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TECHNICAL SPECIFICATION

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Contents

Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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where:

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1 presented to TSG for information;

2 presented to TSG for approval;

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

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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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need not indicates permission not to do something

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

can indicates that something is possible

cannot indicates that something is impossible

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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 Nsoraf Service Based Interface. It provides stage 3 protocol definitions and message flows, and specifies the API for each service offered by the SOR-AF.

The 5G System stage 2 architecture and procedures are specified in 3GPP TS 23.501 [2] and 3GPP TS 23.502 [3]. The stage 2 architecture and procedures for 5G Steering of Roaming are specified in 3GPP TS 23.122 [14].

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://spec.openapis.org/oas/v3.0.0.

[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 9113: HTTP/2.

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

[13] IETF RFC 9457: "Problem Details for HTTP APIs".

[14] 3GPP TS 23.122: "Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode".

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

[16] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces Stage 3".

[17] 3GPP TS 31.115: "Secured packet structure for (Universal) Subscriber Identity Module (U)SIM Toolkit applications".

[18] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".

[19] 3GPP TS 29.544: "5G System; Secured Packet Application Function (SP-AF) services; Stage 3".

[20]   3GPP TS 29.509: "Authentication Server Services; Stage 3".

3   Definitions, symbols and abbreviations

3.1   Terms

SoR Information: In this specification, this refers to the following HPLMN information:

a) an indication of whether the SOR-AF requires the UDM to request an acknowledgement from the UE for successful reception of the Steering of Roaming information; and

b) one of the following:

- a list of preferred PLMN/access technology combinations with an indication that it is included;

- a secured packet with an indication that it is included; or

- the HPLMN indication that 'no change of the "Operator Controlled PLMN Selector with Access Technology" list stored in the UE is needed and thus no list of preferred PLMN/access technology combinations is provided'.

NOTE: The secured packet contains the list of preferred PLMN/access technology combinations encapsulated with a security mechanism as described in 3GPP TS 31.115 [17].

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].

JSON   Javascript Object Notation
NF   Network Function
SOR-AF   Steering Of Roaming Application Function
SoR   Steering of Roaming
SUPI   Subscription Permanent Identifier
UDM   Unified Data Management
UE   User Equipment

4   Overview

4.1   Introduction

Within the 5GC, the Steering Of Roaming Application Function (SOR-AF) provides services (see 3GPP TS 23.122 [14]) to NF service consumers (e.g. UDM) via the Nsoraf service based interface.

NOTE: The generation and calculation of the SoR information and associated roaming business logic are out of scope of this document.

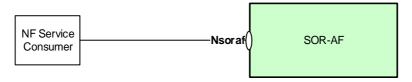Figure°4.1-1 depicts the reference architecture of the SOR-AF.

Figure 4.1-1: Reference model – SOR-AF

5 Services offered by the SOR-AF

5.1 Introduction

The SOR-AF offers the following services to NF consumers (e.g. UDM) via the Nsoraf service based interface:

- Nsoraf_SteeringOfRoaming

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

Table 5.1-1: APIs Description

Service Name	Clause	Description	OpenAPI Specification File	apiName	Annex
Nsoraf_SteeringOfRoaming	6.1	Nsoraf Steering Of Roaming Service	TS29550_Nsoraf_SOR.yaml	nsoraf-sor	A.2

5.2 Nsoraf_SteeringOfRoaming Service

5.2.1 Service Description

The Nsoraf_SteeringOfRoaming (Nsoraf_SOR) service provides Steering of Roaming services to NF consumers (e.g. UDM) to enable the retrieval of SoR information (i.e. the list of preferred PLMN/access technology combinations or an indication that no update to the list of preferred PLMN/access technology combinations is needed) to be conveyed to the UE, as specified in Annex C of 3GPP°TS°23.122 [14]. The latter specifies the 5GS control plane mechanism for Steering of Roaming that aims at allowing the HPLMN to update the "Operator Controlled PLMN Selector with Access Technology" list in the UE by providing and updating this list of preferred PLMN/access technology combinations.

5.2.2 Service Operations

5.2.2.1 Introduction

For the Nsoraf_SteeringOfRoaming service, the following service operations are defined:

- Get

- Info

5.2.2.2 Get

5.2.2.2.1 General

This service operation is used by a NF consumer (e.g. UDM) to retrieve SoR information.

The returned information can consist of either:

- a list of preferred PLMN/access technology combinations;- a secured packet;

- neither of them.

