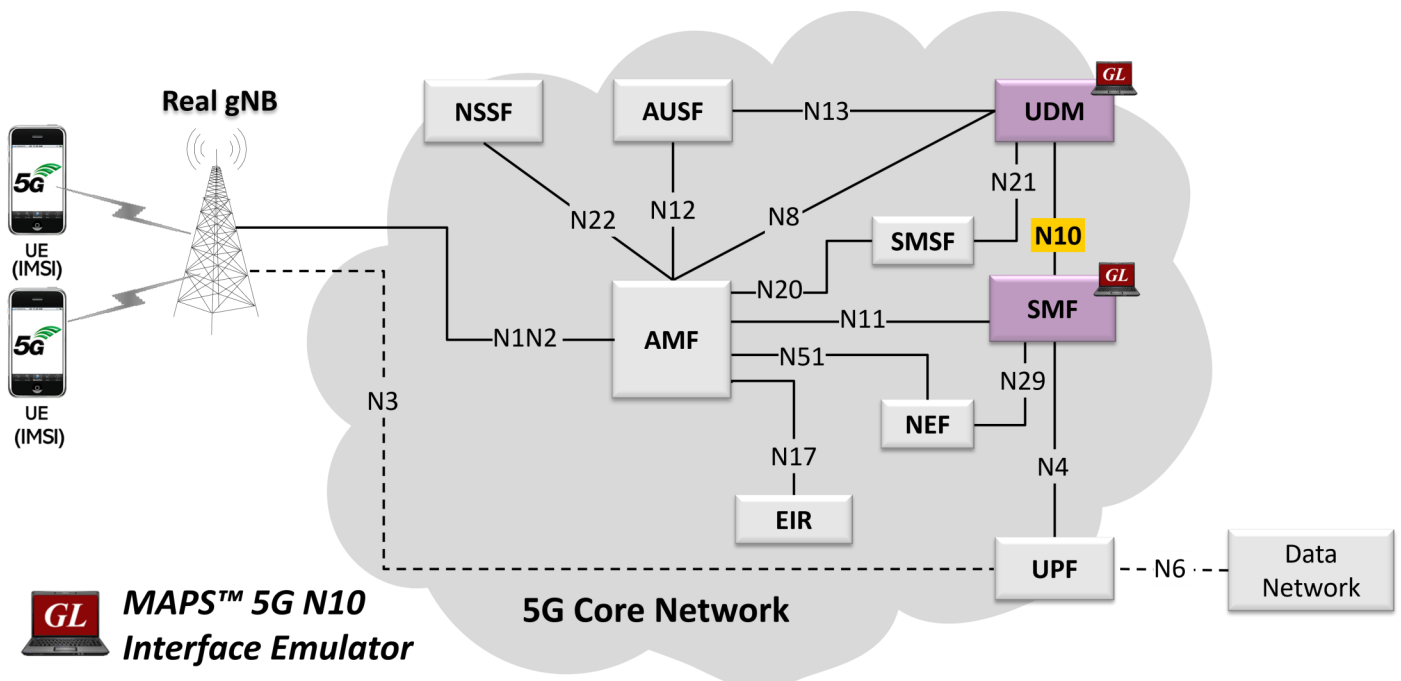


MAPS™ 5G N10 Interface Emulator



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. The service-based interfaces use HTTP/2 protocol with JavaScript Object Notation (JSON) as the application layer serialization protocol.

GL's MAPS™ emulate Unified Data Management (UDM) within the 5G Core offering services to the Session Management Function (SMF) via the Nudm service-based N10 interface. The above network architecture represents the service-based interface, with focus on N10 between UDM and SMF. Here, UDM node act as "NF Producer", which refers Specification TS29.503.

The NFs, UDM and SMF are the entities in 5G Core Network (5GC), which support the following services via the Nudm service-based N10 interface.

The UDM offers the following services via the Nudm interface:

- **Nudm_SubscriberDataManagement:** Get, Subscribe, ModifySubscription, Unsubscribe and Notification operations.
- **Nudm_UEContextManagement:** SMF Registration, Deregistration, Get and Update operations.

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 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.

