ETSI TS 129 563 V16.6.0 (2021-09)

5G;
5G System;
Home Subscriber Server (HSS)
services for interworking with
Unified Data Management (UDM);
Stage 3
(3GPP TS 29.563 version 16.6.0 Release 16)

Reference
RTS/TSGC-0429563vg60

Keywords
5G

ETSI

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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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2 presented to TSG for approval;

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z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

shall indicates a mandatory requirement to do something

shall not indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

should indicates a recommendation to do something

should not indicates a recommendation not to do something

may indicates permission to do something

need not indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

can indicates that something is possible

cannot indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

will indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

will not indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

might indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

1 Scope

The present document specifies the stage 3 protocol, including message flows and API specification details, for the Nhss services, as part of the 5G Service-Based Architecture, offered by the HSS for interworking with the 5G UDM Network Function.

The 5G System stage 2 architecture and procedures are specified in 3GPP TS 23.501 [2] and 3GPP TS 23.502 [3].

The User Data Interworking, Coexistence and Migration stage 2 architecture and procedures are specified in 3GPP TS 23.632 [8].

The Technical Realization of the Service Based Architecture and the Principles and Guidelines for Services Definition are specified in 3GPP TS 29.500 [4] and 3GPP TS 29.501 [5].

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".

[3] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[4] 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".

[5] 3GPP TS 29.501: "5G System; Principles and Guidelines for Services Definition; Stage 3".

[6] 3GPP TS 23.335: "User Data Convergence (UDC); Technical realization and information flows".

[7] 3GPP TS 29.335: "User Data Convergence (UDC); User Data Repository Access Protocol over the Ud interface".

[8] 3GPP TS 23.632: "User Data Interworking, Coexistence and Migration".

[9] IETF RFC 7540: "Hypertext Transfer Protocol Version 2 (HTTP/2)".

[10] OpenAPI Initiative, "OpenAPI 3.0.0 Specification", https://github.com/OAI/OpenAPI-Specification/blob/master/versions/3.0.0.md

[11] IETF RFC 8259: "The JavaScript Object Notation (JSON) Data Interchange Format".

[12] IETF RFC 7807: "Problem Details for HTTP APIs".

[13] 3GPP TS 29.503: "5G System; Unified Data Management Services; Stage 3".

[14] 3GPP TR 21.900: "Technical Specification Group working methods".

[15] 3GPP TS 23.003: "Numbering, addressing and identification".

[16] 3GPP TS 29.303: "Domain Name System Procedures; Stage 3".

[17] 3GPP TS 29.272: "Evolved Packet System; MME and SGSN Related Interfaces Based on Diameter Protocol".

[18] 3GPP TS 23.682: "Architecture enhancements to facilitate communications with packet data networks and applications".

[19] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

Void.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

5GC	5G Core Network
HSS	Home Subscriber Server
JSON	Javascript Object Notation
SBI	Service Based Interface
UDM	Unified Data Management
UDR	Unified Data Repository

4 Overview

4.1 Introduction

Within the 5GC, the HSS offers services to the UDM via the Nhss service-based interface (see 3GPP TS 23.501 [2], 3GPP TS 23.502 [3] and 3GPP TS 23.632 [8]).

Figure 4.1-1 provides the reference model in service-based interface representation with focus on the HSS.

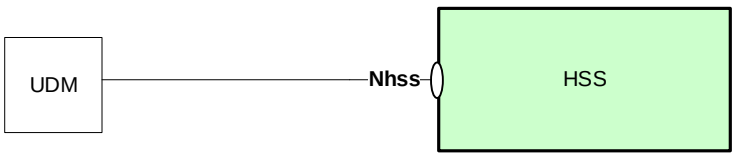

Figure 4.1-1: Reference model – HSS

5 Services offered by the HSS

5.1 Introduction

The HSS offers the following services via the Nhss interface:

- Nhss_UEAuthentication Service
- Nhss_SubscriberDataManagement Service
- Nhss_UEContextManagement service

All scenarios shown in the following clauses assume that the HSS is stateful and stores information in local memory. However, the HSS may be stateless and stores information externally in the EPS-UDR. If so, the stateless HSS makes use of Ud interface as specified in 3GPP TS 23.335 [6] and 3GPP TS 29.335 [7] to retrieve required data from the EPS-UDR and store them locally before processing an incoming request. Processing the incoming request may then include updating data in the EPS-UDR or subscribing to data change notifications at the EPS-UDR by using the Ud interface. After processing the incoming request, the HSS may delete the locally stored data.

Table 5.1-1 summarizes the corresponding APIs defined for this specification.

Table 5.1-1: API Descriptions

Service Name	Clause	Description	OpenAPI Specification File	apiName	Annex
Nhss_UEAuthentication Service	6.1	HSS UE Authentication Service	TS29563_Nhss_UEAU.yaml	nhss-ueau	A.2
Nhss_SubscriberDataManagement Service	6.2	HSS Subscriber Data Management	TS29563_Nhss_SDM.yaml	nhss-sdm	A.3
Nhss_UEContextManagement Service	6.3	HSS UE Context Management	TS29563_Nhss_UECM.yaml	nhss-uecm	A.4

5.2 Nhss_UEAuthentication Service

5.2.1 Service Description

The Nhss_UEAuthentication service allows a NF consumer (UDM) to request calculation of a fresh Authentication Vector (AV) for 5G_AKA or EAP_AKA_PRIME and provide the calculated AV to the requesting NF.

5.2.2 Service Operations

5.2.2.1 Introduction

For the Nhss_UEAuthentication service the following service operation is defined:

- Get

The Nhss_UEAuthentication service is used by the UDM to request the HSS to, calculate a fresh authentication vector (AV) for authentication the method 5G_AKA or EAP_AKA_PRIME, and provide it to the UDM by means of the Get service operation. See 3GPP TS 23.632 [8] clause 4.2.2.

5.2.2.2 Get

5.2.2.2.1 General

The following procedure using the Get service operation is supported:

- Authentication Vector Retrieval

5.2.2.2.2 Authentication Vector Retrieval

Figure 5.2.2.2.2-1 shows a scenario where the NF service consumer (UDM) retrieves an Authentication Vector for the UE from the HSS (see also 3GPP TS 23.632 [8] clause 4.2.2). The request contains the UE's identity (imsi), the serving network name, the authentication method (5G_AKA or EAP_AKA_PRIME) and may contain resynchronization info.

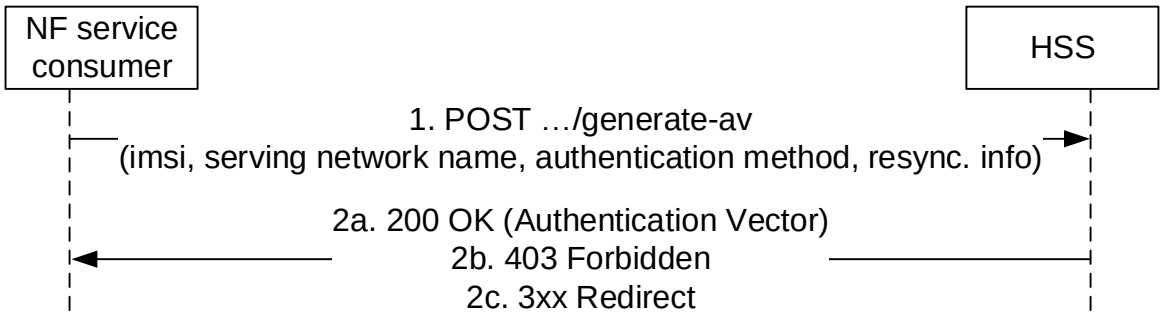

Figure 5.2.2.2.2-1: NF service consumer requesting an Authentication Vector

1. The NF service consumer sends a POST request (custom method: generate-av) to the HSS.

2a. The HSS responds with "200 OK" with the message body containing the authentication vector.

2b. If the operation cannot be authorized due to e.g. UE does not have required subscription data, HTTP status code "403 Forbidden" should be returned including additional error information in the response body (in "ProblemDetails" element).

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.

In the case of redirection, the HSS shall return 3xx status code, which shall contain a Location header with an URI pointing to the endpoint of another HSS (service) instance.

5.3 Nhss_SubscriberDataManagement Service

5.3.1 Service Description

This service is used to retrieve the subscriber data indicated by the requested data type from HSS. In this release, only the PGW-C+SMF FQDN for S5/S8 interface information is supported as requested data type. See 3GPP TS 23.632 [8], clause 6.1.4.

5.3.2 Service Operations

5.3.2.1 Introduction

For the Nhss_SubscriberDataManagement service the following service operations are defined:

- Get

The Nhss_SubscriberDataManagement service is used by Consumer NF (UDM) to retrieve the UE data from the HSS due to IRAT mobility.

5.3.2.2 Get

5.3.2.2.1 General

The following procedure using the Get service operation is supported:

- UE Context In PGW Data Retrieval

5.3.2.2.2 UE Context In PGW Data Retrieval

Figure 5.3.2.2.2-1 shows a scenario where the NF service consumer (UDM) sends a request to the HSS to retrieve the UE's Context In PGW data. The request contains the UE's identity (which shall be an IMSI) and the requested information.

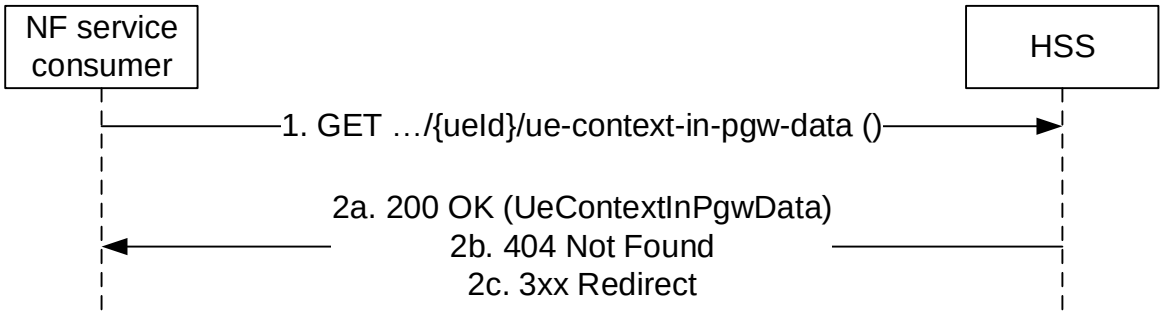

Figure 5.3.2.2.2-1: Requesting a UE's Context in PGW Data

1. The NF service consumer (e.g. UDM) shall send a GET request to the resource representing the UE's Context In PGW Data.

2a. On Success, the HSS shall respond with "200 OK" with the message body containing the UE's Context In PGW Data as relevant for the requesting NF service consumer.

2b. If there is no valid data for the UE, HTTP status code "404 Not Found" shall be returned including additional error information in the response body (in the "ProblemDetails" element).

On failure, the appropriate HTTP status code indicating the error shall be returned and appropriate additional error information should be returned in the GET response body.

In the case of redirection, the HSS shall return 3xx status code, which shall contain a Location header with an URI pointing to the endpoint of another HSS (service) instance.

5.3.2.3 Subscribe

5.3.2.3.1 General

The following procedures using the Subscribe service operation are supported:

- Subscription to notification of data change

5.3.2.3.2 Subscription to notifications of data change

Figure 5.3.2.3.2-1 shows a scenario where the NF service consumer (e.g. UDM) sends a request to the HSS to subscribe to notifications of data change. The request contains a callback URI and the URI of the monitored resource.

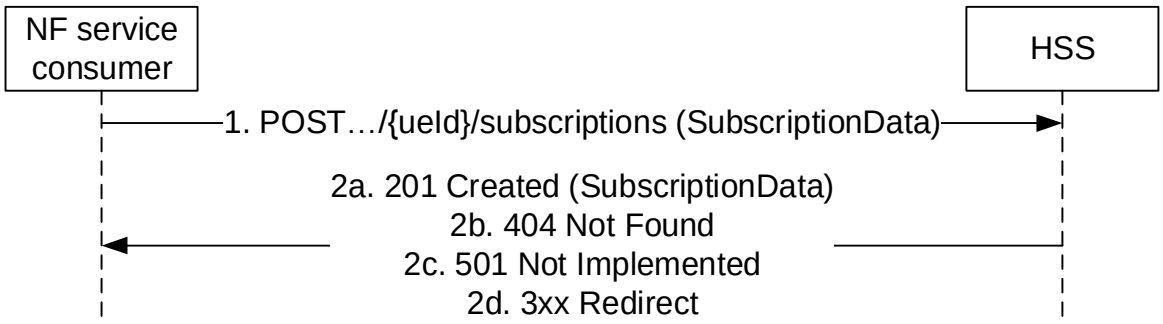

Figure 5.3.2.3.2-1: NF service consumer subscribes to notifications

1. The NF service consumer sends a POST request to the parent resource (collection of subscriptions) (.../{ueId}/subscriptions), to create a subscription as present in message body.

2a. On success, the HSS responds with "201 Created" with the message body containing a representation of the created subscription. The Location HTTP header shall contain the URI of the created subscription.

2b. If there is no valid subscription data for the UE, HTTP status code "404 Not Found" shall be returned including additional error information in the response body (in the "ProblemDetails" element).

2c. If the UE subscription data exist, but the requested subscription to data change notification cannot be created (e.g. due to an invalid/unsupported data reference to be monitored, contained in the SubscriptionData parameter), HTTP status code "501 Not Implemented" shall be returned including additional error information in the response body (in the "ProblemDetails" element).

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.

In the case of redirection, the HSS shall return 3xx status code, which shall contain a Location header with an URI pointing to the endpoint of another HSS (service) instance.

5.3.2.4 Unsubscribe

5.3.2.4.1 General

The following procedures using the Unsubscribe service operation are supported:

- Unsubscribe to notification of data change

5.3.2.4.2 Unsubscribe to notifications of data change

Figure 5.3.2.4.2-1 shows a scenario where the NF service consumer sends a request to the HSS 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.