NOTE: The secured packet contains the list of preferred PLMN/access technology combinations encapsulated with a security mechanism as described in 3GPP TS 31.115 [17].

The following procedures are supported using the "Get" service operation:

- SoR Information Retrieval

5.2.2.2.2   SoR Information Retrieval

Figure 5.2.2.2.2-1 depicts a scenario where a NF consumer (e.g. UDM) sends a request to the SOR-AF to retrieve the SoR information for a UE (see also clause C.2 and C.5 in Annex C of 3GPP°TS°23.122°[14]).

The request contains the UE's identity (/{supi}) and a set of query parameters (e.g. PLMN ID of the visited PLMN the UE is roaming in, or SNPN ID of the visited SNPN).
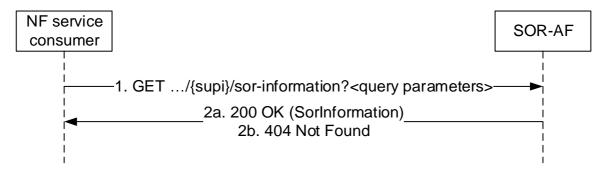

Figure 5.2.2.2.2-1: SoR Information Retrieval Procedure

1. The NF service consumer (e.g. UDM) sends a GET request to the resource representing the SoR information (sor-information), with query parameters indicating the PLMN ID or SNPN ID and other relevant information (e.g. Access type).

2a. On success, the SOR-AF responds with the HTTP status code "200 OK" with the message body containing the SoR information (i.e. list of preferred PLMN/access technology combinations, the SOR-CMCI, if any, the "Store the SOR-CMCI in the ME" indicator, if any, SOR-SNPN-SI, if any and SOR-SNPN-SI-LS, if any, or a secured packet by consuming Nspaf services as specified in 3GPP TS 29.544 [19]) for the concerned UE. The response also contains a Cache-Control HTTP header set to the value "no-cache" instructing the NF consumer (e.g. UDM) to not cache the received SoR information.

2b. If there is no valid SoR information for the UE (e.g. the resource does not exist, the SUPI is unknown to the SOR-AF), the SOR-AF responds with the HTTP status code "404 Not Found" including additional error information in the response body (within the "ProblemDetails" IE).

NOTE: An operator configurable timer shall be used by the NF Service Consumer (e.g. UDM) to control the acceptable time during which it shall wait for the GET response from the SOR-AF, as specified in clause C.2 of 3GPP°TS°23.122°[14] (step 3d of the procedure description). The default value and range of this timer is operator specific and shall take into account the importance of the related procedure (e.g. registration procedure).

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.

5.2.2.3   Info

5.2.2.3.1   General

This service operation is used by a NF consumer (e.g. UDM) to provide the SOR-AF with the reception status of the acknowledgment on successful reception of SoR information by the UE, in case an acknowledgment was requested to the UE.

The following procedures are supported using the "Info" service operation:

- SoR Acknowledgment Reception Notification

5.2.2.3.2 SoR Acknowledgment Reception Notification

Figure 5.2.2.3.2-1 depicts a scenario where a NF consumer (e.g. UDM) sends an indication to the SOR-AF on the reception status of SoR information by the UE (see also clauses C.2 C.3, C.5 and C.6 in Annex C of 3GPP°TS°23.122°[14]).

The request contains the UE's identity (/{supi}), the type of acknowledgment (/sor-information/sor-ack) and the indication (SorAckInfo).
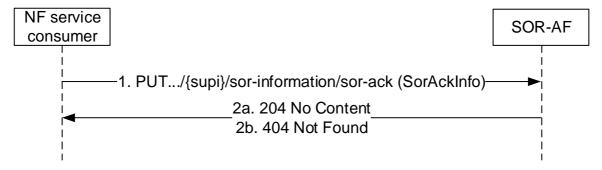

Figure 5.2.2.3.2-1: SoR Acknowledgment Reception Notification procedure

1. The NF service consumer (e.g. UDM) sends a PUT request to the resource representing the SoR information acknowledgment (/{supi}/sor-information/sor-ack) with the SorAckInfo containing an indication on the reception status of SoR information by the UE, and "ME support of SOR-CMCI", "ME support of SOR-SNPN-SI-LS" and, "ME support of SOR-SNPN-SI" if available.

2a. The SOR-AF responds with the HTTP status code "204 No Content".

2b. If there is an error (e.g. the SUPI is unknown to the SOR-AF), the SOR-AF shall respond with the HTTP status code "404 Not Found" including additional error information in the response body (within the "ProblemDetails" IE).

