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Contents

Foreword

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

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

shall indicates a mandatory requirement to do something

shall not indicates an interdiction (prohibition) to do something

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

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

should indicates a recommendation to do something

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

can indicates that something is possible

cannot indicates that something is impossible

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

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

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

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

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

In addition:

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

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

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

1 Scope

The present document specifies the stage 3 protocol and data model for the Nnssaaf Service Based Interface. It provides stage 3 protocol definitions and message flows, and specifies the API for each service offered by the NSSAAF.

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

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

[7] 3GPP TR 21.900: "Technical Specification Group working methods".

[8] 3GPP TS 33.501: "Security architecture and procedures for 5G system".

[9] IETF RFC 6749: "The OAuth 2.0 Authorization Framework".

[10] 3GPP TS 29.510: "5G System; Network Function Repository Services; Stage 3".

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

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

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

[14] IETF RFC 4648: "The Base16, Base32 and Base64 Data Encodings".

[15] 3GPP TS 29.503: "5G System; Unified Data Management Services; Stage 3".

[16] 3GPP TS 29.518: "5G System; Access and Mobility Management Services; Stage 3".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Definition format (Normal)

<defined term>: *<definition>.*

example: text used to clarify abstract rules by applying them literally.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

Symbol format (EW)

<symbol> <Explanation>

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].

NSSAA Network Slice-Specific Authentication and Authorization
NSSAAF NSSAA Function

4 Overview

4.1 Introduction

Within the 5GC, the NSSAAF offers services to the AMF via the Nnssaaf service based interface.

The AMF shall make use of the NSSAAF service when it needs to invoke network slice-specific authentication and authorization for a specific UE and a specific S-NSSAI (see 3GPP TS 23.502 [3] clause 4.2.9.2, and 3GPP TS 33.501 [14] clause 16.2 and 16.3).

The NSSAAF service shall also be used by the AMF to receive slice re-authentication notification or slice authorization revocation notification sent from the AAA-S (see 3GPP TS 23.502 [3] clause 4.2.9.3, 4.2.9.4 and 3GPP TS 33.501 [14] clause 16.3 and 16.4).

Figure 4.1-1 provides the reference model with focus on the NSSAAF.

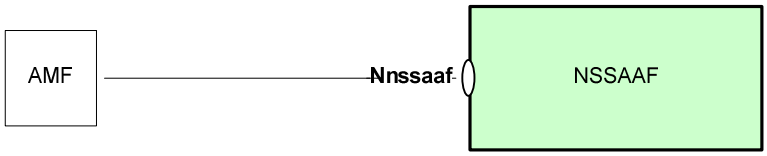

Figure 4.1-1: Reference model – NSSAAF

5 Services offered by the NSSAAF

5.1 Introduction

The NSSAAF offers the following services via the Nnssaaf interface:

- Nnssaaf_NSSAA Service

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
Nnssaaf_NSSAA	5.2	slice-Specific authentication and authorization service	Nnssaaf_NSSAA.yaml	nnssaaf-nssaa	A.2

5.2 Nnssaaf_NSSAA Service

5.2.1 Service Description

The Nnssaaf_NSSAA service provides slice-specific authentication and authorization for a given UE. The NSSAAF is acting as NF Service Producer, while the AMF is the NF Service Consumer.

Following functionalities are provided by the Nnssaaf service:

- Perform slice-specific authentication and authorization for a given UE;
- Trigger slice-specific re-authentication to a given UE;
- Revoke the slice-specific authentication and authorization for a given UE.

The Nnssaaf_NSSAA service supports the following service operations.

Table 5.2.1-1: Service operations supported by the Nnssaaf_NSSAA service

Service Operations	Description	Operation Semantics	Example Consumer(s)
Authenticate	Perform slice-specific authentication and authorization for a given UE.	Request/Response	AMF
Re-Authentication Notification	Request slice-specific re-authentication and re-authorization for a given UE.	Callback	AMF
Revocation Notification	Request revocation of slice-specific authentication and authorization result for a given UE.	Callback	AMF

5.2.2 Service Operations

5.2.2.1 Introduction

See Table 5.2.1-1 for an overview of the service operations supported by the Nnssaaf_NSSAA service.

5.2.2.2 Authenticate

5.2.2.2.1 General

The Authenticate service operation permits the NF Service Consumer (i.e. the AMF) to initiate slice-specific authentication and authorization. The NSSAAF may relay the EAP message to an AAA-S and collect the result of slice-specific authentication and authorization from the AAA-S, as specified in clause 4.2.9.2 of 3GPP TS 23.502 [3], and clause 16.3 of 3GPP TS 33.501 [8].

The NF Service Consumer (i.e. the AMF) shall send a POST request to the resource representing slice authentication collection (i.e. …/v1/slice-authentications) to request the NSSAAF to create the corresponding resource context and perform slice-specific authentication and authorization.