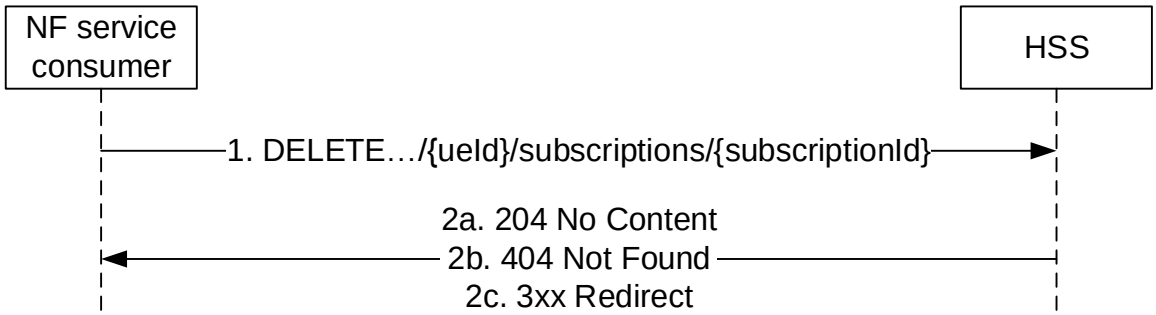

Figure 5.3.2.4.2-1: NF service consumer unsubscribes to notifications

1. The NF service consumer sends a DELETE request to the resource identified by the URI previously received during subscription creation.

2a. On success, the HSS responds with "204 No Content".

2b. If there is no valid subscription available (e.g. due to an unknown subscriptionId value), HTTP status code "404 Not Found" should be returned including additional error information in the response body (in the "ProblemDetails" element).

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.

In the case of redirection, the HSS shall return 3xx status code, which shall contain a Location header with an URI pointing to the endpoint of another HSS (service) instance.

5.3.2.5 Notification

5.3.2.5.1 General

The following procedures using the Notification service operation are supported:

- Data change notification to NF.

5.3.2.5.2 Data Change Notification To NF

Figure 5.3.2.5.2-1 shows a scenario where the HSS notifies the NF service consumer (that has subscribed to receive such notification) about subscription data change. The request contains the callbackReference URI as previously received in the SubscriptionData.

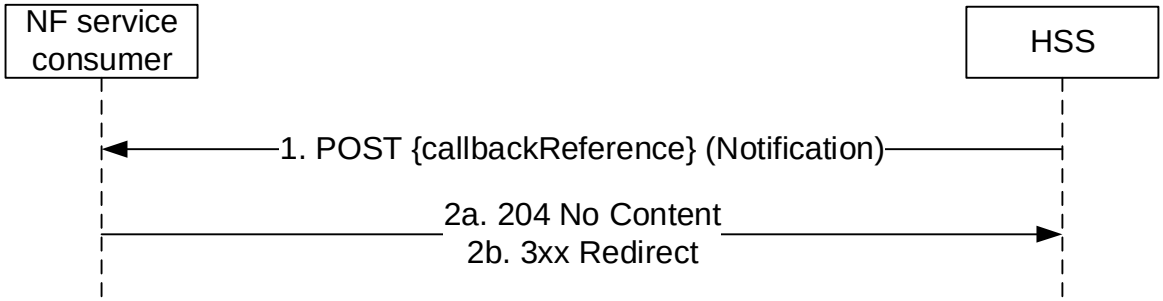

Figure 5.3.2.5.2-1: Subscription Data Change Notification

1. The HSS sends a POST request to the callbackReference as provided by the NF service consumer during the subscription.

2a. The NF service consumer 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 POST response body.

In the case of redirection, the NF Service Consumer shall return 3xx status code, which shall contain a Location header with an URI pointing to an alternative notification endpoint.

5.4 Nhss_UEContextManagement Service

5.4.1 Service Description

The service allows an NF consumer (UDM) to trigger the cancellation of any previous registered serving node due to IRAT mobility. See 3GPP TS 23.632 [8], clause 6.1.3.

5.4.2 Service Operations

5.4.2.1 Introduction

For the Nhss_UEContextManagement service the following service operations are defined:

- SnDeregistration
- ImeiUpdate

The Nhss_UEContextManagement service is used by Consumer NF (UDM) to request HSS to deregister the MME/SGSN via cancel location procedure and to update the IMEI of the UE in the HSS.

5.4.2.2 SnDeregistration

5.4.2.2.1 General

The following procedure using the SnDeregistration service operation is supported:

- SN Deregistration

5.4.2.2.2 SN Deregistration

Figure 5.4.2.2.2-1 shows a scenario where the NF service consumer (UDM) requests HSS to initiate Cancel Location procedure towards the MME/SGSN due to IRAT mobility. The request contains the UE's identity which shall be an IMSI.

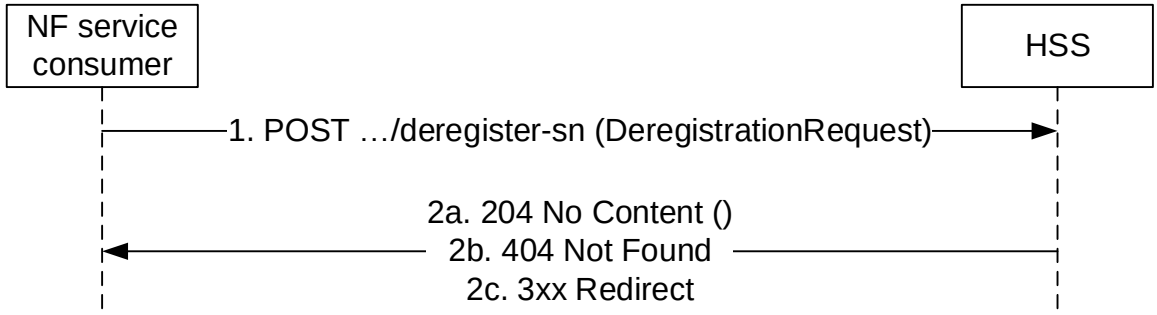

Figure 5.4.2.2.2-1: SN Deregistration

1. The NF service consumer sends a POST request (custom method: deregister-sn) to the HSS; the request body contains the UE identity (IMSI) and the deregistration reason.

   The HSS, based on the value indicated in the deregistration reason, initiates a Cancel Location towards the serving node, including a Cancellation Type value (see 3GPP TS 29.272 [17] and 3GPP TS 29.002 [19]) as follows:

   - "UE_INITIAL_AND_SINGLE_REGISTRATION": S6a/S6d/Gr(S4/Gn/Gp) Cancel Location sent towards MME/SGSN, with a Cancellation-Type set to MME_UPDATE_PROCEDURE/SGSN_UPDATE_PROCEDURE; the HSS shall delete the stored MME/SGSN address and MME/SGSN number.

     Additionally, a MAP D Cancel Location (IMSI) shall be sent towards MSC/VLR if a VLR number was found in the HSS/HLR for the user; the HSS/HLR shall delete the stored MSC/VLR number.

   - "UE_INITIAL_AND_DUAL_REGISTRATION": S6d/Gr(S4) Cancel Location sent towards SGSN, with a Cancellation-Type set to SGSN_UPDATE_PROCEDURE; the HSS shall delete the stored SGSN address and SGSN number.

NOTE 1: As described in 3GPP TS 23.502 [3], a UE operating in dual-registration mode indicates that it is moving from EPS, which implies that there is an MME registered in HSS.

   - "EPS_TO_5GS_MOBILITY": S6a Cancel Location sent towards MME, with a Cancellation-Type set to MME_UPDATE_PROCEDURE; the HSS shall delete the stored MME address and MME number.

     Additionally, a MAP D Cancel Location (IMSI) shall be sent towards MSC/VLR if a VLR number was found in the HSS/HLR for the user; the HSS/HLR shall delete the stored MSC/VLR number.

   - "EPS_TO_5GS_MOBILITY": S6d/Gr(S4) Cancel Location sent towards SGSN, with a Cancellation-Type set to SGSN_UPDATE_PROCEDURE; the HSS shall delete the stored SGSN address and SGSN number.

NOTE 2: Based on operator policy, and the presence of GUAMI in the DeregistrationRequest, the HSS can decide whether a registered VLR in the VPLMN needs to be cancelled. It should be noted that keeping the VLR registration can impact terminating services (e.g. T-ADS, MT-SMS…) causing failed paging attempts.

2a. On success, the HSS responds with "204 No Content". If the HSS has a valid subscription for the UE, but the UE is not registered in EPS network, the HSS shall respond with "204 No Content".

2b. If there is no valid subscription data for the UE, HTTP status code "404 Not Found" should be returned including additional error information in the response body (in the "ProblemDetails" element).

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.

In the case of redirection, the HSS shall return 3xx status code, which shall contain a Location header with an URI pointing to the endpoint of another HSS (service) instance.

5.4.2.2.3 IMEI Update

Figure 5.4.2.2.3-1 shows a scenario where the NF service consumer (UDM) requests HSS to update the IMEI of the UE stored in the HSS. The request contains the UE's identity which shall be an IMSI, and the new IMEI of the UE.

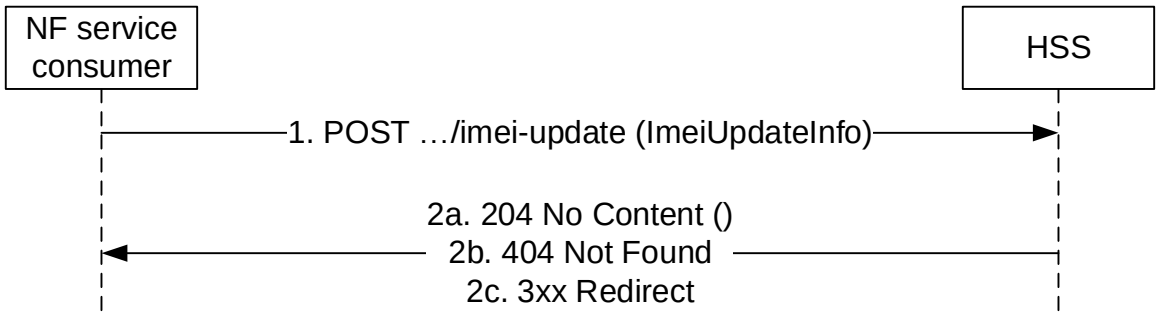

Figure 5.4.2.2.3-1: IMEI Update

1. The NF service consumer sends a POST request (custom method: imei-update) to the HSS; the request body contains the UE identity (IMSI) and the new IMEI of the UE.

2a. On success, the HSS responds with "204 No Content".

2b. If there is no valid subscription data for the UE, or the UE is not registered in EPS network for 3GPP access, HTTP status code "404 Not Found" should be returned including additional error information in the response body (in the "ProblemDetails" element).

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.

In the case of redirection, the HSS shall return 3xx status code, which shall contain a Location header with an URI pointing to the endpoint of another HSS (service) instance.

5.5 Nhss_EventExposure Service

5.5.1 Service Description

See 3GPP TS 23.632 [8].

5.5.2 Service Operations

5.5.2.1 Introduction

For the Nhss_EventExposure service the following service operations are defined:

- Subscribe
- Unsubscribe

- Notify
- ModifySubscription

The Nhss_EventExposure service is used by consumer NFs (e.g. UDM) to subscribe to notifications of event occurrence by means of the Subscribe service operation.

The Nhss_EventExposure service is also used by the consumer NFs (e.g. UDM) that have previously subscribed to notifications, to unsubscribe by means of the Unsubscribe service operation.

The Nhss_EventExposure service is also used by the subscribed consumer NFs (e.g. UDM) to modify an existing subscription by means of the ModifySubscription service operation.

5.5.2.2 Subscribe

5.5.2.2.1 General

The following procedures using the Subscribe service operation are supported:

- Subscribe to Notification of event occurrence

5.5.2.2.2 Subscription to Notification of event occurrence

Figure 5.5.2.2.2-1 shows a scenario where the NF service consumer sends a request to the HSS to subscribe to notifications of event occurrence. The request contains a callback URI, the type of event that is monitored and additional information e.g. SCEF Id, event filters and reporting options.

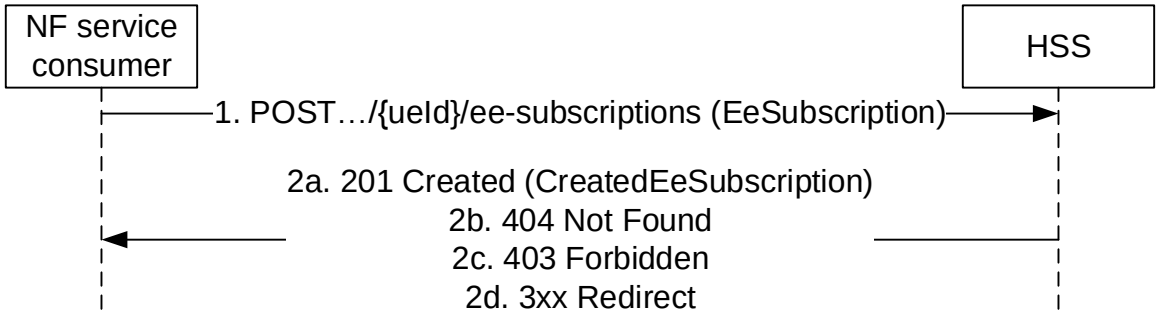

Figure 5.5.2.2.2-1: NF service consumer subscribes to notifications

1. The NF service consumer sends a POST request to the parent resource (collection of subscriptions) (.../{ueId}/ee-subscriptions), to create a subscription as present in message body. The request may contain an expiry time, suggested by the NF Service Consumer, representing the time upto which the subscription is desired to be kept active and the time after which the subscribed event(s) shall stop generating notifications. Additionally, the request may include an SCEF Id if Common Network Exposure is used (i.e. if combined SCEF+NEF requested the event(s) to be subscribed/monitored in EPC)

2a. On success, the HSS responds with "201 Created" with the message body containing a representation of the created subscription. The Location HTTP header shall contain the URI of the created subscription. If both HSS and NF consumer has indicated supporting of ERIR feature (see clause 6.4.8), the HSS shall include available immediate event reports, i.e. reports already received from MME, in the response body.

2b. If the user does not exist, HTTP status code "404 Not Found" shall be returned including additional error information in the response body (in the "ProblemDetails" element).

2c. If there is no valid subscription data for the UE, i.e. based on the UE's subscription information monitoring of the requested EventType is not allowed, or the requested EventType is not supported, HTTP status code "403 Forbidden" shall be returned including additional error information in the response body (in the "ProblemDetails" element).

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.

In the case of redirection, the HSS shall return 3xx status code, which shall contain a Location header with an URI pointing to the endpoint of another HSS (service) instance.

5.5.2.3 Unsubscribe

5.5.2.3.1 General

The following procedures using the Unsubscribe service operation are supported:

- Unsubscribe to Notifications of event occurrence

5.5.2.3.2 Unsubscribe to notifications of event occurrence

Figure 5.5.2.3.2-1 shows a scenario where the NF service consumer sends a request to the HSS to unsubscribe from notifications of event occurrence. The request contains the URI previously received in the Location HTTP header of the response to the subscription.