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

6 API Definitions

6.1 Nsoraf_SteeringOfRoaming Service API

6.1.1 Introduction

The Nsoraf_SOR service shall use the Nsoraf_SOR service API.

The API URI of the Nsoraf_SOR API shall be:

{apiRoot}/<apiName>/<apiVersion>

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 "nsoraf-sor".

- The <apiVersion> shall be "v1".

- The <apiSpecificResourceUriPart> shall be set as described in clause 6.1.3.

6.1.2 Usage of HTTP

6.1.2.1 General

HTTP/2, IETF RFC 9113 [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 Nsoraf_SOR 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 9457 [13].

6.1.2.2.3 Cache-Control

The "Cache-Control" header set to the value "no-cache" shall be included in HTTP responses for resources that shall not be cached (e.g. SorInformation).

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

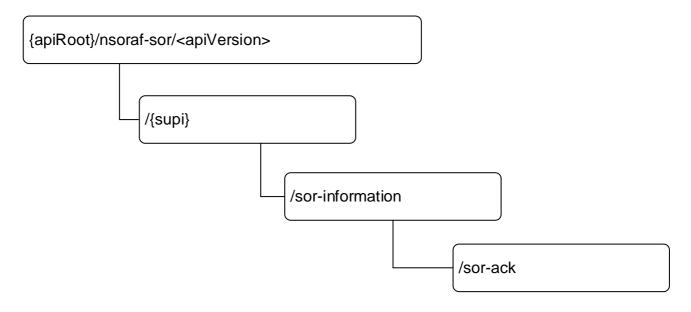The structure of the Resource URIs of the "Nsoraf_SOR" service is depicted in Figure 6.1.3.1-1.

Figure 6.1.3.1-1: Resource URI structure of the Nsoraf_SOR 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
sor-information (Document)	/{supi}/sor-information	GET	Retrieve the SoR information.
sor-ack (Document)	/{supi}/sor-information/sor-ack	PUT	Inform the SOR-AF of the reception status of the Acknowledgment of successful reception of SoR information by the UE.

6.1.3.2   Resource: sor-information

6.1.3.2.1   Description

This resource represents the SoR information for a SUPI. It is used by NF consumers (e.g. UDM) to:

- request the retrieval of the SoR information during registration in a VPLMN as specified in clause C.2 in Annex C of 3GPP°TS°23.122°[14].

6.1.3.2.2   Resource Definition

Resource URI: **{apiRoot}/nsoraf-sor//<apiVersion>/{supi}/sor-information**

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
supi	Supi	Represents the Subscription Permanent Identifier (see 3GPP TS 23.501 [2] clause 5.9.2) pattern: "^(imsi-[0-9]{5,15}|nai-.+|.+)$"

6.1.3.2.3 Resource Standard Methods

6.1.3.2.3.1 GET

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 GET method on this resource

Name	Data type	P	Cardinality	Description	Applicability
supported-features	SupportedFeatures	O	0..1	See clause 6.1.8, and 3GPP TS 29.500 [4] clause 6.6.	
plmn-id	PlmnIdNid	M	1	Identity of the PLMN or SNPN serving the UE.	
access-type	AccessType	O	0..1	Access type used by the UE.	

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 GET Request Body on this resource

Data type	P	Cardinality	Description
n/a			

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

Data type	P	Cardinality	Response codes	Description
SorInformation	M	1	200 OK	Upon success, a response with "200 OK" status code and a response body containing the SoR information as requested by the NF consumer (e.g. UDM) shall be returned by the SOR-AF.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. (NOTE 2)
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. (NOTE 2)
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be set to one of the following application errors: - USER_NOT_FOUND
NOTE 1: The manadatory HTTP error status code for the GET method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.				
NOTE 2: RedirectResponses may be inserted by an SCP, see clause 6.10.9.1 of 3GPP TS 29.500 [4].				

Table 6.1.3.2.3.1-4: Headers supported by the 200 Response Code on this resource

Name	Data type	P	Cardinality	Description
Cache-Control	string	M	1	The Cache-Control HTTP header is set to the value "no-cache" instructing the NF consumer (e.g. UDM) to not cache the received SoR information.

Table 6.1.3.2.3.1-5: Headers supported by the 307 Response Code on this endpoint

Name	Data type	P	Cardinality	Description
Location	string	M	1	A URI pointing to a resource located on alternative SOR-AF. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].

Table 6.1.3.2.3.1-6: Headers supported by the 308 Response Code on this endpoint

Name	Data type	P	Cardinality	Description
Location	string	M	1	A URI pointing to a resource located on alternative SOR-AF. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].