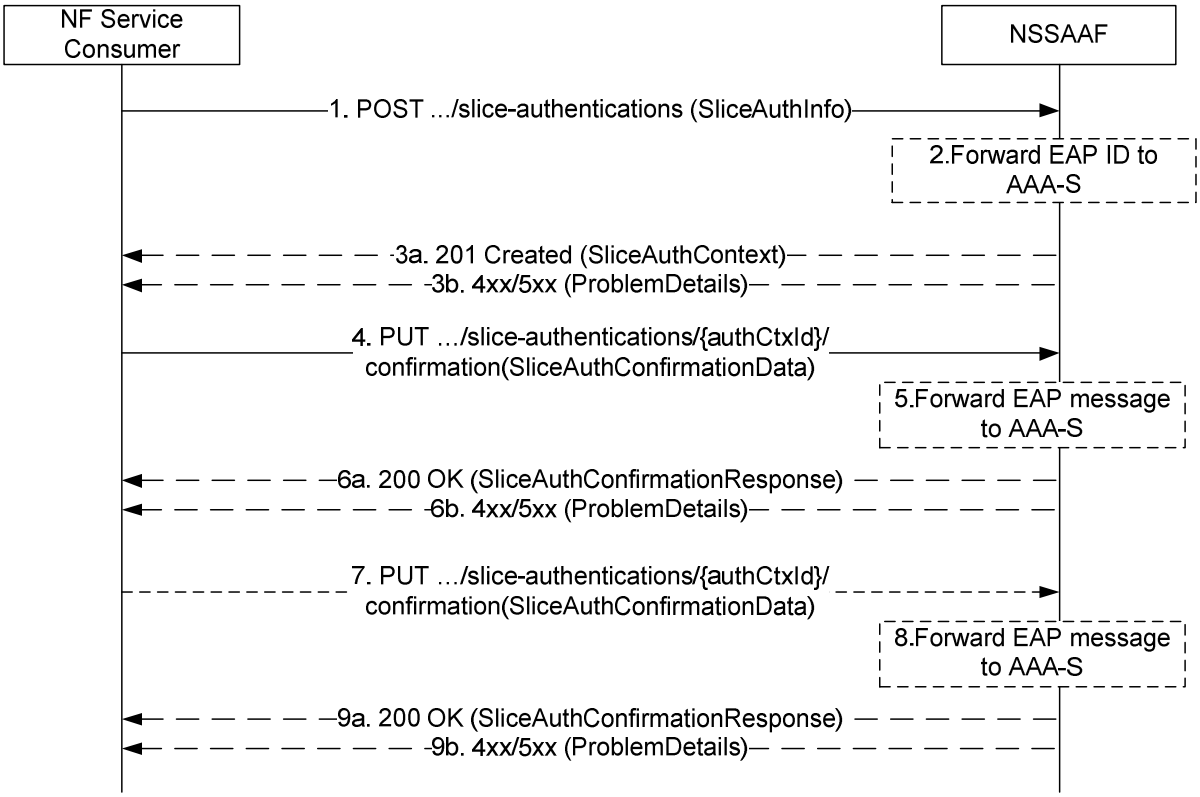

Figure 5.2.2.2.1-1: Slice-Specific Authentication and Authorization

1. The NF Service Consumer (AMF) shall send a POST request to the NSSAAF, targeting the resource of slice authentication collection (i.e. …/v1/slice-authentications), to perform slice-specific authentication and authorization.

   The payload of the body shall contain the slice authentication information, which includes:

   - UE ID (i.e. GPSI)
   - S-NSSAI
   - EAP ID Response message (which is received from the UE)
   - optionally, the AAA-S address

Editor's Note: It is FFS whether the AAA-S address is provided by the AMF in this step and subsequent steps.

   - optionally, the callback URI of the AMF to receive re-authentication notification from the NSSAAF;
   - optionally, the callback URI of the AMF to receive revocation notification from the NSSAAF.

   Based on local policy, the AMF may determine to provide callback URI(s) for receiving re-authentication notification or revocation notification. For example, the callback URIs are provided for an UE identified with low mobility characteristic.

   If Slice-Specific Authentication and Authorization is triggered by the AMF during a Registration procedure as described in clause 4.2.9.2 of 3GPP TS 23.502 [3], the AMF shall set "status" attribute for the given slice listed in "nssaaStatusList" attribute to "PENDING" (See 3GPP TS 29.518 [16]).

2. The NSSAAF creates slice authentication context for the UE, and starts the slice-specific authentication and authorization procedure. If the AAA-S is involved in slice-specific authentication and authorization procedure, the NSSAAF shall forward the EAP ID Response message to the AAA-S. Depending on the result, either step 3a or step 3b is performed.

3a. On success, "201 Created" shall be returned. The "Location" header shall contain the URI of the created resource (e.g. .../v1/slice-authentications/{authCtxId}). The payload body shall contain the slice authentication context, which includes the EAP message generated by the NSSAAF or from the AAA-S. The NF Service Consumer (i.e. the AMF) shall forward the received EAP message to the UE in NAS message, as specified in clause 4.2.9.2 of 3GPP TS 23.502 [3].

3b. On failure, one of the HTTP status code listed in Table 6.1.7.3-1 shall be returned with the message body containing a ProblemDetails structure with the "cause" attribute set to one of the application error listed in Table 6.1.7.3-1. If the slice is not authorized, the NSSAAF shall use the "SLICE_AUTH_REJECTED" application error code.

4. Once receiving EAP message from the UE, the NF Service Consumer (i.e. the AMF) shall send a PUT request to the NSSAAF, targeting the resource of the slice authentication context (i.e. …/v1/slice-authentications/{authCtxId}).

   The payload body shall carry the slice authentication confirmation data which includes:

   - UE ID (i.e. GPSI)
   - S-NSSAI
   - AAA-S address
   - EAP Message (which is received from the UE)

5. The NSSAAF checks and confirms the slice-specific authentication and authorization. If the AAA-S is involved, the NSSAAF shall forward the EAP Message to the AAA-S to confirm the slice-specific authentication and authorization. Depending on the result, either step 6a or step 6b is performed.

6a. On success, "200 OK" shall be returned. The payload body shall contain the slice authentication confirmation response, which includes the EAP message (e.g. EAP success/failure message) generated by the NSSAAF or from the AAA-S. The NF Service Consumer (i.e. the AMF) shall forward the EAP message to the UE in NAS message.

   If the UE is authenticated, the NSSAAF shall set the "authResult" attribute to "EAP_SUCCESS". If failed to authenticate the UE, the "authResult" attribute shall be set to "EAP_FAILURE".

