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Foreword

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1 Scope

The present specification provides the stage 3 definition of the Session Management Event Exposure Service (Nsmf_EventExposure) of the 5G System.

The stage 2 definition and procedures of the Session Management Event Exposure Service are contained in 3GPP TS 23.502 [3] and 3GPP TS 23.503 [6]. The 5G System Architecture is defined in 3GPP TS 23.501 [2].

Stage 3 call flows for policy and charging control use cases are provided in 3GPP TS 29.513 [7].

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

The Session Management Event Exposure Service is provided by the Session Management Function (SMF). This service exposes events related to PDU Sessions observed at the SMF.

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.
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- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".
- [3] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".
- [4] 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".
- [5] 3GPP TS 29.501: "5G System; Principles and Guidelines for Services Definition; Stage 3".
- [6] 3GPP TS 23.503: "Policy and Charging Control Framework for the 5G System; Stage 2".
- [7] 3GPP TS 29.513: "5G System; Policy and Charging Control signalling flows and QoS parameter mapping; Stage 3".
- [8] IETF RFC 9113: "HTTP/2".
- [9] IETF RFC 8259: "The JavaScript Object Notation (JSON) Data Interchange Format".
- [10] OpenAPI: "OpenAPI Specification Version 3.0.0", <https://spec.openapis.org/oas/v3.0.0>.
- [11] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces Stage 3".
- [12] 3GPP TS 29.510: "5G System; Network Function Repository Services; Stage 3".
- [13] 3GPP TS 29.518: "5G System; Access and Mobility Management Services; Stage 3".
- [14] 3GPP TS 29.512: "5G System; Session Management Policy Control Service; Stage 3".
- [15] 3GPP TS 33.501: "Security architecture and procedures for 5G system".
- [16] IETF RFC 6749: "The OAuth 2.0 Authorization Framework".
- [18] IETF RFC 9457: "Problem Details for HTTP APIs".

- [19] 3GPP TR 21.900: "Technical Specification Group working methods".
- [20] 3GPP TS 29.522: "5G System; Network Exposure Function Northbound APIs; Stage 3".
- [21] 3GPP TS 23.288: "Architecture enhancements for 5G System (5GS) to support network data analytics services".
- [22] 3GPP TS 29.514: "5G System; Policy Authorization Service; Stage 3".
- [23] 3GPP TS 29.244: "Interface between the Control Plane and the User Plane of EPC Nodes".
- [24] 3GPP TS 29.122: "T8 reference point for Northbound APIs".
- [25] 3GPP TS 29.591: "5G System; Network Exposure Function Southbound Services; Stage 3".
- [26] 3GPP TS 29.564: "5G System; User Plane Function Services; Stage 3".
- [27] 3GPP TS 29.554: "5G System; Background Data Transfer Policy Control Service; Stage 3".
- [28] 3GPP TS 29.519: "5G System; Usage of the Unified Data Repository service for Policy Control Data, Application Data and Structured Data for Exposure; Stage 3".

3 Definitions 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].

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].

AF	Application Function
AMBR	Aggregate Maximum Bit Rate
AMF	Access and Mobility Management Function
API	Application Programming Interface
DCCF	Data Collection Coordination Function
DDD	Downlink Data Delivery
DNAI	DN Access Identifier
DNN	Data Network Name
EAS	Edge Application Server
FQDN	Fully Qualified Domain Name
GPSI	Generic Public Subscription Identifier
GUAMI	Globally Unique AMF Identifier
HTTP	Hypertext Transfer Protocol
H-SMF	Home SMF
I-SMF	Intermediate SMF
JSON	JavaScript Object Notation
NEF	Network Exposure Function
NF	Network Function
NID	Network Identifier
NRF	Network Repository Function
NSSAI	Network Slice Selection Assistance Information
NWDAF	Network Data Analytics Function
PCF	Policy Control Function
PRA	Presence Reporting Area

QFI	QoS Flow Identifier
SMCC	Session Management Congestion Control
SMCCE	Session Management Congestion Control Experience
SMF	Session Management Function
SNPN	Stand-alone Non-Public Network
SUPI	Subscription Permanent Identifier
S-NSSAI	Single Network Slice Selection Assistance Information
SSC	Session and Service Continuity
UDM	Unified Data Management
UPF	User Plane Function
V-SMF	Visited SMF

4 Session Management Event Exposure Service

4.1 Service Description

4.1.1 Overview

The Session Management Event Exposure Service, as defined in 3GPP TS 23.502 [3] and 3GPP TS 23.503 [6], is provided by the Session Management Function (SMF).