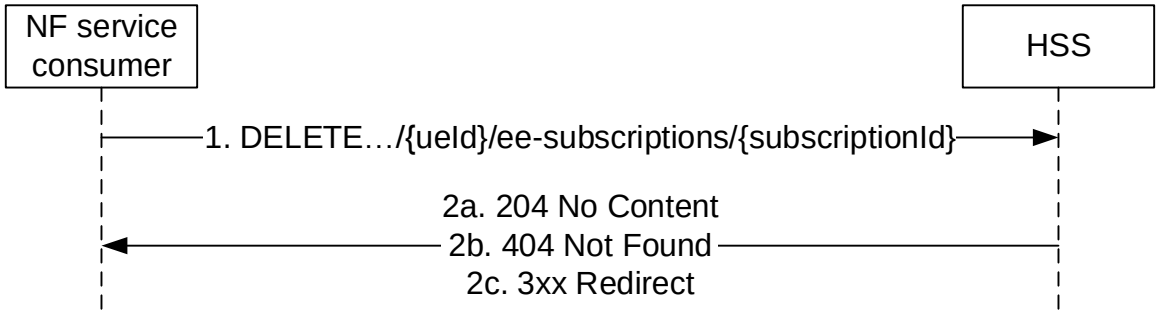

Figure 5.5.2.3.2-1: NF service consumer unsubscribes to notifications

1. The NF service consumer sends a DELETE request to the resource identified by the URI previously received during subscription creation.

2a. On success, the HSS responds with "204 No Content".

2b. If there is no valid subscription available (e.g. due to an unknown SubscriptionId value), HTTP status code "404 Not Found" shall be returned including additional error information in the response body (in the "ProblemDetails" element).

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.

In the case of redirection, the HSS shall return 3xx status code, which shall contain a Location header with an URI pointing to the endpoint of another HSS (service) instance.

5.5.2.4 Notify

5.5.2.4.1 General

The following procedures using the Notify service operation are supported:

- Event Occurrence Notification

5.5.2.4.2 Event Occurrence Notification

Figure 5.5.2.4.2-1 shows a scenario where the HSS notifies the NF service consumer (that has subscribed to receive such notification) about occurrence of an event. The request contains the callbackReference URI as previously received in the EeSubscription.

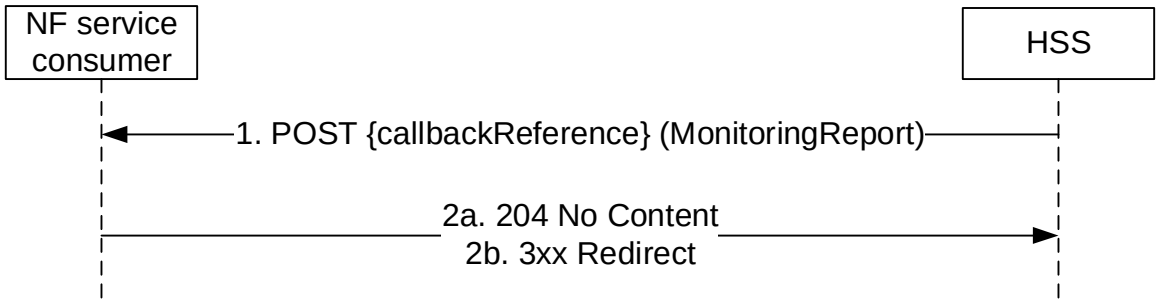

Figure 5.5.2.4.2-1: Event Occurrence Notification

1. The HSS sends a POST request to the callbackReference as provided by the NF service consumer during the subscription.

2a. The NF Service Consumer 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 POST response body.

In the case of redirection, the NF Service Consumer shall return 3xx status code, which shall contain a Location header with an URI pointing to an alternative notification endpoint.

5.5.2.5 ModifySubscription

5.5.2.5.1 General

The following procedures using the ModifySubscription service operation are supported:

- Modification of an EE-Subscription to notification of events

5.5.2.5.2 Modification of a subscription

The service operation is invoked by a NF Service Consumer, e.g. UDM, towards the HSS, when it needs to modify an existing subscription previously created by itself at the HSS.

The NF Service Consumer shall modify the subscription by using HTTP method PATCH with the URI of the individual subscription resource to be modified.

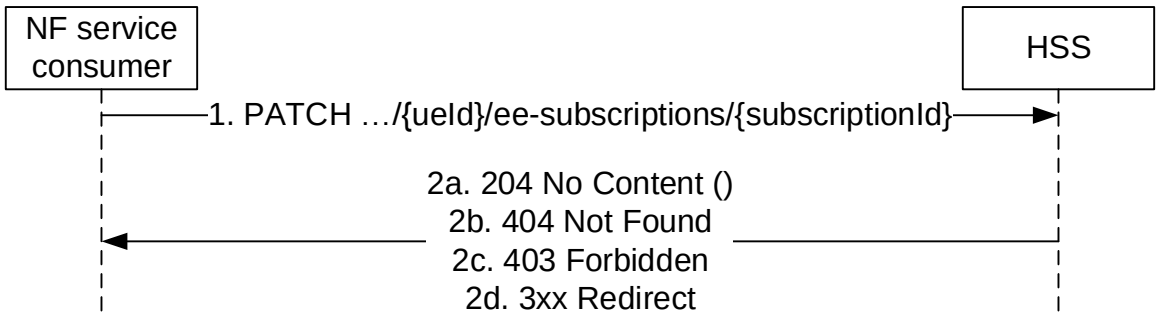

Figure 5.5.2.5.2-1: NF service consumer updates subscription

1. The NF service consumer (e.g. NEF) shall send a PATCH request to the resource representing a subscription. The modification may be for the events subscribed or for updating the event report options.

2a. On success, the request is accepted, the HSS shall respond with "204 No Content".

2b. If the resource does not exist e.g. the subscriptionId cannot be found, HTTP status code "404 Not Found" should be returned including additional error information in the response body (in the "ProblemDetails" element).

2c. If the modification can't be accepted, HTTP status code "403 Forbidden" should be returned including additional error information in the response body (in the "ProblemDetails" element).

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.

In the case of redirection, the HSS shall return 3xx status code, which shall contain a Location header with an URI pointing to the endpoint of another HSS (service) instance.

6 API Definitions

6.1 Nhss_UEAuthentication Service API

6.1.1 Introduction

The Nhss_UEAuthentication service shall use the Nhss_UEAuthentication API.

The request URI used in HTTP request from the NF service consumer towards the NF service producer shall have the structure defined in clause 4.4.1 of 3GPP TS 29.501 [5], i.e.:

{apiRoot}/<apiName>/<apiVersion>/<apiSpecificResourceUriPart>

with the following components:

- The {apiRoot} shall be set as described in 3GPP TS 29.501 [5].
- The <apiName> shall be "nhss-ueau".
- The <apiVersion> shall be "v1".
- The <apiSpecificResourceUriPart> shall be set as described in clause 6.1.

6.1.2 Usage of HTTP

6.1.2.1 General

HTTP/2, as defined in IETF RFC 7540 [9], shall be used as specified in clause 5 of 3GPP TS 29.500 [4].

HTTP/2 shall be transported as specified in clause 5.3 of 3GPP TS 29.500 [4].

HTTP messages and bodies for the Nhss_UEAuthentication service shall comply with the OpenAPI [10] specification contained in Annex A.

6.1.2.2 HTTP standard headers

6.1.2.2.1 General

The usage of HTTP standard headers shall be supported as specified in clause 5.2.2 of 3GPP TS 29.500 [4].

6.1.2.2.2 Content type

The following content types shall be supported:

- JSON, as defined in IETF RFC 8259 [11], signalled by the content type "application/json".
- The Problem Details JSON Object (IETF RFC 7807 [12] signalled by the content type "application/problem+json".

6.1.2.3 HTTP custom headers

6.1.2.3.1 General

In this release of the specification, no specific custom headers are defined for the Nhss_UEAuthentication service.

For 3GPP specific HTTP custom headers used across all service based interfaces, see clause 5.2.3 of 3GPP TS 29.500 [4].

6.1.3 Resources

6.1.3.1 Overview

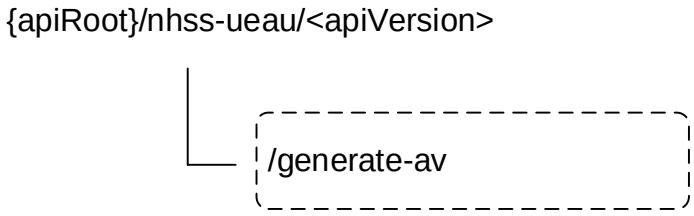

Figure 6.1.3.1-1: Resource URI structure of the nhss-ueau API

Table 6.1.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 6.1.3.1-1: Resources and methods overview

Resource name	Resource URI	HTTP method or custom operation	Description
n/a	generate-av	generate-av (POST)	Generate Authentication Vector

6.1.4 Custom Operations without associated resources

6.1.4.1 Overview

Table 6.1.4.1-1: Custom operations without associated resources

Custom operation URI	Mapped HTTP method	Description
{apiRoot}/nhss-ueau/<apiVersion>/generate-av	POST	The HSS calculates a fresh Authentication Vector taking into account the received information (imsi, serving network name, authentication method)

6.1.4.2 Operation: Generate AV

6.1.4.2.1 Description

This custom operation is used by the NF service consumer (UDM) to request calculation of an authentication vector for the provided imsi.

6.1.4.2.2 Operation Definition

This operation shall support the response data structures and response codes specified in tables 6.1.4.2.2-1 and 6.1.4.2.2-2.

Table 6.1.4.2.2-1: Data structures supported by the POST Request Body

Data type	P	Cardinality	Description
AvGenerationRequest	M	1	Contains input parameters for Authentication Vector calculation

Table 6.1.4.2.2-2: Data structures supported by the POST Response Body

Data type	P	Cardinality	Response codes	Description
AvGenerationResponse	M	1	200 OK	Upon success, a response body containing the generated authentication vector shall be returned
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
ProblemDetails	O	0..1	403 Forbidden	The "cause" attribute may be used to indicate one of the following application errors: - AUTHENTICATION_REJECTED
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be used to indicate one of the following application errors: - USER_NOT_FOUND

Table 6.1.4.2.2-3: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

Table 6.1.4.2.2-4: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

6.1.5 Notifications

In this release of this specification, no notifications are defined for the Nhss_UEAuthentication Service.

6.1.6 Data Model

6.1.6.1 General

This clause specifies the application data model supported by the API.

Table 6.1.6.1-1 specifies the data types defined for the Nhss service based interface protocol.

Table 6.1.6.1-1: Nhss specific Data Types

Data type	Clause defined	Description	Applicability
AvGenerationRequest	6.1.6.2.2	Contains imsi, authentication method, serving network name, resynchronization info	
AvGenerationResponse	6.1.6.2.3	Contains the calculated Authentication Vector	

Table 6.1.6.1-2 specifies data types re-used by the Nhss service based interface protocol from other specifications, including a reference to their respective specifications and when needed, a short description of their use within the Nhss service based interface.

Table 6.1.6.1-2: Nhss re-used Data Types

Data type	Reference	Comments	Applicability
AuthType	3GPP TS 29.503 [13]		
ServingNetworkName	3GPP TS 29.503 [13]		
ResynchronizationInfo	3GPP TS 29.503 [13]		
AvEapAkaPrime	3GPP TS 29.503 [13]		
Av5GHeAka	3GPP TS 29.503 [13]		
ProblemDetails	3GPP TS 29.571 [7]	Response body of error response messages.	
RedirectResponse	3GPP TS 29.571 [7]	Response body of redirect response messages.	

6.1.6.2 Structured data types

6.1.6.2.1 Introduction

This clause defines the structures to be used in resource representations.

6.1.6.2.2 Type: AvGenerationRequest

Table 6.1.6.2.2-1: Definition of type AvGenerationRequest

Attribute name	Data type	P	Cardinality	Description	Applicability
imsi	string	M	1	pattern: "[0-9]{5,15}"	
authType	AuthType	M	1	Indicates the authentication method; "EAP_AKA_PRIME" or "5G_AKA"	
servingNetworkName	ServingNetworkName	M	1		
resynchronizationInfo	ResynchronizationInfo	O	0..1		

6.1.6.2.3 Type: AvGenerationResponse

Table 6.1.6.2.3-1: Definition of type AvGenerationResponse

Attribute name	Data type	P	Cardinality	Description	Applicability
avEapAkaPrime	AvEapAkaPrime	C	0..1	shall be present if av5GHeAka is absent, otherwise shall be absent.	
av5GHeAka	Av5GHeAka	C	0..1	shall be present if avEapAkaPrime is absent, otherwise shall be absent.	

6.1.6.3 Simple data types and enumerations

6.1.6.3.1 Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

6.1.6.3.2 Simple data types

The simple data types defined in table 6.1.6.3.2-1 shall be supported.

Table 6.1.6.3.2-1: Simple data types

Type Name	Type Definition	Description	Applicability

6.1.7 Error Handling

6.1.7.1 General

HTTP error handling shall be supported as specified in clause 5.2.4 of 3GPP TS 29.500 [4].

6.1.7.2 Protocol Errors

Protocol errors handling shall be supported as specified in clause 5.2.7 of 3GPP TS 29.500 [4].

6.1.7.3 Application Errors

The application errors defined for the Nhss_UEAuthentication service are listed in table 6.1.7.3-1.

Table 6.1.7.3-1: Application errors

Application Error	HTTP status code	Description
AUTHENTICATION_REJECTED	403 Forbidden	The user cannot be authenticated
USER_NOT_FOUND	404 Not Found	The user does not exist in the HPLMN

6.1.8 Feature negotiation

The optional features in table 6.1.8-1 are defined for the Nhss_UEAuthentication API. They shall be negotiated using the extensibility mechanism defined in clause 6.6 of 3GPP TS 29.500 [4].

Table 6.1.8-1: Supported Features

Feature number	Feature Name	Description

6.2 Nhss_SubscriberDataManagement Service API

6.2.1 API URI

The Nhss_SubscriberDataManagement service shall use the Nhss_SubscriberDataManagement API.

The request URI used in HTTP request from the NF service consumer towards the NF service producer shall have the structure defined in clause 4.4.1 of 3GPP TS 29.501 [5], i.e.:

{apiRoot}/<apiName>/<apiVersion>/<apiSpecificResourceUriPart>

with the following components:

- The {apiRoot} shall be set as described in 3GPP TS 29.501 [5].
- The <apiName> shall be "nhss-sdm".
- The <apiVersion> shall be "v1".
- The <apiSpecificResourceUriPart> shall be set as described in clause 6.2.3.

6.2.2 Usage of HTTP

6.2.2.1 General

HTTP/2, as defined in IETF RFC 7540 [9], shall be used as specified in clause 5 of 3GPP TS 29.500 [4].

HTTP/2 shall be transported as specified in clause 5.3 of 3GPP TS 29.500 [4].

