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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:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
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  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present specification provides the stage 3 definition of the Network Data Analytics Function Services of the 5G System.

The 5G System Architecture is defined in 3GPP TS 23.501 [2]. The stage 2 definition and related procedures for Network Data Analytics Function Services are specified in 3GPP TS 23.288 [17] and 3GPP TS 23.503 [4].

The 5G System stage 3 call flows are provided in 3GPP TS 29.513 [5].

The Technical Realization of the Service Based Architecture and the Principles and Guidelines for Services Definition are specified in 3GPP TS 29.500 [6] and 3GPP TS 29.501 [7].

The Network Data Analytics Function Services are provided by the Network Data Analytics Function (NWDAF).

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] Void.

[4] 3GPP TS 23.503: "Policy and Charging Control Framework for the 5G System; Stage 2".

[5] 3GPP TS 29.513: "5G System; Policy and Charging Control signalling flows and QoS parameter mapping; Stage 3".

[6] 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".

[7] 3GPP TS 29.501: "5G System; Principles and Guidelines for Services Definition; Stage 3".

[8] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces; Stage 3".

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

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

[11] OpenAPI: "OpenAPI Specification Version 3.0.0", https://spec.openapis.org/oas/v3.0.0

[12] 3GPP TS 29.510: "5G System; Network Function Repository Services; Stage 3".

[13] 3GPP TS 33.501: "Security architecture and procedures for 5G system".

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

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

[16] 3GPP TR 21.900: "Technical Specification Group working methods".

[17] 3GPP TS 23.288: "Architecture enhancements for 5G System (5GS) to support network data analytics services".

[18] 3GPP TS 29.554: "5G System; Background Data Transfer Policy Control Service; Stage 3".

[19] 3GPP TS 29.122: "T8 reference point for Northbound APIs".

[20] 3GPP TS 29.523: "5G System; Policy Control Event Exposure Service; Stage 3".

[21] 3GPP TS 29.514: "5G System; Policy Authorization Service; Stage 3".

[22] 3GPP TS 29.517: "5G System; Application Function (AF) event exposure service".

[23] 3GPP TS 29.503: "5G System; Unified Data Management Services; Stage 3".

[24] 3GPP TS 29.531: "5G System; Network Slice Selection Services; 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].

5QI	5G QoS Identifier
AF	Application Function
AMF	Access and Mobility Management Function
API	Application Programming Interface
CEF	Charging Enablement Function
DCCF	Data Collection Coordination Function
DNN	Data Network Name
GFBR	Guaranteed Flow Bit Rate
HTTP	Hypertext Transfer Protocol
JSON	JavaScript Object Notation
MFAF	Messaging Framework Adaptor Function
ML	Machine Learning
MTLF	Model Training Logical Function
NEF	Network Exposure Function
NF	Network Function
NRF	Network Repository Function
NSSF	Network Slice Selection Function
NWDAF	Network Data Analytics Function
OAM	Operation, Administration, and Maintenance
PCF	Policy Control Function
SUPI	Subscription Permanent Identifier
S-NSSAI	Single Network Slice Selection Assistance Information
SMF	Session Management Function
UDM	Unified Data Management
UPF	User Plane Function
URI	Uniform Resource Identifier
UTC	Universal Time Coordinated

4 Services offered by the NWDAF

4.1 Introduction

The Nnwdaf services are used for the NWDAF to provide specific analytics information.

Analytics information is either statistical information of past events, or predictive information.

The following services are specified for the NWDAF:

Table 4.1-1: Services provided by NWDAF

Service Name	Description	Service Operations	Operation Semantics	Example Consumer(s)
Nnwdaf_EventsSubscription (NOTE)	This service enables the NF service consumers to subscribe to/unsubscribe from notifications for different analytics information from the NWDAF.	Subscribe Unsubscribe Notify	Subscribe / Notify	PCF, NSSF, AMF, SMF, NEF, UDM, AF, OAM, CEF, NWDAF
Nnwdaf_AnalyticsInfo	This service enables the NF service consumers to request and get specific analytics from the NWDAF.	Request	Request / Response	PCF, NSSF, AMF, SMF, NEF, UDM, AF, OAM, NWDAF
Nnwdaf_DataManagement	This service enables the NF service consumers to subscribe to/unsubscribe from notifications when subscribed event(s) are detected or retrieve the subscribed data from the NWDAF.	Subscribe Unsubscribe Notify	Subscribe / Notify	NWDAF, DCCF, MFAF
		Fetch	Request / Response	NWDAF, DCCF, MFAF
Nnwdaf_MLModelProvision	This service enables the NF service consumers to subscribe to/unsubscribe from notifications when a ML model matching the subscription parameters becomes available.	Subscribe Unsubscribe Notify	Subscribe / Notify	NWDAF
NOTE: This service corresponds to the Nnwdaf_AnalyticsSubscription service defined in 3GPP TS 23.288 [17].				

Table 4.1-2 summarizes the corresponding APIs defined in this specification.

Table 4.1-2: API Descriptions

Service Name	Clause	Description	OpenAPI Specification File	apiName	Annex
Nnwdaf_EventsSubscription	5.1	Nnwdaf Events Subscription Service.	TS29520_Nnwdaf_EventsSubscription.yaml	nnwdaf-eventssubscription	A.2
Nnwdaf_AnalyticsInfo	5.2	Nnwdaf Analytics Information Service	TS29520_Nnwdaf_AnalyticsInfo.yaml	nnwdaf-analyticsinfo	A.3
Nnwdaf_DataManagement	5.3	NWDAF Data Management Service	TS29520_Nnwdaf_DataManagement.yaml	nnwdaf-datamanagement	A.4
Nnwdaf_MLModelProvision	5.4	NWDAF ML Model Provision Service	TS29520_Nnwdaf_MLModelProvision.yaml	nnwdaf-mlmodelprovision	A.5

4.2 Nnwdaf_EventsSubscription Service

4.2.1 Service Description

4.2.1.1 Overview

The Nnwdaf_EventsSubscription Service corresponding to Nnwdaf_AnalyticsSubscription Service as defined in 3GPP TS 23.501 [2], 3GPP TS 23.288 [17] and 3GPP TS 23.503 [4], is provided by the Network Data Analytics Function (NWDAF).

This service:

- allows NF consumers to subscribe to and unsubscribe from different analytic events; and
- notifies NF consumers with a corresponding subscription about observed events.

The types of observed events include:

- Slice load level information;
- Network slice instance load level information;
- Service experience;
- NF load;
- Network performance;
- Abnormal behaviour;
- UE mobility;
- UE communication;
- User data congestion; and
- QoS sustainability.

4.2.1.2 Service Architecture

The 5G System Architecture is defined in 3GPP TS 23.501 [2]. The Network Data Analytics Exposure architecture is defined in 3GPP TS 23.288 [17]. The Policy and Charging related 5G architecture is also described in 3GPP TS 23.503 [4] and 3GPP TS 29.513 [5].

The Nnwdaf_EventsSubscription service is part of the Nnwdaf service-based interface exhibited by the Network Data Analytics Function (NWDAF).

Known consumers of the Nnwdaf_EventsSubscription service are:

- Policy Control Function (PCF)
- Network Slice Selection Function (NSSF)
- Access and Mobility Management Function (AMF)
- Session Management Function (SMF)
- Network Exposure Function (NEF)
- Unified Data Management (UDM)
- Application Function (AF)
- Operation, Administration, and Maintenance (OAM)
- Charging Enablement Function (CEF)
- Network Data Analytics Function (NWDAF)

The PCF accesses the Nnwdaf_EventsSubscription service at the NWDAF via the N23 Reference point. The NSSF accesses the Nnwdaf_EventsSubscription service at the NWDAF via the N34 Reference point.

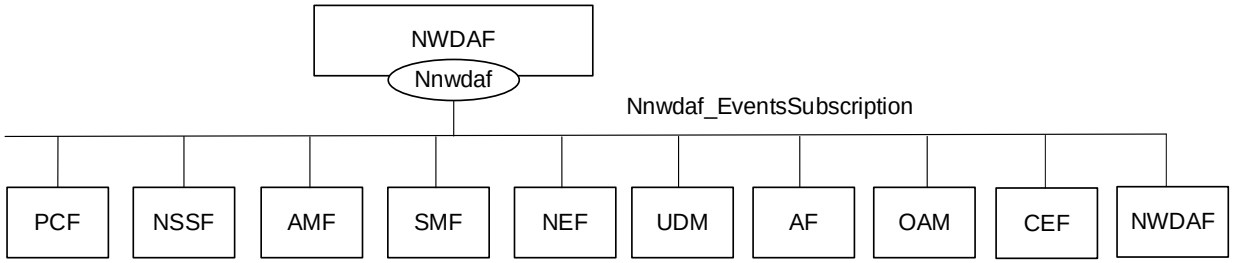

Figure 4.2.1.2-1: Reference Architecture for the Nnwdaf_EventsSubscription Service; SBI representation

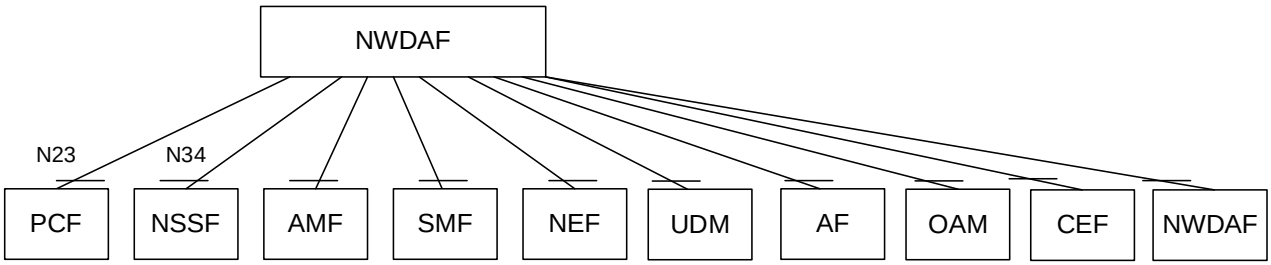

Figure 4.2.1.2-2: Reference Architecture for the Nnwdaf_EventsSubscription Service: reference point representation

4.2.1.3 Network Functions

4.2.1.3.1 Network Data Analytics Function (NWDAF)

The Network Data Analytics Function (NWDAF) provides analytics information for different analytic events to NF consumers.

The Network Data Analytics Function (NWDAF) allows NF consumers to subscribe to and unsubscribe from one-time, periodic notification or notification when an event is detected.

4.2.1.3.2 NF Service Consumers

The Policy Control Function (PCF):

- supports (un)subscription to the notification of analytics information for slice load level information from the NWDAF;
- supports (un)subscription to the notification of analytics information for service experience related network data from the NWDAF;
- supports (un)subscription to the notification of analytics information for network performance from the NWDAF;
- supports (un)subscription to the notification of analytics information for abnormal UE behaviour from the NWDAF;
- supports (un)subscription to the notification of analytics information for QoS sustainability from NWDAF;
- supports taking one or more above input from NWDAF into consideration for policies on assignment of network resources and/or for traffic steering policies.

NOTE: How this information is used by the PCF is not standardized in this release of the specification.

The Network Slice Selection Function (NSSF):

- supports (un)subscription to the notification of analytics information for slice load level information or network slice instance load level information from NWDAF to determine slice selection.
- supports (un)subscription to the notification of analytics information for service experience related network data from the NWDAF;

The Access and Mobility Management Function (AMF):

- supports (un)subscription to the notification of analytics information for SMF load information from NWDAF to determine SMF selection;
- supports (un)subscription to the notification of analytics information for expected UE behavioural information (UE mobility and/or UE communication) from NWDAF to monitor UE behaviour;
- supports (un)subscription to the notification of analytics information for abnormal UE behaviour information from NWDAF to determine adjustment of UE mobility related network parameters to solve the abnormal risk.

The Session Management Function (SMF):

- supports (un)subscription to the notification of analytics information for UPF load information from NWDAF to determine UPF selection;
- supports (un)subscription to the notification of analytics information for expected UE behavioural information (UE mobility and/or UE communication) from NWDAF to monitor UE behaviour;
- supports (un)subscription to the notification of analytics information for abnormal UE behaviour information from NWDAF to determine adjustment of UE communicationrelated network parameters to solve the abnormal risk.
- supports (un)subscription to the notification of analytics information for slice load level information or network slice instance load level information from NWDAF to determine slice selection.
- supports (un)subscription to the notification of analytics information for service experience related network data from the NWDAF;

The Network Exposure Function (NEF):

- supports forwarding UE mobility information from NWDAF to the AF when it is untrusted;
- supports forwarding UE communication information from NWDAF to the AF when it is untrusted;

- supports forwarding expected UE behavioural information (UE mobility and/or UE communication) from NWDAF to the AF when it is untrusted;
- supports forwarding abnormal behaviour information from NWDAF to the AF when it is untrusted;
- supports forwarding user data congestion information from NWDAF to the AF when it is untrusted;
- supports forwarding network performance information from NWDAF to the AF when it is untrusted;
- supports forwarding QoS Sustainability information from NWDAF to the AF when it is untrusted.

The Unified Data Management (UDM):

- supports taking expected UE behaviour information (UE mobility and/or UE communication) from NWDAF into consideration for monitoring UE behaviour.