6.1.3.3   Resource: sor-ack

6.1.3.3.1   Description

This resource represents the notification from the NF consumer (e.g. UDM) of the reception status of the acknowledgment of successful reception of SoR information by the UE as specified in in Annex C of 3GPP°TS°23.122 [14].

6.1.3.3.2   Resource Definition

Resource URI: **{apiRoot}/nsoraf-sor//<apiVersion>/{supi}/sor-information/sor-ack**

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
supi	Supi	Represents the Subscription Permanent Identifier (see 3GPP TS 23.501 [2] clause 5.9.2) pattern: "^(imsi-[0-9]{5,15}|nai-.+|.+)$"

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
SorAckInfo	M	1	Contains an indication on the reception status of the acknowledgment of successful reception of SoR information by the UE.

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
n/a			204 No Content	Upon success, a response with "204 No Content" status code shall be returned.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection. (NOTE 2)
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection. (NOTE 2)
ProblemDetails	O	0..1	404 Not Found	The "cause" attribute may be set to the following application error: - USER_NOT_FOUND
NOTE 1: The manadatory HTTP error status code for the PUT method listed in Table 5.2.7.1-1 of 3GPP TS 29.500 [4] also apply.				
NOTE 2: RedirectResponses may be inserted by an SCP, see clause 6.10.9.1 of 3GPP TS 29.500 [4].				

Table 6.1.3.3.3.1-4: Headers supported by the 307 Response Code on this endpoint

Name	Data type	P	Cardinality	Description
Location	string	M	1	A URI pointing to a resource located on alternative SOR-AF. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].

Table 6.1.3.3.3.1-5: Headers supported by the 308 Response Code on this endpoint

Name	Data type	P	Cardinality	Description
Location	string	M	1	A URI pointing to a resource located on alternative SOR-AF. For the case, when a request is redirected to the same target resource via a different SCP, see clause 6.10.9.1 in 3GPP TS 29.500 [4].

6.1.4   Custom Operations without associated resources

No custom operations without associated resources are defined for the Nsoraf_SOR Service.

6.1.5   Notifications

6.1.5.1   General

In this release of this specification, no notifications are defined for the Nsoraf_SOR 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 Nsoraf_SOR service based interface protocol.

Table 6.1.6.1-1: Nsoraf specific Data Types

Data type	Clause defined	Description	Applicability
SorInformation	6.1.6.2.2	Contains the SoR information to be conveyed to the UE.	
SorAckInfo	6.1.6.2.3	Contains an indication to the SOR-AF on the reception status of the acknowledgment of successful reception of SoR Information by the UE.	
SteeringContainer	6.1.6.2.x	It consists of either a list (array) of SteeringInfo objects, or a Secured Packet.	
SteeringInfo	6.1.6.2.x	Contains a PLMN-ID, or SNPN-ID or a GIN, and, for the case of PLMNs, the preferred access technologies.	
SorAckStatus	6.1.6.3.3	Contains the reception status of the acknowledgment of successful reception of SoR Information by the UE.	

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

Table 6.1.6.1-2: Nsoraf re-used Data Types

Data type	Reference	Comments	Applicability
PlmnId	3GPP TS 29.571 [16]	PLMN Identity	
PlmnIdNid	3GPP TS 29.571 [16]	SNPN Identity or GIN	
ProblemDetails	3GPP TS 29.571 [16]	Common data type used in response bodies	
RedirectResponse	3GPP TS 29.571 [10]	Redirect Response	
SupportedFeatures	3GPP TS 29.571 [16]	see 3GPP TS 29.500 [4] clause 6.6	
Supi	3GPP TS 29.571 [16]	Contains the SUPI information.	
DateTime	3GPP TS 29.571 [16]	Date Time	
AccessType	3GPP TS 29.571 [16]	Access type (e.g. 3GPP)	
SorCmci	3GPP TS 29.503 [15]	Contains SOR-CMCI as defined in 3GPP TS 24.501 [18]	
AccessTech	3GPP TS 29.509 [20]	List of access technologies	
SecuredPacket	3GPP TS 29.509 [20]	Secured Packet	