   If subsequent EAP message exchange is needed between the UE and the NSSAAF(AAA-S), the NSSAAF shall not include SliceAuthResult in the response message.

6b. On failure, one of the HTTP status codes listed in Table 6.1.7.3-1 shall be returned with the message body containing a ProblemDetails structure with the "cause" attribute set to one of the application error listed in Table 6.1.7.3-1.

7-9. If subsequent EAP message exchange is needed between the UE and the NSSAAF to finish the EAP based authentication, step 7-9 are performed.

In above steps, if the AAA-S is involved in the slice-specific authentication and authorization procedure while there is no expected response from the AAA-S in the case of time out, the NSSAAF shall return HTTP status code "504 Gateway Timeout", with the message body containing a ProblemDetails structure with the "cause" attribute set to "TIMED_OUT_REQUEST".

After the completion of slice-specific authentication and authorization procedure, it is up to implementation whether the NSSAAF stores the slice authentication context and related resources for a configured period, or deletes the context and resource immediately, e.g. depending on the potential need for AAA-S initiated slice-specific re-authentication/revocation notification.

If the slice-specific authentication and authorization finally fails, and there are PDU sessions previously established corresponding to the S-NSSAIs required to be authenticated, the AMF should trigger the release of those PDU sessions, if the failure is not due to UE is unreachable.

5.2.2.3 Re-Authentication Notification

5.2.2.3.1 General

The Re-Authentication Notification service operation shall be used by the NSSAAF to notify the AMF to re-initiate slice-specific authentication and authorization for a given UE, as specified in clause 4.2.9.3 of 3GPP TS 23.502 [3], and clause 16.4 of 3GPP TS 33.501 [8].

The NSSAAF shall notify the NF Service Consumer (i.e. the AMF) by using the HTTP POST method as shown in Figure 5.2.2.3.1-1.

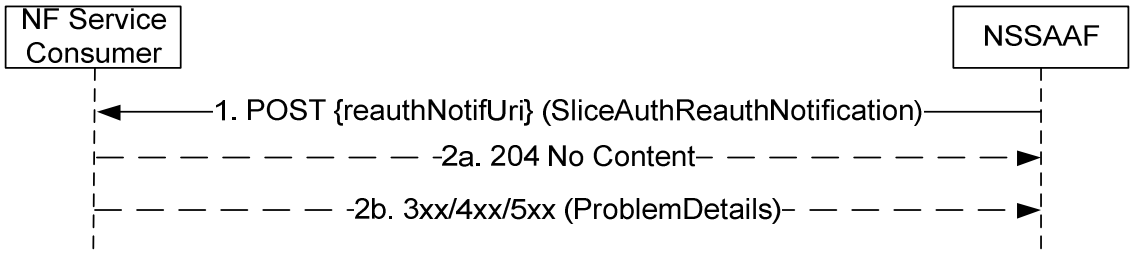

Figure 5.2.2.3.1-1: Re-authentication Notification

1. The NSSAAF shall send a POST request to the callback URI used to receiving re-authentication notification, which is either provided by the NF Service Consumer (i.e. the AMF), or retrieved from the AMF profile stored in the NRF.

   The HTTP payload body of the POST request shall contain the SliceAuthReauthNotification data structure, within which:

   - the notificationType set to the SliceAuthNotificationType of "SLICE_RE_AUTH";

   - the gpsi set to the GPSI of the given UE required to be re-authenticated;

   - the snssai set to the S-NSSAI required to be re-authenticated;

2a. On success, "204 No Content" shall be returned and the payload body of the POST response shall be empty.

   After responding the request, the NF Service Consumer (i.e. the AMF) shall send NAS message to the UE to trigger re-authentication and re-authorization for the given slice.

   If Slice-Specific Authentication and Authorization is triggered by the AAA Server as described in clause 4.2.9.3 of 3GPP TS 23.502 [3], the AMF shall set "status" attribute for the given slice listed in "nssaaStatusList" attribute to "PENDING" (See 3GPP TS 29.518 [16]).

2b. On failure, one of the HTTP status code listed in Table 6.1.7.3-1 shall be returned. For a 4xx/5xx response, the message body shall contain a ProblemDetails structure with the "cause" attribute set to one of the application error listed in Table 6.1.7.3-1.

If slice-specific re-authentication and re-authorization finally fails, and there are PDU sessions previously established corresponding to the S-NSSAIs required to be re-authenticated, the AMF should trigger the release of those PDU sessions, if the failure is not due to UE is unreachable.

5.2.2.4 Revocation Notification

5.2.2.4.1 General

The Revocation Notification service operation shall be used by the NSSAAF to notify the AMF to revoke slice-specific authentication and authorization result, as specified in clause 4.2.9.4 of 3GPP TS 23.502 [3], and clause 16.5 of 3GPP TS 33.501 [8], and may trigger the AMF to release the corresponding PDU sessions associated to the indicated slice.

The NSSAAF shall notify the NF Service Consumer (i.e. the AMF) by using the HTTP POST method as shown in Figure 5.2.2.4.1-1.