This service:

- allows NF service consumers to subscribe and unsubscribe for events on a PDU session; and
- notifies recipient of notification(s) subscribed by NF service consumers with a corresponding subscription about observed events on the PDU session.

The types of observed events applicable for (H-)SMF (i.e. in non-roaming and LBO scenarios) include:

- UP path change (e.g. addition and/or removal of PDU session anchor);
- access type change;
- RAT type change;
- PLMN change;
- PDU session release;
- PDU session establishment;
- Downlink data delivery status;
- UE IP address/prefix change;
- QFI allocation;
- QoS monitoring;
- SM congestion control experience for PDU Session;
- Dispersion;
- Satellite backhaul category change;
- WLAN information for PDU Session;
- Redundant transmission experience for PDU Session;
- UPF events; and/or
- Traffic Correlation.

The types of observed events applicable for V-SMF include:

- Downlink data delivery status;
- UP Path Change (for the HR-SBO scenario).

The types of observed events applicable for I-SMF include:

- Downlink data delivery status;
- UPF events.

4.1.2 Service Architecture

The 5G System Architecture is defined in 3GPP TS 23.501 [2]. The Policy and Charging related 5G architecture is also described in 3GPP TS 29.513 [7].

The Session Management Event Exposure Service (Nsmf_EventExposure) is part of the Nsmf service-based interface exhibited by the Session Management Function (SMF).

The known NF service consumers of the Nsmf_EventExposure service are:

- Network Exposure Function (NEF),
- Access and Mobility Management Function (AMF),
- Application Function (AF),
- Unified Data Management (UDM),
- Network Data Analytics Function (NWDAF), and
- Data Collection Coordination Function (DCCF).

The PCF accesses the Session Management Event Exposure Service at the SMF via the N7 Reference point.

NOTE: The PCF can implicitly subscribe on behalf of the AF or NEF to the UP_PATH_CH, TRAFFIC_CORRELATION event and/or the QOS_MON event by including the information on AF or NEF subscription within the PCC rule.

The AMF accesses the Session Management Event Exposure Service at the SMF via the N11 Reference point.

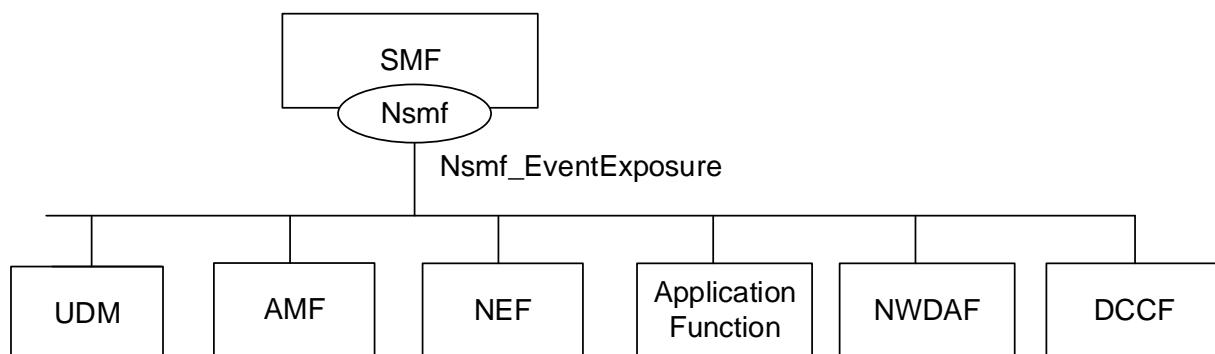


Figure 4.1.2-1: Reference Architecture for the Nsmf_EventExposure Service; SBI representation

