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**5G;
5G System;
Home Subscriber Server (HSS) services for interworking with
Unified Data Management (UDM);
Stage 3
(3GPP TS 29.563 version 16.5.0 Release 16)**



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- need not** indicates permission not to do something

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- 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 Nnss 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.

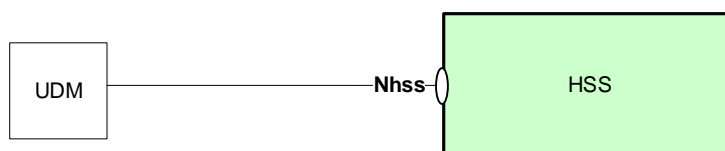


Figure 4.1-1: Reference model – HSS

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.

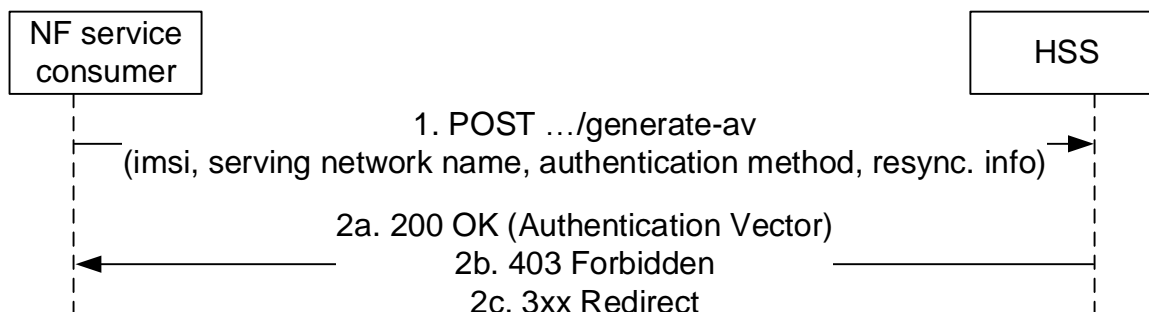


Figure 5.2.2.2.2-1: NF service consumer requesting an Authentication Vector

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.

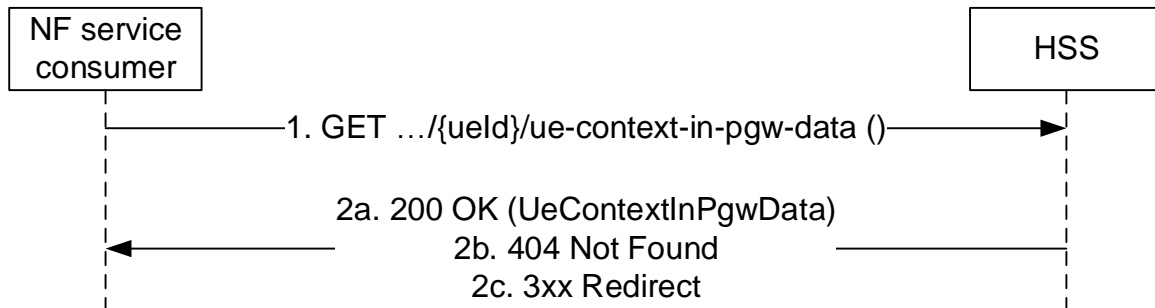


Figure 5.3.2.2.2-1: Requesting a UE's Context in PGW Data

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.

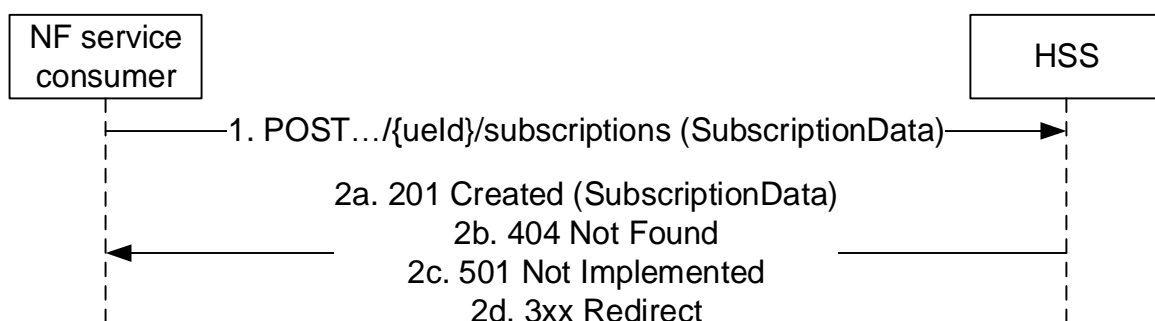


Figure 5.3.2.3.2-1: NF service consumer subscribes to notifications

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.