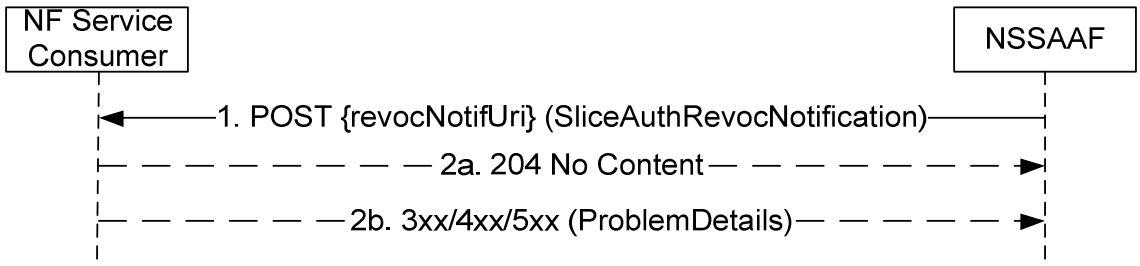

Figure 5.2.2.4.1-1: Revocation Notification

1. The NSSAAF shall send a POST request to the revocation notification callback URI, which is either provided by the NF Service Consumer (i.e. the AMF), or retrieved from the AMF profile stored in the NRF.

   The HTTP payload body of the POST request shall contain the SliceAuthRevocNotification data structure, within which:

   - the notificationType set to the SliceAuthNotificationType of "SLICE_REVOCATION";

   - the gpsi set to the GPSI of the given UE for whom the slice-specific authorization revocation is required;

   - the snssai set to the S-NSSAI for which the slice-specific authorization revocation is required;

2a. On success, "204 No Content" shall be returned and the payload body of the POST response shall be empty.

   On receiving the request, the NF Service Consumer (i.e. the AMF) shall revoke the slice-specific authentication and authorization result for the given UE. If there is PDU session associated to the given slice, the AMF shall trigger the PDU session release to the SMF, with appropriate cause value.

2b. On failure, one of the HTTP status code listed in Table 6.1.7.3-1 shall be returned. For a 4xx/5xx response, the message body shall contain a ProblemDetails structure with the "cause" attribute set to one of the application error listed in Table 6.1.7.3-1.

If there are PDU sessions previously established corresponding to the S-NSSAIs required to be revoked, the AMF shall trigger the release of those PDU sessions.

6 API Definitions

6.1 Nnssaaf_NSSAA Service API

6.1.1 Introduction

The Nnssaaf_NSSAA service shall use the Nnssaaf_NSSAA API.

The API URI of the <Service 1> API shall be:

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

The request URIs used in HTTP request from the NF service consumer towards the NF service producer shall have the Resource URI 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 "nnssaaf-nssaa".
- The <apiVersion> shall be "v1".
- The <apiSpecificResourceUriPart> shall be set as described in clause 5.3.

6.1.2 Usage of HTTP

6.1.2.1 General

HTTP/2, IETF RFC 7540 [11], 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].

The OpenAPI [6] specification of HTTP messages and content bodies for the Nnssaaf_NSSAA API is contained in Annex A.

6.1.2.2 HTTP standard headers

6.1.2.2.1 General

See clause 5.2.2 of 3GPP TS 29.500 [4] for the usage of HTTP standard headers.

6.1.2.2.2 Content type

JSON, IETF RFC 8259 [12], shall be used as content type of the HTTP bodies specified in the present specification as specified in clause 5.4 of 3GPP TS 29.500 [4]. The use of the JSON format shall be signalled by the content type "application/json".

"Problem Details" JSON object shall be used to indicate additional details of the error in a HTTP response body and shall be signalled by the content type "application/problem+json", as defined in IETF RFC 7807 [13].

6.1.2.3 HTTP custom headers

The mandatory HTTP custom header fields specified in clause 5.2.3.2 of 3GPP TS 29.500 [4] shall be applicable.

6.1.3 Resources

6.1.3.1 Overview

The structure of the Resource URIs of the Nnssaaf_NSSAA service is shown in Figure 6.1.3.1-1

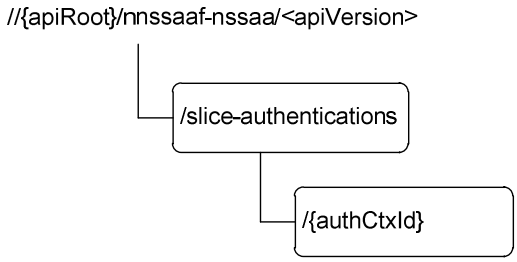

Figure 6.1.3.1-1: Resource URI structure of the NSSAA API

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
slice-authentications (Collection)	/v1/slice-authentications	POST	Initiate the slice-specific authentication and authorization process by providing inputs related to the UE and a specific slice.
slice-authentication (Document)	/v1/slice-authentications/{authCtxId}	PUT	Put the UE response from the EAP process.

6.1.3.2 Resource: slice-authentications (Collection)

6.1.3.2.1 Description

This resource represents a collection of the slice-authentication resources generated by the NSSAAF.

6.1.3.2.2 Resource Definition

Resource URI: **{apiRoot}/nnssaaf-nssaa /<apiVersion>/slice-authentications**

This resource shall support the resource URI variables defined in table 6.1.3.2.2-1.

Table 6.1.3.2.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 6.1.1
apiVersion	string	See clause 6.1.1

6.1.3.2.3 Resource Standard Methods

6.1.3.2.3.1 POST

This method shall support the URI query parameters specified in table 6.1.3.2.3.1-1.

Table 6.1.3.2.3.1-1: URI query parameters supported by the POST method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.1.3.2.3.1-2 and the response data structures and response codes specified in table 6.1.3.2.3.1-3.

Table 6.1.3.2.3.1-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
SliceAuthInfo	M	1	Contains the GPSI, S-NSSAI, and EAP ID Response from the UE, etc.

