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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
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1 Scope

The present document specifies the stage 3 protocol and data model for the Nsmf Service Based Interface. It provides stage 3 protocol definitions and message flows, and specifies the API for each service offered by the SMF other than the Session Management Event Exposure service.

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].

The Session Management Event Exposure Service is specified in 3GPP TS 29.508 [6].

2 References

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

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

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".
- [3] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".
- [4] 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".
- [5] 3GPP TS 29.501: "5G System; Principles and Guidelines for Services Definition; Stage 3".
- [6] 3GPP TS 29.508: "5G System; Session Management Event Exposure Service; Stage 3".
- [7] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".
- [8] 3GPP TS 24.007: "Mobile radio interface signalling layer 3; General aspects".
- [9] 3GPP TS 38.413: "NG Radio Access Network (NG-RAN); NG Application Protocol (NGAP)".
- [10] IETF RFC 2387: "The MIME Multipart/Related Content-type".
- [11] IETF RFC 8259: "The JavaScript Object Notation (JSON) Data Interchange Format".
- [12] IETF RFC 2045: "Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies".
- [13] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces; Stage 3".
- [14] IETF RFC 7540: "Hypertext Transfer Protocol Version 2 (HTTP/2)".
- [15] OpenAPI Initiative, "OpenAPI 3.0.0 Specification", <https://github.com/OAI/OpenAPI-Specification/blob/master/versions/3.0.0.md>.
- [16] 3GPP TS 29.274: "3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3".
- [17] 3GPP TS 33.501: "Security architecture and procedures for 5G system".

- [18] IETF RFC 6749: "The OAuth 2.0 Authorization Framework".
- [19] 3GPP TS 29.510: "Network Function Repository Services; Stage 3".
- [20] 3GPP TS 29.518: "5G System; Access and Mobility Management Service; Stage 3".
- [21] 3GPP TS 23.380: "IMS Restoration Procedures".
- [22] 3GPP TS 32.422: "Telecommunication management; Subscriber and equipment trace; Trace control and configuration management".
- [23] IETF RFC 7807: "Problem Details for HTTP APIs".
- [24] 3GPP TS 23.527: "5G System; Restoration Procedures".
- [25] 3GPP TS 32.255: "Charging management; 5G data connectivity domain charging; stage 2".
- [26] 3GPP TS 32.291: "Charging management; 5G system, charging service; Stage 3".
- [27] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".
- [28] 3GPP TR 21.900: "Technical Specification Group working methods".

3 Definitions and abbreviations

3.1 Definitions

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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].

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3.2 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].

DNN	Data Network Name
HR	Home Routed
JSON	Javascript Object Notation
LADN	Local Area Data Network
SM	Session Management
SMF	Session Management Function

4 Overview

4.1 Introduction

Within the 5GC, the SMF offers services to the AMF, other SMF (V-SMF or H-SMF), PCF and NEF via the Nsmf service based interface (see 3GPP TS 23.501 [2] and 3GPP TS 23.502 [3]).

Figure 4.1-1 provides the reference model (in service based interface representation and in reference point representation), with focus on the SMF and the scope of the present specification.