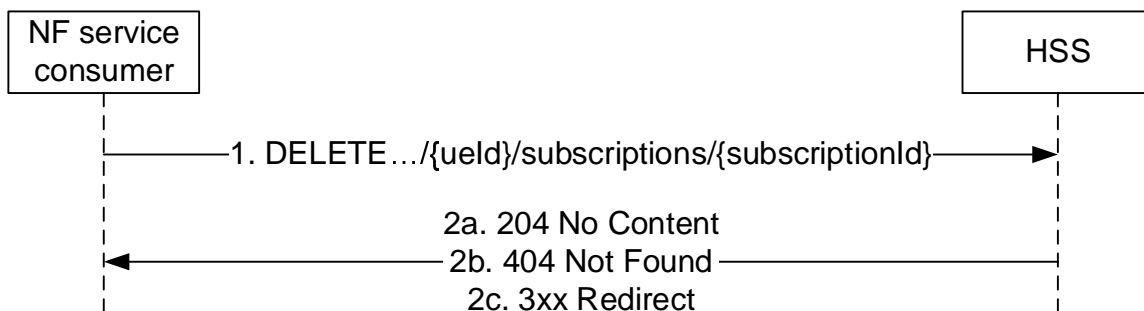


Figure 5.3.2.4.2-1: NF service consumer unsubscribes to notifications

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.

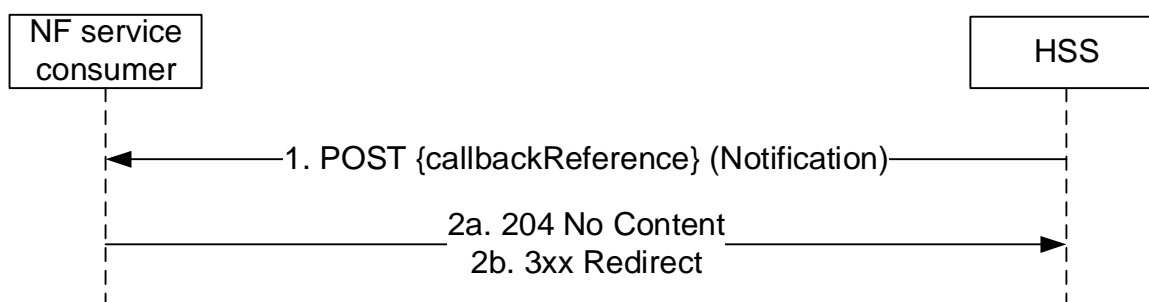


Figure 5.3.2.5.2-1: Subscription Data Change Notification

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.

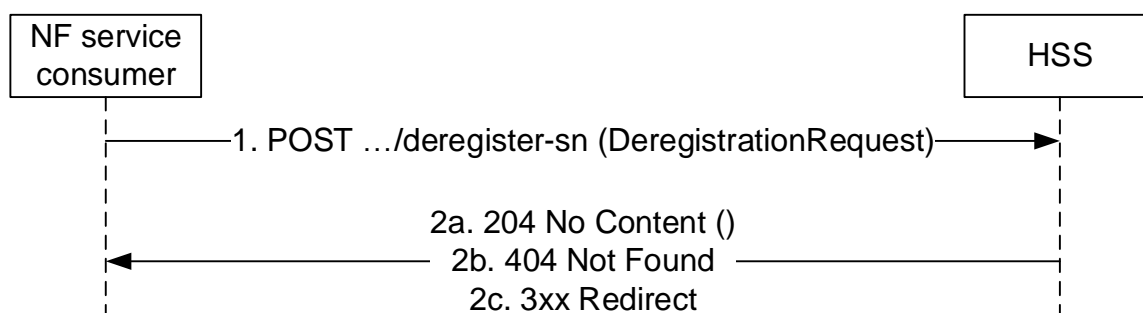


Figure 5.4.2.2.2-1: SN Deregistration

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.