HTTP messages and bodies for the Nhss_SubscriberDataManagement service shall comply with the OpenAPI [10] specification contained in Annex A.

6.2.2.2 HTTP standard headers

6.2.2.2.1 General

The usage of HTTP standard headers shall be supported as specified in clause 5.2.2 of 3GPP TS 29.500 [4].

6.2.2.2.2 Content type

The following content types shall be supported:

- JSON, as defined in IETF RFC 8259 [11], signalled by the content type "application/json".
- The Problem Details JSON Object (IETF RFC 7807 [12] signalled by the content type "application/problem+json".

6.2.2.3 HTTP custom headers

6.2.2.3.1 General

In this release of the specification, no specific custom headers are defined for the Nhss_SubscriberDataManagement service.

For 3GPP specific HTTP custom headers used across all service-based interfaces, see clause 5.2.3 of 3GPP TS 29.500 [4].

6.2.3 Resources

6.2.3.1 Overview

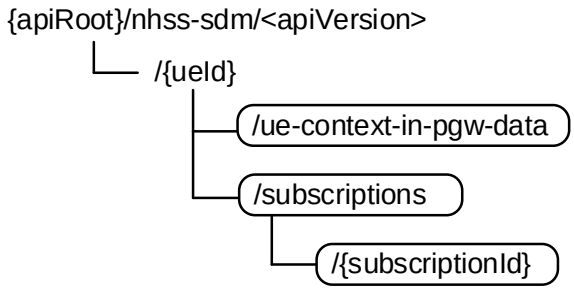

Figure 6.2.3.1-1: Resource URI structure of the nhss-sdm API

Table 6.2.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 6.2.3.1-1: Resources and methods overview

Resource name (Archetype)	Resource URI	HTTP method or custom operation	Description
UeContextInPgwData (Document)	/{ueId}/ue-context-in-pgw-data	GET	Retrieve the UE's Context in PGW Data
Subscriptions (Collection)	/{ueId}/subscriptions	POST	Create a subscription
Individual Subscription (Document)	/{ueId}/subscriptions/{subscriptionId}	DELETE	Delete the subscription identified by {subscriptionId}, i.e. unsubscribe
		PATCH	Modify the subscription identified by {subscriptionId}

6.2.3.2 Resource: UeContextInPgwData

6.2.3.2.1 Description

This resource represents the allocated PGWs for the UE.

6.2.3.2.2 Resource Definition

Resource URI: {apiRoot}/nhss-sdm/<apiVersion>/{ueId}/ue-context-in-pgw-data

This resource shall support the resource URI variables defined in table 6.2.3.2.2-1.

Table 6.2.3.2.2-1: Resource URI variables for this resource

Name	Definition
apiRoot	See clause 6.2.1
apiVersion	See clause 6.2.1
ueId	Represents the UE identifier with type IMSI. pattern: "^(imsi-[0-9]{5,15}|.+)$"

6.2.3.2.3 Resource Standard Methods

6.2.3.2.3.1 GET

This method shall support the URI query parameters specified in table 6.2.3.2.3.1-1.

Table 6.2.3.2.3.3-1: URI query parameters supported by the GET method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 6.2.3.2.3.1-2 and the response data structures and response codes specified in table 6.2.3.2.3.1-3.

Table 6.2.3.2.3.1-2: Data structures supported by the GET Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 6.2.3.2.3.1-3: Data structures supported by the GET Response Body on this resource

Data type	P	Cardinality	Response codes	Description
UeContextInPgwData	M	1	200 OK	A response body containing the UeContextInPgwData shall be returned.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be used to indicate one of the following application errors: - USER_NOT_FOUND - DATA_NOT_FOUND
NOTE: In addition, common data structures as listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] are supported.				

Table 6.2.3.2.3.1-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

Table 6.2.3.2.3.1-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

6.2.3.3 Resource: Subscriptions

6.2.3.3.1 Description

This resource is used to represent subscriptions to notifications.

6.2.3.3.2 Resource Definition

Resource URI: {apiRoot}/nhss-sdm/<apiVersion>/{ueId}/subscriptions

This resource shall support the resource URI variables defined in table 6.2.3.3.2-1.

Table 6.2.3.3.2-1: Resource URI variables for this resource

Name	Definition
apiRoot	See clause 6.1.1
apiVersion	See clause 6.1.1
ueId	Represents the IMSI of the subscriber. pattern: "^(imsi-[0-9]{5,15})$"

6.2.3.3.3 Resource Standard Methods

6.2.3.3.3.1 POST

This method shall support the URI query parameters specified in table 6.2.3.3.3.1-1.

Table 6.2.3.3.3.1-1: URI query parameters supported by the POST method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 6.2.3.3.3.1-2 and the response data structures and response codes specified in table 6.2.3.3.3.1-3.

Table 6.2.3.3.3.1-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
SubscriptionData	M	1	The subscription that is to be created.

Table 6.2.3.3.3.1-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
SubscriptionData	M	1	201 Created	Upon success, a response body containing a representation of the created Individual subscription resource shall be returned. The HTTP response shall include a "Location" HTTP header that contains the resource URI of the created resource.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be used to indicate one of the following application errors: - USER_NOT_FOUND
ProblemDetails	O	0..1	501 Not Implemented	The "cause" attribute may be used to indicate one of the following application errors: - UNSUPPORTED_RESOURCE_URI This response shall not be cached.
NOTE: In addition, common data structures as listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] are supported.				

Table 6.2.3.3.3.1-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

Table 6.2.3.3.3.1-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

6.2.3.4 Resource: Individual subscription

6.2.3.4.1 Description

This resource is used to represent an individual subscription to notifications.

6.2.3.4.2 Resource Definition

Resource URI: {apiRoot}/nhss-sdm/<apiVersion>/{ueId}/subscriptions/{subscriptionId}

This resource shall support the resource URI variables defined in table 6.2.3.4.2-1.

Table 6.2.3.4.2-1: Resource URI variables for this resource

Name	Definition
apiRoot	See clause 6.1.1
apiVersion	See clause 6.1.1
ueId	Represents the IMSI of the subscriber pattern: "^(imsi-[0-9]{5,15})$"
subscriptionId	The subscriptionId identifies an individual subscription to notifications.

6.2.3.4.3 Resource Standard Methods

6.2.3.4.3.1 DELETE

This method shall support the URI query parameters specified in table 6.2.3.4.3.1-1.

Table 6.2.3.4.3.1-1: URI query parameters supported by the DELETE method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 6.2.3.4.3.1-2 and the response data structures and response codes specified in table 6.2.3.4.3.1-3.

Table 6.2.3.4.3.1-2: Data structures supported by the Delete Request Body on this resource

Data type	P	Cardinality	Description
n/a			The request body shall be empty.

Table 6.2.3.4.3.1-3: Data structures supported by the DELETE Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Upon success, an empty response body shall be returned.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be used to indicate one of the following application errors: - USER_NOT_FOUND - SUBSCRIPTION_NOT_FOUND (see 3GPP TS 29.500 [4] table 5.2.7.2-1)
NOTE: In addition, common data structures as listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] are supported.				

Table 6.2.3.4.3.1-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

Table 6.2.3.4.3.1-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

6.2.3.4.3.2 PATCH

This method shall support the URI query parameters specified in table 6.2.3.4.3.2-1.

Table 6.2.3.4.3.2-1: URI query parameters supported by the PATCH method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 6.2.3.4.3.2-2 and the response data structures and response codes specified in table 6.2.3.4.3.2-3.

Table 6.2.3.4.3.2-2: Data structures supported by the PATCH Request Body on this resource

Data type	P	Cardinality	Description
array(PatchItem)	M	1	It contains the list of changes to be made to the resource representing the individual subscription, according to the JSON PATCH format specified in IETF RFC 6902 [13].

Table 6.2.3.4.3.2-3: Data structures supported by the PATCH Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Upon success, a response with no content is returned.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be used to indicate one of the following application errors: - USER_NOT_FOUND - SUBSCRIPTION_NOT_FOUND (see 3GPP TS 29.500 [4] table 5.2.7.2-1)
ProblemDetails	O	0..1	403 Forbidden	One or more attributes are not allowed to be modified. The "cause" attribute may be used to indicate one of the following application errors: - MODIFICATION_NOT_ALLOWED (see 3GPP TS 29.500 [4] table 5.2.7.2-1)
NOTE: In addition, common data structures as listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] are supported.				

Table 6.2.3.4.3.2-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

Table 6.2.3.4.3.2-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

6.2.4 Custom Operations without associated resources

In this release of this specification, no custom operations without associated resources are defined for the Nhss_SubscriberDataManagement Service.

6.2.5 Notifications

6.2.5.1 General

This clause specifies the use of notifications and corresponding protocol details.

6.2.5.2 Data Change Notification

The POST method shall be used for Data Change Notifications and the URI shall be as provided during the subscription procedure.

Resource URI: {callbackReference}

Support of URI query parameters is specified in table 6.2.5.2-1.

Table 6.2.5.2-1: URI query parameters supported by the POST method

Name	Data type	P	Cardinality	Description
n/a				

Support of request data structures is specified in table 6.2.5.2-2 and of response data structures and response codes is specified in table 6.2.5.2-3.

Table 6.2.5.2-2: Data structures supported by the POST Request Body

Data type	P	Cardinality	Description
ModificationNotification	M	1	

Table 6.2.5.2-3: Data structures supported by the POST Response Body

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Upon success, an empty response body shall be returned.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing a different URI. The URI shall be an alternative URI of the notification endpoint of the subscribing NF Service Consumer. If an SCP redirects the message to another SCP then the location header field shall contain the same URI or a different URI pointing to the endpoint of the NF service consumer to which the notification should be sent.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing a different URI. The URI shall be an alternative URI of the notification endpoint of the subscribing NF Service Consumer. If an SCP redirects the message to another SCP then the location header field shall contain the same URI or a different URI pointing to the endpoint of the NF service consumer to which the notification should be sent.
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be used to indicate one of the following application errors: - CONTEXT_NOT_FOUND See table 6.2.7.3-1 for the description of this error.
NOTE: In addition, common data structures as listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] are supported.				

Table 6.2.5.2-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	A URI pointing to the endpoint of the NF service consumer to which the notification should be sent.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

Table 6.2.5.2-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	A URI pointing to the endpoint of the NF service consumer to which the notification should be sent.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

6.2.6 Data Model

6.2.6.1 General

This clause specifies the application data model supported by the API.

Table 6.2.6.1-1 specifies the data types defined for the Nhss_SubscriberDataManagement service API.

Table 6.2.6.1-1: Nhss_SubscriberDataManagement specific Data Types

Data type	Clause defined	Description
UeContextInPgwData	6.2.6.2.2	
SubscriptionData	6.2.6.2.3	Subscription Data
SubscriptionDataSets	6.2.6.2.4	UE Subscription Data Sets

Table 6.2.6.1-2 specifies data types re-used by the Nhss_SubscriberDataManagement service API from other APIs, including a reference and when needed, a short description of their use within the Nhss_SubscriberDataManagement service API.

Table 6.2.6.1-2: Nhss_SubscriberDataManagement re-used Data Types

Data type	Reference	Comments
PgwInfo	3GPP TS 29.503 [13]	
ModificationNotification	3GPP TS 29.503 [13]	
NfInstanceId	3GPP TS 29.571 [7]	Network Function Instance Identifier
Uri	3GPP TS 29.571 [7]	Uniform Resource Identifier
DateTime	3GPP TS 29.571 [7]	
ProblemDetails	3GPP TS 29.571 [7]	Response body of error response messages.
RedirectResponse	3GPP TS 29.571 [7]	Response body of redirect response messages.

6.2.6.2 Structured data types

6.2.6.2.1 Introduction

This clause defines the data structures to be used in resource representations.

6.2.6.2.2 Type: UeContextInPgwData

Table 6.2.6.2.2-1: Definition of type UeContextInPgwData

Attribute name	Data type	P	Cardinality	Description
pgwInfo	array(PgwInfo)	O	1..N	Information about the APNs and PGW-C+SMF FQDNs used in interworking with UDM
emergencyFqdn	string	O	0..1	PGW-C+SMF FQDN for emergency session
Note: At least one of pgwInfo and emergencyFqdn shall be present. The format of PGW-C+SMF FQDN is specified in clause 5.12.3.2, 3GPP TS 29.303 [16].				

6.2.6.2.3 Type: SubscriptionData

Table 6.2.6.2.3-1: Definition of type SubscriptionData

Attribute name	Data type	P	Cardinality	Description
nfInstanceId	NfInstanceId	M	1	Identity of the NF Instance creating the subscription.
callbackReference	Uri	M	1	URI provided by the NF service consumer to receive notifications
monitoredResourceUris	array(Uri)	M	1..N	A set of URIs that identify the resources for which a change triggers a notification. The URI shall take the form of either an absolute URI or an absolute-path reference as defined in IETF RFC 3986 [31]. See NOTE 1.
expires	DateTime	O	0..1	If present in a POST request, it indicates the point in time at which the subscription expires. Within a POST request the proposed expiry time is conveyed whereas in a POST response or PATCH response the confirmed expiry time is returned.
immediateReport	boolean	O	0..1	This IE indicates whether immediate report is needed or not. When present, this IE shall be set as following: - true: immediate report is required - false (default) immediate report is not required
report	SubscriptionDataSets	C	0..1	This IE shall be present in Subscribe response, if the immediateReport attribute is set to "true" in Subscribe request. When present, this IE shall contain the representation of subscription data sets that to be monitored, i.e. listed in monitoredResourceUris attribute.
NOTE 1: The HSS should handle only the relative-path part (apiSpecificResourceUriPart, see 3GPP TS 29.501 [5] clause 4.4.1) and ignore possible inconsistencies (caused by e.g. an SCP) in the base URI part.				

6.2.6.2.4 Type: SubscriptionDataSets

Table 6.2.6.2.4-1: Definition of type SusbcriptionDataSets

Attribute name	Data type	P	Cardinality	Description
ueContextInPgwData	UeContextInPgwData	O	0..1	UE Context in PGW Data

6.2.6.3 Simple data types and enumerations

6.2.6.3.1 Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

6.2.6.3.2 Simple data types

The simple data types defined in table 6.2.6.3.2-1 shall be supported.

Table 6.2.6.3.2-1: Simple data types

Type Name	Type Definition	Description

6.2.7 Error Handling

6.2.7.1 General

HTTP error handling shall be supported as specified in clause 5.2.4 of 3GPP TS 29.500 [4].

6.2.7.2 Protocol Errors

Protocol errors handling shall be supported as specified in clause 5.2.7 of 3GPP TS 29.500 [4].