Config	Value	Enable
SMF Configuration		<input checked="" type="checkbox"/>
SMF IP Address	192.168.1.28	
SMF Client Port	35000	
SMF Server Port	36002	
URI Scheme	HTTP	
UDM		
UDM Parameters		
UDM IP Address	192.168.1.216	
UDM Port	33320	
UDM API Versions		
UE Authentication Service	v1	
Context Management Service	v1	
Subscriber Data Management Service	v2	
Event Exposure Service	v1	
Parameter Provision Service	v1	
NIDD Authorization Service	v2	
UE Simulation Parameters		
Type Of UE Simulation	Profiles	
End User Configuration	UE_Profiles.xml	
Auto Generated Users Info		

Buttons: Start, Edit

Bottom status: ● Initialisation Errors ● Error Events

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.

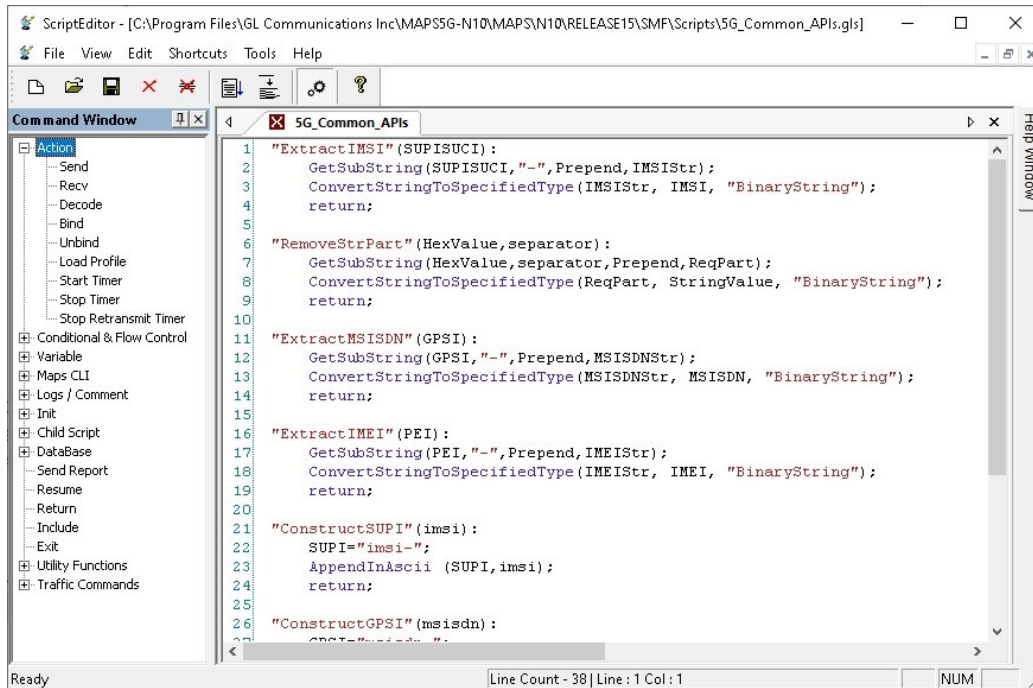


Figure: Script Editor

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 **UE_Profiles** include 5G parameters, that is required to configure multiple UEs to emulate Signaling and Traffic.