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: SorInformation

Table 6.1.6.2.2-1: Definition of type SorInformation

Attribute name	Data type	P	Cardinality	Description	Applicability
supportedFeatures	SupportedFeatures	O	0..1	Features supported by the SOR-AF (see clause 6.1.8).	
steeringContainer	SteeringContainer	C	0..1	When present, this attribute contains the information needed to update the "Operator Controlled PLMN Selector with Access Technology" list stored in the UE, either as an array of preferred PLMN/Access Technologies combinations in priority order (with the first entry in the array indicating the highest priority and the last entry indicating the lowest) or a secured packet. If no change of the "Operator Controlled PLMN Selector with Access Technology" list stored in the UE is needed, then this attribute shall be absent. When the eNPN feature is supported, this IE may contain SOR information for SNPNs or GINs.	
sorAckIndication	boolean	M	1	This attribute indicates to the NF consumer (e.g. UDM) whether an Acknowledgment of successful reception of SoR information shall be requested to the UE (when set to "True") or not (when set to "False").	
sorCmci	SorCmci	O	0..1	When present, provides the SOR-CMCI values as defined in 3GPP TS 24.501 [18] If "ME Support of SOR-CMCI" as provided in meSupportOfSorCmci from UE to SOR-AF via AMF and UDM is not stored as "supported", then this attribute shall be absent. Shall be absent if steeringContainer is provided with contents in secured packet.	

storeSorCmciInMe	boolean	O	0..1	When present, indicates "Store the SOR-CMCI in the ME" as supported as defined in 3GPP TS 23.122 [14] and 3GPP TS 24.501 [18]. If sorCmci is absent, then this attribute shall also be absent. - True: Indicates to store the SOR-CMCI in the ME - False or absent: Indicates storing the SOR-CMCI in the ME is not required Shall be absent if steeringContainer is provided with contents in secured packet.	
sorSendingTime	DateTime	M	1	Contains the date and time at which SOR-AF returns SorInformation. It is used to correlate the SoR acknowledgement with the associated SoR information.	
sorSnpnSi	Bytes	O	0..1	When present, provides the SOR-SNPN-SI values as defined in 3GPP TS 24.501 [18]. If "ME Support of SOR-SNPN-SI-LS" as provided in meSupportOfSorSnpnSi from UE to SOR-AF via AMF and UDM is not stored as "supported", then this attribute shall be absent.	
sorSnpnSiLs	Bytes	O	0..1	When present, provides the SOR-SNPN-SI-LS values as defined in 3GPP TS 24.501 [18] If "ME Support of SOR-SNPN-SI-LS" as provided in meSupportOfSorSnpnSiLs from UE to SOR-AF via AMF and UDM is not stored as "supported", then this attribute shall be absent.	

6.1.6.2.3 Type: SorAckInfo

Table 6.1.6.2.3-1: Definition of type SorAckInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
sorAckStatus	SorAckStatus	M	1	Contains the reception status of the acknowledgment of successful reception of SoR Information by the UE.	
sorSendingTime	DateTime	M	1	Contains the date and time at which SOR-AF sent the SorInformation to which the acknowledgment status relates.	
meSupportOfSorCmci	boolean	O	0..1	When present, indicates "ME support of SOR-CMCI" sent from UE to SOR-AF via AMF and UDM as defined in 3GPP TS 23.122 [14] and 3GPP TS 24.501 [18]. - True: ME supports SOR-CMCI - False or absent: ME does not support SOR-CMCI	
meSupportOfSorSnpnSi	boolean	O	0..1	When present, it indicates the "ME support for SOR-SNPN-SI" sent from UE to SOR-AF of SNPN vas described in 3GPP TS 23.122 [14]. - True: ME supports SOR-SNPN-SI - False or absent: ME does not support SOR-SNPN-SI	
meSupportOfSorSnpnSiLs	boolean	O	0..1	When present, it indicates the "ME support for SOR-SNPN-SI-LS" sent from UE to SOR-AF of SNPN vas described in 3GPP TS 23.122 [14]. - True: ME supports SOR-SNPN-SI-LS - **False or absent: ME does not support SOR-SNPN-SI_LS.**	

6.1.6.2.4 Type: SteeringContainer

Table 6.1.6.2.4.-1: Definition of type SteeringContainer as a list of mutually exclusive alternatives

Data type	Cardinality	Description
array(SteeringInfo)	1..N	List of PLMN/AccessTechnologies combinations.
SecuredPacket	1	A secured packet containing one or more APDUs commands dedicated to Remote File Management.