6.2.7.3 Application Errors

The common application errors defined in the Table 5.2.7.2-1 in 3GPP TS 29.500 [4] may also be used for the Nhss_SubscriberDataManagement service. The following application errors listed in Table 6.2.7.3-1 are specific for the Nhss_SubscriberDataManagement service.

Table 6.2.7.3-1: Application errors

Application Error	HTTP status code	Description
USER_NOT_FOUND	404 Not Found	The user does not exist.
DATA_NOT_FOUND	404 Not Found	The requested data is not found/does not exist.
CONTEXT_NOT_FOUND	404 Not Found	It is used during the modification of an existing subscription when no corresponding context exists.

6.2.8 Feature Negotiation

The optional features in table 6.2.8-1 are defined for the Nhss_SubscriberDataManagement API. They shall be negotiated using the extensibility mechanism defined in clause 6.6 of 3GPP TS 29.500 [4].

Table 6.2.8-1: Supported Features

Feature number	Feature Name	Description

6.3 Nhss_UEContextManagement Service API

6.3.1 Introduction

The Nhss_UEContextManagement service shall use the Nhss_UEContextManagement API.

The request URI used in HTTP request from the NF service consumer towards the NF service producer shall have the structure defined in clause 4.4.1 of 3GPP TS 29.501 [5], i.e.:

{apiRoot}/<apiName>/<apiVersion>/<apiSpecificResourceUriPart>

with the following components:

- The {apiRoot} shall be set as described in 3GPP TS 29.501 [5].
- The <apiName> shall be "nhss-uecm".
- The <apiVersion> shall be "v1".
- The <apiSpecificResourceUriPart> shall be set as described in clause 6.1.

6.3.2 Usage of HTTP

6.3.2.1 General

HTTP/2, as defined in IETF RFC 7540 [9], shall be used as specified in clause 5 of 3GPP TS 29.500 [4].

HTTP/2 shall be transported as specified in clause 5.3 of 3GPP TS 29.500 [4].

HTTP messages and bodies for the Nhss_UEContextManagement service shall comply with the OpenAPI [10] specification contained in Annex A.

6.3.2.2 HTTP standard headers

6.3.2.2.1 General

The usage of HTTP standard headers shall be supported as specified in clause 5.2.2 of 3GPP TS 29.500 [4].

6.3.2.2.2 Content type

The following content types shall be supported:

- JSON, as defined in IETF RFC 8259 [11], signalled by the content type "application/json".
- The Problem Details JSON Object (IETF RFC 7807 [12] signalled by the content type "application/problem+json".

6.3.2.3 HTTP custom headers

6.3.2.3.1 General

In this release of the specification, no specific custom headers are defined for the Nhss_UEContextManagement service.

For 3GPP specific HTTP custom headers used across all service-based interfaces, see clause 5.2.3 of 3GPP TS 29.500 [4].

6.3.3 Resources

6.3.3.1 Overview

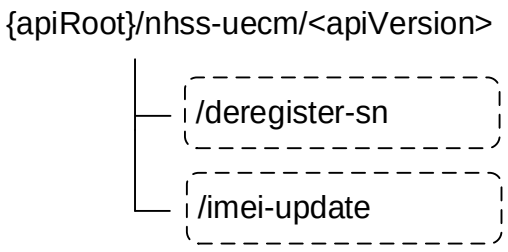

Figure 6.3.3.1-1: Resource URI structure of the nhss-uecm API

Table 6.3.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 6.3.3.1-1: Resources and methods overview

Resource name	Resource URI	HTTP method or custom operation	Description
n/a	deregister-sn	deregister-sn (POST)	Requesting MME/SGSN deregistration
n/a	imei-update	imei-update (POST)	Requests the update of the IMEI of the UE stored in HSS

6.3.4 Custom Operations without associated resources

6.3.4.1 Overview

Table 6.3.4.1-1: Custom operations without associated resources

Custom operation URI	Mapped HTTP method	Description
{apiRoot}/nhss-uecm/<apiVersion>/deregister-sn	POST	Requesting MME/SGSN deregistration.

6.3.4.2 Operation: deregister-sn

6.3.4.2.1 Description

This custom operation is used by the NF service consumer (UDM) to request MME/SGSN deregistration.

6.3.4.2.2 Operation Definition

This operation shall support the data structures and response codes specified in tables 6.3.4.2.2-1 and 6.3.4.2.2-2.

Table 6.3.4.2.2-1: Data structures supported by the POST Request Body

Data type	P	Cardinality	Description
DeregistrationRequest	M	1	

Table 6.3.4.2.2-2: Data structures supported by the POST Response Body

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Upon success, an empty response body shall be returned.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be used to indicate one of the following application errors: - USER_NOT_FOUND

Table 6.3.4.2.2-3: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

Table 6.3.4.2.2-4: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

6.3.4.3 Operation: imei-update

6.3.4.3.1 Description

This custom operation is used by the NF service consumer (UDM) to request the update of the IMEI of the UE.

6.3.4.3.2 Operation Definition

This operation shall support the data structures and response codes specified in tables 6.3.4.3.2-1 and 6.3.4.3.2-2.

Table 6.3.4.3.2-1: Data structures supported by the POST Request Body

Data type	P	Cardinality	Description
ImeiUpdateInfo	M	1	

Table 6.3.4.3.2-2: Data structures supported by the POST Response Body

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Upon success, an empty response body shall be returned.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be used to indicate one of the following application errors: - USER_NOT_FOUND - CONTEXT_NOT_FOUND

Table 6.3.4.3.2-3: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

Table 6.3.4.3.2-4: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

6.3.5 Notifications

In this release of this specification, no notifications are defined for the Nhss_UEContextManagement Service.

6.3.6 Data Model

6.3.6.1 General

This clause specifies the application data model supported by the API.

Table 6.3.6.1-1 specifies the structured data types defined for the Nhss_UECM service API.

Table 6.3.6.1-1: Nhss_UECM specific Data Types

Data type	Clause defined	Description	Applicability
DeregistrationRequest	6.3.6.2.2	Contains IMSI, deregistration reason	
ImeiUpdateInfo	6.3.6.2.3	Contains IMSI, new IMEI	

Table 6.3.6.1-2 specifies data types re-used by the Nhss_UECM service API from other specifications, including a reference to their respective specifications and when needed, a short description of their use within the Nhss_UECM service API.

Table 6.3.6.1-2: Nhss_UECM re-used Data Types

Data type	Reference	Comments	Applicability
Guami	3GPP TS 29.571 [7]		
ProblemDetails	3GPP TS 29.571 [7]	Response body of error response messages.	
RedirectResponse	3GPP TS 29.571 [7]	Response body of redirect response messages.	

6.3.6.2 Structured data types

6.3.6.2.1 Introduction

This clause defines the structures to be used in resource representations.

6.3.6.2.2 Type: DeregistrationRequest

Table 6.3.6.2.2-1: Definition of type DeregistrationRequest

Attribute name	Data type	P	Cardinality	Description	Applicability
imsi	string	M	1	pattern: "^[0-9]{5,15}$"	
deregReason	DeregistrationReason	M	1	String, see clause 6.3.6.3.3	
guami	Guami	O	0..1	The GUAMI identifying the AMF where the UE is registered. May be used by the HSS based on operator policy to decide whether a registered VLR shall be cancelled.	

6.3.6.2.3 Type: ImeiUpdateInfo

Table 6.3.6.2.3-1: Definition of type ImeiUpdateInfo

Attribute name	Data type	P	Cardinality	Description
imsi	string	M	1	IMSI of the subscriber. pattern: "^[0-9]{5,15}$"
imei	string	C	0..1	IMEI of the UE as described in 3GPP TS 23.003 [15], clause 6.2.1; it shall not include the Check Digit. pattern: "^[0-9]{14}$"
imeisv	string	C	0..1	IMEISV of the UE as described in 3GPP TS 23.003 [15], clause 6.2.2. pattern: "^[0-9]{16}$"
NOTE: Exactly one of attributes "imei" or "imeisv" shall be present.				

6.3.6.3 Simple data types and enumerations

6.3.6.3.1 Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

6.3.6.3.2 Simple data types

The simple data types defined in table 6.3.6.3.2-1 shall be supported.

Table 6.3.6.3.2-1: Simple data types

Type Name	Type Definition	Description

6.3.6.3.3 Enumeration: DeregistrationReason

Table 6.3.6.3.3-1: Enumeration DeregistrationReason

Enumeration value	Description
"UE_INITIAL_AND_SINGLE_REGISTRATION"	This value is used when the UDM needs to indicate to HSS that the MME/SGSN, if any, shall be cancelled due to an initial registration for single registration.
"UE_INITIAL_AND_DUAL_REGISTRATION"	This value is used when the UDM needs to indicate to HSS that an SGSN shall be cancelled (due to initial registration), but the MME shall not be cancelled (due to dual registration).
"EPS_TO_5GS_MOBILITY"	This value is used when the UDM needs to indicate to HSS that the MME/SGSN, if any, shall be cancelled due to a mobility event (i.e. for single registration which is not an initial registration).

6.3.7 Error Handling

6.3.7.1 General

HTTP error handling shall be supported as specified in clause 5.2.4 of 3GPP TS 29.500 [4].

6.3.7.2 Protocol Errors

Protocol errors handling shall be supported as specified in clause 5.2.7 of 3GPP TS 29.500 [4].

6.3.7.3 Application Errors

The common application errors defined in the Table 5.2.7.2-1 in 3GPP TS 29.500 [4] may also be used for the Nudm_UEContextManagement service. The application errors defined for the Nhss_UEContextManagement service are listed in Table 6.3.7.3-1.

Table 6.3.7.3-1: Application errors

Application Error	HTTP status code	Description
USER_NOT_FOUND	404 Not Found	The user does not exist.
CONTEXT_NOT_FOUND	404 Not Found	It is used when no corresponding UE context exists.

6.3.8 Feature Negotiation

The optional features in table 6.3.8-1 are defined for the Nhss_UEContextManagement API. They shall be negotiated using the extensibility mechanism defined in clause 6.6 of 3GPP TS 29.500 [4].

Table 6.3.8-1: Supported Features

Feature number	Feature Name	Description

6.4 Nhss_EventExposure Service API

6.4.1 API URI

URIs of this API shall have the following root:

{apiRoot}/<apiName>/<apiVersion>/

where "apiRoot" is defined in clause 4.4.1 of 3GPP TS 29.501 [5], the "apiName" shall be set to "nhss-ee" and the "apiVersion" shall be set to "v1" for the current version of this specification.

6.4.2 Usage of HTTP

6.4.2.1 General

HTTP/2, as defined in IETF RFC 7540 [13], shall be used as specified in clause 5 of 3GPP TS 29.500 [4].

HTTP/2 shall be transported as specified in clause 5.3 of 3GPP TS 29.500 [4].

HTTP messages and bodies for the Nhss_EE service shall comply with the OpenAPI [14] specification contained in Annex A5.

6.4.2.2 HTTP standard headers

6.4.2.2.1 General

The usage of HTTP standard headers shall be supported as specified in clause 5.2.2 of 3GPP TS 29.500 [4].

6.4.2.2.2 Content type

The following content types shall be supported:

JSON, as defined in IETF RFC 8259 [15], signalled by the content type "application/json".

The Problem Details JSON Object (IETF RFC 7807 [16] signalled by the content type "application/problem+json"

JSON Patch (IETF RFC 6902 [41]). The use of the JSON Patch format in a HTTP request body shall be signalled by the content type "application/json-patch+json".

6.4.2.3 HTTP custom headers

6.4.2.3.1 General

The usage of HTTP custom headers shall be supported as specified in clause 5.2.3 of 3GPP TS 29.500 [4].

6.4.3 Resources

6.4.3.1 Overview

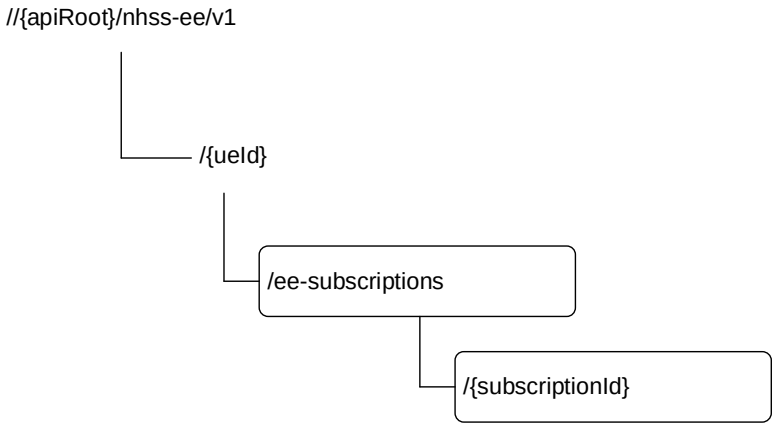

Figure 6.4.3.1-1: Resource URI structure of the Nhss_EE API

Table 6.4.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 6.4.3.1-1: Resources and methods overview

Resource name (Archetype)	Resource URI	HTTP method or custom operation	Description
EeSubscriptions (Collection)	/{ueId}/ee-subscriptions	POST	Create a subscription
Individual subscription (Document)	/{ueId}/ee-subscriptions/{subscriptionId}	PATCH	Update the subscription identified by {subscriptionId}
		DELETE	Delete the subscription identified by {subscriptionId}, i.e. unsubscribe

6.4.3.2 Resource: EeSubscriptions (Collection)

6.4.3.2.1 Description

This resource is used to represent subscriptions to notifications.

6.4.3.2.2 Resource Definition

Resource URI: {apiRoot}/nhss-ee/<apiVersion>/{ueId}/ee-subscriptions

This resource shall support the resource URI variables defined in table 6.4.3.2.2-1.

Table 6.4.3.2.2-1: Resource URI variables for this resource

Name	Definition
apiRoot	See clause 6.4.1
ueId	Represents the identity of the UE in the HSS (IMSI) pattern: See type Imsi in clause 6.4.6.3.2 of this document.

6.4.3.2.3 Resource Standard Methods

6.4.3.2.3.1 POST

This method shall support the URI query parameters specified in table 6.4.3.2.3.1-1.

Table 6.4.3.2.3.1-1: URI query parameters supported by the POST method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 6.4.3.2.3.1-2 and the response data structures and response codes specified in table 6.4.3.2.3.1-3.

Table 6.4.3.2.3.1-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
EeSubscription	M	1	The subscription that is to be created

Table 6.4.3.2.3.1-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
CreatedEeSubscription	M	1	201 Created	Upon success, a response body containing a representation of the created Individual subscription resource shall be returned, along with event reports that might be immediately available at the HSS. The HTTP response shall include a "Location" HTTP header that contains the resource URI of the created resource.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
ProblemDetails	O	0..1	403 Forbidden	The "cause" attribute may be used to indicate one of the following application errors: - MONITORING_NOT_ALLOWED - MAXIMUM_RESOURCES_EXCEEDED
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be used to indicate one of the following application errors: - USER_NOT_FOUND
ProblemDetails	O	0..1	501 Not Implemented	The "cause" attribute may be used to indicate one of the following application errors: - UNSUPPORTED_MONITORING_EVENT_TYPE - UNSUPPORTED_MONITORING_REPORT_OPTIONS This response shall not be cached.