Table 6.1.3.2.3.1-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
SliceAuthContext	M	1	201 Created	This case indicates the corresponding resource has been created by the NSSAAF for the requested slice-specific authentication and authorization, and further EAP process is required. The HTTP response shall include a "Location" header that contains the resource URI of the created resource.
ProblemDetails	O	0..1	400 Bad Request	This case represents the failure to start slice-specific authentication and authorization because of input parameter error.
ProblemDetails	O	0..1	403 Forbidden	This case represents when the UE or the slice is not allowed to be authenticated. The "cause" attribute may be used to indicate one of the following application errors: - SLICE_AUTH_REJECTED
ProblemDetails	O	0..1	404 Not Found	This case represents the user or user context is not found. The "cause" attribute may be used to indicate one of the following application errors: - CONTEXT_NOT_FOUND - USER_NOT_FOUND
ProblemDetails	O	0..1	504 Gateway Time out	This case represents network error or remote peer (i.e. AAA-S) error, e.g. not reachable, no response and time out. The "cause" attribute may be used to indicate one of the following application errors: - NETWORK_FAILURE - UPSTREAM_SERVER_ERROR - TIME_OUT_REQUEST
NOTE: The mandatory HTTP error status code for the POST method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.				

Table 6.1.3.2.3.1-4: Headers supported by the POST method on this resource

Name	Data type	P	Cardinality	Description
n/a				

Table 6.1.3.2.3.1-5: Headers supported by the 201 response code on this resource

Name	Data type	P	Cardinality	Description
Location	URI	M	1	URI of created resource for the slice authentication context. The URI structure is defined in clause 6.1.3.3.1.

Table 6.1.3.2.3.1-6: Links supported by the 201 Response Code on this endpoint

Name	Resource name	HTTP method or custom operation	Link parameter(s)	Description
n/a				

6.1.3.2.4 Resource Custom Operations

There is no Resource Custom Operations in the current version of this API.

6.1.3.3 Resource: slice-authentication (Document)

6.1.3.3.1 Description

The sub-resource "slice-authentication" is generated by the NSSAAF. This subresource should not persist after the slice-specific authentication and authorization process finishes.

6.1.3.3.2 Resource Definition

Resource URI: **{apiRoot}/nnssaaf-nssaa/<apiVersion>/slice-authentications/{authCtxId}**

This resource shall support the resource URI variables defined in table 6.1.3.3.2-1.

Table 6.1.3.3.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See clause 6.1.1
apiVersion	string	See clause 6.1.1
authCtxId	string	The slice authentication context ID, which is of data type SliceAuthCtxId defined in clause 6.1.6.3.2.

6.1.3.3.3 Resource Standard Methods

6.1.3.3.3.1 PUT

This method shall support the URI query parameters specified in table 6.1.3.3.3.1-1.

Table 6.1.3.3.3.1-1: URI query parameters supported by the PUT method on this resource

Name	Data type	P	Cardinality	Description	Applicability
n/a					

This method shall support the request data structures specified in table 6.1.3.3.3.1-2 and the response data structures and response codes specified in table 6.1.3.3.3.1-3.

Table 6.1.3.3.3.1-2: Data structures supported by the PUT Request Body on this resource

Data type	P	Cardinality	Description
SliceAuthConfirmationData	M	1	Contains the EAP message generated by the UE and provided to the AMF.

Table 6.1.3.3.3.1-3: Data structures supported by the PUT Response Body on this resource

Data type	P	Cardinality	Response codes	Description
SliceAuthConfirmationResponse	M	1	200 OK	This case indicates that the NSSAAF has performed the slice-specific authentication. The response body shall contain the result of the slice-specific authentication and authorization.
ProblemDetails	O	0..1	400 Bad Request	This case represents a slice-specific authentication failure because of input parameter error. This indicates that the NSSAAF was not able to process the slice-specific authentication.
ProblemDetails	O	0..1	403 Forbidden	This case represents when the UE or the slice is not allowed to be authenticated. The "cause" attribute may be used to indicate one of the following application errors: - SLICE_AUTH_REJECTED
ProblemDetails	O	0..1	404 Not Found	This case represents the UE or UE related context is not found. The "cause" attribute may be used to indicate one of the following application errors: - CONTEXT_NOT_FOUND - USER_NOT_FOUND
ProblemDetails	O	0..1	504 Gateway Time out	This case represents network error or remote peer (i.e. AAA-S) error, e.g. not reachable, no response when time out. The "cause" attribute may be used to indicate one of the following application errors: - NETWORK_FAILURE - UPSTREAM_SERVER_ERROR - TIMED_OUT_REQUEST
NOTE: The mandatory HTTP error status code for the PUT method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.				

Table 6.1.3.3.3.1-4: Headers supported by the PUT method on this resource

Name	Data type	P	Cardinality	Description
n/a				

Table 6.1.3.3.3.1-5: Headers supported by the 200 response code on this resource

Name	Data type	P	Cardinality	Description
n/a				

Table 6.1.3.3.3.1-6: Links supported by the 200 Response Code on this endpoint

Name	Resource name	HTTP method or custom operation	Link parameter(s)	Description
n/a				

6.1.3.3.4 Resource Custom Operations

There is no Resource Custom Operations in the current version of this API.

6.1.4 Custom Operations without associated resources

6.1.4.1 Overview

There is no Custom Operation in the current version of this API.

6.1.5 Notifications

6.1.5.1 General

Notifications shall comply to clause 6.2 of 3GPP TS 29.500 [4] and clause 4.6.2.3 of 3GPP TS 29.501 [5].

Table 6.1.5.1-1: Notifications overview

Notification	Resource URI	HTTP method or custom operation	Description (service operation)
Re-authentication Notification	{reauthNotifUri} (NF Service Consumer provided callback reference)	POST	Re-authentication Notification
Revocation Notification	{revocNotifUri} (NF Service Consumer provided callback reference)	POST	Revocation Notification

6.1.5.2 Re-authentication Notification

6.1.5.2.1 Description

The Re-authentication Notification is used by the NSSAAF to trigger the NF Service Consumer (i.e. the AMF) to re-initiate slice-specific authentication and authorization for a given UE.