The Application Function (AF):

- supports receiving UE mobility information from NWDAF or via the NEF;
- supports receiving UE communication information from NWDAF or via the NEF;
- supports receiving expected UE behavioural information (UE mobility and/or UE communication) from NWDAF or via the NEF;
- supports receiving abnormal behaviour information from NWDAF or via the NEF;
- supports receiving user data congestion information from NWDAF or via the NEF;
- supports receiving network performance information from NWDAF or via the NEF;
- supports receiving QoS Sustainability information from NWDAF or via the NEF.

The Operation, Administration, and Maintenance (OAM):

- supports receiving observed service experience from NWDAF;
- supports receiving NF load information from NWDAF;
- supports receiving network performance information from NWDAF;
- supports receiving UE mobility information from NWDAF;
- supports receiving UE communication information from NWDAF;
- supports receiving expected UE behaviour information (UE mobility and/or UE communication) from NWDAF;
- supports receiving abnormal UE behaviour information from NWDAF.

The Charging Enablement Function (CEF):

- supports (un)subscription to the notification of analytics information for slice load level information from the NWDAF;
- supports (un)subscription to the notification of analytics information for service experience statistics information from the NWDAF.

The Network Data Analytics Function (NWDAF):

- supports (un)subscription to the notification of analytics information for all types of network analytics from the NWDAF.

4.2.2 Service Operations

4.2.2.1 Introduction

Table 4.2.2.1-1: Operations of the Nnwdaf_EventsSubscription Service

Service operation name	Description	Initiated by
Nnwdaf_EventsSubscription_Subscribe	This service operation is used by an NF to subscribe or update subscription for event notifications of the analytic information. One-time, periodic notification or notification upon event detected can be subscribed.	NF consumer (PCF, NSSF, AMF, SMF, NEF, UDM, AF, OAM, CEF, NWDAF)
Nnwdaf_EventsSubscription_UnSubscribe	This service operation is used by an NF to unsubscribe from event notifications.	NF consumer (PCF, NSSF, AMF, SMF, NEF, UDM, AF, OAM, CEF, NWDAF)
Nnwdaf_EventsSubscription_Notify	This service operation is used by an NWDAF to notify NF consumers about subscribed events.	NWDAF

4.2.2.2 Nnwdaf_EventsSubscription_Subscribe service operation

4.2.2.2.1 General

The Nnwdaf_EventsSubscription_Subscribe service operation is used by an NF service consumer to subscribe or update subscription for event notifications from the NWDAF.

4.2.2.2.2 Subscription for event notifications

Figure 4.2.2.2.2-1 shows a scenario where the NF service consumer sends a request to the NWDAF to subscribe for event notification(s) (as shown in 3GPP TS 23.288 [17]).

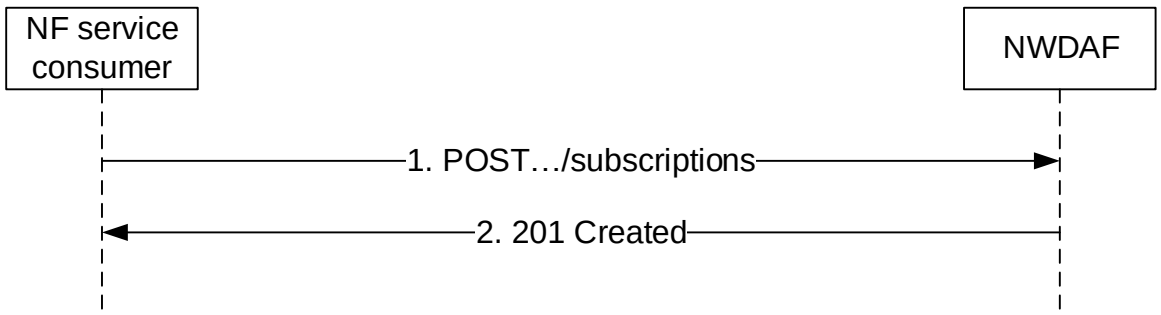

Figure 4.2.2.2.2-1: NF service consumer subscribes to notifications

The NF service consumer shall invoke the Nnwdaf_EventsSubscription_Subscribe service operation to subscribe to event notification(s). The NF service consumer shall send an HTTP POST request with "{apiRoot}/nnwdaf-eventssubscription/v1/subscriptions" as Resource URI representing the "NWDAF Events Subscriptions", as shown in figure 4.2.2.2.2-1, step 1, to create a subscription for an "Individual NWDAF Event Subscription" according to the information in message body. The NnwdafEventsSubscription data structure provided in the request body shall include:

- an URI where to receive the requested notifications as "notificationURI" attribute; and
- a description of the subscribed events as "eventSubscriptions" attribute that, for each event, the EventSubscription data type shall include

  1) an event identifier as "event" attribute; and

  2) if the event notification method "PERIODIC" is selected via the "notificationMethod" attribute, repetition period as "repetitionPeriod" attribute;

  and may include:

1) maximum number of objects in the "maxObjectNbr" attribute;

2) maximum number of SUPIs expected for an analytics report in the "maxSupiNbr" attribute;

3) identification of time window to which the subscription applies via identification of date-time(s) in the "startTs" and "endTs" attributes;

4) preferred level of accuracy of the analytics in the "accuracy" attribute;

5) identification of time when analytics information is needed in the "timeAnaNeeded" atribute if the feature "EneNA" is supported;

6) indication of which analytics metadata is requested to be delivered with the notification in the "anaMeta" attribute if the feature "Aggregation" is supported; and/or

7) requested values for analytics metadata information to be used for the generation of the analytics in the "anaMetaInd" attribute if the feature "Aggregation" is supported.

The NnwdafEventsSubscription data structure provided in the request body may include:

- event reporting information as the "evtReq" attribute, which applies for each event and may contain the following attributes:

  1) event notification method (periodic, one time, on event detection) in the "notifMethod" attribute;

  2) maximum Number of Reports in the "maxReportNbr" attribute;

  3) monitoring duration in the "monDur" attribute;

  4) repetition period for periodic reporting in the "repPeriod" attribute;

  5) immediate reporting indication in the "immRep" attribute;

  6) percentage of sampling among impacted UEs in the "sampRatio" attribute;

  7) partitioning criteria for partitioning the impacted UEs before performing sampling as "partitionCriteria" attribute if the EneNA feature is supported; and/or

  8) group reporting guard time for aggregating the reports for a group of UEs in the "grpRepTime" attribute;

NOTE 1: The notification method indicated as the "notifMethod" attribute and the periodic reporting time indicated as the "repPeriod" attributes within the event reporting information as the "evtReq" attribute provided in NnwdafEventsSubscription data type, if present, supersedes the event notification method as the "notificationMethod" attribute and repetition period as the "repetitionPeriod" attribute respectively in the EventSubscription data type.

For different event types, the "eventSubscriptions" attribute:

- if the event is "SLICE_LOAD_LEVEL", shall provide:

  1) Network slice level load level threshold in the "loadLevelThreshold" attribute if the "notifMethod" attribute in "evtReq" attribute is set to "ON_EVENT_DETECTION" or the "notificationMethod" attribute in "eventSubscriptions" attribute is set to "THRESHOLD" or omitted; and

  2) identification of network slice(s) to which the subscription applies via identification of network slice(s) in the "snssais" attribute or any slices indication in the "anySlice" attribute;

- if the feature "NsiLoad" is supported and the event is "NSI_LOAD_LEVEL", shall provide:

  1) identification of network slice and the optionally associated network slice instance(s) if available, via the "nsiIdInfos" attribute or any slices indication in the "anySlice" attribute;

NOTE 2: The network slice instance of a PDU session is not available in the PCF.

  2) the network slice or network slice instance load level thresholds in the "nsiLevelThrds" attribute if the "notifMethod" attribute in "evtReq" attribute is set to "ON_EVENT_DETECTION" or the "notificationMethod" attribute in "eventSubscriptions" attribute is set to "THRESHOLD" or omitted;

- if the feature "NfLoad" is supported and the event is "NF_LOAD", shall provide:

  1) identification of target UE(s) to which the subscription applies by "supis" or "anyUe" in the "tgtUe" attribute; and

  2) NF load level thresholds in the "nfLoadLvlThds" attribute if the "notifMethod" attribute in "evtReq" attribute is set to "ON_EVENT_DETECTION" or the "notificationMethod" attribute in "eventSubscriptions" attribute is set to "THRESHOLD" or omitted;

  and may include:

  1) either list of NF instance IDs in the "nfInstanceIds" attribute or list of NF set IDs in the "nfSetIds" attribute if the identification of target UE(s) applies to all UEs;

  2) list of NF instance types in the "nfTypes" attribute;

  3) identification of network slice(s) by "snssais" attribute; and/or

  4) a matching direction in the "matchingDir" attribute if the "nfLoadLvlThds" attribute is provided.

- if the feature "NetworkPerformance" is supported and the event is "NETWORK_PERFORMANCE", it shall provide:

  1) identification of target UE(s) to which the subscription applies by "supis", "intGroupIds" or "anyUe" attribute in the "tgtUe" attribute; and

  2) The network performance requirements via "nwPerfRequs" attribute;

  and may provide:

  1) identification of network area to which the subscription applies via identification of network area by "networkArea" attribute (mandatory if "anyUe" attribute is set to true);

  2) a matching direction in the "matchingDir" attribute if the "nwPerfRequs" attribute is provided;

- if the feature "ServiceExperience" is supported and the event is "SERVICE_EXPERIENCE", shall provide:

  1) identification of target UE(s) to which the subscription applies by "supis", "intGroupIds" or "anyUe" attribute in the "tgtUe" attribute;

  2) any slices indication in the "anySlice" attribute or identification of network slice(s) together with the optionally associated network slice instance(s) if available, via the "nsiIdInfos" attribute;

NOTE 3: The network slice instance of a PDU session is not available in the PCF.

  and may provide:

  1) identification of application to which the subscription applies via identification of application(s) by "appIds" attribute;

  2) identification of network area to which the subscription applies via identification of network area(s) by "networkArea" attribute (mandatory if "anyUe" attribute is set to true);

  3) identification of DNN to which the subscription applies via identification of application(s) by "dnns" attribute; and

  4) identification of a user plane access to one or more DN(s) where applications are deployed by "dnais" attribute;

  5) if "appIds" attribute is provided, the bandwidth requirement of each application by "bwRequs" attribute.

- if the feature "UeMobility" is supported and the event is "UE_MOBILITY", shall provide:

  1) identification of target UE(s) to which the subscription applies by "supis" or "intGroupIds" attribute in the "tgtUe" attribute;

  and may provide:

1) identification of network area to which the subscription applies via identification of network area by "networkArea" attribute;

- if the feature "UeCommunication" is supported and the event is "UE_COMM", shall provide:

  1) identification of target UE(s) to which the subscription applies by "supis" or "intGroupIds" attribute in the "tgtUe" attribute;

  and may provide:

  1) identification of the application in the "appIds" attribute;

  2) identification of network area to which the subscription applies via identification of network area by "networkArea" attribute;

  3) an identification of DNN in the "dnns" attribute; and/or

  4) identification of network slice in the "snssais" attribute;

- if the feature "QoSSustainability" is supported and the event is "QOS_SUSTAINABILITY", shall provide:

  1) identification of network area to which the subscription applies via identification of network area by "networkArea" attribute;

  2) The QoS requirements via "qosRequ" attribute;

  3) QoS flow retainability threshold(s) by the "qosFlowRetThds" attribute for the 5QI of GBR resource type or RAN UE throughout threshold(s) by the "ranUeThrouThds" attribute for the 5QI of non-GBR resource type, if the "notifMethod" attribute in "evtReq" attribute is set to "ON_EVENT_DETECTION" or the "notificationMethod" attribute in "eventSubscriptions" attribute is set to "THRESHOLD" or omitted; and

  4) identification of target UE(s) to which the subscription applies by "anyUe" in the "tgtUe" attribute;

  and may include:

  1) identification of network slice(s) by "snssais" attribute;

  2) a matching direction in the "matchingDir" attribute if the "qosFlowRetThds" attribute or the "ranUeThrouThds" attribute is provided;

- if the feature "AbnormalBehaviour" is supported and the event is "ABNORMAL_BEHAVIOUR", shall provide:

  1) identification of target UE(s) to which the subscription applies by "supis", "intGroupIds" or "anyUe" attribute in the "tgtUe" attribute; and

  2) either the expected analytics type via "exptAnaType" attribute or a list of exception Ids with the associated thresholds via "excepRequs" attribute. If the expected analytics type via "exptAnaType" attribute is provided, the NWDAF shall derive the corresponding Exception Ids from the received expected analytics type as follows:

     a) if "exptAnaType" attribute sets to "MOBILITY", the corresponding list of Exception Ids are "UNEXPECTED_UE_LOCATION", "PING_PONG_ACROSS_CELLS", "UNEXPECTED_WAKEUP" and "UNEXPECTED_RADIO_LINK_FAILURES";

     b) if "exptAnaType" attribute sets to "COMMUN", the corresponding list of Exception Ids are "UNEXPECTED_LONG_LIVE_FLOW", "UNEXPECTED_LARGE_RATE_FLOW", "SUSPICION_OF_DDOS_ATTACK", "WRONG_DESTINATION_ADDRESS" and "TOO_FREQUENT_SERVICE_ACCESS";

     c) if "exptAnaType" attribute sets to "MOBILITY_AND_COMMUN", the corresponding list of Exception Ids includes all above derived exception Ids.