Table 6.4.3.2.3.1-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

Table 6.4.3.2.3.1-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

6.4.3.3 Resource: Individual subscription (Document)

6.4.3.3.1 Resource Definition

Resource URI: {apiRoot}/nhss-ee/<apiVersion>/{ueId}/ee-subscriptions/{subscriptionId}

This resource shall support the resource URI variables defined in table 6.4.3.3.1-1.

Table 6.4.3.3.1-1: Resource URI variables for this resource

Name	Definition
apiRoot	See clause 6.4.1
ueId	Represents the identity of the UE in the HSS (IMSI) pattern: See type Imsi in clause 6.4.6.3.2 of this document.
subscriptionId	The subscriptionId identifies an individual subscription to notifications The type is string.

6.4.3.3.2 Resource Standard Methods

6.4.3.3.2.1 DELETE

This method shall support the URI query parameters specified in table 6.4.3.3.2.1-1.

Table 6.4.3.3.1.1-1: URI query parameters supported by the DELETE method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 6.4.3.3.2.1-2 and the response data structures and response codes specified in table 6.4.3.3.2.1-3.

Table 6.4.3.3.2.1-2: Data structures supported by the Delete Request Body on this resource

Data type	P	Cardinality	Description
n/a			The request body shall be empty.

Table 6.4.3.3.2.1-3: Data structures supported by the DELETE Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Upon success, an empty response body shall be returned.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be used to indicate one of the following application errors: - USER_NOT_FOUND - SUBSCRIPTION_NOT_FOUND, see 3GPP TS 29.500 [4] table 5.2.7.2-1.

Table 6.4.3.3.2.1-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

Table 6.4.3.3.2.1-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

6.4.3.3.2.2 PATCH

This method shall support the URI query parameters specified in table 6.4.3.3.2.2-1.

Table 6.4.3.3.2.2-1: URI query parameters supported by the PATCH method on this resource

Name	Data type	P	Cardinality	Description
supported-features	SupportedFeatures	O	0..1	see 3GPP TS 29.500 [4] clause 6.6

This method shall support the request data structures specified in table 6.4.3.3.2.2-2 and the response data structures and response codes specified in table 6.4.3.3.2.2-3.

Table 6.4.3.3.2.2-2: Data structures supported by the PATCH Request Body on this resource

Data type	P	Cardinality	Description
array(PatchItem)	M	1..N	Items describe the modifications to the Event Subscription

Table 6.4.3.3.2.2-3: Data structures supported by the PATCH Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Upon success, an empty response body shall be returned.
PatchResult	M	1	200 OK	Upon success, the execution report is returned.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing a different URI, or the same URI if a request is redirected to the same target resource via a different SCP. In the former case, the URI shall be an alternative URI of the resource located on an alternative service instance within the same HSS (service) set.
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be used to indicate one of the following application errors: - USER_NOT_FOUND - SUBSCRIPTION_NOT_FOUND, see 3GPP TS 29.500 [4] table 5.2.7.2-1.
ProblemDetails	O	0..1	403 Forbidden	One or more attributes are not allowed to be modified. The "cause" attribute may be used to indicate one of the following application errors: - MODIFICATION_NOT_ALLOWED, see 3GPP TS 29.500 [4] table 5.2.7.2-1.

Table 6.4.3.3.2.2-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

Table 6.4.3.3.2.2-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located on an alternative service instance within the same HSS (service) set. Or the same URI, if a request is redirected to the same target resource via a different SCP.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

6.4.4 Custom Operations without associated resources

In this release of this specification, no custom operations without associated resources are defined for the Nhss_EventExposure Service.

6.4.5 Notifications

6.4.5.1 General

This clause will specify the use of notifications and corresponding protocol details if required for the specific service. When notifications are supported by the API, it will include a reference to the general description of notifications support over the 5G SBIs specified in TS 29.500 / TS 29.501.

6.4.5.2 Event Occurrence Notification

The POST method shall be used for Event Occurrence Notifications and the URI shall be as provided during the subscription procedure.

Resource URI: {callbackReference}

Support of URI query parameters is specified in table 6.4.5.2-1.

Table 6.4.5.2-1: URI query parameters supported by the POST method

Name	Data type	P	Cardinality	Description
n/a				

Support of request data structures is specified in table 6.4.5.2-2 and of response data structures and response codes is specified in table 6.4.5.2-3.

Table 6.4.5.2-2: Data structures supported by the POST Request Body

Data type	P	Cardinality	Description
array(MonitoringReport)	M	1..N	A list of MonitoringReports each of which contains information regarding the occurred event

Table 6.4.5.2-3: Data structures supported by the POST Response Body

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Upon success, an empty response body shall be returned.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. The response shall include a Location header field containing a different URI. The URI shall be an alternative URI of the notification endpoint of the subscribing NF Service Consumer. If an SCP redirects the message to another SCP then the location header field shall contain the same URI or a different URI pointing to the endpoint of the NF service consumer to which the notification should be sent.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. The response shall include a Location header field containing a different URI. The URI shall be an alternative URI of the notification endpoint of the subscribing NF Service Consumer. If an SCP redirects the message to another SCP then the location header field shall contain the same URI or a different URI pointing to the endpoint of the NF service consumer to which the notification should be sent.
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be used to indicate one of the following application errors: - CONTEXT_NOT_FOUND
NOTE: In addition, common data structures as listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] are supported.				

Table 6.4.5.2-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	A URI pointing to the endpoint of the NF service consumer to which the notification should be sent.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

Table 6.4.5.2-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	A URI pointing to the endpoint of the NF service consumer to which the notification should be sent.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance ID towards which the request is redirected.

6.4.6 Data Model

6.4.6.1 General

This clause specifies the application data model supported by the API.

Table 6.4.6.1-1 specifies the data types defined for the Nhss_EE service API.

Table 6.4.6.1-1: Nhss_EE specific Data Types

Data type	Clause defined	Description
EeSubscription	6.4.6.2.2	A subscription to Notifications
CreatedEeSubscription	6.4.6.2.3	
MonitoringConfiguration	6.4.6.2.4	Monitoring Configuration
MonitoringReport	6.4.6.2.5	Monitoring Report
Report	6.4.6.2.6	
ReportingOptions	6.4.6.2.7	
LocationReportingConfiguration	6.4.6.2.8	
ReachabilityForSmsReport	6.4.6.2.9	
LossConnectivityConfiguration	6.4.6.2.10	
ReachabilityForDataConfiguration	6.4.6.2.11	
PduSessionStatusCfg	6.4.6.2.12	Reporting configuration for events related to PDN connectivity Status
ReachabilityForDataReport	6.4.6.2.13	Report of "UE_REACHABILITY_FOR_DATA" event
EventType	6.4.6.3.3	
LocationAccuracy	6.4.6.3.4	

Table 6.4.6.1-2 specifies data types re-used by the Nhss_EE service API from other specifications, including a reference to their respective specifications and when needed, a short description of their use within the Nhss_EE service API.

Table 6.4.6.1-2: Nhss_EE re-used Data Types

Data type	Reference	Comments
Uri	3GPP TS 29.571 [7]	Uniform Resource Identifier
SupportedFeatures	3GPP TS 29.571 [7]	See 3GPP TS 29.500 [4] clause 6.6
DateTime	3GPP TS 29.571 [7]	
PatchResult	3GPP TS 29.571 [7]	
DurationSec	3GPP TS 29.571 [7]	
DiameterIdentity	3GPP TS 29.571 [7]	
Dnn	3GPP TS 29.571 [7]	Data Network Name with Network Identifier only.
ProblemDetails	3GPP TS 29.571 [7]	Response body of error response messages.
RedirectResponse	3GPP TS 29.571 [7]	Response body of redirect response messages.
LossConnectivityReport	3GPP TS 29.503 [13]	Report of "LOSS_OF_CONNECTIVITY" event
LocationReport	3GPP TS 29.503 [13]	Report of "LOCATION_REPORTING" event
PdnConnectivityStatReport	3GPP TS 29.503 [13]	Report of "PDN_CONNECTIVITY_STATUS" event

6.4.6.2 Structured data types

6.4.6.2.1 Introduction

This clause defines the data structures to be used in resource representations.

6.4.6.2.2 Type: EeSubscription

Table 6.4.6.2.2-1: Definition of type EeSubscription

Attribute name	Data type	P	Cardinality	Description
callbackReference	Uri	M	1	URI provided by the NF service consumer to receive notifications
monitoringConfigurations	map(MonitoringConfiguration)	O	1..N	A map (list of key-value pairs where referenceId converted from integer to string serves as key) of MonitoringConfigurations
scefId	DiameterIdentity	O	0..1	Diameter Identify (FQDN) of the SCEF
supportedFeatures	SupportedFeatures	O	0..1	See clause 6.4.8
reportingOptions	ReportingOptions	O	0..1	This IE may be included if the NF service consumer wants to describe how the reports of the event are to be generated. If this attribute is not present in the request, it means that the NF service consumer does not specify any maximum number of reports or any expiry time for the subscription; still, the NF service producer (HSS) may set an expiry time in the response to the subscription creation (see clause 6.4.6.2.7).

6.4.6.2.3 Type: CreatedEeSubscription

Table 6.4.6.2.3-1: Definition of type CreatedEeSubscription

Attribute name	Data type	P	Cardinality	Description	Applicability
eeSubscription	EeSubscription	M	1	This IE shall contain the representation of the created event subscription.	
eventReports	array(MonitoringReport)	O	1..N	This IE may be included when the NF consumer has indicated supporting of ERIR feature in the subscription creation request (see clause 6.4.8). This IE when present, shall contain the status of events that are requested for immediate reporting as well, if those events are available at the time of subscription.	ERIR
supportedFeatures	SupportedFeatures	O	0..1	See clause 6.4.8	

6.4.6.2.4 Type: MonitoringConfiguration

Table 6.4.6.2.4-1: Definition of type MonitoringConfiguration

Attribute name	Data type	P	Cardinality	Description
eventType	EventType	M	1	Event type
immediateFlag	boolean	O	0..1	Indicates if an immediate event report in the subscription response indicating current value / status of the event is required, if available. If the flag is not present, then immediate reporting may be skipped.
locationReportingConfiguration	LocationReportingConfiguration	C	0..1	Shall be present if eventType is "LOCATION_REPORTING"
lossConnectivityConfiguration	LossConnectivityConfiguration	O	0..1	May be present if eventType is "LOSS_OF_CONNECTIVITY".
reachabilityForDataConfiguration	ReachabilityForDataConfiguration	O	0..1	May be present if eventType is "UE_REACHABILITY_FOR_DATA"
pduSessionStatusCfg	PduSessionStatusCfg	O	0..1	may be present if eventType is "PDN_CONNECTIVITY_STATUS"

6.4.6.2.5 Type: MonitoringReport

Table 6.4.6.2.5-1: Definition of type MonitoringReport

Attribute name	Data type	P	Cardinality	Description
referenceId	ReferenceId	M	1	Shall contain the Reference ID which was provided as the key of the associated monitoring configuration in subscription request. The consumer can use this IE to uniquely associate the report with the corresponding event that was requested to be monitored.
eventType	EventType	M	1	String; see clause 6.4.6.3.3 only the following values are allowed: "UE_REACHABILITY_FOR_SMS"
timeStamp	DateTime	M	1	Point in time at which the event occured
report	Report	O	0..1	Shall be present if eventType is "UE_REACHABILITY_FOR_SMS" "UE_REACHABILITY_FOR_DATA" "LOSS_OF_CONNECTIVITY" "LOCATION_REPORTING" "PDN_CONNECTIVITY_STATUS"

6.4.6.2.6 Type: Report

Table 6.4.6.2.6-1: Definition of type Report

Attribute name	Data type	P	Cardinality	Description
reachabilityForSmsReport	ReachabilityForSms Report	O	0..1	Reports the UE reachacbility for SMS
reachabilityForDataReport	ReachabilityForData Report	O	0..1	Reports the UE reachacbility for Data
lossConnectivityReport	LossConnectivityRe port	O	0..1	Reports the Loss of Connectivity
locationReport	LocationReport	O	0..1	Reports the UE Location
pdnConnectivityStatReport	PdnConnectivityStat Report	O	0..1	Reports the PDN Connectivity Status

6.4.6.2.7 Type: ReportingOptions

Table 6.4.6.2.7-1: Definition of type ReportingOptions

Attribute name	Data type	P	Cardinality	Description
maxNumOfReports	MaxNumOfReports	O	0..1	Maximum number of reports. If not present, the NF service consumer does not specify any maximum number of reports to be received. (NOTE)
expiry	DateTime	C	0..1	This IE shall be included in an event subscription response, if, based on operator policy, the HSS needs to include an expiry time, and may be included in an event subscription request. When present, this IE shall represent the time at which monitoring shall cease and the subscription becomes invalid. If the maxNumOfReports included in an event subscription response is 1 and if an event report is included in the subscription response then the value of the expiry included in the response shall be an immediate timestamp. (NOTE)
reportPeriod	DurationSec	C	0..1	Indicates the interval time between which the event notification is reported, may be present if event type is "LOCATION_REPORTING"
NOTE: If parameter "maxNumOfReports" and "expiry" are included at the same time, the subscription will expire as soon as one of the conditions is met.				

6.4.6.2.8 Type: LocationReportingConfiguration

Table 6.4.6.2.8-1: Definition of type LocationReportingConfiguration

Attribute name	Data type	P	Cardinality	Description
currentLocation	boolean	M	1	true: Indicates that current location is requested. false: Indicates that last known location is requested.
accuracy	LocationAccuracy	C	0..1	Indicates whether Cell-level or TA-level accuracy is requested. Shall be present when current location is requested.

6.4.6.2.9 Type: ReachabilityForSmsReport

Table 6.4.6.2.9-1: Definition of type ReachabilityForSmsReport

Attribute name	Data type	P	Cardinality	Description
reachabilitySmsStatus	boolean	M	1	true: UE is reachable for SMS false: UE is not reachable for SMS
maxAvailabilityTime	DateTime	O	0..1	Indicates the time (in UTC) until which the UE is expected to be reachable. This information may be used by the SMS Service Center to prioritize the retransmission of pending Mobile Terminated Short Message to UEs using a power saving mechanism (eDRX, PSM etc.).

