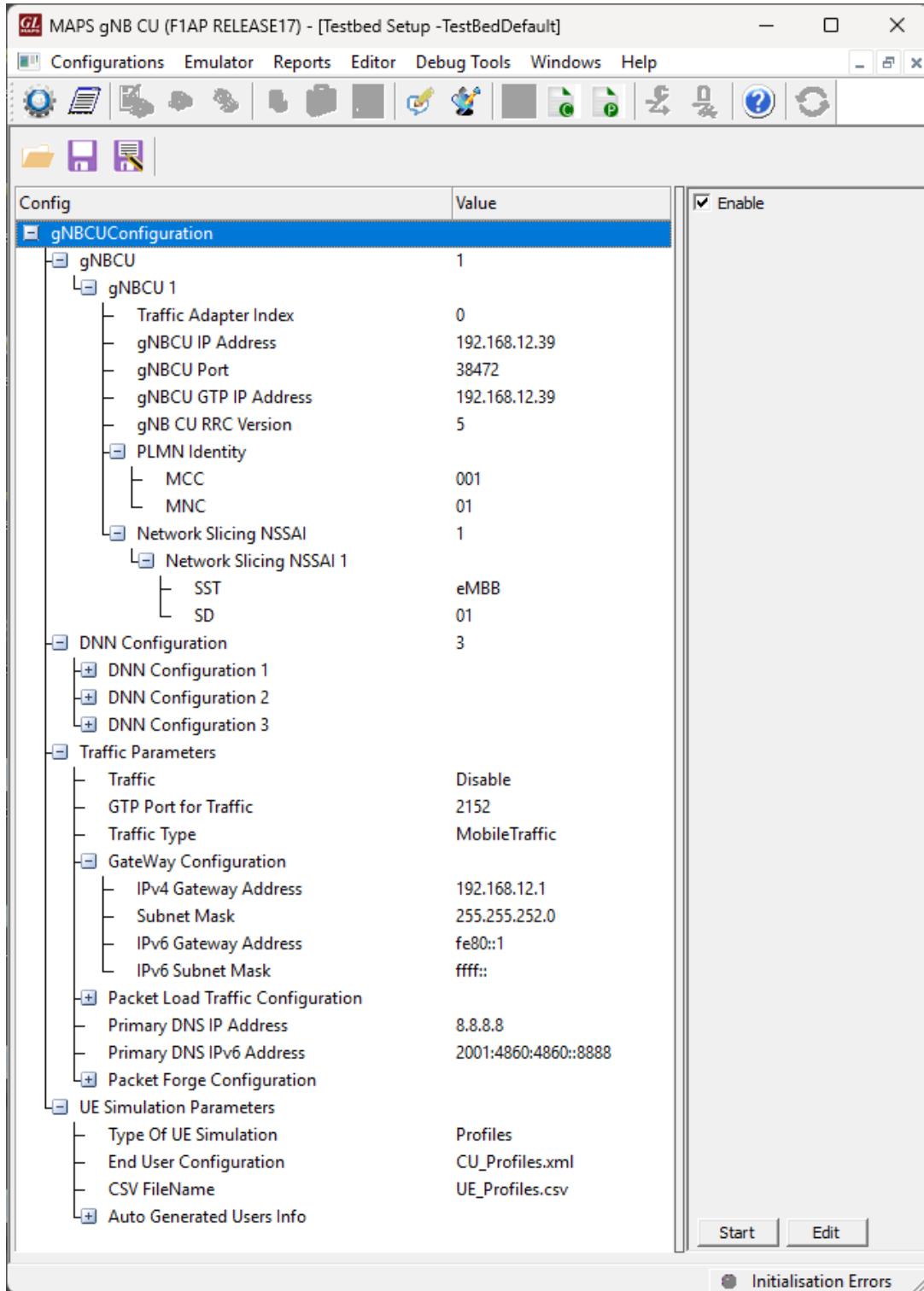
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## Testbed Configuration

The testbed setup window allow users to setup the required test configurations in F1 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 F1AP interface with the supported gNB DU and gNB CU parameters.