     The derived list of Exception Ids are used by the NWDAF to notify the NF service consumer when UE's behaviour is exceptional based on one or more Exception Ids within the list.

     If the "anyUe" attribute in the "tgtUe" attribute sets to "true",

a) the expected analytics type via the"exptAnaType" attribute or the list of Exception Ids via "excepRequs" attribute shall not be requested for both mobility and communication related analytics at the same time.

b) if the expected analytics type via the"exptAnaType" attribute or the list of Exception Ids via "excepRequs" attribute is mobility related, at least one of identification of network area by "networkArea" attribute and identification of network slice(s) by "snssais" attribute should be provided;

c) if the expected analytics type via the"exptAnaType" attribute or the list of Exception Ids via "excepRequs" attribute is communication related, at least one of identification of network area by "networkArea" attribute, identification of application(s) by "appIds" attribute, identification of DNN(s) in the "dnns" attribute and identification of network slice(s) by "snssais" attribute should be provided;

and may provide:

1) expected UE behaviour via "exptUeBehav" attribute.

- if the feature "UserDataCongestion" is supported and the event is "USER_DATA_CONGESTION", shall provide:

  1) identification of target UE(s) to which the subscription applies by "supis", "gpsis" (if feature "UserDataCongestionExt" is supported) or "anyUe" attribute;

  and may include:

  1) congestion threshold by the "congThresholds" attribute if the "notifMethod" attribute in "evtReq" attribute is set to "ON_EVENT_DETECTION" or the "notificationMethod" attribute in "eventSubscriptions" attribute is set to "THRESHOLD" or omitted;

  2) identification of network area to which the subscription applies via identification of network area by "networkArea" attribute (mandatory if "anyUe" attribute is set to true);

  3) identification of network slice(s) by "snssais" attribute;

  4) a matching direction in the "matchingDir" attribute if the "congThresholds" attribute is provided; and/or

  5) if the feature "UserDataCongestionExt" is also supported, indications to request a list of top applications that contribute the most to the traffic in uplink and/or downlink directions upon the "topAppListUlInd" attribute and/or the "topAppListDlInd" attribute.

Upon the reception of an HTTP POST request with: "{apiRoot}/nnwdaf-eventssubscription/v1/subscriptions" as Resource URI and NnwdafEventsSubscription data structure as request body, the NWDAF shall:

- create a new subscription;
- assign an event subscriptionId;
- store the subscription.

If the NWDAF created an "Individual NWDAF Event Subscription" resource, the NWDAF shall respond with "201 Created" with the message body containing a representation of the created subscription, as shown in figure 4.2.2.2.2-1, step 2. If not all the requested analytics events in the subscription are accepted, then the NWDAF may include the "failEventReports" attribute indicating the event(s) for which the subscription failed and the associated reason(s). The NWDAF shall include a Location HTTP header field. The Location header field shall contain the URI of the created subscription i.e. "{apiRoot}/nnwdaf-eventssubscription/v1/subscriptions/{subscriptionId}". If the immediate reporting indication in the "immRep" attribute within the "evtReq" attribute sets to true in the event subscription, the NWDAF shall include the reports of the events subscribed, if available, in the HTTP POST response.

4.2.2.2.3 Update subscription for event notifications

Figure 4.2.2.2.3-1 shows a scenario where the NF service consumer sends a request to the NWDAF to update the subscription for event notifications (see also 3GPP TS 23.288 [17]).

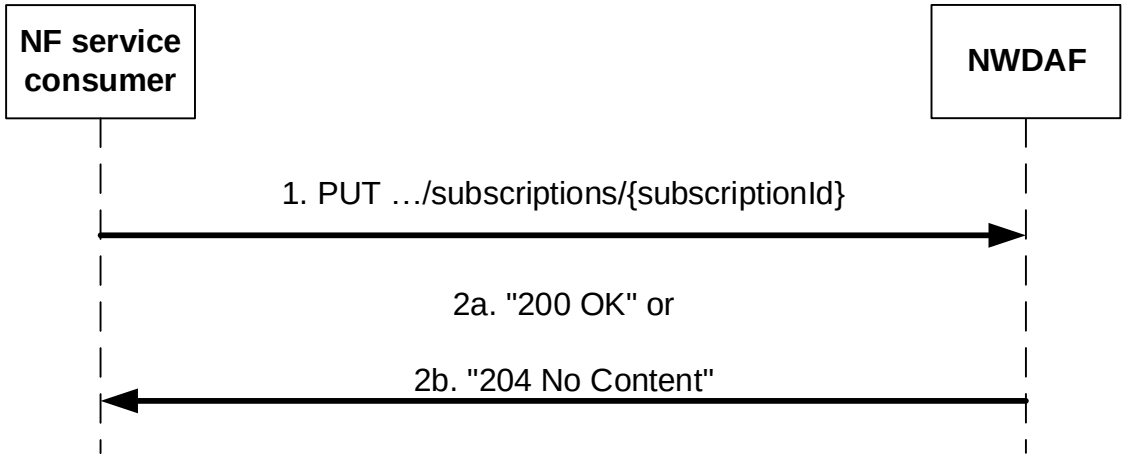

Figure 4.2.2.2.3-1: NF service consumer updates subscription to notifications

The NF service consumer shall invoke the Nnwdaf_EventsSubscription_Subscribe service operation to update subscription to event notifications. The NF service consumer shall send an HTTP PUT request with "{apiRoot}/nnwdaf-eventssubscription/v1/subscriptions/{subscriptionId}" as Resource URI representing the "Individual NWDAF Event Subscription", as shown in figure 4.2.2.2.3-1, step 1, to update the subscription for an "Individual NWDAF Event Subscription" resource identified by the {subscriptionId}. The NnwdafEventsSubscription data structure provided in the request body shall include the same contents as described in subclause 4.2.2.2.2:

Upon the reception of an HTTP PUT request with: "{apiRoot}/nnwdaf-eventssubscription/v1/subscriptions/{subscriptionId}" as Resource URI and NnwdafEventsSubscription data structure as request body, the NWDAF shall:

- update the subscription of corresponding subscriptionId; and
- store the subscription.

NOTE: The "notificationURI" attribute within the NnwdafEventsSubscription data structure can be modified to request that subsequent notifications are sent to a new NF service consumer.

If the NWDAF successfully processed and accepted the received HTTP PUT request, the NWDAF shall update an "Individual NWDAF Event Subscription" resource, and shall respond with:

a) HTTP "200 OK" status code with the message body containing a representation of the updated subscription, as shown in figure 4.2.2.2.3-1, step 2a. If not all the requested analytics events in the subscription are modified successfully, then the NWDAF may include the "failEventReports" attribute indicating the event(s) for which the modification failed and the associated reason(s); or

b) HTTP "204 No Content" status code, as shown in figure 4.2.2.2.3-1, step 2b.

If errors occur when processing the HTTP PUT request, the NWDAF shall send an HTTP error response as specified in subclause 5.1.7

If the Individual NWDAF Event Subscription resource does not exist, the NWDAF shall respond with "404 Not Found".

If the feature "ES3XX" is supported, and the NWDAF determines the received HTTP PUT request needs to be redirected, the NWDAF shall send an HTTP redirect response as specified in subclause 6.10.9 of 3GPP TS 29.500 [6].

4.2.2.3 Nnwdaf_EventsSubscription_Unsubscribe service operation

4.2.2.3.1 General

The Nnwdaf_EventsSubscription_Unsubscribe service operation is used by an NF service consumer to unsubscribe from event notifications.

4.2.2.3.2 Unsubscribe from event notifications

Figure 4.2.2.3.2-1 shows a scenario where the NF service consumer sends a request to the NWDAF to unsubscribe from event notifications (see also 3GPP TS 23.288 [17]).

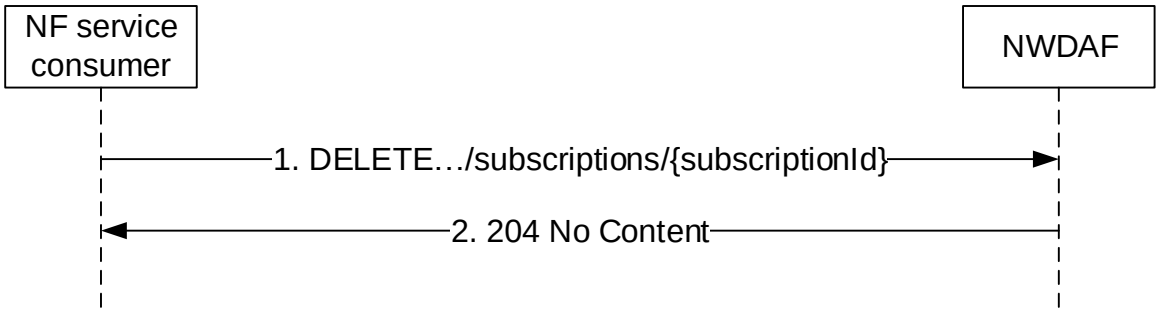

Figure 4.2.2.3.2-1: NF service consumer unsubscribes from notifications

The NF service consumer shall invoke the Nnwdaf_EventsSubscription_UnSubscribe service operation to unsubscribe to event notifications. The NF service consumer shall send an HTTP DELETE request with: "{apiRoot}/nnwdaf-eventssubscription/v1/subscriptions/{subscriptionId}" as Resource URI, where "{subscriptionId}" is the event subscriptionId of the existing subscription that is to be deleted.

Upon the reception of an HTTP DELETE request with: "{apiRoot}/nnwdaf-eventssubscription/v1/subscriptions/{subscriptionId}" as Resource URI, if the NWDAF successfully processed and accepted the received HTTP DELETE request, the NWDAF shall:

- remove the corresponding subscription;
- respond with HTTP "204 No Content" status.

If errors occur when processing the HTTP DELETE request, the NWDAF shall send an HTTP error response as specified in subclause 5.1.7

If the Individual NWDAF Event Subscription resource does not exist, the NWDAF shall respond with "404 Not Found".

If the feature "ES3XX" is supported, and the NWDAF determines the received HTTP DELETE request needs to be redirected, the NWDAF shall send an HTTP redirect response as specified in subclause 6.10.9 of 3GPP TS 29.500 [6].

4.2.2.4 Nnwdaf_EventsSubscription_Notify service operation

4.2.2.4.1 General

The Nnwdaf_EventsSubscription_Notify service operation is used by an NWDAF to notify NF consumers about subscribed events.

4.2.2.4.2 Notification about subscribed event

Figure 4.2.2.4.2-1 shows a scenario where the NWDAF sends a request to the NF Service Consumer to notify for event notifications (see also 3GPP TS 23.288 [17]).

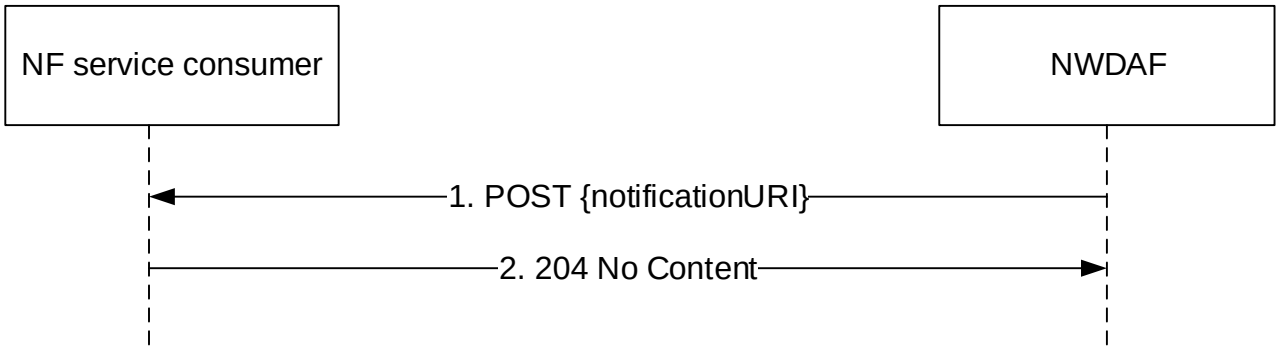

Figure 4.2.2.4.2-1: NWDAF notifies the subscribed event

The NWDAF shall invoke the Nnwdaf_EventsSubscription_Notify service operation to notify the subscribed event. The NWDAF shall send an HTTP POST request with "{notificationURI}" received in the Nnwdaf_EventsSubscription_Subscribe service operation as Resource URI, as shown in figure 4.2.2.4.2-1, step 1. The NnwdafEventsSubscriptionNotification data structure provided in the request body shall include:

- a description of the notified event as "eventNotifications" attribute that for each event shall include:

  a) an event identifier as "event" attribute;

  b) network slice load level information in the "sliceLoadLevelInfo" attribute when subscribed event is "SLICE_LOAD_LEVEL";

  c) service experience information as "svcExps" attribute when subscribed event is "SERVICE_EXPERIENCE";

  d) UE mobility information in the "ueMobs" attribute when subscribed event is "UE_MOBILITY";

  e) UE communication information in the "ueComms" attribute when subscribed event is "UE_COMM";

  f) Abnormal behaviour information in the "abnorBehavrs" attribute when subscribed event is "ABNORMAL_BEHAVIOUR";

  g) User data congestion information in the "userDataCongInfos" attribute when subscribed event is "USER_DATA_CONGESTION";

  h) QoS sustainability information in the "qosSustainInfos" attribute when subscribed event is "QOS_SUSTAINABILITY";

  i) NF load information in "nfLoadLevelInfos" attribute when subscribed event is "NF_LOAD";

  j) Network performance information in the "nwPerfs" attribute when subscribed event is "NETWORK_PERFORMANCE"; and

  k) Load level information for the network slice(s) and the optionally associated network slice instance(s) in "nsiLoadLevelInfos" attribute when subscribed event is "NSI_LOAD_LEVEL";

  and may include:

  a) Information about analytics metadata required for aggregation of the analytics in the "anaMetaInfo" attribute if the feature "Aggregation" is supported.