6.4.6.2.10 Type: LossConnectivityConfiguration

Table 6.4.6.2.10-1: Definition of type LossConnectivityConfiguration

Attribute name	Data type	P	Cardinality	Description
maxDetectionTime	DurationSec	O	0..1	When present, it indicates the configured Maximum Detection Time

6.4.6.2.11 Type: ReachabilityForDataConfiguration

Table 6.4.6.2.11-1: Definition of type ReachabilityForDataConfiguration

Attribute name	Data type	P	Cardinality	Description
maximumLatency	DurationSec	O	0..1	When present, it indicates the configured Maximum Latency. (NOTE)
maximumResponseTime	DurationSec	O	0..1	When present, it indicates the configured Maximum Response Time. (NOTE)
suggestedPacketNumDl	integer	O	0..1	When present, it indicates the configured Suggested number of downlink packets. (NOTE)
NOTE: At least one of maximumLatency, maximumResponseTime or suggestedPacketNumDl shall be present				

6.4.6.2.12 Type: PduSessionStatusCfg

Table 6.4.6.2.12-1: Definition of type PduSessionStatusCfg

Attribute name	Data type	P	Cardinality	Description
apn	Dnn	O	0..1	When present, it indicates the APN for which the event is monitored.

6.4.6.2.13 Type: ReachabilityForDataReport

Table 6.4.6.2.13-1: Definition of type ReachabilityForDataReport

Attribute name	Data type	P	Cardinality	Description
reachabilityDataStatus	boolean	M	1	true: UE is reachable for Data false: UE is not reachable for Data
maxAvailabilityTime	DateTime	O	0..1	Indicates the time (in UTC) until which the UE is expected to be reachable. This information may be used by the SMS Service Center to prioritize the retransmission of pending Mobile Terminated Short Message to UEs using a power saving mechanism (eDRX, PSM etc.).

6.4.6.3 Simple data types and enumerations

6.4.6.3.1 Introduction

This clause defines simple data types and enumerations that can be referenced from data structures defined in the previous clauses.

6.4.6.3.2 Simple data types

The simple data types defined in table 6.4.6.3.2-1 shall be supported.

Table 6.4.6.3.2-1: Simple data types

Type Name	Type Definition	Description
ReferenceId	integer	ReferenceId is used as key in a map of MonitoringConfigurations; see clause 6.4.6.2.4. The numeric value should not be higher than 2^64-1 (i.e. it should be possible to convey it in an unsigned 64 integer Information Element, used in other protocols), if interworking with the Event Exposure framework in EPC is required.
Imsi	string	IMSI pattern: '^(imsi-[0-9]{5,15})$'
MaxNumOfReports	integer	Maximum number of reports. Minimum: 1

6.4.6.3.3 Enumeration: EventType

Table 6.4.6.3.3-1: Enumeration EventType

Enumeration value	Description
"LOSS_OF_CONNECTIVITY"	Loss of connectivity
"UE_REACHABILITY_FOR_DATA"	UE reachability for data, implements the "UE Reachability" monitoring event as specified in clause 4.15.3.1 in 3GPP TS 23.502 [3]. When this event is subscribed by an NF service consumer, the UDM subscribes to "ReachabilityReport" event for "UE Reachability for DL Traffic" on the AMF without URRP-AMF. When this event is subscribed by an NF service consumer, the UDM shall request the AMF to directly send notification to NF.
"UE_REACHABILITY_FOR_SMS"	UE reachability for SMS, implements the "UE Reachability for SMS Delivery" event as specified in 3GPP TS 23.682 [18]. This event only supports One-Time reporting.
"LOCATION_REPORTING"	Location Reporting
"COMMUNICATION_FAILURE"	Communication Failure
"AVAILABILITY_AFTER_DDN_FAILURE"	Availability after DDN failure
"PDN_CONNECTIVITY_STATUS"	PDN_CONNECTIVITY_STATUS

6.4.6.3.4 Enumeration: LocationAccuracy

Table 6.4.6.3.4-1: Enumeration LocationAccuracy

Enumeration value	Description
"CELL_LEVEL"	Change of cell shall be reported
"TA_LEVEL"	Change of TA shall be reported

6.4.7 Error Handling

6.4.7.1 General

HTTP error handling shall be supported as specified in clause 5.2.4 of 3GPP TS 29.500 [4].

6.4.7.2 Protocol Errors

Protocol errors handling shall be supported as specified in clause 5.2.7 of 3GPP TS 29.500 [4].

6.4.7.3 Application Errors

The common application errors defined in the Table 5.2.7.2-1 in 3GPP TS 29.500 [4] may also be used for the Nhss_EventExposure service. The following application errors listed in Table 6.4.7.3-1 are specific for the Nhss_EventExposure service.

Table 6.4.7.3-1: Application errors

Application Error	HTTP status code	Description
MONITORING_NOT_ALLOWED	403 Forbidden	The subscriber does not have the necessary subscription for monitoring with the requested Event Type.
USER_NOT_FOUND	404 Not Found	The user does not exist
CONTEXT_NOT_FOUND	404 Not Found	It is used when no corresponding context exists.
UNSUPPORTED_MONITORING_EVENT_TYPE	501 Not Implemented	The monitoring configuration contains unsupported event type.
UNSUPPORTED_MONITORING_REPORT_OPTIONS	501 Not Implemented	The monitoring configuration contains unsupported report options.

6.4.8 Feature Negotiation

The optional features in table 6.4.8-1 are defined for the Nhss_EE API. They shall be negotiated using the extensibility mechanism defined in clause 6.6 of 3GPP TS 29.500 [4].

Table 6.4.8-1: Supported Features

Feature number	Feature Name	Description
1	ERIR	Event Reports in Response An NF consumer supporting this feature shall be able to handle the event reports within the Event Subscrpition Create Repsonse, as specified in clause 5.5.2.2.2.

6.4.9 Security

As indicated in 3GPP TS 33.501 [6] and 3GPP TS 29.500 [4], the access to the Nhss_EE API may be authorized by means of the OAuth2 protocol (see IETF RFC 6749 [18]), based on local configuration, using the "Client Credentials" authorization grant, where the NRF (see 3GPP TS 29.510 [19]) plays the role of the authorization server.

If OAuth2 is used, an NF Service Consumer, prior to consuming services offered by the Nhss_EE API, shall obtain a "token" from the authorization server, by invoking the Access Token Request service, as described in 3GPP TS 29.510 [19], clause 5.4.2.2.

NOTE: When multiple NRFs are deployed in a network, the NRF used as authorization server is the same NRF that the NF Service Consumer used for discovering the Nhss_EE service.

The Nhss_EE API defines a single scope "nhss-ee" for OAuth2 authorization (as specified in 3GPP TS 33.501 [6]) for the entire API, and it does not define any additional scopes at resource or operation level.

Annex A (normative): OpenAPI specification

A.1 General

This Annex specifies the formal definition of the Nhss Service API(s). It consists of OpenAPI 3.0.0 specifications in YAML format.

This Annex takes precedence when being discrepant to other parts of the specification with respect to the encoding of information elements and methods within the API(s).

NOTE: The semantics and procedures, as well as conditions, e.g. for the applicability and allowed combinations of attributes or values, not expressed in the OpenAPI definitions but defined in other parts of the specification also apply.

Informative copies of the OpenAPI specification files contained in this 3GPP Technical Specification are available on a Git-based repository, that uses the GitLab software version control system (see 3GPP TS 29.501 [5] clause 5.3.1 and 3GPP TR 21.900 [14] clause 5B).

A.2 Nhss_UEAuthentication API

```
openapi: 3.0.0
info:
  version: '1.0.1'
  title: 'NhssUEAU'
  description: |
    HSS UE Authentication Service.
    © 2021, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.

externalDocs:
  description: 3GPP TS 29.563 HSS Services for Interworking With UDM, version 16.5.0
  url: 'http://www.3gpp.org/ftp/Specs/archive/29_series/29.563/'

servers:
  - url: '{apiRoot}/nhss-ueau/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501.

security:
  - oAuth2ClientCredentials:
    - nhss-ueau
  - {}

paths:
  /generate-av:
    post:
      summary: Generate authentication vector for the UE
      operationId: GenerateAV
      tags:
        - Generate Auth Vector
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/AvGenerationRequest'
        required: true
      responses:
        '200':
          description: Expected response to a valid request
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/AvGenerationResponse'
        '307':
          $ref: 'TS29571_CommonData.yaml#/components/responses/307'
        '308':
```

```
          $ref: 'TS29571_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '403':
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '501':
          $ref: 'TS29571_CommonData.yaml#/components/responses/501'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          description: Unexpected error


components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{nrfApiRoot}/oauth2/token'
          scopes:
            nhss-ueau: Access to the nhss-ueau API


  schemas:

# COMPLEX TYPES:

    AvGenerationRequest:
      type: object
      required:
        - imsi
        - authType
        - servingNetworkName
      properties:
        imsi:
          type: string
          pattern: '^[0-9]{5,15}$'
        authType:
          $ref: 'TS29503_Nudm_UEAU.yaml#/components/schemas/AuthType'
        servingNetworkName:
          $ref: 'TS29503_Nudm_UEAU.yaml#/components/schemas/ServingNetworkName'
        resynchronizationInfo:
          $ref: 'TS29503_Nudm_UEAU.yaml#/components/schemas/ResynchronizationInfo'

    AvGenerationResponse:
      type: object
      oneOf:
        - required:
          - avEapAkaPrime
        - required:
          - av5GHeAka
      properties:
        avEapAkaPrime:
          $ref: 'TS29503_Nudm_UEAU.yaml#/components/schemas/AvEapAkaPrime'
        av5GHeAka:
          $ref: 'TS29503_Nudm_UEAU.yaml#/components/schemas/Av5GHeAka'


# SIMPLE TYPES:


# ENUMS:
```

A.3 Nhss_SubscriberDataManagement API

```
openapi: 3.0.0

info:
  version: '1.0.2'
  title: 'Nhss_SDM'
```

```
  description: |
    HSS Subscriber Data Management.
    © 2021, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.

externalDocs:
  description: 3GPP TS 29.563 HSS Services for Interworking With UDM, version 16.5.0
  url: 'http://www.3gpp.org/ftp/Specs/archive/29_series/29.563/'

servers:
  - url: '{apiRoot}/nhss-sdm/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501.

security:
  - oAuth2ClientCredentials:
    - nhss-sdm
  - {}

paths:
  /{ueId}/ue-context-in-pgw-data:
    get:
      summary: Retrieve the UE Context In PGW
      operationId: GetUeCtxInPgwData
      tags:
        - UE Context In PGW Data Retrieval
      parameters:
        - name: ueId
          in: path
          description: Identifier of the UE
          required: true
          schema:
            type: string
            pattern: '^(imsi-[0-9]{5,15})$'
      responses:
        '200':
          description: Expected response to a valid request
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/UeContextInPgwData'
        '307':
          $ref: 'TS29571_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29571_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          description: Unexpected error

  /{ueId}/subscriptions:
    post:
      summary: subscribe to notifications
      operationId: Subscribe
      tags:
        - Subscription Creation
      parameters:
        - name: ueId
          in: path
          description: IMSI of the user
          required: true
          schema:
            type: string
            pattern: '^(imsi-[0-9]{5,15})$'
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/SubscriptionData'
        required: true
```

```
      responses:
        '201':
          description: Expected response to a valid request
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/SubscriptionData'
          headers:
            Location:
              description: 'Contains the URI of the newly created resource, according to the
structure: {apiRoot}/nhss-sdm/<apiVersion>/{ueId}/subscriptions/{subscriptionId}'
              required: true
              schema:
                type: string
        '307':
          $ref: 'TS29571_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29571_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '501':
          $ref: 'TS29571_CommonData.yaml#/components/responses/501'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          description: Unexpected error
      callbacks:
        datachangeNotification:
          '{request.body#/callbackReference}':
            post:
              requestBody:
                required: true
                content:
                  application/json:
                    schema:
                      $ref: 'TS29503_Nudm_SDM.yaml#/components/schemas/ModificationNotification'
              responses:
                '204':
                  description: Successful Notification response
                '307':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/307'
                '308':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/308'
                '400':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/400'
                '404':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/404'
                '500':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/500'
                '503':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/503'
                default:
                  description: Unexpected error

  /{ueId}/subscriptions/{subscriptionId}:
    delete:
      summary: unsubscribe from notifications
      operationId: Unsubscribe
      tags:
        - Subscription Deletion
      parameters:
        - name: ueId
          in: path
          description: IMSI of the user
          required: true
          schema:
            type: string
            pattern: '^(imsi-[0-9]{5,15})$'
        - name: subscriptionId
          in: path
          description: Id of the Subscription
          required: true
          schema:
            type: string
```

```
      responses:
        '204':
          description: Successful response
        '307':
          $ref: 'TS29571_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29571_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          description: Unexpected error
    patch:
      summary: modify the subscription
      operationId: Modify
      tags:
        - Subscription Modification
      parameters:
        - name: ueId
          in: path
          description: IMSI of the user
          required: true
          schema:
            type: string
            pattern: '^(imsi-[0-9]{5,15})$'
        - name: subscriptionId
          in: path
          description: Id of the Subscription
          required: true
          schema:
            type: string
      requestBody:
        content:
          application/json-patch+json:
            schema:
              type: array
              items:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/PatchItem'
              minItems: 1
        required: true
      responses:
        '204':
          description: Successful modification
        '307':
          $ref: 'TS29571_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29571_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '403':
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          description: Unexpected error

components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{nrfApiRoot}/oauth2/token'
          scopes:
            nhss-sdm: Access to the nhss-sdm API


  schemas:
```

```
# COMPLEX TYPES:

    UeContextInPgwData:
      type: object
      properties:
        pgwInfo:
          type: array
          items:
            $ref: 'TS29503_Nudm_SDM.yaml#/components/schemas/PgwInfo'
          minItems: 1
        emergencyFqdn:
          type: string

    SubscriptionData:
      type: object
      required:
        - nfInstanceId
        - callbackReference
        - monitoredResourceUris
      properties:
        nfInstanceId:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/NfInstanceId'
        callbackReference:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        monitoredResourceUris:
          type: array
          items:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
          minItems: 1
        expires:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        immediateReport:
          type: boolean
          default: false
        report:
          $ref: '#/components/schemas/SubscriptionDataSets'

    SubscriptionDataSets:
      type: object
      properties:
        ueContextInPgwData:
          $ref: '#/components/schemas/UeContextInPgwData'

# SIMPLE TYPES:


# ENUMS:
```