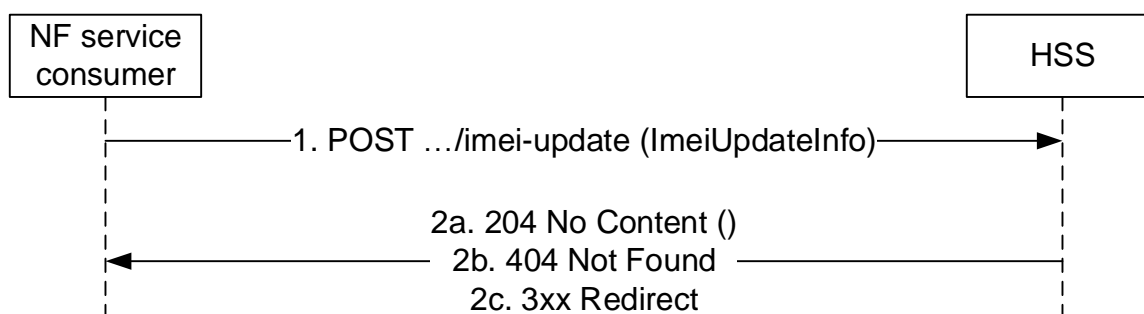


Figure 5.4.2.2.3-1: IMEI Update

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.

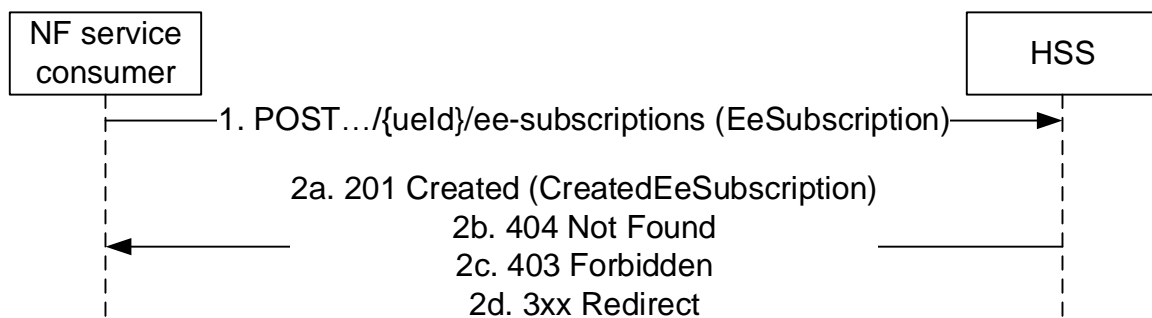


Figure 5.5.2.2.2-1: NF service consumer subscribes to notifications

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.
- 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.

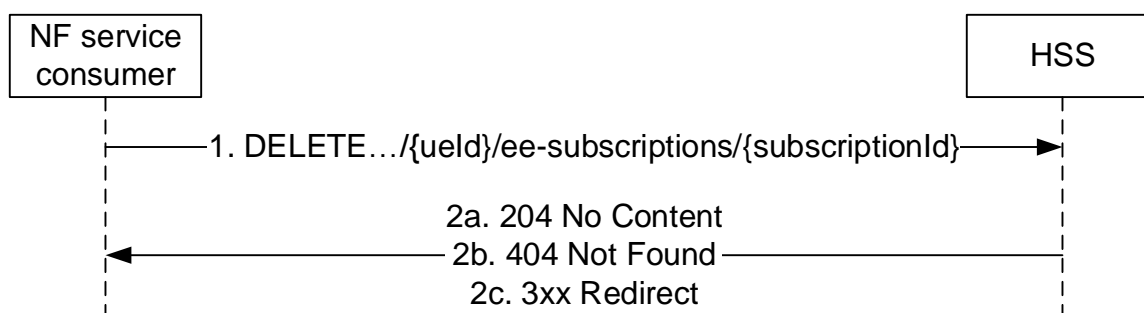


Figure 5.5.2.3.2-1: NF service consumer unsubscribes to notifications

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.