- an event subscriptionId as "subscriptionId" attribute.

If the feature "EneNA" is supported and the time when analytics information is needed has been provided (via the "timeAnaNeeded" attribute within the "extraReportReq" attribute) during the subscription for an event (via the "event" attribute within the EventSubscription data type), if the time when analytics information is needed is reached but the subscribed analytics information is not ready, the consumer does not need to wait for the analytics information any longer. In this case, the NWDAF may send an HTTP POST request as shown in step 1 of figure 4.2.2.4.2-1, which shall only provide (within the EventNotification data type in the NnwdafEventsSubscriptionNotification data type) an indication of the failure event via the "event" attribute and the corresponding failure reason via a "failNotifyCode" attribute, and may also provide a minimum time interval recommended by the NWDAF for the event via a

"rvWaitTime" attribute which will be used by the NF service consumer to determine the time when analytics information is needed in similar future analytics subscriptions.

Upon the reception of an HTTP POST request with: "{notificationURI}" as Resource URI and NnwdafEventsSubscriptionNotification data structure as request body, if the NF service consumer successfully processed and accepted the received HTTP POST request, the NF Service Consumer shall:

- store the notification;
- respond with HTTP "204 No Content" status code.

If errors occur when processing the HTTP POST request, the NF service consumer shall send an HTTP error response as specified in subclause 5.1.7.

If the feature "ES3XX" is supported, and the NF service consumer determines the received HTTP POST request needs to be redirected, the NF service consumer shall send an HTTP redirect response as specified in subclause 6.10.9 of 3GPP TS 29.500 [6].

4.3 Nnwdaf_AnalyticsInfo Service

4.3.1 Service Description

4.3.1.1 Overview

The Nnwdaf_AnalyticsInfo Service as defined in 3GPP TS 23.501 [2], 3GPP TS 23.288 [17] and 3GPP TS 23.503 [4], is provided by the Network Data Analytics Function (NWDAF).

This service:

- allows NF consumers to request and get different type of analytic event information.

The types of observed events include:

- Slice load level information;
- Network slice instance load level information;
- Service experience;
- NF load;
- Network performance;
- Abnormal behaviour;
- UE mobility;
- UE communication;
- User data congestion; and
- QoS sustainability.

4.3.1.2 Service Architecture

The 5G System Architecture is defined in 3GPP TS 23.501 [2]. The Network Data Analytics Exposure architecture is defined in 3GPP TS 23.288 [17]. The Policy and Charging related 5G architecture is also described in 3GPP TS 23.503 [4] and 3GPP TS 29.513 [5].

The Nnwdaf_AnalyticsInfo service is part of the Nnwdaf service-based interface exhibited by the Network Data Analytics Function (NWDAF).

Known consumers of the Nnwdaf_AnalyticsInfo service are:

- Policy Control Function (PCF)
- Network Slice Selection Function (NSSF)
- Access and Mobility Management Function (AMF)
- Session Management Function (SMF)
- Network Exposure Function (NEF)
- Unified Data Management (UDM)
- Application Function (AF)
- Operation, Administration, and Maintenance (OAM)
- Network Data Analytics Function (NWDAF)

The PCF accesses the Nnwdaf_AnalyticsInfo service at the NWDAF via the N23 Reference point. The NSSF accesses the Nnwdaf_AnalyticsInfo service at the NWDAF via the N34 Reference point.

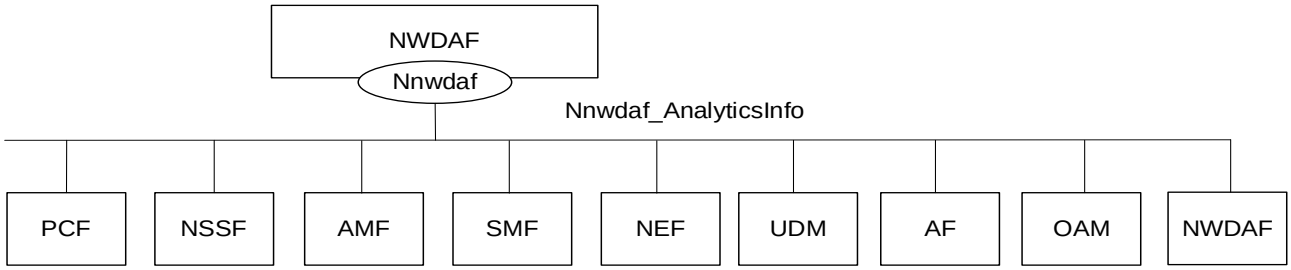

Figure 4.3.1.2-1: Reference Architecture for the Nnwdaf_AnalyticsInfo Service; SBI representation

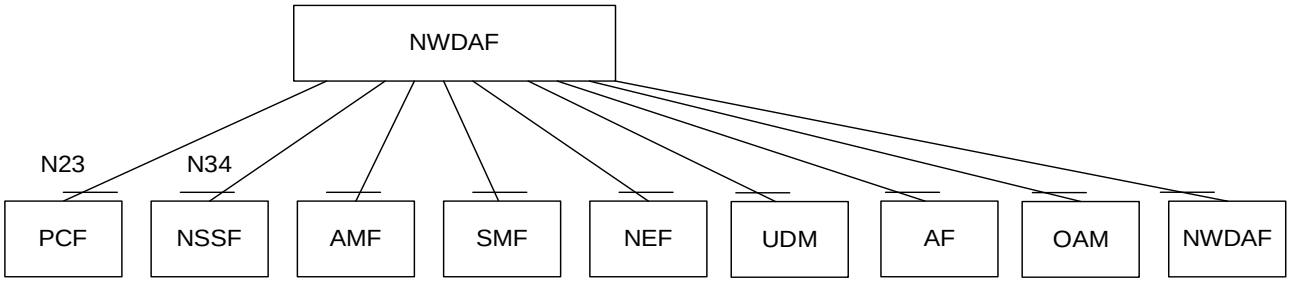

Figure 4.3.1.2-2: Reference Architecture for the Nnwdaf_AnalyticsInfo Service: reference point representation

4.3.1.3 Network Functions

4.3.1.3.1 Network Data Analytics Function (NWDAF)

The Network Data Analytics Function (NWDAF) provides specific analytics information for different analytic events to NF consumers.

4.3.1.3.2 NF Service Consumers

The Policy Control Function (PCF):

- supports taking analytics information for slice load level information from the NWDAF;
- supports taking analytics information for service experience related network data from the NWDAF;

- supports taking analytics information for network performance from the NWDAF;
- supports taking analytics information for abnormal UE behaviour from the NWDAF;
- supports taking one or more above input from NWDAF into consideration for policies on assignment of network resources and/or for traffic steering policies.

NOTE: How this information is used by the PCF is not standardized in this release of the specification.

The Network Slice Selection Function (NSSF):

- supports taking slice load level information or network slice instance load level information from NWDAF into consideration for slice selection.
- supports taking analytics information for service experience related network data from the NWDAF;

The Access and Mobility Management Function (AMF):

- supports taking SMF load information from NWDAF into consideration for SMF selection;
- supports taking expected UE behaviour information (UE mobility and/or UE communication) from NWDAF into consideration for monitoring UE behaviour;
- supports taking abnormal UE behaviour information from NWDAF into consideration for adjustment of UE mobility related network parameters to solve the abnormal risk.
- supports taking slice load level information or network slice instance load level information from NWDAF into consideration for slice selection.
- supports taking analytics information for service experience related network data from the NWDAF;

The Session Management Function (SMF):

- supports taking UPF load information from NWDAF into consideration for UPF selection;
- supports taking expected UE behaviour information (UE mobility and/or UE communication) from NWDAF into consideration for monitoring UE behaviour;
- supports taking abnormal UE behaviour information from NWDAF into consideration for adjustment of UE mobility related network parameters to solve the abnormal risk.

The Network Exposure Function (NEF):

- supports forwarding UE mobility information from NWDAF to the AF when it is untrusted;
- supports forwarding UE communication information from NWDAF to the AF when it is untrusted;
- supports forwarding expected UE behavioural information (UE mobility and/or UE communication) from NWDAF to the AF when it is untrusted;
- supports forwarding abnormal behaviour information from NWDAF to the AF when it is untrusted;
- supports forwarding user data congestion information from NWDAF to the AF when it is untrusted;
- supports forwarding network performance information from NWDAF to the AF when it is untrusted;
- supports forwarding QoS Sustainability information from NWDAF to the AF when it is untrusted.

The Unified Data Management (UDM):

- supports taking expected UE behaviour information (UE mobility and/or UE communication) from NWDAF into consideration for monitoring UE behaviour.

The Application Function (AF):

- supports receiving UE mobility information from NWDAF or via the NEF;
- supports receiving UE communication information from NWDAF or via the NEF;

- supports receiving expected UE behavioural information (UE mobility and/or UE communication) from NWDAF or via the NEF;
- supports receiving abnormal behaviour information from NWDAF or via the NEF;
- supports receiving user data congestion information from NWDAF or via the NEF;
- supports receiving network performance information from NWDAF or via the NEF;
- supports receiving QoS Sustainability information from NWDAF or via the NEF.

The Operation, Administration, and Maintenance (OAM):

- supports receiving observed service experience from NWDAF;
- supports receiving NF load information from NWDAF;
- supports receiving network performance information from NWDAF;
- supports receiving UE mobility information from NWDAF;
- supports receiving UE communication information from NWDAF;
- supports receiving expected UE behaviour information (UE mobility and/or UE communication) from NWDAF;
- supports receiving abnormal UE behaviour information from NWDAF.

The Network Data Analytics Function (NWDAF):

- supports receiving information for all types of network data analytics from NWDAF.

4.3.2 Service Operations

4.3.2.1 Introduction

Table 4.3.2.1-1: Operations of the Nnwdaf_AnalyticsInfo Service

Service operation name	Description	Initiated by
Nnwdaf_AnalyticsInfo_Request	This service operation is used by an NF to request and get specific analytics from NWDAF.	NF consumer (PCF, NSSF, AMF, SMF, NEF, UDM, AF, OAM, NWDAF)

4.3.2.2 Nnwdaf_AnalyticsInfo_Request service operation

4.3.2.2.1 General

The Nnwdaf_AnalyticsInfo_Request service operation is used by an NF service consumer to request and get specific analytics information from the NWDAF.

4.3.2.2.2 Request and get from NWDAF Analytics information

Figure 4.3.2.2.2-1 shows a scenario where the NF service consumer (e.g. PCF) sends a request to the NWDAF to request and get from NWDAF analytics information (as shown in 3GPP TS 23.288 [17]).

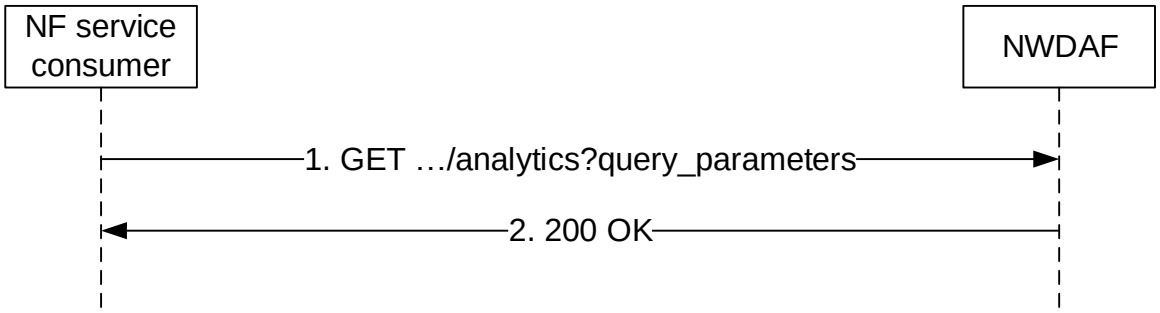

Figure 4.3.2.2.2-1: Requesting a NWDAF Analytics information

The NF service consumer (e.g. PCF) shall invoke the Nnwdaf_AnalyticsInfo_Request service operation when requesting the NWDAF analytics information. The NF service consumer shall send an HTTP GET request on the resource URI "{apiRoot}/nnwdaf-analyticsinfo/v1/analytics" representing the "NWDAF Analytics" (as shown in figure 4.3.2.2.2-1, step 1), to request analytics data according to the query parameter value of the "event-id" attribute. In addition, the following information may be provided:

- common reporting requirement in the "ana-req" attribute as follows:

  1) identification of time window for the requested analytics data applies via identification of date-time(s) in the "startTs" and "endTs" attributes;

  2) preferred level of accuracy of the analytics in "accuracy" attribute;

  3) percentage of sampling among impacted UEs in the "sampRatio" attribute;

  4) maximum number of objects in the “maxObjectNbr” attribute;

  5) maximum number of SUPIs expected for an analytics report in the "maxSupiNbr" attribute;

  6) identification of time when analytics information is needed in the "timeAnaNeeded" attribute;

  7) indication of which analytics metadata is requested to be delivered with the response in the "anaMeta" attribute if the feature "Aggregation" is supported; and/or

  8) requested values for the analytics metadata information to be used for the generation of the analytics in the "anaMetaInd" attribute if the feature "Aggregation" is supported.