Testbed Setup

## 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.

GL MAPS gNB DU (F1AP RELEASE17) - [Profile Editor -UE\_Profiles]

Configurations Emulator Reports Editor Debug Tools Windows Help

Profiles (Edit-F2)

MSIN3012041631

Config

Value

Enable

Registration Parameters

- Registration Type: Initial Registration
- SMS Over NAS Transport Requested: Not Supported
- Follow On Request: Follow On Request Pending
- NG RAN Radio Capability Update: Not Needed

Mobile Identity

- Type Of Identity: SUCI
- SUCI

  - SUPI Format: IMSI
  - IMSI: 001013012041631
  - TMSI: 10000001
  - IMEI: 359877068325248
  - IMEISV: 1234567890123001
  - MSISDN: 3012041631
  - C RNTI: 1631

GMM Capability

- S1 Mode: Not Supported
- HO Attach: Not Supported
- LPP Capability: LPP in N1 Mode not supp...

Requested NSSAI

- RNNSAI

  - RNNSAI 1

    - Requesting NSSAI SST: eMBB
    - Requesting NSSAI SD: 1

Include UEContextRequest IE

RRC Establish Cause: MO Signaling

nRCGI

- MCC: 001
- MNC: 01
- Cell Identity: 000000001

Tracking Area Information

- TAC: 37

Authentication Parameters

- Authentication Type: 5G-AKA
- Authentication Algorithm Type: Milenage
- Key: 0011233445566778899aa...
- Operator Variant Parameter Type: OPc
- OP: 01020304050607080910111...
- OPc: 01020304050607080910111...