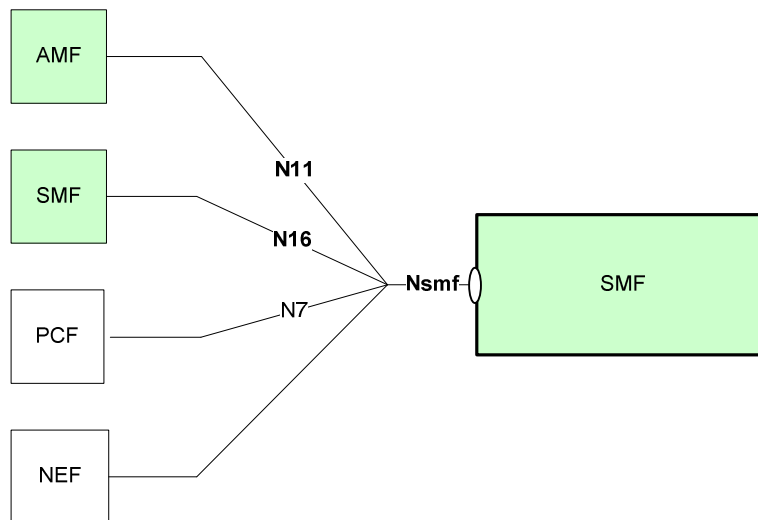


Figure 4.1-1: Reference model – SMF

The functionalities supported by the SMF are listed in clause 6.2.2 of 3GPP TS 23.501 [2].

5 Services offered by the SMF

5.1 Introduction

The SMF supports the following services.

Table 5.1-1: NF Services provided by SMF

Service Name	Description	Example Consumer
Nsmf_PDUSession	This service manages the PDU sessions and uses the policy and charging rules received from the PCF. The service operations exposed by this NF service allows the consumer NFs to establish, modify and delete the PDU sessions.	V-SMF, H-SMF, AMF
Nsmf_EventExposure	This service exposes the events happening on the PDU sessions to the consumer NFs.	PCF, NEF, AMF

The Nsmf_EventExposure service is specified in 3GPP TS 29.508 [6].

5.2 Nsmf_PDUSession Service

5.2.1 Service Description

The Nsmf_PDUSession service operates on the PDU Sessions. The service operations exposed by this service allow other NFs to establish, modify and release the PDU Sessions. The following are the key functionalities of this NF service:

- Creation, modification and deletion of SM contexts for PDU Sessions upon receiving N1 message notification from AMF carrying the NAS SM messages; an SM context represents an association between the NF Service Consumer (e.g. AMF) and the SMF for a PDU session;
- Retrieval of SM contexts of PDU sessions, e.g. to move PDU sessions towards the EPC using the N26 interface;
- Creation, modification and deletion of PDU sessions between the V-SMF and H-SMF, in HR roaming scenarios;

- Association of policy and charging rules with PDU Sessions and binding the policy and charging rules to flows;
- Interacting with the UPF over N4 for creating, modifying and releasing user plane sessions;
- Process user plane events from the UPF and apply the corresponding policy and charging rules.

The Nsmf_PDUSession service supports the following service operations.

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

Service Operations	Description	Operation Semantics	Example Consumer(s)
Create SM Context	Create an SM context in SMF, or in V-SMF in HR roaming scenarios, for a PDU session.	Request/Response	AMF
Update SM Context	Update the SM context of a PDU session and/or provide the SMF with N1 or N2 SM information received from the UE or from the AN.	Request/Response	AMF
Release SM Context	Release the SM context of a PDU session when the PDU session has been released.	Request/Response	AMF
Notify SM Context Status (see NOTE 1)	Notify the NF Service Consumer about the status of an SM Context of a PDU session (e.g. the SM Context is released within the SMF).	Subscribe/Notify	AMF
Retrieve SM Context (see NOTE 2)	Retrieve an SM context of a PDU session from SMF, or from V-SMF in HR roaming scenarios, for 5GS to EPS mobility.	Request/Response	AMF
Create	Create a PDU session in the H-SMF, in HR roaming scenarios.	Request/Response	V-SMF
Update	Update a PDU session in the H-SMF or V-SMF, in HR roaming scenarios.	Request/Response	V-SMF, H-SMF
Release	Release a PDU session in the H-SMF, in HR roaming scenarios.	Request/Response	V-SMF
Notify Status (see NOTE 3)	Notify the NF Service Consumer about the status of a PDU session (e.g. the PDU session is released due to local reasons within the H-SMF).	Subscribe/Notify	V-SMF
NOTE 1: This corresponds to the SMContextStatusNotify service operation defined in 3GPP TS 23.502 [3].			
NOTE 2: This corresponds to the ContextRequest service operation defined in 3GPP TS 23.502 [3].			
NOTE 3: This corresponds to the StatusNotify service operation defined in 3GPP TS 23.502 [3].			