6.1.5.2.2 Target URI

The Notification URI **"{reauthNotifUri}"** shall be used with the resource URI variables defined in table 6.1.5.2.2-1.

Table 6.1.5.2.2-1: Resource URI variables for this resource

Name	Definition
reauthNotifUri	String formatted as URI which carries the re-authentication notification URI.

6.1.5.2.3 Standard Methods

6.1.5.2.3.1 POST

This method shall support the request data structures specified in table 6.1.5.2.3.1-1 and the response data structures and response codes specified in table 6.1.5.2.3.1-1.

Table 6.1.5.2.3.1-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
SliceAuthReauthNotification	M	1	SliceAuthReauthNotification which carries the re-authentication notification for a given UE.

Table 6.1.5.2.3.1-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a				
NOTE: The mandatory HTTP error status codes for the POST method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.				

6.1.5.3 Revocation Notification

6.1.5.3.1 Description

The Revocation Notification is used by the NSSAAF to trigger the NF Service Consumer (i.e. the AMF) to revoke the slice-specific authentication and authorization result for a given UE.

6.1.5.3.2 Target URI

The Notification URI **"{revocNotifUri}"** shall be used with the resource URI variables defined in table 6.1.5.3.2-1.

Table 6.1.5.3.2-1: Resource URI variables for this resource

Name	Definition
revocNotifUri	String formatted as URI which carries the revocation notification URI.

6.1.5.3.3 Standard Methods

6.1.5.3.3.1 POST

This method shall support the request data structures specified in table 6.1.5.3.3.1-1 and the response data structures and response codes specified in table 6.1.5.3.3.1-2.

Table 6.1.5.3.3.1-1: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
SliceAuthRevocNotification	M	1	SliceAuthNotification which carries the revocation notification for a given UE.

Table 6.1.5.3.3.1-2: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a				
NOTE: The mandatory HTTP error status codes for the POST method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.				

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 Nnssaaf service based interface protocol.

Table 6.1.6.1-1: Nnssaaf specific Data Types

Data type	Clause defined	Description	Applicability
SliceAuthInfo	6.1.6.2.2	Contains the GPSI, S-NSSAI, EAP ID Response, etc.	
SliceAuthContext	6.1.6.2.3	Contains the information of the resource created for slice-specific authentication and authorization.	
SliceAuthConfirmationData	6.1.6.2.4	Contains the EAP message from the UE for EAP process.	
SliceAuthConfirmationResponse	6.1.6.2.5	Contains the slice-specific authentication and authorization result from the NSSAAF to the UE.	
SliceAuthReauthNotification	6.1.6.2.6	Contains the re-authentication notification for slice-specific authentication and authorization.	
SliceAuthRevocNotification	6.1.6.2.7	Contains the revocation notification for slice-specific authentication and authorization.	
SliceAuthCxtId	6.1.6.3.2	Contains the resource ID of slice authentication context.	
EapMessage	6.1.6.3.2	Contains the string formatted EAP message.	
SliceNotificationType	6.1.6.3.3	Notification type of slice-specification authentication and authorization.	

Table 6.1.6.1-2 specifies data types re-used by the Nnssaaf 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 Nnssaaf service based interface.

Table 6.1.6.1-2: Nnssaaf re-used Data Types

Data type	Reference	Comments	Applicability
ProblemDetails	3GPP TS 29.571 [10]	Common Data Type used in response bodies	
Gpsi	3GPP TS 29.571 [10]	GPSI	
Snssai	3GPP TS 29.571 [10]	S-NSSAI	
AuthStatus	3GPP TS 29.571 [10]	Slice Authentication Status	

6.1.6.2 Structured data types

The following clause defines the structures to be used in resource representations.

6.1.6.2.1 Introduction

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

6.1.6.2.2 Type: SliceAuthInfo

Table 6.1.6.2.2-1: Definition of type SliceAuthInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
gpsi	Gpsi	M	1	Contains the GPSI of the UE.	
snssai	Snssai	M	1	Contains the S-NSSAI for authentication.	
eapIdRsp	EapMessage	M	1	Contains the EAP ID Responses message from the UE.	
amfInstanceId	NfInstanceId	O	0..1	This IE may be present, if the AMF determines to provide the re-authentication/revocation notification URI to the NSSAAF. When present, it shall contain the NF Instance Id of the AMF.	
reauthNotifUri	Uri	O	0..1	This IE may be present, e.g. if the AMF determines the UE with low mobility characteristic. When present, it shall contain the re-authentication notification URI.	
revocNotifUri	Uri	O	0..1	This IE may be present, e.g. if the AMF determines the UE with low mobility characteristic. When present, it shall contain the revocation notification URI.	

6.1.6.2.3 Type: SliceAuthContext

Table 6.1.6.2.3-1: Definition of type SliceAuthContext

Attribute name	Data type	P	Cardinality	Description	Applicability
gpsi	Gpsi	M	1	Contains the GPSI of the UE.	
snssai	Snssai	M	1	Contains the S-NSSAI for authentication.	
authCtxId	SliceAuthCtxId	M	1	Indicates the resource ID uniquely identifying the slice authentication context, generated by the NSSAAF.	
eapMessage	EapMessage	M	1	Contains the EAP message to be sent to the UE.	

6.1.6.2.4 Type: SliceAuthConfirmationData

Table 6.1.6.2.4-1: Definition of type SliceAuthConfirmationData

Attribute name	Data type	P	Cardinality	Description	Applicability
gpsi	Gpsi	M	1	Contains the GPSI of the UE.	
snssai	Snssai	M	1	Contains the S-NSSAI for authentication.	
eapMessage	EapMessage	M	1	Contains the EAP message received from the UE.	