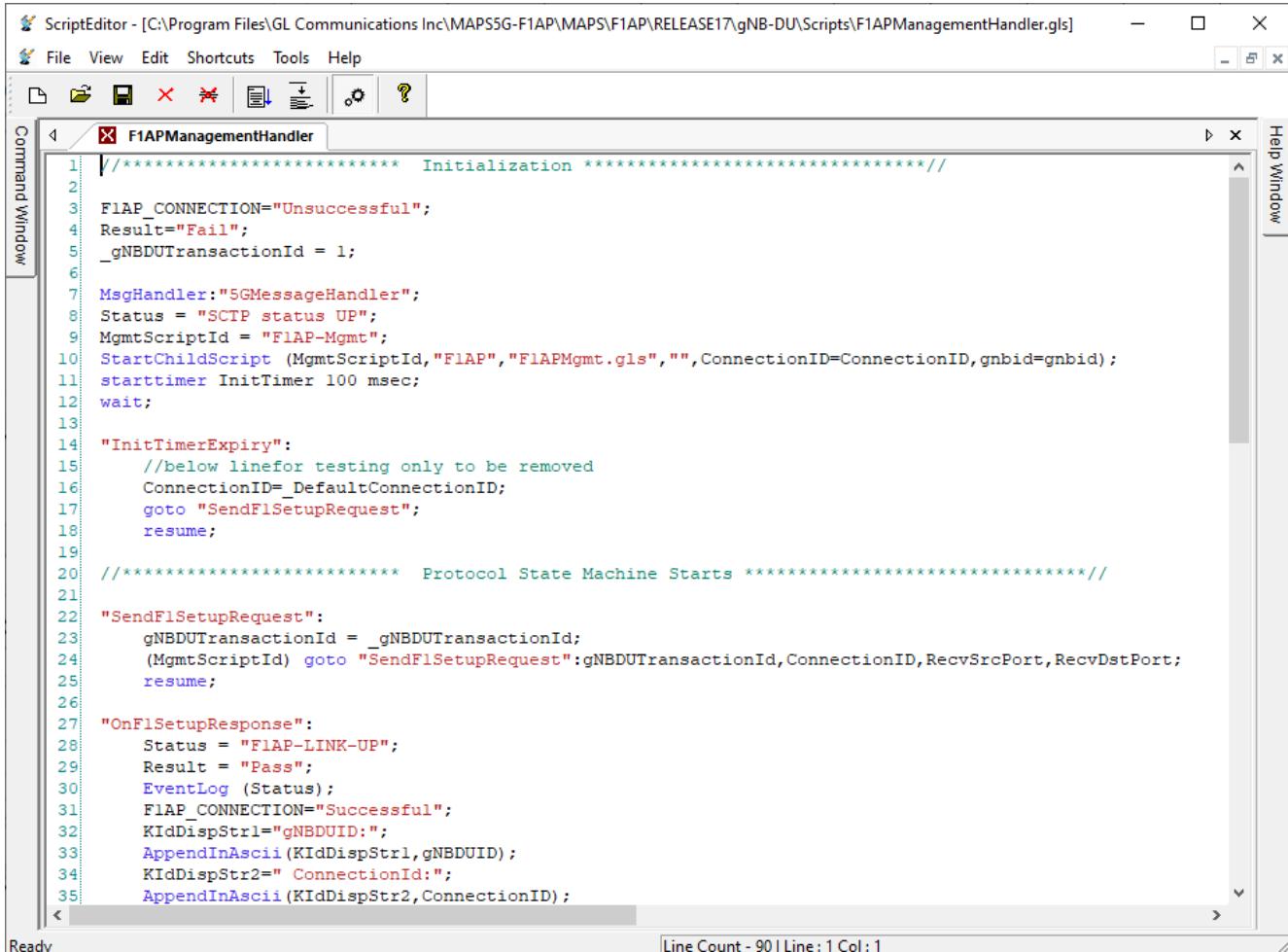
Add Insert Delete Properties

Initialisation Errors Error Events Capt

Profile Editor

## 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.



The screenshot shows the Script Editor window with the following details:

- Title Bar:** ScriptEditor - [C:\Program Files\GL Communications Inc\MAPS5G-F1AP\MAPS\F1AP\RELEASE17\gNB-DU\Scripts\F1APManagementHandler.gls]
- Menu Bar:** File, View, Edit, Shortcuts, Tools, Help
- Toolbar:** Includes icons for New, Open, Save, Cut, Copy, Paste, Find, Replace, and Help.
- Script Content:**

```

1 //***** Initialization *****/
2
3 F1AP_CONNECTION="Unsuccessful";
4 Result="Fail";
5 _gNBDUTransactionId = 1;
6
7 MsgHandler:"5GMessageHandler";
8 Status = "SCTP status UP";
9 MgmtScriptId = "F1AP-Mgmt";
10 StartChildScript (MgmtScriptId, "F1AP", "F1APMgmt.gls", "", ConnectionID=ConnectionID, gnbid=gnbid);
11 starttimer InitTimer 100 msec;
12 wait;
13
14 "InitTimerExpiry":
15     //below line for testing only to be removed
16     ConnectionID=_DefaultConnectionID;
17     goto "SendF1SetupRequest";
18     resume;
19
20 //***** Protocol State Machine Starts *****/
21
22 "SendF1SetupRequest":
23     gNBDUTransactionId = _gNBDUTransactionId;
24     (MgmtScriptId) goto "SendF1SetupRequest":gNBDUTransactionId, ConnectionID, RecvSrcPort, RecvDstPort;
25     resume;
26
27 "OnF1SetupResponse":
28     Status = "F1AP-LINK-UP";
29     Result = "Pass";
30     EventLog (Status);
31     F1AP_CONNECTION="Successful";
32     KIdDispStr1="gNBDUID:";
33     AppendInAscii (KIdDispStr1, gNBDUID);
34     KIdDispStr2=" ConnectionId:";
35     AppendInAscii (KIdDispStr2, ConnectionID);

```
- Bottom Status Bar:** Ready | Line Count - 90 | Line: 1 Col: 1

Script 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 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.