6.1.6.2.5   Type: SteeringInfo

Table 6.1.6.2.5-1: Definition of type SteeringInfo

Attribute name	Data type	P	Cardinality	Description
plmnId	PlmnId	C	0..1	Contains a preferred PLMN identity. (NOTE)
snpnId	PlmnIdNid	C	0..1	Contains a preferred SNPN identity. (NOTE)
gin	PlmnIdNid	C	0..1	Contains a preferred Group ID for Network Selection. (NOTE)
accessTechList	array(AccessTech)	O	1..N	This IE is only applicable when plmnId is present, and it shall be absent when snpnId or gin are present. It contains the preferred access technologies for such PLMN, as listed in clause 6.2.6.3.3 of 3GPP TS 29.509 [20]. If absent it means that all access technologies are equivalently preferred in such PLMN.
NOTE: Exactly one of plmnId, snpnId or gin shall be present.				

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
n/a			

6.1.6.3.3   Enumeration: SorAckStatus

The enumeration SorAckStatus represents an indication to the SOR-AF on whether the acknowledgment of successful reception of SoR information was received from the UE. It shall comply with the provisions defined in table 6.1.6.3.3-1.

Table 6.1.6.3.3-1: Enumeration SorAckStatus

Enumeration value	Description	Applicability
"ACK_SUCCESSFUL"	Indicates to the SOR-AF that the acknowledgment of successful reception of SoR information was received from the UE and the integrity check was successful.	
"ACK_NOT_RECEIVED"	Indicates to the SOR-AF that the acknowledgment of successful reception of SoR information was NOT received from the UE.	
"ACK_NOT_SUCCESSFUL"	Indicates to the SOR-AF that the acknowledgment of successful reception of SoR information was received from the UE and the integrity check was NOT successful.	

6.1.7   Error Handling

6.1.7.1   General

For the Nsoraf_SOR 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 Nsoraf_SOR API.

6.1.7.2   Protocol Errors

No specific procedures for the Nsoraf_SOR service are specified.

6.1.7.3   Application Errors

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

Table 6.1.7.3-1: Application errors

Application Error	HTTP status code	Description
USER_NOT_FOUND	404 Not Found	The user does not exist This error is applicable to all Nsoraf_SOR operations.

6.1.8   Feature negotiation

The optional features in table 6.1.8-1 are defined for the Nsoraf_SOR 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
1	eNPN	If this feature is supported, the query parameter "plmn-id" (see Table 6.1.3.2.3.1-1) is recognized by the SOR-AF as a PLMN-ID or an SNPN-ID, and the steeringContainer attribute (see clause 6.1.6.2.2) returned by the SOR-AF may include SOR information for SNPNs. If this feature is not supported, such query parameter is recognized by the SOR-AF as a PLMN-ID, and the steeringContainer attribute contains only SOR information for PLMNs.

6.1.9   Security

As indicated in 3GPP TS 33.501 [8] and 3GPP TS 29.500 [4], the access to the Nsoraf_SOR 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 Nsoraf_SOR 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 Nsoraf_SOR service.

The Nsoraf_SOR API defines a single scope "nsoraf-sor" for the entire service, and it does not define any additional scopes at resource or operation level.

6.1.10 HTTP redirection

An HTTP request may be redirected to a different SOR-AF service instance when using direct or indirect communications (see 3GPP TS 29.500 [4]).

An SCP that reselects a different SOR-AF producer instance will return the NF Instance ID of the new SOR-AF producer instance in the 3gpp-Sbi-Producer-Id header, as specified in clause 6.10.3.4 of 3GPP TS 29.500 [4].

If an SOR-AF redirects a service request to a different SOR-AF using an 307 Temporary Redirect or 308 Permanent Redirect status code, the identity of the new SOR-AF towards which the service request is redirected shall be indicated in the 3gpp-Sbi-Target-Nf-Id header of the 307 Temporary Redirect or 308 Permanent Redirect response as specified in clause 6.10.9.1 of 3GPP TS 29.500 [4].