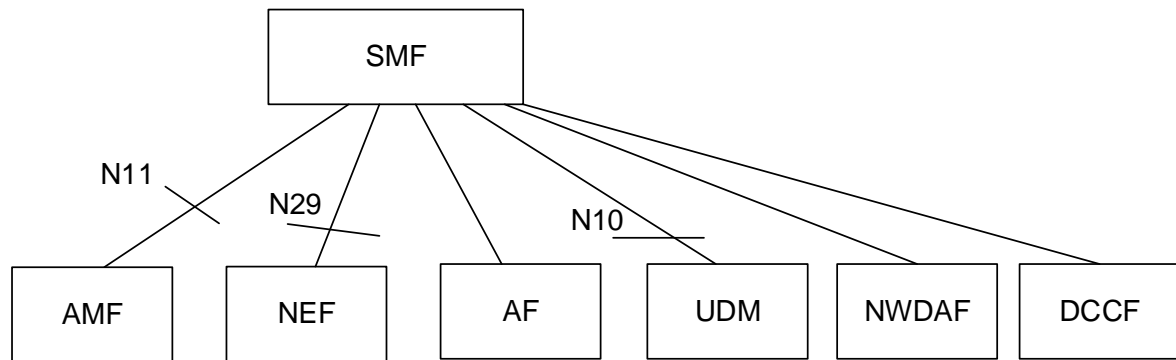


Figure 4.1.2-2: Reference Architecture for the Nsmf_EventExposure Service: reference point representation

4.1.3 Network Functions

4.1.3.1 Session Management Function (SMF)

The Session Management function (SMF) provides:

- Session Management e.g. Session establishment, modification and release;
- UE IP address allocation & management;
- Selection and control of UP function;
- Termination of interfaces towards Policy control functions; and
- Control part of policy enforcement and QoS.

4.1.3.2 NF Service Consumers

The Network Exposure Function (NEF);

- provides means to securely expose the services and capabilities provided by 3GPP network functions to e.g. 3rd parties or internal exposure consumer NF.

The Access and Mobility Management function (AMF) provides:

- Registration management;
- Connection management;
- Reachability management; and
- Mobility Management.

The Application Function (AF)

- interacts with the 3GPP Core Network to provide services.

The Unified Data Management (UDM).

- has access to subscriber information, can determine the SMF serving a user based on that data, and can then subscribe to event notifications for a user (e.g. when triggered by the NEF).

The Network Data Analytics Function (NWDAF)

- collects data based on event subscription provided by AMF, SMF, UPF, PCF, UDM, AF (directly or via NEF) and OAM;

- retrieves information about NFs;
- performs on demand provision of analytics to NF service consumers, as indicated in clause 6, 3GPP TS 23.288 [21].

The Data Collection Coordination Function (DCCF)

- coordinates the collection and distribution of data and analytics.

4.2 Service Operations

4.2.1 Introduction

Table 4.2.1-1: Operations of the Nsmf_EventExposure Service

Service operation name	Description	Initiated by
Notify	Report UE PDU session related event(s) to recipient of notification(s) which the NF service consumer has subscribed to the event report service.	(H-)SMF, V-SMF, I-SMF
Subscribe	This service operation is used by an NF service consumer to subscribe for event notifications on a specified PDU session, or for all PDU Sessions of one UE, a group of UE(s) or any UE, or to modify a subscription.	NF service consumers (e.g. AMF, NEF, AF, UDM, NWDAF, DCCF)
UnSubscribe	This service operation is used by an NF service consumer to unsubscribe from event notifications.	NF service consumers (e.g. AMF, NEF, AF, UDM, NWDAF, DCCF)
AppRelocationInfo	This service operation is used by an NF service consumer to acknowledge the notification from the SMF regarding UE PDU Session related event(s)	NF service consumers (e.g. NEF, AF)

NOTE: The Nsmf_TrafficCorrelation_Notify Service Operation defined in clause 5.2.8.5.2 of 3GPP TS 23.502 [3] is implemented as the "TRAFFIC_CORRELATION" event in the Nsmf_EventExposure_Notify Service Operation with "CommonEASDNAI" feature support.