The screenshot shows the MAPS gNB DU (F1AP RELEASE17) software interface for 'Call Generation - CallGenDefault'. The main window is divided into several sections:

- Top Bar:** Includes 'Configurations', 'Emulator', 'Reports', 'Editor', 'Debug Tools', 'Windows', and 'Help'.
- Script List:** A table showing four scripts:
 

Sr...	Script Name	Profile	Call Info	Script Execution	Status	Events	Events...	Result	Total Iterations	Completed Iterations
1	5GFIAP_UESessionControl.gls	MSIN3012041631	TMSI_0x5F5AB0CB IMSI_001013012041631	Start	RM-DEREGISTERED	None		Pass	1	1
2	5GFIAP_UESessionControl.gls	MSIN3012041632		Start		None		Unknown	1	0
3	5GFIAP_UESessionControl.gls	MSIN3012041633		Start		None		Unknown	1	0
4	5GFIAP_UESessionControl.gls	MSIN3012041634		Start		None		Unknown	1	0
- Message Sequence:** A timeline showing the sequence of messages between gNB-DU-0 and gNBCU. The messages listed are:
  - InitialULRRCMessageTransfer, RRCSsetupRequest
  - DLRRCMessageTransfer, RRCSsetup
  - ULRRCMessageTransfer, RRCSsetupComplete, Registration Request
  - DLRRCMessageTransfer, DLInformationTransfer, Authentication Request
  - ULRRCMessageTransfer, ULInformationTransfer, Authentication Response
  - DLRRCMessageTransfer, DLInformationTransfer, Security Mode Command
  - ULRRCMessageTransfer, ULInformationTransfer, Security Mode Complete
  - DLRRCMessageTransfer, SecurityModeCommand
  - ULRRCMessageTransfer, SecurityModeComplete
  - DLRRCMessageTransfer, DLInformationTransfer, Registration Accept
  - ULRRCMessageTransfer, ULInformationTransfer, Registration Complete
  - ULRRCMessageTransfer, ULInformationTransfer, UL NAS Transport, Session Establishment Request
  - UEContextSetupRequest
  - UEContextSetupResponse
  - DLRRCMessageTransfer, DLInformationTransfer, DL NAS Transport, Session Establishment Accept
  - ULRRCMessageTransfer, ULInformationTransfer, UL NAS Transport, Session Release Request
  - UEContextModificationRequest
  - UEContextModificationResponse
  - DLRRCMessageTransfer, DLInformationTransfer, DL NAS Transport, Session Release Command
  - ULRRCMessageTransfer, ULInformationTransfer, UL NAS Transport, Session Release Complete
  - ULRRCMessageTransfer, ULInformationTransfer, Dereistration Request
  - UEContextReleaseCommand, RRCCRelease
  - UEContextReleaseComplete
- Message Structure:** A detailed view of the selected message structure for the 'InitialULRRCMessageTransfer, RRCSsetupRequest' message, showing its internal fields and their definitions.
- Bottom Navigation:** Includes tabs for 'Scripts', 'Message Sequence', 'Event Config', 'Script Flow', 'Capture Events', and status indicators for 'Initialisation Errors', 'Error Events', 'Captured Errors', and 'Link Status Up=1 Down=0'.