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 Nsmf_PDUSession service.

5.2.2.2 Create SM Context service operation

5.2.2.2.1 General

The Create SM Context service operation shall be used to create an individual SM context, for a given PDU session, in the SMF, or in the V-SMF for HR roaming scenarios.

It is used in the following procedures:

- UE requested PDU Session Establishment (see clause 4.3.2 of 3GPP TS 23.502 [3]);
- EPS to 5GS Idle mode mobility or handover using N26 interface (see clause 4.11.1 of 3GPP TS 23.502 [3]);
- EPS to 5GS mobility without N26 interface (see clause 4.11.2.3 3GPP TS 23.502 [3]);

- Handover of a PDU session between 3GPP access and non-3GPP access, when the target AMF does not know the SMF resource identifier of the SM context used by the source AMF, e.g. when the target AMF is not in the PLMN of the N3IWF (see clause 4.9.2.3.2 of 3GPP TS 23.502 [3]), or when the UE is roaming and the selected N3IWF is in the HPLMN (see clause 4.9.2.4.2 of 3GPP TS 23.502 [3]);
- Handover from EPS to 5GC-N3IWF (see clause 4.11.3.1 of 3GPP TS 23.502 [3]);
- Handover from EPC/ePDG to 5GS (see clause 4.11.4.1 of 3GPP TS 23.502 [3]).

There shall be only one individual SM context per PDU session.

The NF Service Consumer (e.g. AMF) shall create an SM context by using the HTTP POST method as shown in Figure 5.2.2.2.1-1.

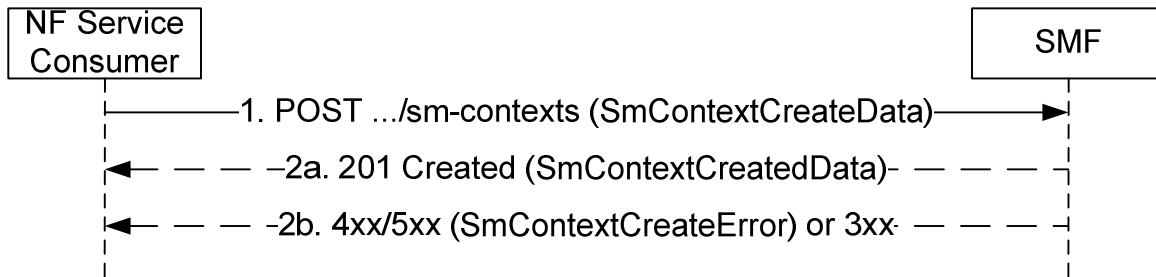


Figure 5.2.2.2.1-1: SM context creation

1. The NF Service Consumer shall send a POST request to the resource representing the SM contexts collection resource of the SMF. The payload body of the POST request shall contain:
 - a representation of the individual SM context resource to be created;
 - the Request Type IE, if it is received from the UE and if the request refers to an existing PDU session or an existing Emergency PDU session, the Request Type IE may be included otherwise;
 - the Old PDU Session ID, if it is received from the UE (i.e. for a PDU session establishment for the SSC mode 3 operation);
 - the indication that the UE is inside or outside of the LADN (Local Area Data Network) service area, if the DNN corresponds to a LADN;
 - a subscription for SM context status notification;
 - the servingNfId identifying the serving AMF;
 - trace control and configuration parameters, if trace is to be activated (see 3GPP TS 32.422 [22]).

For the UE requested PDU Session Establishment procedure in home routed roaming scenario (see clause 4.3.2.2.2 of 3GPP TS 23.502 [3]), the NF Service Consumer shall provide the URI of the Nsmf_PDUSession service of the H-SMF in the hSmfUri IE and may provide the URI of the Nsmf_PDUSession service of additional H-SMFs. The V-SMF shall try to create the PDU session using the hSmfUri IE. If due to communication failure on the N16 interface the V-SMF does not receive any response from the H-SMF, then:

- depending on operator policy, the V-SMF may try reaching the hSmfUri via an alternate path; or
- if additional H-SMF URI is provided, the V-SMF may try to create the PDU session on one of the additional H-SMF(s) provided.