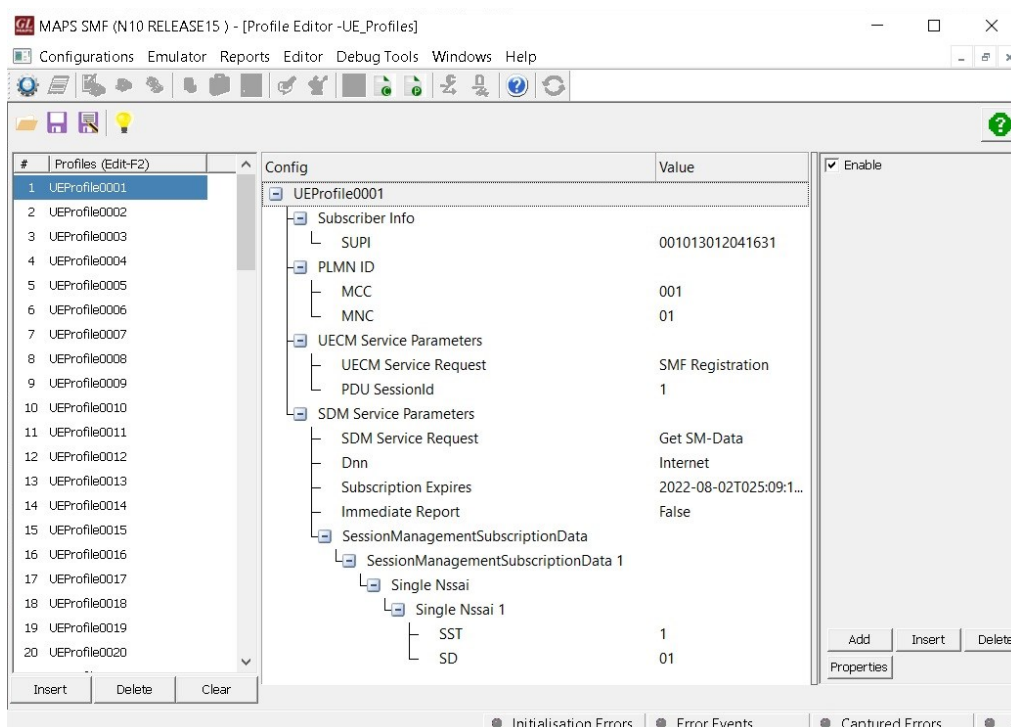


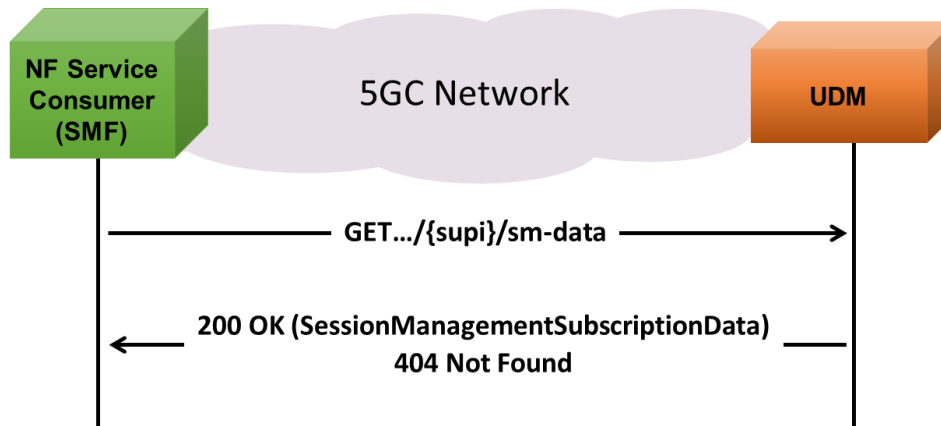
Figure: Profile Editor

Nudm_SubscriberDataManagement Service:

Session Management Subscription Data Retrieval

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

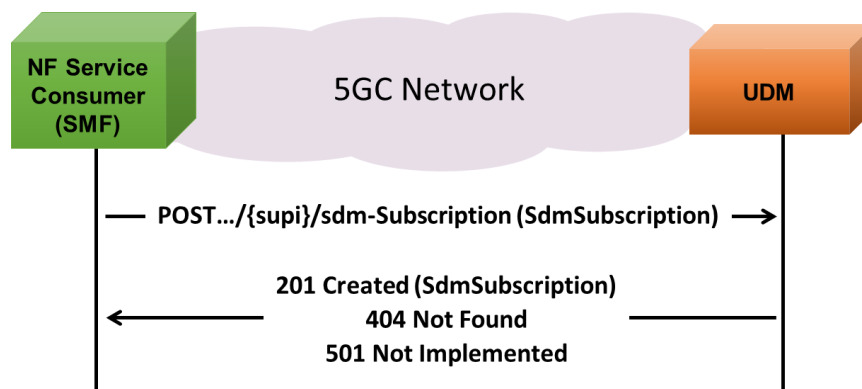
The NF service consumer (e.g. SMF) sends a request to the UDM to receive the UE's session management subscription data. The request contains the UE's identity ($\text{/}{supi}$), the type of the requested information (/sm-data), and query parameters (single-nssai, dnn, supported-features, plmn-id).



- 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.