Editor's Note: It is FFS to specify if the "partitionCriteria" attribute of the "ana-req" attribute may be used in this service and to implement all the corresponding changes in the API, the data model etc, as required.

For different event types:

- if the event is "LOAD_LEVEL_INFORMATION", it shall provide the event specific filter information within "event-filter" attribute including identification(s) of the network slice via:

  1) identification of network slice(s) in the "snssais" attribute; or

  2) any slices indication in the "anySlice" attribute.

- if the feature "NsiLoad" is supported and the event is "NSI_LOAD_LEVEL", it shall provide the event specific filter information within "event-filter" attribute including identification(s) of the network slice via:

  1) identification of network slice(s) and the optionally associated instance(s) if available, in the "nsiIdInfos" attribute; or

NOTE 1: The network slice instance of a PDU session is not available in the PCF.

  2) any slices indication in the "anySlice" attribute.

- if the feature "NfLoad" is supported and the event is "NF_LOAD", it shall provide:

  1) identification of target UE(s) to which the subscription applies by "supis" or "anyUe" in the "tgt-ue" attribute; and

the "event-filter" attribute may provide:

a) either list of NF instance IDs in the "nfInstanceIds" attribute or list of NF set IDs in the "nfSetIds" attribute if the identification of target UE(s) applies to all UEs;

b) list of NF instance types in the "nfTypes" attribute; and/or

c) identification of network slice(s) in the "snssais" attribute;

- if the feature "UeMobility" is supported and the event is "UE_MOBILITY", it shall provide:

1) identification of target UE(s) to which the subscription applies by "supis" or "intGroupIds" attribute in the "tgt-ue" attribute;

and may provide:

1) event specific filter information in the "event-filter" attribute:

a) identification of network area to which the subscription applies via identification of network area by "networkArea" attribute;

- if the feature "UeCommunication" is supported and the event is "UE_COMM", it shall provide:

1) identification of target UE(s) to which the subscription applies by "supis" or "intGroupIds" attribute in the "tgt-ue" attribute;

and may provide:

1) event specific filter information in the "event-filter" attribute:

a) identification of the application as "appIds" attribute;

b) identification of network area to which the subscription applies via identification of network area by "networkArea" attribute;

c) identification of DNN in the "dnns" attribute; and

d) identification of network slice(s) in the "snssais" attribute;

- if the feature "NetworkPerformance" is supported and the event is "NETWORK_PERFORMANCE", it shall provide:

1) identification of target UE(s) to which the subscription applies by "supis", "intGroupIds" or "anyUe" attribute in the "tgt-ue" attribute; and

2) event specific filter information in the "event-filter" attribute which shall provide:

a) the network performance types via "nwPerfTypes" attribute; and

the "event-filter" attribute may provide:

a) identification of network area to which the subscription applies via identification of network area by "networkArea" attribute (mandatory if "anyUe" attribute is set to true).

- if the feature "ServiceExperience" is supported and the event is "SERVICE_EXPERIENCE", it shall provide:

1) identification of target UE(s) to which the subscription applies by "supis", "intGroupIds" or "anyUe" attribute in the "tgt-ue" attribute;

2) event specific filter information in the "event-filter" attribute which shall provide:

a) any slices indication in the "anySlice" attribute or identification of network slice(s) together with the optionally associated network slice instance(s) if available, via the "nsiIdInfos" attribute; and

NOTE 2: The network slice instance of a PDU session is not available in the PCF.

the "event-filter" attribute may provide:

a) identification of application(s) to which the subscription applies via "appIds" attribute;

b) identification of DNN via identification of Dnn(s) by "dnns" attribute;

c) identification of user plane accesses to one or more DN(s) where applications are deployed via "dnais" attribute;

d) identification of network area to which the subscription applies via identification of network area by "networkArea" attribute (mandatory if "anyUe" attribute is set to true);

e) if "appIds" attribute is provided, the bandwidth requirement of each application by "bwRequs" attribute.

- if the feature "QoSSustainability" is supported and the event is "QOS_SUSTAINABILITY", it shall provide:

1) event specific filter information in the "event-filter" attribute which shall provide:

a) identification of network area to which the subscription applies via identification of network area by "networkArea" attribute;

b) QoS requirements via "qosRequ" attribute; and

2) identification of target UE(s) to which the subscription applies by "anyUe" in the "tgt-ue" attribute;

the "event-filter" attribute may provide:

a) identification of network slice(s) by "snssais" attribute;

- if the feature "AbnormalBehaviour" is supported and the event is "ABNORMAL_BEHAVIOUR", it shall provide:

1) identification of target UE(s) to which the subscription applies by "supis", "intGroupIds" or "anyUe" attribute in the "tgt-ue" attribute; and

2) event specific filter information in the "event-filter" attribute which shall provide

a) either the expected analytics type via "exptAnaType" attribute or a list of exception Ids via "excepIds" attribute. If the expected analytics type via "exptAnaType" attribute is provided, the NWDAF shall derive the corresponding Exception Ids from the received expected analytics type as follows:

- if "exptAnaType" attribute sets to "MOBILITY", the corresponding list of Exception Ids are "UNEXPECTED_UE_LOCATION", "PING_PONG_ACROSS_CELLS", "UNEXPECTED_WAKEUP" and "UNEXPECTED_RADIO_LINK_FAILURES";

- if "exptAnaType" attribute sets to "COMMUN", the corresponding list of Exception Ids are "UNEXPECTED_LONG_LIVE_FLOW", "UNEXPECTED_LARGE_RATE_FLOW", "SUSPICION_OF_DDOS_ATTACK", "WRONG_DESTINATION_ADDRESS" and "TOO_FREQUENT_SERVICE_ACCESS";

- if "exptAnaType" attribute sets to "MOBILITY_AND_COMMUN", the corresponding list of Exception Ids includes all above derived exception Ids.

The derived list of Exception Ids are used by the NWDAF to notify the NF service consumer when UE's behaviour is exceptional based on one or more Exception Ids within the list.

If the "anyUe" attribute in the "tgt-ue" attribute sets to "true",

a) the expected analytics type via the"exptAnaType" attribute or the list of Exception Ids via "excepIds" attribute shall not be requested for both mobility and communication related analytics at the same time.

b) if the expected analytics type via the"exptAnaType" attribute or the list of Exception Ids via "excepIds" attribute is mobility related, at least one of identification of network area by "networkArea" attribute and identification of network slice(s) by "snssais" attribute should be provided;

c) if the expected analytics type via the"exptAnaType" attribute or the list of Exception Ids via "excepIds" attribute is communication related, at least one of identification of network area by

"networkArea" attribute, identification of application(s) by "appIds" attribute, identification of DNN(s) in the "dnns" attribute and identification of network slice(s) by "snssais" attribute should be provided;

the "event-filter" attribute may provide:

1) expected UE behaviour via "exptUeBehav" attribute.

- if the feature "UserDataCongestion" is supported and the event is "USER_DATA_CONGESTION", it shall provide one of the following attributes:

  1) identification of target UE(s) via "supis" "gpsis" (if feature "UserDataCongestionExt" is supported) or "anyUe" attribute within "tgt-ue" attribute;

  and may provide:

  1) event specific filter information in the "event-filter" attribute which may provide:

     a) identification of network slice(s) by "snssais" attribute;

     b) identification of network area to which the subscription applies via identification of network area by "networkArea" attribute (mandatory if "anyUe" attribute is set to true); and/or

     c) if the feature "UserDataCongestionExt" is also supported, indications to request a list of top applications that contribute the most to the traffic in uplink and/or downlink directions upon the "topAppListUlInd" attribute and/or the "topAppListDlInd" attribute.

Upon the reception of the HTTP GET request, the NWDAF shall:

- analyse the requested analytic data according to the requested event

If the HTTP request message from the NF service consumer is accepted, the NWDAF shall respond with "200 OK" status code with the message body containing the analytics with parameters as relevant for the requesting NF service consumer. The AnalyticsData data structure in the response body shall include:

- analytics with the corresponding information as described in subclause 4.2.2.4.2.

If the request NWDAF Analytics data does not exist, the NWDAF shall respond with "204 No Content".

If the "timeAnaNeeded" attribute within EventReportingRequirement is provided during the request, if the time is reached but the requested analytics information is not ready, the consumer does not need to wait for the analytics information any longer, the NWDAF may send an "500 Internal Server Error" status code to the NF service consumer. In addition, if the EneNA feature is supported, the NWDAF may provide, within the ReqFailureCause data in the response, the corresponding failure reason via a "problemDetails" attribute with the "cause" attribute set to "UNSATISFIED_REQUESTED_ANALYTICS_TIME" and a minimum time interval recommended by the NWDAF via a "rvWaitTime" attribute which is used by the NF service consumer to determine the time when analytics information is needed in similar future analytics requests.

4.4 Nnwdaf_DataManagement Service

4.4.1 Service Description

4.4.1.1 Overview

4.4.1.2 Service Architecture

4.4.1.3 Network Functions

4.4.2 Service Operations

4.4.2.1 Introduction

Table 4.4.2.1-1: Operations of the Nnwdaf_DataManagement Service

Service operation name	Description	Initiated by
Nnwdaf_DataManagement_Subscribe	This service operation is used by an NF service consumer to subscribe to data management related event(s) from NWDAF.	NF service consumer (NWDAF, DCCF, MFAF)
Nnwdaf_DataManagement_Unsubscribe	This service operation is used by an NF service consumer to unsubscribe to data management related event(s).	NF service consumer (NWDAF, DCCF, MFAF)
Nnwdaf_DataManagement_Notify	This service operation is used by the NWDAF to notify the detected event(s) to the NF service consumer instance which has subscribed to.	NWDAF
Nnwdaf_DataManagement_Fetch	This service operation is used by an NF service consumer to retrieve the subscribed data.	NF service consumer (NWDAF, DCCF, MFAF)

4.4.2.2 Nnwdaf_DataManagement_Subscribe service operation

4.4.2.3 Nnwdaf_DataManagement_Unsubscribe service operation

4.4.2.4 Nnwdaf_DataManagement_Notify service operation

4.4.2.5 Nnwdaf_DataManagement_Fetch service operation

4.5 Nnwdaf_MLModelProvision Service

4.5.1 Service Description

4.5.1.1 Overview

The Nnwdaf_MLModelProvision Service as defined in 3GPP TS 23.501 [2], 3GPP TS 23.288 [17] and 3GPP TS 23.503 [4], is provided by the Network Data Analytics Function (NWDAF) containing Model Training Logical Function (MTLF).

This service:

- allows the NF service consumers to subscribe to and unsubscribe from different ML model analytic events; and
- notifies the NF service consumers with a corresponding subscription about ML model information.

The types of analytics events include:

- Slice load level information;
- Network slice instance load level information;
- Service experience;
- NF load;
- Network performance;
- UE mobility;
- UE communication;
- Abnormal behaviour;
- User data congestion;
- QoS sustainability;
- SM congestion control experience;
- Redundant transmission experience; and
- WLAN performance.

NOTE: ML model provisioning is limited to a single vendor environment in this release of current specification.

4.5.1.2 Service Architecture

The 5G System Architecture is defined in 3GPP TS 23.501 [2]. The Network Data Analytics Exposure architecture is defined in 3GPP TS 23.288 [17]. The Policy and Charging related 5G architecture is also described in 3GPP TS 23.503 [4] and 3GPP TS 29.513 [5].

The Nnwdaf_MLModelProvision service is part of the Nnwdaf service-based interface exhibited by the Network Data Analytics Function (NWDAF) containing Model Training Logical Function (MTLF).

Known consumers of the Nnwdaf_MLModelProvision service are:

- Network Data Analytics Function (NWDAF)

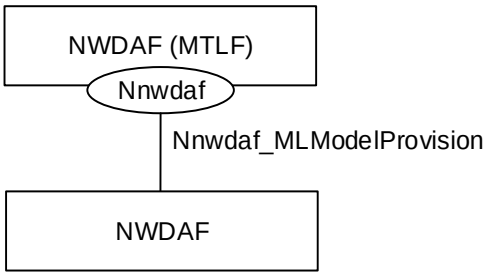

Figure 4.2.1.2-1: Reference Architecture for the Nnwdaf_MLModelProvision Service; SBI representation

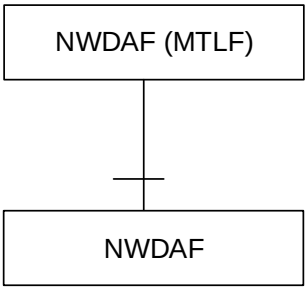

Figure 4.2.1.2-2: Reference Architecture for the Nnwdaf_MLModelProvision Service: reference point representation

4.5.1.3 Network Functions

4.5.1.3.1 Network Data Analytics Function (NWDAF)

The Network Data Analytics Function (NWDAF), containing Model Training Logical Function (MTLF), provides ML model information for different analytic events to NF consumers.