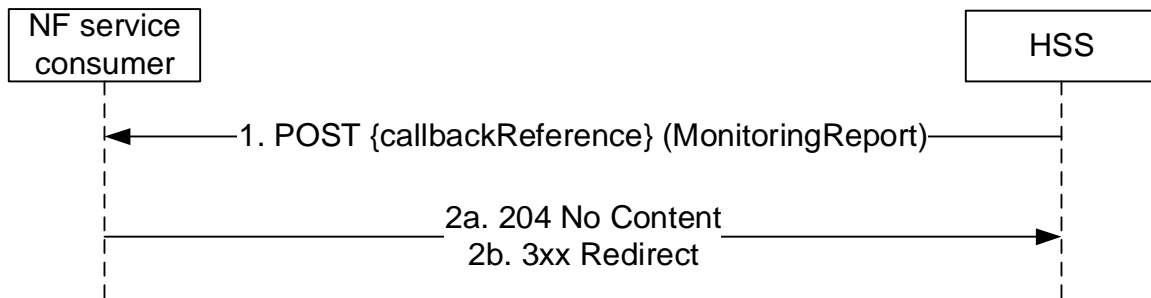


Figure 5.5.2.4.2-1: Event Occurrence Notification

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.

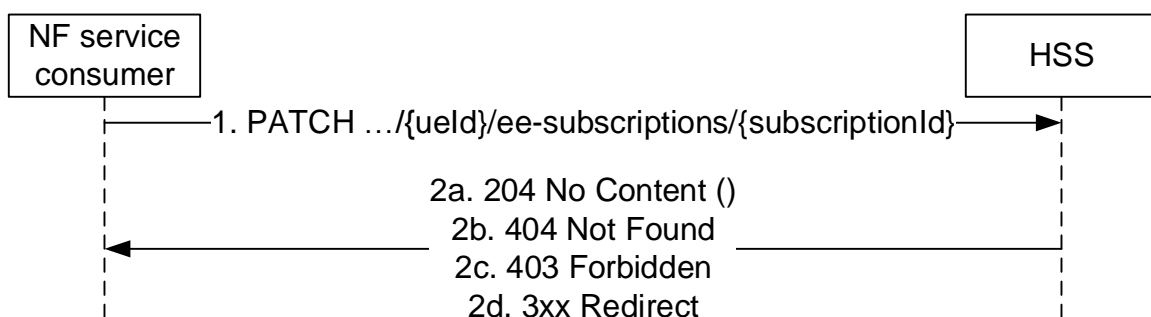


Figure 5.5.2.5.2-1: NF service consumer updates subscription

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

{apiRoot}/nhss-ueau/<apiVersion>

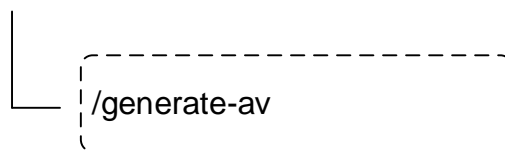


Figure 6.1.3.1-1: Resource URI structure of the nhss-ueau API

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. 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. 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. |
| 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. |
| 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

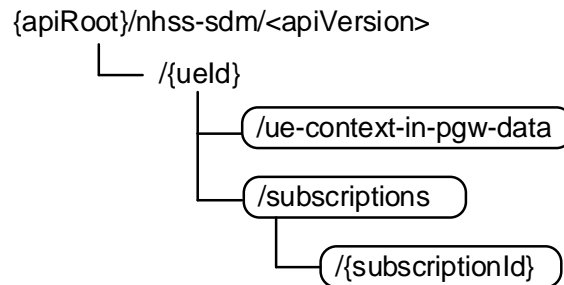


Figure 6.2.3.1-1: Resource URI structure of the nhss-sdm API

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 6.2.3.2.3.1-1: 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. 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. 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. |
| 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. |
| 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 6.2.3.3.1-3: 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. 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. 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 6.2.3.3.1-4: 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. |
| 3gpp-Sbi-Target-Nf-Id | string | O | 0..1 | Identifier of the target NF (service) instance ID towards which the request is redirected. |