### Call Generation

## Call Generation and Call Reception (Contd.)

MAPS gNB CU (F1AP RELEASE17) - [Call Reception]

Configurations Emulator Reports Editor Debug Tools Windows Help

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Results
1	F1APManagementHandler.gls		gNBUDId:100, gNBDUTransactionId:1, ConnectionId:1002	Stop	F1 Setup Successful	SendF1Reset	Pass
2	gNBCUSessionControl.gls		MSIN:3012041531	Completed	DE-REGISTRATION ACCEPTED	None	Pass

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

Save Column Width Show Latest

gNB-DU gNB-CU-0

InitialULRRCMessageTransfer, RRCSsetupRequest → 11:30:05.309000

DLRRCMessageTransfer, RRCSsetup ← 11:30:05.314000

ULRRCMessageTransfer, RRCSsetupComplete, Registration Request → 11:30:05.506000

DLRRCMessageTransfer, DLInformationTransfer, Authentication Request ← 11:30:05.510000

ULRRCMessageTransfer, ULInformationTransfer, Authentication Response → 11:30:05.707000

DLRRCMessageTransfer, DLInformationTransfer, Security Mode Command ← 11:30:05.709000

ULRRCMessageTransfer, ULInformationTransfer, Security Mode Complete → 11:30:05.907000

DLRRCMessageTransfer, SecurityModeCommand ← 11:30:05.910000

ULRRCMessageTransfer, SecurityModeComplete → 11:30:06.108000

DLRRCMessageTransfer, DLInformationTransfer, Registration Accept ← 11:30:06.110000

ULRRCMessageTransfer, ULInformationTransfer, Registration Complete → 11:30:06.310000

ULRRCMessageTransfer, ULInformationTransfer, UL NAS Transport, Session Establishment Request → 11:30:06.311000

UEContextSetupRequest ← 11:30:06.314000

UEContextSetupResponse → 11:30:06.508000

DLRRCMessageTransfer, DLInformationTransfer, DL NAS Transport, Session Establishment Accept ← 11:30:06.510000

ULRRCMessageTransfer, ULInformationTransfer, UL NAS Transport, Session Release Request → 11:30:13.845000

UEContextModificationRequest ← 11:30:13.847000

UEContextModificationResponse → 11:30:14.045000

DLRRCMessageTransfer, DLInformationTransfer, DL NAS Transport, Session Release Command ← 11:30:14.047000

ULRRCMessageTransfer, ULInformationTransfer, UL NAS Transport, Session Release Complete → 11:30:14.246000

ULRRCMessageTransfer, ULInformationTransfer, Deregistration Request → 11:30:14.247000

UEContextReleaseCommand, RRCRelease ← 11:30:14.250000

UEContextReleaseComplete → 11:30:14.445000

Find

```
===== F1AP Layer =====
0000 F1AP-PDU
0000 Choice Index
0000 InitiatingMessage
0001 ProcedureCode
0001 Contents
0002 Criticality
0002 Contents
0003 Length
0005 Value
0005 InitialULRRCMessageTransferIEs
0005 Extensibility Marker
0005 ProtocolIE-Container
0006 Iteration Count
0008 ProtocolIE-Container
0008 ProtocolIE-Field
0008 ProtocolIE-ID
0008 Contents
000A Criticality
000A Contents
000B Length
000C Value
000C gNB-DU-UE-F1AP-ID
000C Length Determinant
000D Contents
000E ProtocolIE-Container
000E ProtocolIE-Field
000E ProtocolIE-ID
000E Contents
0010 Criticality
0010 Contents
0011 Length
0012 Value
0012 NRCGI
0012 Extensibility Marker
0012 Preamble
0013 plMN-Identity
0013 MCC
0013 MNC
0016 nRCellIdentity
0000 nRCellIdentity
001B ProtocolIE-Container
001B ProtocolIE-Field
001B ProtocolIE-ID
001B Contents
001D Criticality
001D Contents
001E Length
001F Value
001F C-RNTI
001F Extensibility Marker
0022 Contents
```