The Network Data Analytics Function (NWDAF) allows NF consumers to subscribe to and unsubscribe from one-time, periodic notification or notification when an event is detected.

4.5.1.3.2 NF Service Consumers

The Network Data Analytics Function (NWDAF) supports (un)subscription to the notification of different ML model information from the NWDAF which contains Model Training Logical Function (MTLF).

4.5.2 Service Operations

4.5.2.1 Introduction

Table 4.5.2.1-1: Operations of the Nnwdaf_MLModelProvision Service

Service operation name	Description	Initiated by
Nnwdaf_MLModelProvision_Subscribe	This service operation is used by an NF service consumer to subscribe to ML model provision from NWDAF.	NF service consumer (NWDAF)
Nnwdaf_MLModelProvision_Unsubscribe	This service operation is used by an NF service consumer to unsubscribe to ML model provision.	NF service consumer (NWDAF)
Nnwdaf_MLModelProvision_Notify	This service operation is used by the NWDAF to notify the ML model information to the NF service consumer instance which has subscribed to.	NWDAF

4.5.2.2 Nnwdaf_MLModelProvision_Subscribe service operation

4.5.2.2.1 General

The Nnwdaf_MLModelProvision_Subscribe service operation is used by an NF service consumer to subscribe or update subscription for event notifications from the NWDAF which contains Model Training Logical Function (MTLF).

4.5.2.2.2 Subscription for event notifications

Figure 4.5.2.2.2-1 shows a scenario where the NF service consumer sends a request to the NWDAF to subscribe for event notification(s) (as shown in 3GPP TS 23.288 [17]).

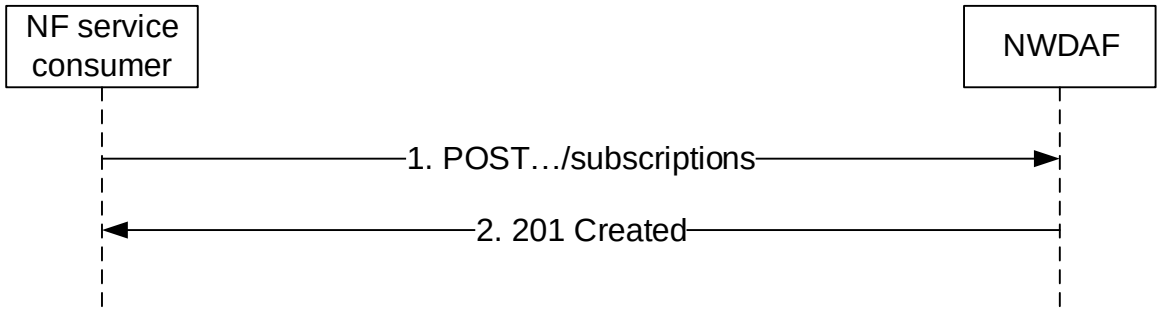

Figure 4.5.2.2.2-1: NF service consumer subscribes to notifications

The NF service consumer shall invoke the Nnwdaf_MLModelProvision_Subscribe service operation to subscribe to event notification(s). The NF service consumer shall send an HTTP POST request with "{apiRoot}/nnwdaf-mlmodelprovision/v1/subscriptions" as Resource URI representing the "NWDAF ML Model Provision Subscriptions", as shown in figure 4.5.2.2.2-1, step 1, to create a subscription for an "Individual NWDAF ML Model Provision Subscription" according to the information in message body.

The NwdafMLModelProvSubsc data structure provided in the request body shall include:

- an URI where to receive the requested notifications as the "notifUri" attribute;
- a description of the subscribed events as the "mLEventSubscs" attribute that, for each event, the MLEventSubscription data type shall include an event identifier as the "mLEvent" attribute, event filter information as the "mLEventFilter"attirbute, and may include an identification of target UE information as the "tgtUe" attribute.

For different event types, the "mLEventFilter" attribute within the MLEventSubscription data type:

- if the ServiceExperience feature is supported and the event is "SERVICE_EXPERIENCE", shall provide

Editor's Note: The mandatory and optional information is FFS for the ServiceExperience feature.

- if the UeMobility feature is supported and the event is "UE_MOBILITY", shall provide

Editor's Note: The mandatory and optional information is FFS for the UeMobility feature.

- if the UeCommunication feature is supported and the event is "UE_COMM", shall provide

Editor's Note: The mandatory and optional information is FFS for the UeCommunication feature.

- if the QoSSustainability feature is supported and the event is "QOS_SUSTAINABILITY", shall provide

Editor's Note: The mandatory and optional information is FFS for the QoSSustainability feature.

- if the AbnormalBehaviour feature is supported and the event is "ABNORMAL_BEHAVIOUR", shall provide

Editor's Note: The mandatory and optional information is FFS for the AbnormalBehaviour feature.

- if the UserDataCongestion feature is supported and the event is "USER_DATA_CONGESTION", shall provide

Editor's Note: The mandatory and optional information is FFS for the UserDataCongestion feature.

- if the NfLoad feature is supported and the event is "NF_LOAD", shall provide

Editor's Note: The mandatory and optional information is FFS for the NfLoad feature.

- if the NetworkPerformance feature is supported and the event is "NETWORK_PERFORMANCE", shall provide

Editor's Note: The mandatory and optional information is FFS for the NetworkPerformance feature.

- if the NsiLoad feature is supported and the event is "NSI_LOAD_LEVEL", shall provide

Editor's Note: The mandatory and optional information is FFS for the NsiLoad feature.

- if the SMCongestion feature is supported and the event is "SM_CONGESTION", shall provide

Editor's Note: The mandatory and optional information is FFS for the SMCongestion feature.

- if the RedundantTransmission feature is supported and the event is "REDUNDANT_TRANSMISSION", shall provide

Editor's Note: The mandatory and optional information is FFS for the RedundantTransmission feature.

- if the WLANPerformance feature is supported and the event is "WLAN_PERFORMANCE", shall provide

Editor's Note: The mandatory and optional information is FFS for the WLANPerformance feature.

Upon the reception of an HTTP POST request with: "{apiRoot}/nnwdaf-mlmodelprovision/v1/subscriptions" as Resource URI and NwdafMLModelProvSubsc data structure as request body, the NWDAF shall create a new subscription and store the subscription.

If the NWDAF created an "Individual NWDAF ML Model Provision Subscription" resource, the NWDAF shall respond with "201 Created" with the message body containing a representation of the created subscription, as shown in figure 4.5.2.2.2-1, step 2. The NWDAF shall include a Location HTTP header field. The Location header field shall contain the URI of the created subscription i.e. "{apiRoot}/nnwdaf-mlmodelprovision/v1/subscriptions/{subscriptionId}".

If the immediate reporting indication in the "immRep" attribute within the "evtReq" attribute sets to true during the event subscription, the NWDAF shall include the reports of the subscribed events, if available, as the "mLEventNotifs" attribute in the HTTP POST response.

4.5.2.2.3 Update subscription for event notifications

Editor's Note: It's FFS that whether and how the ML model consumer NWDAF (e.g. AnLF) can negotiate the ML model update.

Editor's Note: It's FFS that whether PATCH is also possible for partial update.

4.5.2.3 Nnwdaf_MLModelProvision_Unsubscribe service operation

4.5.2.3.1 General

The Nnwdaf_MLModelProvision_Unsubscribe service operation is used by an NF service consumer to unsubscribe from event notifications.

4.5.2.3.2 Unsubscribe from event notifications

Figure 4.5.2.3.2-1 shows a scenario where the NF service consumer sends a request to the NWDAF to unsubscribe from event notifications (see also 3GPP TS 23.288 [17]).

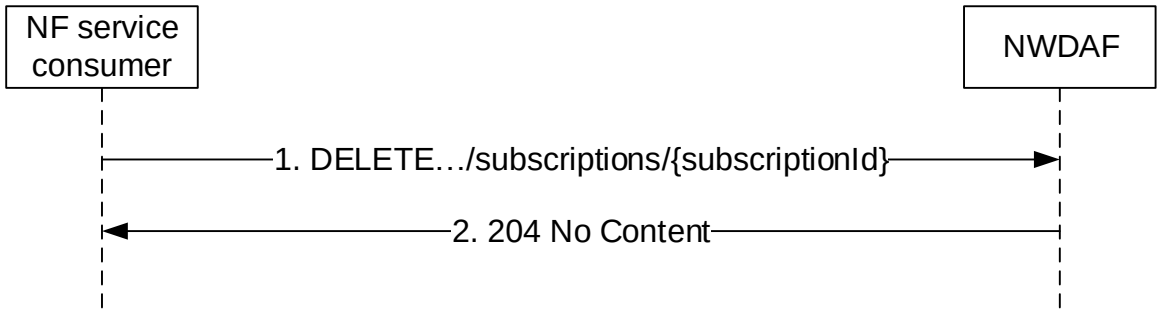

Figure 4.5.2.3.2-1: NF service consumer unsubscribes from notifications

The NF service consumer shall invoke the Nnwdaf_MLModelProvision_UnSubscribe service operation to unsubscribe to event notifications. The NF service consumer shall send an HTTP DELETE request with: "{apiRoot}/nnwdaf-

mlmodelprovision/v1/subscriptions/{subscriptionId}" as Resource URI, where "{subscriptionId}" is the event subscriptionId of the existing subscription that is to be deleted.

Upon the reception of an HTTP DELETE request, if the NWDAF successfully processed and accepted the received HTTP DELETE request, the NWDAF shall:

- remove the corresponding subscription;
- respond with HTTP "204 No Content" status.

If the feature "ES3XX" is supported, and the NWDAF determines the received HTTP DELETE request needs to be redirected, the NWDAF shall send an HTTP redirect response as specified in subclause 6.10.9 of 3GPP TS 29.500 [6].

If the Individual NWDAF ML Model Provision Subscription resource does not exist, the NWDAF shall respond with "404 Not Found".

4.5.2.4 Nnwdaf_MLModelProvision_Notify service operation

4.5.2.4.1 General

The Nnwdaf_MLModelProvision_Notify service operation is used by an NWDAF to notify NF consumers about subscribed events.

4.5.2.4.2 Notification about subscribed event

Figure 4.5.2.4.2-1 shows a scenario where the NWDAF sends a request to the NF Service Consumer to notify for event notifications (see also 3GPP TS 23.288 [17]).

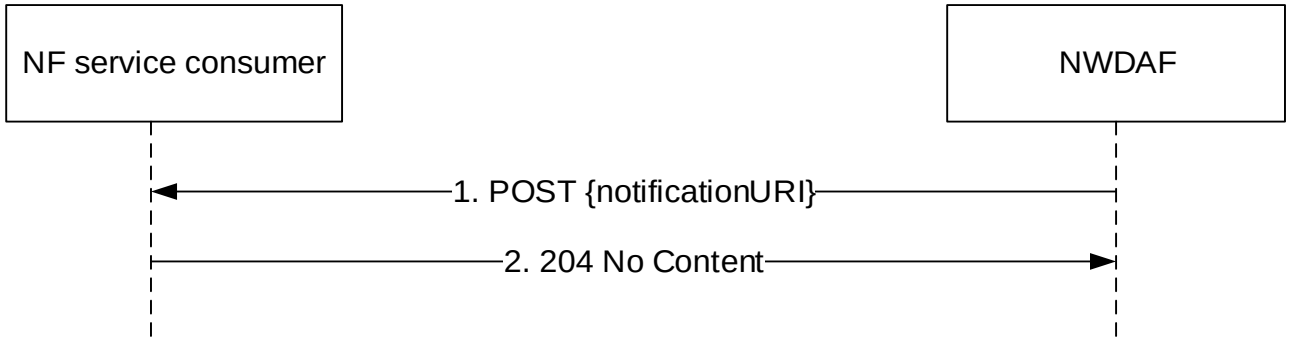

Figure 4.5.2.4.2-1: NWDAF notifies the subscribed event

The NWDAF shall invoke the Nnwdaf_MLModelProvision_Notify service operation to notify the subscribed event. The NWDAF shall sends an HTTP POST request with "{notifUri}" received in the Nnwdaf_MLModelProvision_Subscribe service operation as Resource URI, as shown in figure 4.2.2.4.2-1, step 1. The NwdafMLModelProvNotif data structure provided in the request body that shall include an event subscriptionId as "subscriptionId" attribute and description of the notified event as "eventNotifs" attribute, that for each event, the MLEventNotif data type shall be included.

Upon the reception of an HTTP POST request, if the NF service consumer successfully processed and accepted the received HTTP POST request, the NF Service Consumer shall store the notification and respond with HTTP "204 No Content" status code.

If the feature "ES3XX" is supported, and the NF service consumer determines the received HTTP POST request needs to be redirected, the NF service consumer shall send an HTTP redirect response as specified in subclause 6.10.9 of 3GPP TS 29.500 [6].

5 API Definitions

5.1 Nnwdaf_EventsSubscription Service API

5.1.1 Introduction

The Nnwdaf_EventsSubscription Service shall use the Nnwdaf_EventsSubscription API.

The API URI of the Nnwdaf_EventsSubscription API shall be:

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

The request URIs used in each HTTP requests from the NF service consumer towards the NWDAF shall have the Resource URI structure defined in subclause 4.4.1 of 3GPP TS 29.501 [7], i.e.:

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

with the following components:

- The {apiRoot} shall be set as described in 3GPP TS 29.501 [7].
- The <apiName> shall be "nnwdaf-eventssubscription".
- The <apiVersion> shall be "v1".
- The <apiSpecificResourceUriPart> shall be set as described in subclause 5.1.3.