A.4 Nhss_UEContextManagement API

```
openapi: 3.0.0

info:
  version: '1.0.2'
  title: 'Nhss_UECM'
  description: |
    HSS UE Context Management
    © 2021, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.

externalDocs:
  description: 3GPP TS 29.563 HSS Services for Interworking With UDM, version 16.5.0
  url: 'http://www.3gpp.org/ftp/Specs/archive/29_series/29.563/'

servers:
  - url: '{apiRoot}/nhss-uecm/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501.

security:
  - oAuth2ClientCredentials:
    - nhss-uecm
  - {}
```

```
paths:
  /deregister-sn:
    post:
      summary: MME/SGSN Deregistration
      operationId: DeregisterSN
      tags:
        - MME/SGSN Deregistration
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/DeregistrationRequest'
        required: true
      responses:
        '204':
          description: No content
        '307':
          $ref: 'TS29571_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29571_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '501':
          $ref: 'TS29571_CommonData.yaml#/components/responses/501'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          description: Unexpected error

  /imei-update:
    post:
      summary: IMEI Update
      operationId: IMEIUpdate
      tags:
        - IMEI Update
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/ImeiUpdateInfo'
        required: true
      responses:
        '204':
          description: No content
        '307':
          $ref: 'TS29571_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29571_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '501':
          $ref: 'TS29571_CommonData.yaml#/components/responses/501'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          description: Unexpected error

components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{nrfApiRoot}/oauth2/token'
          scopes:
            nhss-uecm: Access to the nhss-uecm API

  schemas:

# COMPLEX TYPES:
```

```
    DeregistrationRequest:
      type: object
      required:
        - imsi
        - deregReason
      properties:
        imsi:
          type: string
          pattern: '^[0-9]{5,15}$'
        deregReason:
          $ref: '#/components/schemas/DeregistrationReason'
        guami:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Guami'

    ImeiUpdateInfo:
      type: object
      required:
        - imsi
      oneOf:
        - required: [ imei ]
        - required: [ imeisv ]
      properties:
        imsi:
          type: string
          pattern: '^[0-9]{5,15}$'
        imei:
          type: string
          pattern: '^[0-9]{14,15}$'
        imeisv:
          type: string
          pattern: '^[0-9]{16}$'

# SIMPLE TYPES:


# ENUMS:

    DeregistrationReason:
      anyOf:
        - type: string
          enum:
            - UE_INITIAL_AND_SINGLE_REGISTRATION
            - UE_INITIAL_AND_DUAL_REGISTRATION
            - EPS_TO_5GS_MOBILITY
        - type: string
```

A.5 Nhss_EE API

```
openapi: 3.0.0

info:
  version: '1.0.4'
  title: 'Nhss_EE'
  description: |
    HSS Event Exposure
    © 2021, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.

externalDocs:
  description: 3GPP TS 29.563 HSS Services for Interworking With UDM, version 16.6.0
  url: 'http://www.3gpp.org/ftp/Specs/archive/29_series/29.563/'

servers:
  - url: '{apiRoot}/nhss-ee/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501.

security:
  - {}
  - oAuth2ClientCredentials:
    - nhss-ee

paths:
```

```
  /{ueId}/ee-subscriptions:
    post:
      summary: Subscribe
      operationId: CreateEeSubscription
      tags:
        - EE Subscription (Collection)
      parameters:
        - name: ueId
          in: path
          description: IMSI of the subscriber
          required: true
          schema:
            $ref: '#/components/schemas/Imsi'
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/EeSubscription'
        required: true
      responses:
        '201':
          description: Expected response to a valid request
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/CreatedEeSubscription'
          headers:
            Location:
              description: 'Contains the URI of the newly created resource, according to the
structure: {apiRoot}/nhss-ee/v1/{ueId}/ee-subscriptions/{subscriptionId}'
              required: true
              schema:
                type: string
        '307':
          $ref: 'TS29571_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29571_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '403':
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '501':
          $ref: 'TS29571_CommonData.yaml#/components/responses/501'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          description: Unexpected error
      callbacks:
        eventOccurrenceNotification:
          '{request.body#/callbackReference}':
            post:
              requestBody:
                required: true
                content:
                  application/json:
                    schema:
                      type: array
                      items:
                        $ref: '#/components/schemas/MonitoringReport'
                      minItems: 1
              responses:
                '204':
                  description: Successful Notification response
                '307':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/307'
                '308':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/308'
                '400':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/400'
                '404':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/404'
                '500':
                  $ref: 'TS29571_CommonData.yaml#/components/responses/500'
                '503':
```

```
                $ref: 'TS29571_CommonData.yaml#/components/responses/503'
              default:
                description: Unexpected error

  /{ueId}/ee-subscriptions/{subscriptionId}:
    delete:
      summary: Unsubscribe
      operationId: DeleteEeSubscription
      tags:
        - Delete EE Subscription
      parameters:
        - name: ueId
          in: path
          description: IMSI of the subscriber
          required: true
          schema:
            $ref: '#/components/schemas/Imsi'
        - name: subscriptionId
          in: path
          description: Id of the EE Subscription
          required: true
          schema:
            type: string
      responses:
        '204':
          description: Successful response
        '307':
          $ref: 'TS29571_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29571_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          description: Unexpected error
    patch:
      summary: Patch
      operationId: UpdateEeSubscription
      tags:
        - Update EE Subscription
      parameters:
        - name: ueId
          in: path
          description: IMSI of the subscriber
          required: true
          schema:
            $ref: '#/components/schemas/Imsi'
        - name: subscriptionId
          in: path
          description: Id of the EE Subscription
          required: true
          schema:
            type: string
      requestBody:
        content:
          application/json-patch+json:
            schema:
              type: array
              items:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/PatchItem'
              minItems: 1
        required: true
      responses:
        '200':
          description: Expected response to a valid request
          content:
            application/json:
              schema:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/PatchResult'
        '204':
          description: Successful response
        '307':
          $ref: 'TS29571_CommonData.yaml#/components/responses/307'
```

```
        '308':
          $ref: 'TS29571_CommonData.yaml#/components/responses/308'
        '403':
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        default:
          description: Unexpected error

components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{nrfApiRoot}/oauth2/token'
          scopes:
            nhss-ee: Access to the nhss-ee API

  schemas:

# COMPLEX TYPES:

    EeSubscription:
      type: object
      required:
        - callbackReference
      properties:
        callbackReference:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        scefId:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DiameterIdentity'
        monitoringConfigurations:
          description: A map (list of key-value pairs where ReferenceId serves as key) of
MonitoringConfigurations
          type: object
          additionalProperties:
            $ref: '#/components/schemas/MonitoringConfiguration'
          minProperties: 1
        supportedFeatures:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
        reportingOptions:
          $ref: '#/components/schemas/ReportingOptions'

    CreatedEeSubscription:
      type: object
      required:
        - eeSubscription
      properties:
        eeSubscription:
            $ref: '#/components/schemas/EeSubscription'
        eventReports:
          type: array
          items:
            $ref: '#/components/schemas/MonitoringReport'
          minItems: 1
        supportedFeatures:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'

    MonitoringConfiguration:
      type: object
      required:
        - eventType
      properties:
        eventType:
          $ref: '#/components/schemas/EventType'
        immediateFlag:
          type: boolean
        locationReportingConfiguration:
          $ref: '#/components/schemas/LocationReportingConfiguration'
        lossConnectivityConfiguration:
          $ref: '#/components/schemas/LossConnectivityConfiguration'
        reachabilityForDataConfiguration:
          $ref: '#/components/schemas/ReachabilityForDataConfiguration'
        pduSessionStatusCfg:
          $ref: '#/components/schemas/PduSessionStatusCfg'

    MonitoringReport:
```

```
      type: object
      required:
        - referenceId
        - eventType
        - timeStamp
      properties:
        referenceId:
          $ref: '#/components/schemas/ReferenceId'
        eventType:
          $ref: '#/components/schemas/EventType'
        timeStamp:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        report:
          $ref: '#/components/schemas/Report'

    ReportingOptions:
      type: object
      properties:
        maxNumOfReports:
          $ref: '#/components/schemas/MaxNumOfReports'
        expiry:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        reportPeriod:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'

    Report:
      type: object
      properties:
        reachabilityForSmsReport:
          $ref: '#/components/schemas/ReachabilityForSmsReport'
        reachabilityForDataReport:
          $ref: '#/components/schemas/ReachabilityForDataReport'
        lossConnectivityReport:
          $ref: 'TS29503_Nudm_EE.yaml#/components/schemas/LossConnectivityReport'
        locationReport:
          $ref: 'TS29503_Nudm_EE.yaml#/components/schemas/LocationReport'
        pdnConnectivityStatReport:
          $ref: 'TS29503_Nudm_EE.yaml#/components/schemas/PdnConnectivityStatReport'

    ReachabilityForSmsReport:
      type: object
      required:
        - reachabilitySmsStatus
      properties:
        reachabilitySmsStatus:
          type: boolean
        maxAvailabilityTime:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'

    ReachabilityForDataReport:
      description: Contains data for a Monitoring Event Report, specific to the 'Reachability For
Data' event type
      type: object
      required:
        - reachabilityDataStatus
      properties:
        reachabilityDataStatus:
          type: boolean
        maxAvailabilityTime:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'

    LossConnectivityConfiguration:
      type: object
      properties:
        maxDetectionTime:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'

    LocationReportingConfiguration:
      type: object
      required:
        - currentLocation
      properties:
        currentLocation:
          type: boolean
        accuracy:
          $ref: '#/components/schemas/LocationAccuracy'

    ReachabilityForDataConfiguration:
```

```
      type: object
      anyOf:
        - required: [ maximumLatency ]
        - required: [ maximumResponseTime ]
        - required: [ suggestedPacketNumDl ]
      properties:
        maximumLatency:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'
        maximumResponseTime:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'
        suggestedPacketNumDl:
          type: integer
          minimum: 1

    PduSessionStatusCfg:
      type: object
      properties:
        apn:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Dnn'

# SIMPLE TYPES:

    ReferenceId:
      type: integer

    Imsi:
      type: string
      pattern: '^(imsi-[0-9]{5,15})$'

    MaxNumOfReports:
      type: integer
      minimum: 1

# ENUMS:

    EventType:
      anyOf:
        - type: string
          enum:
          - LOSS_OF_CONNECTIVITY
          - UE_REACHABILITY_FOR_DATA
          - UE_REACHABILITY_FOR_SMS
          - LOCATION_REPORTING
          - COMMUNICATION_FAILURE
          - AVAILABILITY_AFTER_DDN_FAILURE
          - PDN_CONNECTIVITY_STATUS
        - type: string

    LocationAccuracy:
      anyOf:
        - type: string
          enum:
          - CELL_LEVEL
          - TA_LEVEL
        - type: string
```

Annex B (informative): Withdrawn API versions

B.1 General

This Annex lists withdrawn API versions of the APIs defined in the present specification. 3GPP TS 29.501 [5] clause 4.3.1.6 describes the withdrawal of API versions.

Annex C (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2019-05	CT4#91	C4-192407				Initial Draft.	0.1.0
2019-09	CT4#93	C4-193847				Incorporation of pCRs agreed at CT4#93 in C4-193553, C4-193624.	0.2.0
2019-10	CT4#94	C4-194521				Incorporation of pCRs agreed at CT4#94 in C4-194346.	0.3.0
2019-11	CT4#95	C4-195636				Incorporation of pCRs agreed at CT4#95 in C4-195579.	0.4.0
2019-12	CT#86	CP-193067				TS presented for information	1.0.0
2020-03	CT4#96	C4-201271				Incorporation of pCRs agreed at CT4#96 in C4-200880, C4-200917, C4-200964, C4-201100.	1.1.0
2020-03	CT#87	CP-200065				TS presented for approval	2.0.0
2020-03	CT#87					Approved at CT#87	16.0.0
2020-07	CT#88	CP-201033	0001	-	B	Storage of YAML files in ETSI Forge	16.1.0
2020-07	CT#88	CP-201033	0002	-	F	PGW-C+SMF FQDN for Emergency Session	16.1.0
2020-07	CT#88	CP-201033	0003	1	B	Initial Registration	16.1.0
2020-07	CT#88	CP-201033	0004	1	B	HSS Event Exposure	16.1.0
2020-07	CT#88	CP-201033	0005	1	F	Serving Node Deregistration	16.1.0
2020-07	CT#88	CP-201073	0006	-	F	29.563 Rel-16 API version and External doc update	16.1.0
2020-09	CT#89	CP-202111	0007	-	F	UE Id Correction for EE Subscription	16.2.0
2020-09	CT#89	CP-202111	0008	1	F	Correction of HSS Event Exposure data types	16.2.0
2020-09	CT#89	CP-202096	0009	-	F	29.563 Rel-16 API version and External doc update	16.2.0
2020-12	CT#90	CP-205049	0010	1	F	Config APN for PDN connectivity status	16.3.0
2020-12	CT#90	CP-205049	0011	1	F	Definition of SubscriptionData	16.3.0
2020-12	CT#90	CP-205049	0012	-	F	References and Cardinality errors clean up	16.3.0
2020-12	CT#90	CP-205048	0013	-	F	Storage of YAML files in GitLab	16.3.0
2020-12	CT#90	CP-205049	0014	-	F	Reference ID	16.3.0
2020-12	CT#90	CP-205036	0015	-	F	29.563 Rel-16 API version and External doc update	16.3.0
2021-03	CT#91	CP-210042	0018	-	F	GUAMI in Deregistration Request	16.4.0
2021-03	CT#91	CP-210054	0022	-	F	29.563 Rel-16 API version and External doc update	16.4.0
2021-03	CT#91	CP-210042	0023	-	F	Cancellation Type sent to MME/SGSN when UE registers in 5G	16.4.0
2021-06	CT#92	CP-211064	0024	-	F	Serving Node Deregistration	16.5.0
2021-06	CT#92	CP-211065	0030	2	F	Monitored Resource URI	16.5.0
2021-06	CT#92	CP-211059	0032	-	F	Redirect Responses	16.5.0
2021-06	CT#92	CP-211064	0034	1	F	VLR Cancellation	16.5.0
2021-06	CT#92	CP-211073	0038	-	F	29.563 Rel-16 API version and External doc update	16.5.0
2021-09	CT#93	CP-212060	0039	-	F	3xx description correction for SCP	16.6.0
2021-09	CT#93	CP-212069	0042	1	F	Immediate Report in Response	16.6.0
2021-09	CT#93	CP-212069	0044	-	F	Missing Event Reports	16.6.0
2021-09	CT#93	CP-212080	0051	-	F	29.563 Rel-16 API version and External doc update	16.6.0

History

Document history		
V16.1.0	July 2020	Publication
V16.2.0	November 2020	Publication
V16.3.0	January 2021	Publication
V16.4.0	April 2021	Publication
V16.5.0	August 2021	Publication
V16.6.0	September 2021	Publication