4.2.2 Nsmf_EventExposure_Notify Service Operation

4.2.2.1 General

The Nsmf_EventExposure_Notify service operation enables the SMF (i.e. (H-)SMF, V-SMF and/or I-SMF) to send notifications to recipient of notification(s) subscribed by NF service consumers upon the occurrence of a previously subscribed event on the related PDU session.

The following procedure using the Nsmf_EventExposure_Notify service operation is supported:

- notification about subscribed events.

4.2.2.2 Notification about subscribed events

The present "notification about subscribed events" procedure is performed by the SMF when any of the subscribed events occur.

The following applies with respect to the detection of subscribed events:

- If:
 - the SMF supports the "DownlinkDataDeliveryStatus" feature,
 - the event "DDDS" is subscribed,

- the traffic descriptors of the downlink data source have been provided for that subscription, and
- the SMF is informed that the UE corresponding to that subscription is unreachable,
- if the data is buffered at the UPF, then the SMF shall interact with the UPF to notify that the UPF buffers the downlink packets. The SMF shall include the traffic descriptor of the subscriptions in the PDR with a higher priority if the PCC is not applied to the PDU session or derive the PDR from the PCC rule received from the PCF as defined in clause 4.2.4.27 of 3GPP TS 29.512 [14] if the PCC is applied to the PDU session and request the UPF to report when there are corresponding buffered downlink packets or discarded packets in the UPF as defined in clause 5.28.1 of 3GPP TS 29.244 [23]. When receiving the report from the UPF, the SMF shall determine whether that subscribed event with delivery status "DISCARDED" or "BUFFERED" occurred. The SMF shall determine that subscribed event with delivery status "TRANSMITTED" occurred by the fact that the related PDU session becomes ACTIVE.
- if the data is buffered at the SMF, the SMF shall determine whether that subscribed event occurred by comparing the downlink packets with the traffic descriptors received in the corresponding event subscription. If the SMF decides to buffer the packets, the subscribed event with delivery status "BUFFERED" occurred. If the SMF decides to discard the packets, the subscribed event with delivery status "DISCARDED" occurred. The SMF shall determine that subscribed event with delivery status "TRANSMITTED" occurred by the fact that the related PDU session becomes ACTIVE.

Figure 4.2.2.2-1 illustrates the notification about subscribed events.

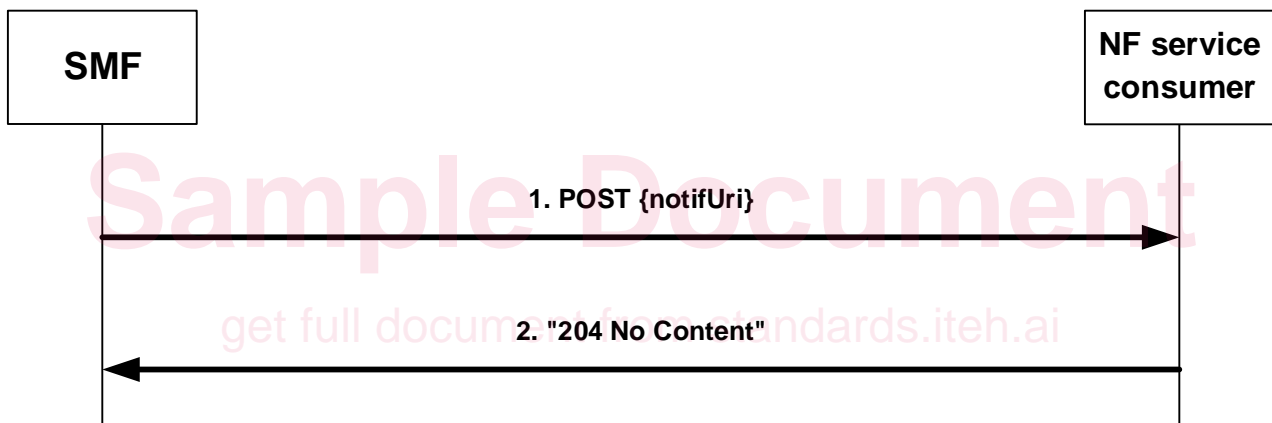


Figure 4.2.2.2-1: Notification about subscribed events

If the SMF observes PDU Session related event(s) for which an NF service consumer has subscribed, the SMF shall send an HTTP POST request with "{notifUri}", as previously provided by the NF service consumer within the corresponding subscription, as URI and NsmfEventExposureNotification data structure as request body that shall include:

- Notification correlation ID provided by the NF service consumer during the subscription, or as provided by the PCF for implicit subscription of UP path change and/or traffic correlation as defined in clause 4.2.6.2.6.2 of 3GPP TS 29.512 [14], or as provided by the PCF for implicit subscription of QoS Monitoring as defined in clause 4.2.3.25 of 3GPP TS 29.512 [14], as "notifId" attribute, or as provided by the V-NEF for implicit subscription of UP path change as defined in clause 4.4.2.4.2 of 3GPP TS 29.591 [28], as "upPathChgNotifCorreId" attribute within "eventNotifications" attribute; and
- information about the observed event(s) within the "eventNotifs" attribute that shall contain for each observed event an "EventNotification" data structure that shall include:
 1. the Event Trigger as "event" attribute;
 2. for a UP path change notification:
 - a) type of notification ("EARLY" or "LATE") as "dnaiChgType" attribute;
 - b) source DNAI and/or target DNAI as "sourceDnai" attribute and "targetDnai" attribute if DNAI is changed, respectively (NOTE 3); and

- c) if the PDU Session type is IP, for the source DNAI IP address/prefix of the UE as "sourceUeIpv4Addr" attribute or "sourceUeIpv6Prefix" attribute; and
- d) if the PDU Session type is IP, for the target DNAI IP address/prefix of the UE as "targetUeIpv4Addr" attribute or "targetUeIpv6Prefix" attribute;
- e) if available (NOTE 3), for the source DNAI, N6 traffic routing information related to the UE as "sourceTraRouting" attribute;
- f) if available (NOTE 3), for the target DNAI, N6 traffic routing information related to the UE as "targetTraRouting" attribute;
- g) if the PDU Session type is Ethernet, the MAC address of the UE in the "ueMac" attribute;
- h) if the "CommonEASDNAI" feature is supported,
 - the candidate DNAI(s) for the PDU Session in "candidateDnais" attribute, optionally together with the indication of their prioritization within the "candDnaisPrioInd" attribute, if the "candDnaiInd" attribute was set to "true" in the PCC rule(s); or
 - the indication of EAS re-discovery in "easRediscoverInd" attribute if EAS re-discovery took place.
- i) if both the SMF and the NF service consumer support "ULBuffering" and/or "EASIPreplacement" features, these supported features within the "supportedFeatures" attribute.

NOTE 1: The SMF gets the knowledge of the feature supported by the NF service consumer as described in clause 5.8.

- j) if the "EasRelocationEnh" feature is supported and the SMF determines that the target DNAI is supported by an AF different to the one that shall receive this notification, the identifier of the target AF that supports this DNAI in the "targetAFId" attribute.
- k) if the "HR-SBO" feature is supported and the SMF determines that the UE has moved to a serving PLMN in which local traffic offload is allowed, the identifier of this new serving PLMN within the "plmnId" attribute, as well as the DNN and S-SNSSAI of the HPLMN within the "dnn" and "snssai" attributes, respectively.

NOTE 2: The SMF can determine this by comparing the AF ID of the EAS Deployment Information entry that contains the old DNAI with the AF ID of the EAS Deployment Information entry that contains the target DNAI. These EAS Deployment Information entries are received via the Nnef_EASDeployment API defined in 3GPP TS 29.591 [25].

NOTE 3: UP path change notification, i.e. DNAI change notification and/or N6 traffic routing information change notification, can be the result of an implicit subscription of the PCF on behalf of the NEF/AF as part of setting PCC rule(s) via the Npcf_SMPolicyControl service (see clause 4.2.6.2.6.2 of 3GPP TS 29.512 [14]).