5.1.2 Usage of HTTP

5.1.2.1 General

HTTP/2, IETF RFC 7540 [9], shall be used as specified in clause 5 of 3GPP TS 29.500 [6].

HTTP/2 shall be transported as specified in subclause 5.3 of 3GPP TS 29.500 [6].

The OpenAPI [11] specification of HTTP messages and content bodies for the Nnwdaf_EventsSubscription is contained in Annex A.

5.1.2.2 HTTP standard headers

5.1.2.2.1 General

See subclause 5.2.2 of 3GPP TS 29.500 [6] for the usage of HTTP standard headers.

5.1.2.2.2 Content type

JSON, IETF RFC 8259 [10], shall be used as content type of the HTTP bodies specified in the present specification as specified in subclause 5.4 of 3GPP TS 29.500 [6]. 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 [15].

5.1.2.3 HTTP custom headers

The Nnwdaf_EventsSubscription Service API shall support the mandatory HTTP custom header fields specified in subclause 5.2.3.2 of 3GPP TS 29.500 [6] and may support the optional HTTP custom header fields specified in subclause 5.2.3.3 of 3GPP TS 29.500 [6].

In this release of the specification, no specific custom headers are defined for the Nnwdaf_EventsSubscription Service API.

5.1.3 Resources

5.1.3.1 Resource Structure

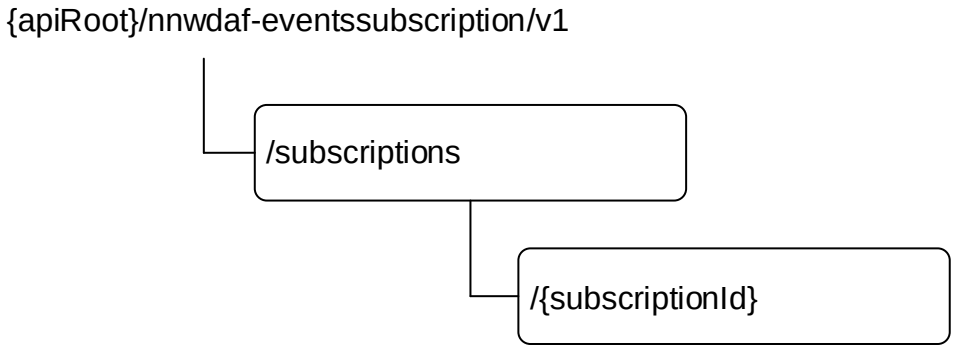

Figure 5.1.3.1-1: Resource URI structure of the Nnwdaf_EventsSubscription API

Table 5.1.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 5.1.3.1-1: Resources and methods overview

Resource name	Resource URI	HTTP method or custom operation	Description
NWDAF Events Subscriptions	/subscriptions	POST	Creates a new Individual NWDAF Event Subscription resource.
Individual NWDAF Event Subscription	/subscriptions/{subscriptionId}	DELETE	Deletes an Individual NWDAF Event Subscription identified by subresource {subscriptionId}.
		PUT	Modifies an existing Individual Event Subscription subresource.

5.1.3.2 Resource: NWDAF Events Subscriptions

5.1.3.2.1 Description

The NWDAF Events Subscriptions resource represents all subscriptions to the Nnwdaf_EventsSubscription Service at a given NWDAF. The resource allows an NF service consumer to create a new Individual NWDAF Event Subscription resource.

5.1.3.2.2 Resource definition

Resource URI: **{apiRoot}/nnwdaf-eventssubscription/v1/subscriptions**

This resource shall support the resource URI variables defined in table 5.1.3.2.2-1.

Table 5.1.3.2.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See subclause 5.1.1

5.1.3.2.3 Resource Standard Methods

5.1.3.2.3.1 POST

This method shall support the URI query parameters specified in table 5.1.3.2.3.1-1.

Table 5.1.3.2.3.1-1: URI query parameters supported by the POST method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 5.1.3.2.3.1-2 and the response data structures and response codes specified in table 5.1.3.2.3.1-3.

Table 5.1.3.2.3.1-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
NnwdafEventsSubscription	M	1	Create a new Individual NWDAF Event Subscription resource.

Table 5.1.3.2.3.1-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
NnwdafEventsSubscription	M	1	201 Created	The creation of an Individual NWDAF Event Subscription resource is confirmed and a representation of that resource is returned.
NOTE: The mandatory HTTP error status codes for the POST method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply.				

Table 5.1.3.2.3.1-4: Headers supported by the 201 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	Contains the URI of the newly created resource, according to the structure: {apiRoot}/nnwdaf-eventssubscription/v1/subscriptions/{subscriptionId}

5.1.3.2.4 Resource Custom Operations

None in this release of the specification.

5.1.3.3 Resource: Individual NWDAF Event Subscription

5.1.3.3.1 Description

The Individual NWDAF Event Subscription resource represents a single subscription to the Nnwdaf_EventsSubscription Service at a given NWDAF.

5.1.3.3.2 Resource definition

Resource URI: {apiRoot}/nnwdaf-eventssubscription/v1/subscriptions/{subscriptionId}

This resource shall support the resource URI variables defined in table 5.1.3.3.2-1.

Table 5.1.3.3.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See subclause 5.1.1
subscriptionId	string	Identifies a subscription to the Nnwdaf_EventsSubscription Service

5.1.3.3.3 Resource Standard Methods

5.1.3.3.3.1 DELETE

This method shall support the URI query parameters specified in table 5.1.3.3.3.1-1.

Table 5.1.3.3.3.1-1: URI query parameters supported by the DELETE method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 5.1.3.3.3.1-2 and the response data structures and response codes specified in table 5.1.3.3.3.1-3.

Table 5.1.3.3.3.1-2: Data structures supported by the DELETE Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 5.1.3.3.3.1-3: Data structures supported by the DELETE Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Successful case: The Individual NWDAF Event Subscription resource matching the subscriptionId was deleted.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection, during Individual NWDAF Event Subscription deletion. The response shall include a Location header field containing an alternative URI of the resource located in an alternative NWDAF (service) instance. Applicable if the feature "ES3XX" is supported.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection, during Individual NWDAF Event Subscription deletion. The response shall include a Location header field containing an alternative URI of the resource located in an alternative NWDAF (service) instance. Applicable if the feature "ES3XX" is supported.
ProblemDetails	O	0..1	404 Not Found	The Individual NWDAF Event Subscription resource does not exist. (NOTE 2)
NOTE 1: The mandatory HTTP error status codes for the DELETE method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply. NOTE 2: Failure cases are described in subclause 5.1.7.				

Table 5.1.3.3.3.1-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative NWDAF (service) instance.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance towards which the request is redirected.

Table 5.1.3.3.3.1-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative NWDAF (service) instance.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance towards which the request is redirected.

5.1.3.3.3.2 PUT

This method shall support the URI query parameters specified in table 5.1.3.3.3.2-1.

Table 5.1.3.3.3.2-1: URI query parameters supported by the PUT method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 5.1.3.3.3.2-2 and the response data structures and response codes specified in table 5.1.3.3.3.2-3.

Table 5.1.3.3.3.2-2: Data structures supported by the PUT Request Body on this resource

Data type	P	Cardinality	Description
NnwdafEventsSubscription	M	1	Parameters to replace a subscription to NWDAF Event Subscription resource.

Table 5.1.3.3.3.2-3: Data structures supported by the PUT Response Body on this resource

Data type	P	Cardinality	Response codes	Description
NnwdafEventsSubscription	M	1	200 OK	The Individual NWDAF Event Subscription resource was modified successfully and a representation of that resource is returned.
n/a			204 No Content	The Individual NWDAF Event Subscription resource was modified successfully.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection, during Individual NWDAF Event Subscription modification. The response shall include a Location header field containing an alternative URI of the resource located in an alternative NWDAF (service) instance. Applicable if the feature "ES3XX" is supported.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection, during Individual NWDAF Event Subscription modification. The response shall include a Location header field containing an alternative URI of the resource located in an alternative NWDAF (service) instance. Applicable if the feature "ES3XX" is supported.
ProblemDetails	O	0..1	404 Not Found	The Individual NWDAF Event Subscription resource does not exist. (NOTE 2)
NOTE 1: The mandatory HTTP error status codes for the PUT method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply. NOTE 2: Failure cases are described in subclause 5.1.7.				

Table 5.1.3.3.3.2-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative NWDAF (service) instance.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance towards which the request is redirected.

Table 5.1.3.3.3.2-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative NWDAF (service) instance.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance towards which the request is redirected.

5.1.3.3.4 Resource Custom Operations

None in this release of the specification.

5.1.4 Custom Operations without associated resources

None in this release of the specification.

5.1.5 Notifications

5.1.5.1 General

Notifications shall comply with subclause 6.2 of 3GPP TS 29.500 [6] and subclause 4.6.2.3 of 3GPP TS 29.501 [7].

Table 5.3.3.4.1-1: Notifications overview

Notification	Callback URI	HTTP method or custom operation	Description (service operation)
Event Notification	{notificationURI}	POST	Report one or several observed Events.

5.1.5.2 Event Notification

5.1.5.2.1 Description

The Event Notification is used by the NWDAF to report one or several observed Events to a NF service consumer that has subscribed to such Notifications via the Individual NWDAF Event Subscription Resource.

5.1.5.2.2 Operation Definition

Callback URI: **{notificationURI}**

The operation shall support the callback URI variables defined in table 5.1.5.2.2-1, the request data structures specified in table 5.1.5.2.2-2 and the response data structure and response codes specified in table 5.1.5.2.2-3.

Table 5.1.5.2.2-1: Callback URI variables

Name	Data type	Definition
notificationURI	Uri	The Notification Uri as assigned within the Individual NWDAF Event Subscription and described within the NnwdafEventsSubscription type (see table 5.1.6.2.2-1).

Table 5.1.5.2.2-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
array(NnwdafEventsSubscriptionNotification)	M	1..N	Provides Information about observed events

Table 5.1.5.2.2-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	The receipt of the Notification is acknowledged.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection, during the event notification. The response shall include a Location header field containing an alternative URI representing the end point of an alternative NF consumer (service) instance where the notification should be sent. Applicable if the feature "ES3XX" is supported.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection, during the event notification. The response shall include a Location header field containing an alternative URI representing the end point of an alternative NF consumer (service) instance where the notification should be sent. Applicable if the feature "ES3XX" is supported.
NOTE: The mandatory HTTP error status codes for the POST method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply.				

Table 5.1.5.2.2-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI representing the end point of an alternative NF consumer (service) instance towards which the notification should be redirected.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance towards which the notification request is redirected.

Table 5.1.5.2.2-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI representing the end point of an alternative NF consumer (service) instance towards which the notification should be redirected.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance towards which the notification request is redirected.

5.1.6 Data Model

5.1.6.1 General

This subclause specifies the application data model supported by the API.

Table 5.1.6.1-1 specifies the data types defined for the Nnwdaf_EventsSubscription service based interface protocol.

Table 5.1.6.1-1: Nnwdaf_EventsSubscription specific Data Types

Data type	Section defined	Description	Applicability
AbnormalBehaviour	5.1.6.2.15	Represents the abnormal behaviour information.	AbnormalBehaviour
Accuracy	5.1.6.3.5	Represents the preferred level of accuracy of the analytics.	
AdditionalMeasurement	5.1.6.2.26		AbnormalBehaviour
AddressList	5.1.6.2.28		AbnormalBehaviour
AnalyticsMetadata	5.1.6.3.14	Represents the types of analytics metadata information that can be requested.	Aggregation
AnalyticsMetadataIndication	5.1.6.2.36	Contains analytics metadata values indicated to be used during analytics generation.	Aggregation
AnalyticsMetadataInfo	5.1.6.2.37	Contains analytics metadata information required for analytics aggregation.	Aggregation
AnySlice	5.1.6.3.2	Represents the any slices.	
BwRequirement	5.1.6.2.25	Represents bandwidth requirement.	ServiceExperience
CircumstanceDescription	5.1.6.2.29		AbnormalBehaviour
CongestionInfo	5.1.6.2.18		UserDataCongestion
CongestionType	5.1.6.3.8		UserDataCongestion
DatasetStatisticalProperty	5.1.6.3.15	Dataset statistical properties of the data used to generate the analytics.	Aggregation
EventNotification	5.1.6.2.5	Describes Notifications about events that occurred.	
EventReportingRequirement	5.1.6.2.7	Represents the type of reporting the subscription requires.	
EventSubscription	5.1.6.2.3	Represents the subscription to a single event.	
Exception	5.1.6.2.16	Describes the Exception information.	AbnormalBehaviour
ExceptionId	5.1.6.3.6	Describes the Exception Id.	AbnormalBehaviour
ExceptionTrend	5.1.6.3.7	Describes the Exception Trend.	AbnormalBehaviour
ExpectedAnalyticsType	5.1.6.3.11		AbnormalBehaviour
FailureEventInfo	5.1.6.2.35	Contains information on the event for which the subscription is not successful.	
IpEthFlowDescription	5.1.6.2.27		AbnormalBehaviour
LoadLevelInformation	5.1.6.3.2	Represents load level information of the network slice and the optionally associated network slice instance.	
LocationInfo	5.1.6.2.11		UeMobility
MatchingDirection	5.1.6.3.12	Defines the matching direction when crossing a threshold.	NfLoad, QoSSustainability, UserDataCongestion, NetworkPerformance
NetworkPerfInfo	5.1.6.2.23		NetworkPerformance
NetworkPerfRequirement	5.1.6.2.22		NetworkPerformance
NetworkPerfType	5.1.6.3.10		NetworkPerformance
NfLoadLevelInformation	5.1.6.2.31	Represents load level information of a given NF instance.	NfLoad
NfStatus	5.1.6.2.32	Provides the percentage of time spent on various NF states.	NfLoad
NwdafEvent	5.1.6.3.4	Describes the NWDAF Events.	
NnwdafEventsSubscription	5.1.6.2.2	Represents an Individual NWDAF Event Subscription resource.	