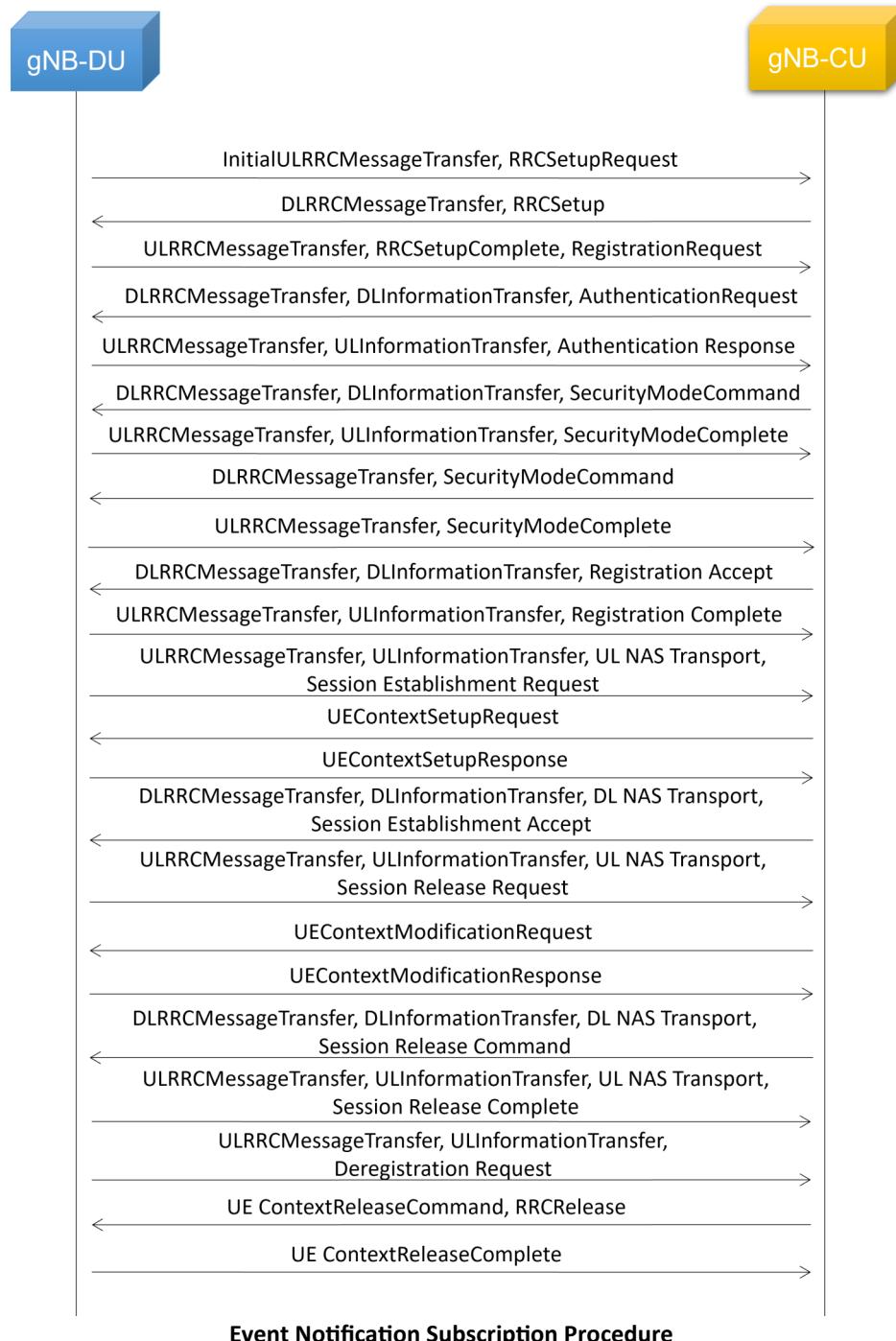
Scripts Message Sequence Event Config Script Flow