NOTE 4: If the DNAI is not changed while the N6 traffic routing information change, the source DNAI and target DNAI are not provided.

NOTE 5: The change from the UP path status where no DNAI applies to a status where a DNAI applies indicates the activation of the related AF request and therefore only the target DNAI and N6 traffic routing information is provided in the event notification; the change from the UP path status where a DNAI applies to a status where no DNAI applies indicates the de-activation of the related AF request and therefore only the source DNAI and N6 traffic routing information is provided in the event notification.

3. for a UE IP address change:
 - a) added new UE IP address or prefix as "adIpv4Addr" attribute or "adIpv6Prefix" attribute, respectively; and/or
 - b) released UE IP address or prefix as "reIpv4Addr" attribute or "reIpv6Prefix" attribute, respectively;
4. for an access type change:
 - a) new access type as "accType" attribute;

5. for a PLMN Change:
 - a) new PLMN as "plmnId" attribute;
 6. for a PDU Session Release:
 - a) ID of the released PDU session as "pduSeId" attribute;
 - b) DNN of the released PDU session as "dnn" attribute, if the "PduSessionStatus" feature is supported;
 - c) The type of the released PDU session as "pduSessType" attribute, if the "PduSessionStatus" feature is supported;
 - d) UE IPv4 address as "ipv4Addr" attribute and/or IPv6 information (IPv6 prefix(es) or IPv6 address(es)) as "ipv6Prefixes" or "ipv6Addrs" attributes, if the released PDU session type is IP and the "PduSessionStatus" feature is supported; and
 - e) S-NSSAI of the released PDU session as "snssai" attribute, if the "EneNA" feature is supported and "snssai" attribute is present in the subscribed "NsmfEventExposure" data type;
 7. the time at which the event was observed encoded as "timeStamp" attribute;
 8. the SUPI as the "supi" attribute if the subscription applies to a group of UE(s) or any UE. If the "WlanPerformanceExt_AIML" feature is supported, the "supi" attribute may also be included for a single UE when the subscription applies to the "WLAN_INFO" event;
 9. if available, the GPSI as the "gpsi" attribute if the subscription applies to a group of UE(s) or any UE;
 10. for a Downlink Data Delivery Status, if the "DownlinkDataDeliveryStatus" feature is supported:
 - a) the downlink data delivery status as "dddStatus" attribute;
 - b) the downlink data descriptors impacted by the downlink data delivery status change within the "dddTraDescriptor" attribute; and
 - c) for downlink data delivery status "BUFFERED". the estimated maximum waiting time as "maxWaitTime" attribute;
 11. for a Communication Failure, if the "CommunicationFailure" feature is supported:
 - a) the detailed communication failure information (e.g. 5G SM cause) as "commFailure" attribute; and
 12. for QoS Monitoring event, if the "QoSMonitoring" feature is supported:
 - a) the uplink packet delays within the "ulDelays" attribute; and/or
 - b) the downlink packet delays within the "dlDelays" attribute; and/or
 - c) the round trip packet delays within the "rtDelays" attribute; or
- NOTE 6: The UPF reports one UL, DL and/or round-trip packet delay measurement for each periodic and/or event-triggered report as described in 3GPP TS 29.244 [23]. i.e, the SMF can include only one element within the "ulDelays", "dlDelays", and/or "rtDelays" array(s), each one with the received report from the UPF for the UL, DL and/or round trip delay(s).
- d) if the feature "PacketDelayFailureReport" is supported, the packet delay measurement failure indicator within the "pdmf" attribute; and/or
 - e) if the feature "EnQoSMon" is supported, UL and/or DL congestion information within the "ulCongInfo" attribute and "dlCongInfo" attribute; and/or
 - f) if the feature "EnQoSMon" is supported, UL and/or DL data rate measurement within the "ulDataRate" attribute and/or "dlDataRate" attribute.

NOTE 7: The SMF gets the knowledge of the NF service consumer support of "QoSMonitoring", "PacketDelayFailureReport" and "EnQoSMon" features as described in 3GPP TS 29.512 [14].