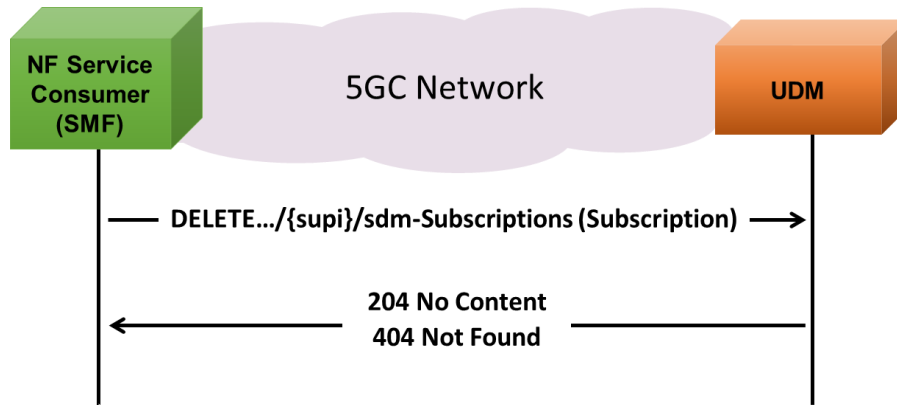


- The NF service consumer sends a POST request to the parent resources, to create a subscription as present in message body
- On **Success**, the UDM responds with "201 Created"
- If there is no valid subscription data for the UE, HTTP status code "404 Not Found" shall be returned
- If the UE subscription 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.)

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.

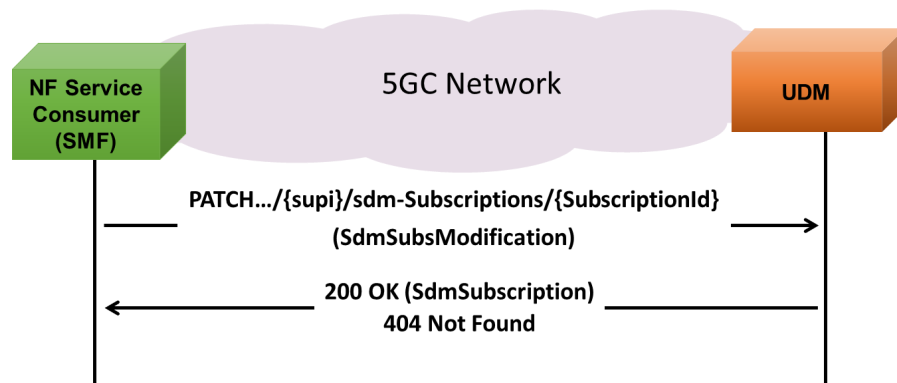


- The NF service consumer sends a DELETE request to the resource identified by the URI previously received during subscription creation
- On **Success**, the UDM responds with "204 No Content"
- If there is no valid subscription available, HTTP status code "404 Not Found" should be returned
- On **Failure**,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

Nudm_SubscriberDataManagement Service:

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.



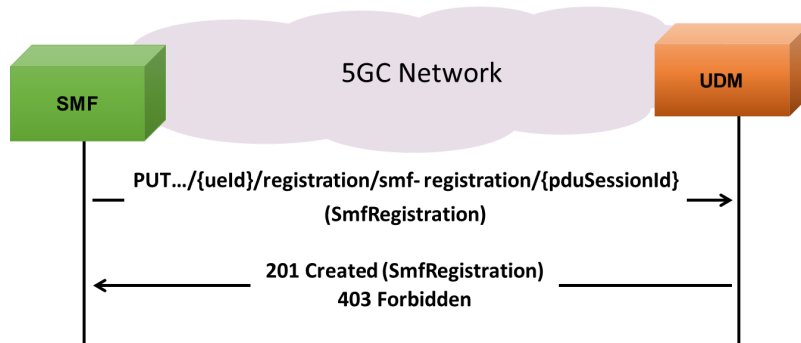
- The NF service consumer sends a PATCH request to the resource identified by the URI previously received during subscription creation
- The NF service consumer may include "monitoredResourceUris" to replace the existing monitored resource URIs
- On **Success**, the UDM responds with "200 OK"
- If there 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

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.