The payload body of the POST request may further contain:

- the name of the AMF service to which SM context status notification are to be sent (see clause 6.5.2.2 of 3GPP TS 29.500 [4]), encoded in the serviceName attribute.

- 2a. On success, "201 Created" shall be returned, the payload body of the POST response shall contain the representation describing the status of the request and the "Location" header shall be present and shall contain the URI of the created resource. The authority and/or deployment-specific string of the apiRoot of the created

resource URI may differ from the authority and/or deployment-specific string of the apiRoot of the request URI received in the POST request.

If the Request Type was received in the request and set to EXISTING_PDU_SESSION or EXISTING_EMERGENCY_PDU_SESSION (i.e. indicating that this is a request for an existing PDU session or an existing emergency PDU session), the SMF shall identify the existing PDU session or emergency PDU session based on the PDU Session ID; in this case, the SMF shall not create a new SM context but instead update the existing SM context and provide the representation of the updated SM context in the "201 Created" response to the NF Service Consumer.

The POST request shall be considered as colliding with an existing SM context if:

- it includes the same SUPI, or PEI for an emergency registered UE without a UICC or without an authenticated SUPI, and the same PDU Session ID as for an existing SM context; and
- this is a request to establish a new PDU session, i.e. the RequestType is absent in the request or is present and set to INITIAL_REQUEST or INITIAL_EMERGENCY_REQUEST.

A POST request that collides with an existing SM context shall be treated as a request for a new SM context. Before creating the new SM context, the SMF should delete the existing SM context locally and any associated resources in the UPF and PCF. If the smContextStatusUri of the existing SM context differs from the smContextStatusUri received in the POST request, the SMF shall also send an SM context status notification (see clause 5.2.2.5) targeting the smContextStatusUri of the existing SM context to notify the release of the existing SM context. For a HR PDU session, if the H-SMF URI in the request is different from the H-SMF URI of the existing PDU session, the V-SMF should also delete the existing PDU session in the H-SMF by invoking the Release service operation (see clause 5.2.2.9).

If the Request Type was received in the request and indicates this is a request for a new PDU session (i.e. INITIAL_REQUEST) and if the Old PDU Session ID was also included in the request, the SMF shall identify the existing PDU session to release and to which the new PDU session establishment relates, based on the Old PDU Session ID.

If no GPSI IE is provided in the request, e.g. for a PDU session moved from another access or another system, and the SMF knows that a GPSI is already associated with the PDU session (or a GPSI is received from h-SMF for a HR PDU session), the SMF shall include the GPSI in the response.

- 2b. If the request does not include the "UE presence in LADN service area" indication and the SMF determines that the DNN corresponds to a LADN, then the SMF shall consider that the UE is outside of the LADN service area. The SMF shall reject the request if the UE is outside of the LADN service area.

On failure, or redirection during a UE requested PDU Session Establishment, one of the HTTP status code listed in Table 6.1.3.2.3.1-3 shall be returned. For a 4xx/5xx response, the message body shall contain an SmContextCreateError structure, including:

- a ProblemDetails structure with the "cause" attribute set to one of the application error listed in Table 6.1.3.2.3.1-3;
- N1 SM information (PDU Session Reject), if the request included N1 SM information, except if the error prevents the SMF from generating a response to the UE (e.g. invalid request format).

5.2.2.2.2 EPS to 5GS Idle mode mobility using N26 interface

The NF Service Consumer (e.g. AMF) shall request the SMF to move a UE EPS PDN connection to 5GS using N26 interface, as follows.