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 , 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 Nsoraf_SOR API

```
openapi: 3.0.0
info:
  title: 'Nsoraf_SOR'
  version: 1.2.0
  description: |
    Nsoraf Steering Of Roaming Service.
    © 2024, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
externalDocs:
  description: 3GPP TS 29.550 V18.3.0; Steering Of Roaming Application Function Services.
  url: http://www.3gpp.org/ftp/Specs/archive/29_series/29.550/
servers:
  - url: '{apiRoot}/nsoraf-sor/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in clause 4.4 of 3GPP TS 29.501
security:
  - {}
  - oAuth2ClientCredentials:
    - nsoraf-sor
paths:
  /{supi}/sor-information:
    get:
      summary: retrieve the steering of roaming information for a UE
      operationId: GetSorInformation
      tags:
        - SoR Information Retrieval
      parameters:
        - name: supi
          in: path
          description: Identifier of the UE
          required: true
          schema:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/Supi'
        - name: supported-features
          in: query
          description: Supported Features
          schema:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
        - name: plmn-id
          in: query
          description: serving PLMN ID or SNPN ID
          required: true
          content:
            application/json:
```

```
            schema:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/PlmnIdNid'
        - name: access-type
          in: query
          description: Access type used by the UE
          schema:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/AccessType'
      responses:
        '200':
          description: Expected response to a valid request
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/SorInformation'
          headers:
            Cache-Control:
              description: Cache-Control (as described in RFC 9111) with value "no-cache" to
indicate that the returned SoR information should not be cached
              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'
        '401':
          $ref: 'TS29571_CommonData.yaml#/components/responses/401'
        '403':
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '406':
          $ref: 'TS29571_CommonData.yaml#/components/responses/406'
        '429':
          $ref: 'TS29571_CommonData.yaml#/components/responses/429'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '502':
          $ref: 'TS29571_CommonData.yaml#/components/responses/502'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          description: Unexpected error
  /{supi}/sor-information/sor-ack:
    put:
      summary: SoR Acknowledgment Reception Notification
      operationId: SorAckInfo
      tags:
        - Providing the reception status of the acknowledgement of Steering of Roaming information
reception by the UE
      parameters:
        - name: supi
          in: path
          description: Identifier of the UE
          required: true
          schema:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/Supi'
      requestBody:
        required: true
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/SorAckInfo'
      responses:
        '204':
          description: Successful reception of the indication
        '307':
          $ref: 'TS29571_CommonData.yaml#/components/responses/307'
        '308':
          $ref: 'TS29571_CommonData.yaml#/components/responses/308'
        '400':
          $ref: 'TS29571_CommonData.yaml#/components/responses/400'
        '401':
          $ref: 'TS29571_CommonData.yaml#/components/responses/401'
        '403':
          $ref: 'TS29571_CommonData.yaml#/components/responses/403'
        '404':
```

```
              $ref: 'TS29571_CommonData.yaml#/components/responses/404'
            '429':
              $ref: 'TS29571_CommonData.yaml#/components/responses/429'
            '500':
              $ref: 'TS29571_CommonData.yaml#/components/responses/500'
            '502':
              $ref: 'TS29571_CommonData.yaml#/components/responses/502'
            '503':
              $ref: 'TS29571_CommonData.yaml#/components/responses/503'
            default:
              description: Unexpected error
components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{nrfApiRoot}/oauth2/token'
          scopes:
            nsoraf-sor: Access to the Nsoraf_SOR API
  schemas:

#
# COMPLEX DATA TYPES
#

    SorInformation:
      description: Represents the SoR information to be conveyed to a UE.
      type: object
      required:
        - sorAckIndication
        - sorSendingTime
      properties:
        supportedFeatures:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
        steeringContainer:
          $ref: '#/components/schemas/SteeringContainer'
        sorAckIndication:
          type: boolean
        sorCmci:
          $ref: 'TS29503_Nudm_SDM.yaml#/components/schemas/SorCmci'
        storeSorCmciInMe:
          type: boolean
        sorSendingTime:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        sorSnpnSi:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Bytes'
        sorSnpnSiLs:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Bytes'

    SorAckInfo:
      description: >
        Represents an indication to the SOR-AF on the reception status of the
        acknowledgment of successful reception of SoR Information by a UE.
      type: object
      required:
        - sorAckStatus
        - sorSendingTime
      properties:
        sorAckStatus:
          $ref: '#/components/schemas/SorAckStatus'
        sorSendingTime:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        meSupportOfSorCmci:
          type: boolean
        meSupportOfSorSnpnSi:
          type: boolean
        meSupportOfSorSnpnSiLs:
          type: boolean

    SteeringContainer:
      description: It consists of either a list (array) of SteeringInfo objects or a Secured Packet
      oneOf:
        - type: array
          items:
            $ref: '#/components/schemas/SteeringInfo'
          minItems: 1
        - $ref: 'TS29509_Nausf_SoRProtection.yaml#/components/schemas/SecuredPacket'
```

```
SteeringInfo:
  description: >
    Contains either a PLMN-ID, an SNPN-ID or a GIN and, for the case of PLMNs, zero or more
    preferred access technologies for accessing such PLMN
  type: object
  oneOf:
    - required: [ plmnId ]
    - required: [ snpnId ]
    - required: [ gin ]
  properties:
    plmnId:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/PlmnId'
    snpnId:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/PlmnIdNid'
    gin:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/PlmnIdNid'
    accessTechList:
      type: array
      items:
        $ref: 'TS29509_Nausf_SoRProtection.yaml#/components/schemas/AccessTech'
      minItems: 1


#
# ENUMS
#

    SorAckStatus:
      description: >
        Represents the reception status of the acknowledgment of successful reception of
        SoR Information by a UE.

      anyOf:
        - type: string
          enum:
          - ACK_SUCCESSFUL
          - ACK_NOT_RECEIVED
          - ACK_NOT_SUCCESSFUL
        - type: string
```