6.1.6.2.5 Type: SliceAuthConfirmationResponse

Table 6.1.6.2.5-1: Definition of type SliceAuthConfirmationResponse

Attribute name	Data type	P	Cardinality	Description	Applicability
gpsi	Gpsi	M	1	Contains the GPSI of the UE.	
snssai	Snssai	M	1	Contains the S-NSSAI for authentication.	
eapMessage	EapMessage	M	1	Contains the EAP success/failure message needs to be sent to the UE.	
authResult	AuthStatus	O	0..1	When present, it shall indicate the result of slice-specific authentication and authorization.	

6.1.6.2.6 Type: SliceAuthReauthNotification

Table 6.1.6.2.6-1: Definition of type SliceAuthReauthNotification

Attribute name	Data type	P	Cardinality	Description	Applicability
notificationType	SliceAuthNotificationType	M	1	Indicate the type of slice authentication notification.	
gpsi	Gpsi	M	1	Contains the GPSI of the UE.	
snssai	Snssai	M	1	Contains the S-NSSAI for authentication.	

6.1.6.2.7 Type: SliceAuthRevocNotification

Table 6.1.6.2.7-1: Definition of type SliceAuthRevocNotification

Attribute name	Data type	P	Cardinality	Description	Applicability
notificationType	SliceAuthNotificationType	M	1	Indicate the type of slice authentication notification.	
gpsi	Gpsi	M	1	Contains the GPSI of the UE.	
snssai	Snssai	M	1	Contains the S-NSSAI for authentication.	

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
SliceAuthCtxId	string	The resource ID uniquely identifying the slice authentication context, generated by the NSSAAF.	
EapMessage	string	The EAP packet is encoded using base64 (see IETF RFC 4648 [14]) and represented as a String. Format: base64	

6.1.6.3.3 Enumeration: SliceAuthNotificationType

The enumeration SliceAuthNotificationType represents the notification type of slice-specific authentication and authorization. It shall comply with the provisions defined in table 6.1.6.3.3-1.

Table 6.1.6.3.3-1: Enumeration SliceAuthNotificationType

Enumeration value	Description	Applicability
SLICE_RE_AUTH	This value is used to indicate the re-authentication is needed	
SLICE_REVOCATION	This value is used to indicate the previous slice-specific authentication and authorization shall be revoked.	

6.1.6.4 Data types describing alternative data types or combinations of data types

There is no alternative data types defined in this specification.

6.1.6.5 Binary data

There is no binary data type defined in this specification.

6.1.7 Error Handling

6.1.7.1 General

For the Nnssaaf_NSSAA API, HTTP error responses shall be supported as specified in clause 4.8 of 3GPP TS 29.501 [5]. Protocol errors and application errors specified in table 5.2.7.2-1 of 3GPP TS 29.500 [4] shall be supported for an HTTP method if the corresponding HTTP status codes are specified as mandatory for that HTTP method in table 5.2.7.1-1 of 3GPP TS 29.500 [4].

In addition, the requirements in the following clauses are applicable for the Nnssaaf_NSSAA API.

6.1.7.2 Protocol Errors

No specific procedures for the Nnssaaf_NSSAA service are specified.

6.1.7.3 Application Errors

The application errors defined for the Nnssaaf_NSSAA service are listed in Table 6.1.7.3-1.

Table 6.1.7.3-1: Application errors

Application Error	HTTP status code	Description
SLICE_AUTH_REJECTED	403 Forbidden	The user cannot be authenticated, e.g. authentication request rejected by the AAA-S.
CONTEXT_NOT_FOUND	404 Not Found	The NSSAAF cannot find the resource corresponding to the URI provided by the NF Service Consumer, i.e. the resource identified by the authCtxId does not exist in the NSSAAF.
USER_NOT_FOUND	404 Not Found	The user does not exist in the HPLMN.
UPSTREAM_SERVER_ERROR	504 Gateway Timeout	Error happens in reaching the remote peer (i.e. the AAA-S).
NETWORK_FAILURE	504 Gateway Timeout	The request is rejected due to a network problem.
TIMED_OUT_REQUEST	504 Gateway Timeout	No response is received from the remote peer (i.e. the AAA-S) when time out.

6.1.8 Feature negotiation

The optional features in table 6.1.8-1 are defined for the Nnssaaf_NSSAA 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

6.1.9 Security

As indicated in 3GPP TS 33.501 [8] and 3GPP TS 29.500 [4], the access to the Nnssaaf_NSSAA API may be authorized by means of the OAuth2 protocol (see IETF RFC 6749 [9]), based on local configuration, using the "Client Credentials" authorization grant, where the NRF (see 3GPP TS 29.510 [10]) plays the role of the authorization server.

If OAuth2 is used, an NF Service Consumer, prior to consuming services offered by the Nnssaaf_NSSAA API, shall obtain a "token" from the authorization server, by invoking the Access Token Request service, as described in 3GPP TS 29.510 [10], 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 Nnssaaf_NSSAA service.

The Nnssaaf_NSSAA API defines a single scope "nnssaaf-nssaa" for the entire service, 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 API(s) defined in the present specification. 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 hosted in ETSI Forge, that uses the GitLab software version control system (see 3GPP TS 29.501 [5] clause 5.3.1 and 3GPP TR 21.900 [7] clause 5B).