Table 6.2.3.3.1-5: 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. |
| 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 |
| ueld | 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. 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. 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. |
| 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. |
| 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. 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. 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. |
| 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. |
| 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 |
|------------------------------|---|-------------|-------------|
| ModificationNotificati on | 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. |
| 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. |
| 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 | An alternative URI of the notification endpoint of the subscribing NF Service Consumer. |
| 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 | An alternative URI of the notification endpoint of the subscribing NF Service Consumer. |
| 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 SubscriptionDataSets

| 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

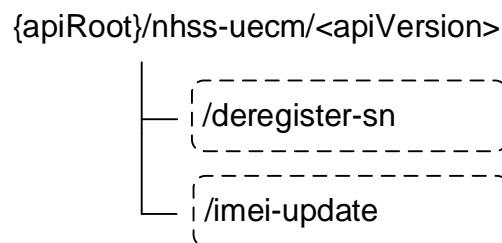


Figure 6.3.3.1-1: Resource URI structure of the nhss-uecm API

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. 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. 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. |
| 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. |
| 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. 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. 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. |
| 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. |
| 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

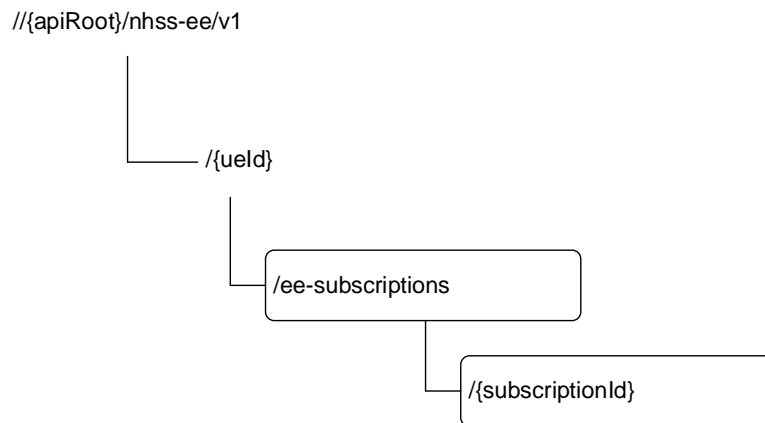


Figure 6.4.3.1-1: Resource URI structure of the Nhss_EE API

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 lmsi 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. 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. 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. |
| 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. |
| 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. 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. 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. |
| 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. |
| 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. 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. 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. |
| 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. |
| 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. |
| 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. |
| 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 | An alternative URI of the notification endpoint of the subscribing NF. |
| 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 | An alternative URI of the notification endpoint of the subscribing NF. |
| 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 |
| 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. |

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 referenced converted from integer to string serves as key) of MonitoringConfigurations |
| scefld | 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 |
|----------------|-------------------------|---|-------------|---|
| eeSubscription | EeSubscription | M | 1 | This IE shall contain the representation of the created event subscription. |
| eventReports | array(MonitoringReport) | O | 1..N | 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. |

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 occurred |
| report | Report | O | 0..1 | Shall be present if eventType is "UE_REACHABILITY_FOR_SMS" |

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 | ReachabilityForSmsReport | O | 0..1 | Reports the UE reachability for SMS |

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. |

6.4.6.3 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 |
|-----------------|-----------------|--|
| Referenceld | integer | Referenceld 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: <code>^(imsi-[0-9]{5,15})\$</code> |
| 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 |
|----------------|--------------|-------------|
| | | |

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: '1.0.3'
  title: 'Nhss_EE'
  description: |
    HSS Event Exposure
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    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-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

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'

ReachabilityForSmsReport:
  type: object
  required:
    - reachabilitySmsStatus
  properties:
    reachabilitySmsStatus:
      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 |

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 |