Annex B (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2019-11	CT4#95	C4-195242				Initial Draft.	0.1.0
2020-03	CT4#96e	C4-200833				Pseudo-CR on the scope part of SOR-AF API	0.2.0
2020-03	CT4#96e	C4-201197				Pseudo-CR on the overview part of SOR-AF API	0.2.0
2020-03	CT4#96e	C4-201198				Pseudo-CR on the definition of Nsoraf service	0.2.0
2020-03	CT4#96e	C4-201206				Pseudo-CR on the resources part of SOR-AF API	0.2.0
2020-03	CT4#96e	C4-201208				Pseudo-CR on the data model aspects of SOR-AF API	0.2.0
2020-03	CT4#96e	C4-201209				Pseudo-CR on the OpenAPI part of SOR-AF API	0.2.0
2020-03	CT-87e	CP-200063				TS presented for information and approval	1.0.0
2020-03	CT-87e					Approved at CT#87e	16.0.0
2020-07	CT#88e	CP-201042	0001		F	SoR Information wording clarification	16.1.0
2020-07	CT#88e	CP-201042	0002	1	F	Storage of YAML files in ETSI Forge	16.1.0
2020-07	CT#88e	CP-201042	0003		F	Miscellaneous Corrections	16.1.0
2020-07	CT#88e	CP-201042	0006	1	F	Add Data type column in the URI variables tables	16.1.0
2020-07	CT#88e	CP-201042	0007	1	F	Add supported headers tables	16.1.0
2020-07	CT#88e	CP-201042	0008		F	Add API descriptions table	16.1.0
2020-07	CT#88e	CP-201042	0009	2	B	Remaining input parameters to Nsoraf_SOR_Get service operation	16.1.0
2020-07	CT#88e	CP-201042	0010	1	B	SoR retrieval response timing control	16.1.0
2020-07	CT#88e	CP-201073	0011		F	29.550 Rel-16 API version and External doc update	16.1.0
2020-09	CT#89e	CP-202115	0012		F	Miscellaneous Corrections	16.2.0
2020-11	CT#90e	CP-203035	0015		F	Removal of the reference to ETSI forge	16.3.0
2021-03	CT#91e	CP-210034	0018	1	F	OpenAPI Reference	17.0.0
2021-06	CT#92e		0021	1	F	Adding some missing description fields to data type definitions in OpenAPI specification files of the Nsoraf_SOR API	17.1.0
2021-09	CT#93e	CP-212247	0023	3	F	Redirect Response	17.2.0
2021-12	CT#94e		0027	1	B	SOR-CMCI support	17.3.0
2022-06	CT#96	CP-221064	0030		A	access-type query parameter format	17.4.0
2022-06	CT#96	CP-221301	0031	2	F	SOR functionality with SNPNs	17.4.0
2022-06	CT#96	CP-221302	0032	1	F	29.550 Rel-17 API version and External doc update	17.4.0
2022-12	CT#98	CP-223028	0035	1	F	Missing Mandatory Status Codes in OpenAPI	18.0.0
2022-12	CT#98	CP-223033	0036		F	29.550 Rel-18 API version and External doc update	18.0.0
2023-06	CT#100		0037	4	F	Location header and missing Redirection clause	18.1.0
2023-06	CT#100		0039	4	F	SOR update information for localized services in SNPN	18.1.0
2023-12	CT#102	CP-233044	0042	1	F	Major API version	18.2.0
2023-12	CT#102	CP-233029	0043	1	F	Update and replace obsoleted HTTP RFCs	18.2.0
2023-12	CT#102	CP-233031	0045		F	Replacing obsoleted HTTP RFC 7807 with 9457	18.2.0
2023-12	CT#102	CP-233060	0047		F	API version and External doc update	18.2.0
2024-06	CT#104	CP-241052	0048	-	F	API version and External doc update	18.3.0

History

Document history		
V18.2.0	May 2024	Publication
V18.3.0	July 2024	Publication