A.2 Nnssaaf_NSSAA API

```
openapi: 3.0.0
info:
  title: Nnssaaf_NSSAA
  version: 1.0.0
  description: |
    Network Slice-Specific Authentication and Authorization Service.
    © 2019, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
externalDocs:
  description: 3GPP TS29.526, NSSAA Service, version 16.0.0.
  url: http://www.3gpp.org/ftp/Specs/archive/29_series/29.526/
servers:
  - url: '{apiRoot}/nnssaaf-nssaa/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501
security:
  - {}
  - oAuth2ClientCredentials:
    - nnssaaf-nssaa
paths:
  /slice-authentications:
    post:
      summary: Create slice authentication context
      operationId: CreateSliceAuthenticationContext
      tags:
        - Slice Authentication Context Creation
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/SliceAuthInfo'
        required: true
      responses:
        '201':
          description: SliceAuthContext
          content:
            application/3gppHal+json:
              schema:
                $ref: '#/components/schemas/SliceAuthContext'
          headers:
            Location:
              description: 'Contains the URI of the newly created resource according to the
structure: {apiRoot}/nnssaaf-nssaa/v1/slice-authentications/{authCtxId}'
              required: true
              schema:
                type: string
```

```
        '400':
          description: Bad Request from the AMF
          content:
            application/problem+json:
              schema:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/ProblemDetails'
        '403':
          description: Forbidden due to slice authentication rejected
          content:
            application/problem+json:
              schema:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/ProblemDetails'
        '404':
          description: User does not exist
          content:
            application/problem+json:
              schema:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/ProblemDetails'
        '504':
          description: Network error or remote peer error
          content:
            application/problem+json:
              schema:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/ProblemDetails'
    callbacks:
      reauthenticationNotification:
        '{request.body#/reauthNotifUri}':
          post:
            requestBody:
              required: true
              content:
                application/json:
                  schema:
                    $ref: '#/components/schemas/SliceAuthReauthNotification'
            responses:
              '204':
                description: slice re-authentication notification response
              '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
      revocationNotification:
        '{request.body#/revocNotifUri}':
          post:
            requestBody:
              required: true
              content:
                application/json:
                  schema:
                    $ref: '#/components/schemas/SliceAuthRevocNotification'
            responses:
              '204':
                description: slice revocation notification response
              '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
  /slice-authentications/{authCtxId}:
    put:
      summary: Confirm the slice authentication result
      operationId: ConfirmSliceAuthentication
      tags:
        - Confirm Slice Authentication
      parameters:
        - name: authCtxId
          in: path
```

```
          required: true
          schema:
            type: string
      requestBody:
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/SliceAuthConfirmationData'
      responses:
        '200':
          description: Request processed (EAP success or Failure)
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/SliceAuthConfirmationResponse'
        '400':
          description: Bad Request
          content:
            application/problem+json:
              schema:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/ProblemDetails'
        '500':
          description: Internal Server Error
          content:
            application/problem+json:
              schema:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/ProblemDetails'
        '504':
          description: Network error or remote peer error
          content:
            application/problem+json:
              schema:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/ProblemDetails'
components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{nrfApiRoot}/oauth2/token'
          scopes:
            nnssaaf-nssaa: Access to the nnssaaf-nssaa API
  schemas:

    # COMPLEX TYPES:

    SliceAuthInfo:
      type: object
      properties:
        gpsi:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
        snssai:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
        eapIdRsp:
          $ref: '#/components/schemas/EapMessage'
        amfInstanceId:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/NfInstanceId'
        reauthNotifUri:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        revocNotifUri:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
      required:
        - gpsi
        - snssai
        - eapIdRsp

    SliceAuthContext:
      type: object
      properties:
        gpsi:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
        snssai:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
        authCtxId:
          $ref: '#/components/schemas/SliceAuthCtxId'
        eapMessage:
          $ref: '#/components/schemas/EapMessage'
      required:
```

```
      - gpsi
      - snssai
      - authCtxId
      - eapMessage

    SliceAuthConfirmationData:
      type: object
      properties:
        gpsi:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
        snssai:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
        eapMessage:
          $ref: '#/components/schemas/EapMessage'
      required:
        - gpsi
        - snssai
        - eapMessage

    SliceAuthConfirmationResponse:
      type: object
      properties:
        gpsi:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
        snssai:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
        eapMessage:
          $ref: '#/components/schemas/EapMessage'
        authResult:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/AuthStatus'
      required:
        - gpsi
        - snssai
        - eapMessage

    SliceAuthReauthNotification:
      type: object
      properties:
        notifType:
          $ref: '#/components/schemas/SliceAuthNotificationType'
        gpsi:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
        snssai:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
      required:
        - notifType
        - gpsi
        - snssai

    SliceAuthRevocNotification:
      type: object
      properties:
        notifType:
          $ref: '#/components/schemas/SliceAuthNotificationType'
        gpsi:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
        snssai:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
      required:
        - notifType
        - gpsi
        - snssai

    # SIMPLE TYPES:

    SliceAuthCtxId:
      type: string
      description: contains the resource ID of slice authentication context
      nullable: false

    SliceAuthNotificationType:
      type: string
      enum:
        - SLICE_RE_AUTH
        - SLICE_REVOCATION

    EapMessage:
      type: string
```

```
      format: base64
      description: contains an EAP packet
      nullable: true
```

Annex B (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2020-06	CT4#98E	C4-203683				TS skeleton.	0.1.0
2020-06	CT4#98E	C4-202084 C4-202085 C4-202086 C4-203709 C4-203710				Implementation of pCRs agreed in CT4#98E	0.2.0
2020-06	CT#88e	CP-201193				TS presented for information and approval.	1.0.0
2020-06	CT#88e					TS approved at CT#88e	16.0.0
2020-09	CT#89	CP-202104	0005	1	F	Update References	16.1.0
2020-09	CT#89	CP-202104	0007	1	F	Release PDU Session if NSSAA Re-Authentication and Re-Authorization Fails	16.1.0
2020-09	CT#89	CP-202104	0008	1	F	NSSAA status management	16.1.0

History

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