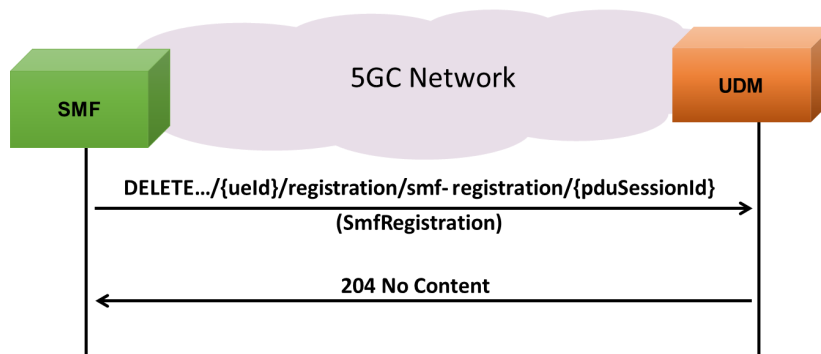
- The SMF sends a PUT request to the resource $\dots\{ueid\}/registrations/smf-registrations/\{pduSessionId\}$, to create an SMF Registration as present in the message body
- The UDM responds with "201 Created"
- If the operation cannot be authorized due to e.g UE does not have required subscription 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

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.

The screenshot shows the MAPS SMF (N10 RELEASE15) - [Call Generation - CallGenDefault] interface. The main window displays a message sequence between SMF and UDM. The sequence includes a GET request from SMF to UDM and a 200 OK response from UDM to SMF. The status bar at the bottom indicates 'Initialisation Errors', 'Error Events', 'Captured Errors', and 'Link Status Up'.

Sr No.	Script Name	Profile	Call Info	Script Execution	Status	Events	Result	Total Iterations
1	Nudm_UECM_Control.gls	UEProfile0001	SUPI : .imsi-001013012041631	Start	Update the SMF Registration is successful	None	Pass	1
2	Nudm_SDM_Control.gls	UEProfile0001	SUPI : .imsi-001013012041631	Start	UE's SM Data Received	None	Pass	1

Message Sequence:

```

SMF → UDM: GET /nudm-sdm/v2/imsi-001013012041631/sm-data?dnn=internet
UDM → SMF: 200 OK
  
```

Find:

```

GET http://192.168.1.20:33320/nudm-sdm/v2/imsi-001013012041631/s
accept : application/json,
application/problem+json
  
```

Figure: Call Generation

The screenshot shows the MAPS UDM (N10 RELEASE15) - [Call Reception] interface. The main window displays a message sequence between SMF and UDM. The sequence includes a GET request from SMF to UDM and a 200 response from UDM to SMF. The status bar at the bottom indicates 'Initialisation Errors', 'Error Events', and 'Captured Er'.

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Results
1	Nudm_UECM_Control.gls		SUPI : .imsi-001013012041631	Completed	SMF Registration is updated	None	Pass
2	Nudm_SDM_Control.gls		SUPI : .imsi-001013012041631	Completed	Succesful Response Sent	None	Pass

Message Sequence:

```

SMF → UDM: GET /nudm-sdm/v2/imsi-001013012041631/sm-data
UDM → SMF: 200
  
```

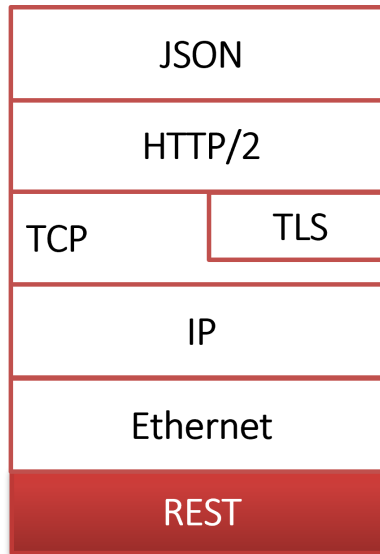
Find:

```

Status: 0
:method : GET
:path : /nudm-sdm/v2/imsi-001013012041631/sm-data?dnn=int
:scheme : http
:authority : 192.168.1.20:33320
accept : application/json,
application/problem+json
  
```

Figure: Call Reception

Supported Protocols and Specifications



Supported Protocols	Standard/ Specification
N10 Interface (UDM - SMF)	TS29.503 Release 15
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)

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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