Initialisation Errors Error Events Captured Errors Link Status Up=1 Down=0

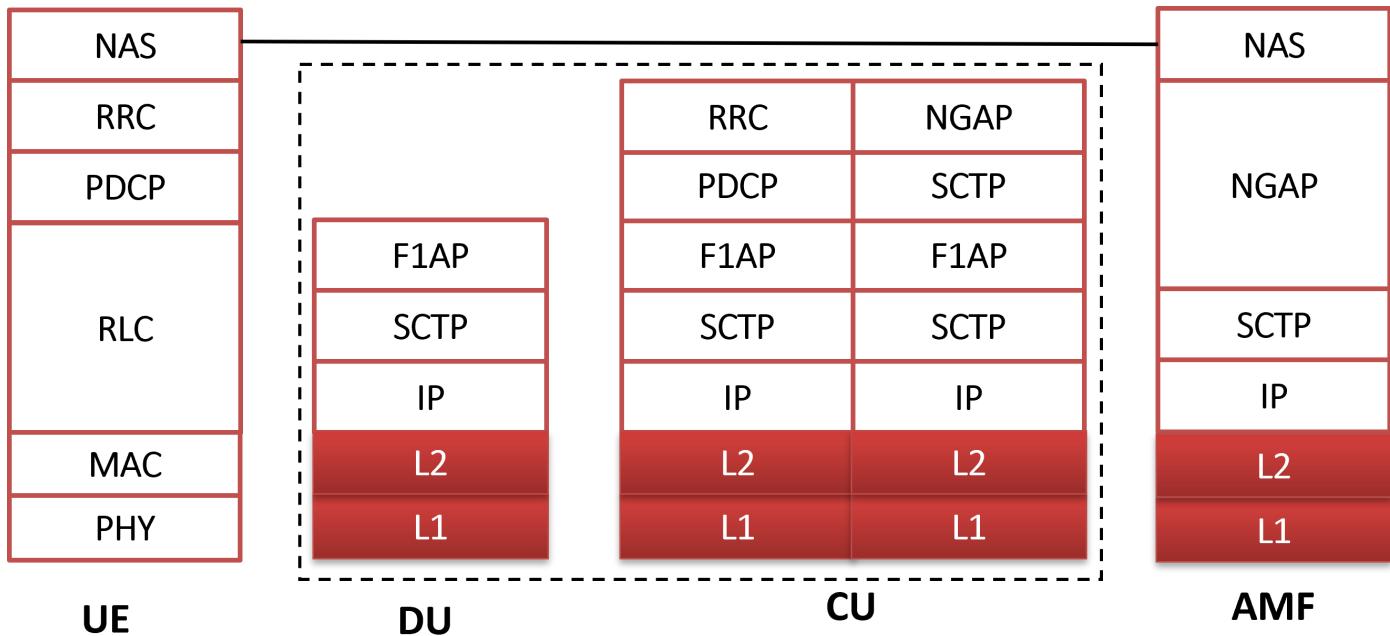
Call Reception

## Emulation of 5G F1AP Signaling Procedure

The below 5G F1AP signaling procedure indicates the messages flow between gNB DU and gNB CU, which are emulated using MAPS™ application.



## Supported Protocols and Specifications



Supported Protocols	Standard / Specifications
F1 Interface (gNB-CU – gNB-DU)	TS38.473
SCTP	RFC 4960
Non-Access-Stratum (NAS)	3GPP TS 24.501
NR and NG-RAN	3GPP TS 38.300 V17

## Buyer's Guide

Item No	Product Description
<a href="#">PKS512</a>	MAPS™ 5G-F1AP Interface Emulator
<a href="#">PKS513</a>	MAPS™ 5G-E1AP Interface Emulator
Item No	Related Software
<a href="#">PKS500</a>	MAPS™ 5G N1/N2 Interface Emulator
<a href="#">PKS501</a>	MAPS™ 5G N4 Interface Emulator
<a href="#">PKS502</a>	5G service-based Emulation (Prerequisite 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 Emulation (Requires PKS502)
<a href="#">PKS502</a>	MAPS™ 5G N17 Interface Emulator
<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="#">PKS305</a>	MAPS™ 5G Multi-Interface Emulation
<a href="#">PKS170</a>	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.