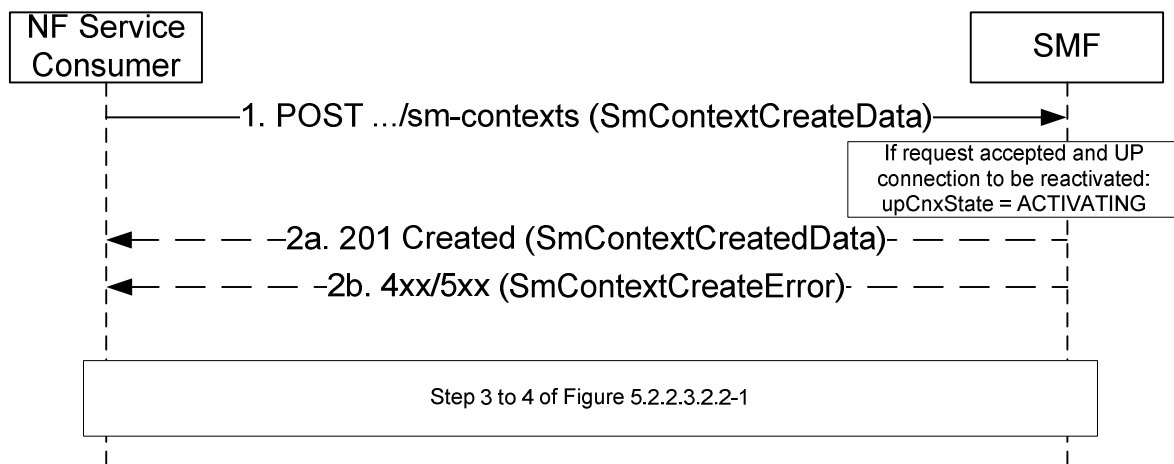


Figure 5.2.2.2-1: EPS to 5GS Idle mode mobility using N26 interface

1. The NF Service Consumer shall send a POST request towards the SMF (+PGW-C) of each UE EPS PDN connection, as specified in clause 5.2.2.2.1, with the following additional information:

- UE EPS PDN connection, including the EPS bearer contexts, received from the MME, representing the individual SM context resource to be created;
- the pduSessionsActivateList attribute, including the PDU Session ID of all the PDU session(s) to be re-activated;
- the epsBearerCxtStatus attribute, indicating the status of all the EPS bearer contexts in the UE, if corresponding information is received in the Registration Request from the UE.

2a. Upon receipt of such a request, if:

- a corresponding PDU session is found based on the EPS bearer contexts (after invoking a Create service operation towards the H-SMF, for a Home Routed PDU session);
- the default EPS bearer context of the corresponding PDU session is not reported as inactive by the UE in the epsBearerCxtStatus attribute, if received; and
- it is possible to proceed with moving the PDN connection to 5GS,

then the SMF shall return a 201 Created response including the following information:

- PDU Session ID corresponding to the default EPS bearer ID of the EPS PDN connection;
- the allocatedEbiList attribute, containing the EBI(s) allocated to the PDU session;

and, if the PDU session that is derived by the SMF based on the EPS bearer contexts was requested to be re-activated, i.e. if the PDU Session ID was present in the pduSessionsActivateList:

- the upCnxState attribute set to ACTIVATING;
- N2 SM information to request the 5G-AN to assign resources to the PDU session (see PDU Session Resource Setup Request Transfer IE in clause 9.3.4.1 of 3GPP TS 38.413 [9]), including (among others) the transport layer address and tunnel endpoint of the uplink termination point for the user plane data for this PDU session (i.e. UPF's GTP-U F-TEID for uplink traffic).

The "Location" header shall be present in the POST response and shall contain the URI of the created SM context resource.

If the epsBearerCxtStatus attribute is received in the request, the SMF shall check whether some EPS bearer(s) of the corresponding PDU session have been deleted by the UE but not notified to the EPS, and if so, the SMF shall release these EPS bearers, corresponding QoS rules and QoS flow level parameters locally, as specified in clause 4.11.1.3.3 of 3GPP TS 23.502 [3].