NnwdafEventsSubscriptionNotification	5.1.6.2.4	Represents an Individual NWDAF Event Subscription Notification resource.	
NwdafFailureCode	5.1.6.3.13	Identifies the failure reason.	
NotificationMethod	5.1.6.3.3	Represents the notification methods that can be subscribed.	
NsiIdInfo	5.1.6.2.33	Represents the S-NSSAI and the optionally associated Network Slice Instance Identifier(s).	ServiceExperience NsiLoad NsiLoadExt
NsiLoadLevelInfo	5.1.6.2.34	Represents the load level information for an S-NSSAI and the optionally associated network slice instance.	NsiLoad NsiLoadExt
OutputStrategy	5.1.6.3.16	Represents the output strategy used for the reporting of the analytics.	Aggregation
QosRequirement	5.1.6.2.20		QoSSustainability
QosSustainabilityInfo	5.1.6.2.19	Represents the QoS Sustainability information.	QoSSustainability
RetainabilityThreshold	5.1.6.2.21		QoSSustainability
ServiceExperienceInfo	5.1.6.2.24	Represents the service experience information.	ServiceExperience
SliceLoadLevelInformation	5.1.6.2.6	Represents the slices and their load level information.	
TargetUeInformation	5.1.6.2.8	Identifies the target UE information.	ServiceExperience NfLoad NetworkPerformance UserDataCongestion UserDataCongestionExt UeMobility UeCommunication AbnormalBehaviour QoSSustainability
ThresholdLevel	5.1.6.2.30	Describe a threshold level.	UserDataCongestion NfLoad
TimeUnit	5.1.6.3.9		QoSSustainability
TrafficCharacterization	5.1.6.2.14		UeCommunication
TopApplication	5.1.6.2.39	Top application that contributes the most to the traffic.	UserDataCongestionExt
UeCommunication	5.1.6.2.13		UeCommunication
UeMobility	5.1.6.2.10		UeMobility
UserDataCongestionInfo	5.1.6.2.17	Represents the user data congestion information.	UserDataCongestion

Table 5.1.6.1-2 specifies data types re-used by the Nnwdaf_EventsSubscription 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 Nnwdaf service based interface.

Table 5.1.6.1-2: Nnwdaf_EventsSubscription re-used Data Types

Data type	Reference	Comments	Applicability
5Qi	3GPP TS 29.571 [8]	Identifies the 5G QoS identifier	QoSSustainability
ApplicationId	3GPP TS 29.571 [8]	Identifies the application identifier.	ServiceExperience UeCommunication AbnormalBehaviour
BitRate	3GPP TS 29.571 [8]	String representing a bit rate that shall be formatted as follows: pattern: "^\d+(\.\d+)?(bps|Kbps|Mbps|Gbps|Tbps)$" Examples: "125 Mbps", "0.125 Gbps", "125000 Kbps".	ServiceExperience QoSSustainability
DateTime	3GPP TS 29.571 [8]	Identifies the time.	
Dnai	3GPP TS 29.571 [8]	Identifies a user plane access to one or more DN(s).	ServiceExperience
Dnn	3GPP TS 29.571 [8]	Identifies the DNN.	ServiceExperience AbnormalBehaviour UeCommunication
DurationSec	3GPP TS 29.571 [8]		
EthFlowDescription	3GPP TS 29.514 [21]		UeCommunication AbnormalBehaviour
ExpectedUeBehaviourData	3GPP TS 29.503 [23]		AbnormalBehaviour
Float	3GPP TS 29.571 [8]		
FlowDescription	3GPP TS 29.514 [21]		UeCommunication AbnormalBehaviour
FlowInfo	3GPP TS 29.122 [19]		UserDataCongestionExt
GroupId	3GPP TS 29.571 [8]	Identifies a group of UEs.	UeMobility UeCommunication NetworkPerformance AbnormalBehaviour ServiceExperience
Ipv4Addr	3GPP TS 29.571 [8]		
Ipv6Addr	3GPP TS 29.571 [8]		
NetworkAreaInfo	3GPP TS 29.554 [18]	Identifies the network area.	ServiceExperience QoSSustainability AbnormalBehaviour UeMobility UserDataCongestion NetworkPerformance NsiLoadExt
NfInstanceId	3GPP TS 29.571 [8]	Identifies an NF instance	NfLoad
NfSetId	3GPP TS 29.571 [8]	Identifies an NF Set instance	NfLoad
NFType	3GPP TS 29.510 [12]	Indentifies a type of NF	NfLoad
NsiId	3GPP TS 29.531 [24]	Identifies a Network Slice Instance	ServiceExperience NsiLoad NsiLoadExt
PacketDelBudget	3GPP TS 29.571 [8]		QoSSustainability
PacketErrRate	3GPP TS 29.571 [8]		QoSSustainability
ProblemDetails	3GPP TS 29.571 [8]	Used in error responses to provide more detailed information about an error.	
QosResourceType	3GPP TS 29.571 [8]	Identifies the resource type in QoS characteristics.	QoSSustainability
RedirectResponse	3GPP TS 29.571 [8]	Contains redirection related information.	ES3XX
ReportingInformation	3GPP TS 29.523 [20]	Represents the type of reporting the subscription requires.	
SamplingRatio	3GPP TS 29.571 [8]		
ScheduledCommunicationTime	3GPP TS 29.122 [19]		UeMobility UeCommunication
Snssai	3GPP TS 29.571 [8]	Identifies the S-NSSAI (Single	

		Network Slice Selection Assistance Information).	
Supi	3GPP TS 29.571 [8]	The SUPI for an UE.	ServiceExperience, NfLoad NetworkPerformance, UserDataCongestion UeMobility UeCommunication AbnormalBehaviour
Gpsi	3GPP TS 29.571 [8]	The GPSI for an UE.	UserDataCongestionExt
SupportedFeatures	3GPP TS 29.571 [8]	Used to negotiate the applicability of the optional features defined in table 5.1.8-1.	
SvcExperience	3GPP TS 29.517 [22]		ServiceExperience
TimeWindow	3GPP TS 29.122 [19]		
Uinteger	3GPP TS 29.571 [8]	Unsigned Integer, i.e. only value 0 and integers above 0 are permissible.	
Uri	3GPP TS 29.571 [8]		
UserLocation	3GPP TS 29.571 [8]		UeMobility
Volume	3GPP TS 29.122 [19]		UeCommunication AbnormalBehaviour
FailureEventInfo	5.1.6.2.35	Represents the failure event and the corresponding failure reason.	

5.1.6.2 Structured data types

5.1.6.2.1 Introduction

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

5.1.6.2.2 Type NnwdafEventsSubscription

Table 5.1.6.2.2-1: Definition of type NnwdafEventsSubscription

Attribute name	Data type	P	Cardinality	Description	Applicability
eventSubscriptions	array(EventSubscription)	M	1..N	Subscribed events	
evtReq	ReportingInformation	O	0..1	Represents the reporting requirements of the event subscription. (NOTE 1, NOTE 2) If omitted, the default values within the ReportingInformation data type apply.	
notificationURI	Uri	C	0..1	Identifies the recipient of Notifications sent by the NWDAF. This parameter shall be supplied by the NF service consumer in the HTTP POST requests that create the subscriptions for event notifications and in the HTTP PUT requests that update the subscriptions for event notifications..	
eventNotifications	array(EventNotification)	C	1..N	Notifications about Individual Events. Shall only be present if the immediate reporting indication in the "immRep" attribute within the "evtReq" attribute sets to true in the event subscription, and the reports are available.	
failEventReports	array(FailureEventInfo)	O	1..N	Supplied by the NWDAF When available, shall contain the event(s) for which the subscription is not successful including the failure reason(s).	
supportedFeatures	SupportedFeatures	C	0..1	List of Supported features used as described in subclause 5.1.8. This parameter shall be supplied by NF service consumer in the POST request that request the creation of an NWDAF Event Subscriptions resource, and shall be supplied by the NWDAF in the reply of corresponding request.	

NOTE 1: If the "evtReq" attribute (of data type ReportingInformation) is provided and contains the "notifMethod" attribute, the notification method indicated by the "notifMethod" attribute within the ReportingInformation data type takes preference over the notification method indicated by the "notificationMethod" attribute within the EventSubscription data type.

NOTE 2: If the "evtReq" attribute (of data type ReportingInformation) is provided and contains the "repPeriod" attribute, the periodic reporting time indicated by the "repPeriod" attribute in the ReportingInformation data type takes preference over the periodic reporting time indicated by the "repetitionPeriod" attribute in the EventSubscription data type.

5.1.6.2.3 Type EventSubscription

Table 5.1.6.2.3-1: Definition of type EventSubscription

Attribute name	Data type	P	Cardinality	Description	Applicability
anySlice	AnySlice	C	0..1	Default is "FALSE". (NOTE 1)	
appIds	array(ApplicationId)	C	1..N	Identification(s) of application to which the subscription applies. The absence of appIds means subscription to all applications. (NOTE 8)	ServiceExperience UeCommunication AbnormalBehaviour
dnns	array(Dnn)	C	1..N	Identification(s) of DNN to which the subscription applies. Each DNN is a full DNN with both the Network Identifier and Operator Identifier, or a DNN with the Network Identifier only. The absence of dnns means subscription to all DNNs (NOTE 8)	ServiceExperience, AbnormalBehaviour UeCommunication
dnais	array(Dnai)	C	1..N	Identification(s) of user plane access to DN(s) which the subscription applies.	ServiceExperience
event	NwdafEvent	M	1	Event that is subscribed.	
extraReportReq	EventReportingRequirement	O	0..1	The extra event reporting requirement information.	
loadLevelThreshold	integer	C	0..1	Indicates that the NWDAF shall report the corresponding network slice load level to the NF service consumer where the load level of the network slice identified by snssais is reached. (NOTE 4) May be included when subscribed event is "SLICE_LOAD_LEVEL".	
matchingDir	MatchingDirection	O	0..1	A matching direction may be provided alongside a threshold. If omitted, the default value is CROSSED.	NfLoad, QoSSustainability, UserDataCongestion, NetworkPerformance
nfLoadLvlThds	array(ThresholdLevel)	C	1..N	Shall be supplied in order to start reporting when an average load level is reached.(NOTE 4)	NfLoad
networkArea	NetworkAreaInfo	C	0..1	Identification of network area to which the subscription applies. The absence of networkArea means subscription to all network areas. (NOTE 7), (NOTE 8)	ServiceExperience UeMobility UeCommunication QoSSustainability AbnormalBehaviour UserDataCongestion NetworkPerformance NsiLoadExt
topAppListUlInd	boolean	O	0..1	Indicates the list of top applications that contribute the most to the traffic in Uplink direction is requested, if it is included and set to "true". Default value is "false".	UserDataCongestionExt
topAppListDlInd	boolean	O	0..1	Indicates that the list of top	UserDataConge

				applications that contribute the most to the traffic in Downlink direction is requested, if it is included and set to "true". Default value is "false".	stionExt
nfInstanceIds	array(NfInstanceId)	O	1..N	Identification(s) of NF instances.	NfLoad
nfSetIds	array(NfSetId)	O	1..N	Identification(s) of NF instance sets.	NfLoad
nfTypes	array(NFType)	O	1..N	Identification(s) of NF types.	NfLoad
notificationMethod	NotificationMethod	O	0..1	Indicate the notification method. (NOTE 2)	
nsiIdInfos	array(NsiIdInfo)	O	1..N	Each element identifies the S-NSSAI and the optionally associated network slice instance(s). May be included when subscribed event is "NSI_LOAD_LEVEL" or "SERVICE_EXPERIENCE". (NOTE 1)	ServiceExperience NsiLoad NsiLoadExt
nsiLevelThrds	array(Uinteger)	O	1..N	Identifies the load threshold for each S-NSSAI or S-NSSAI and the optionally associated network slice instance identified by the "nsiIds" attribute within the "nsiIdInfos" attribute. (NOTE 4)	NsiLoad NsiLoadExt
qosRequ	QosRequirement	C	0..1	Indicates the QoS requirements. It shall be included when subscribed event is "QOS_SUSTAINABILITY".	QoSSustainability
qosFlowRetThds	array(RetainabilityThreshold)	C	1..N	Represents the QoS flow retainability thresholds.Shall be supplied for the 5QI ("5qi" in "qosRequ") or resource type ("resType" in "qosRequ") of GBR resource type. (NOTE 4)	QoSSustainability
ranUeThrouThds	array(BitRate)	C	1..N	Represents the RAN UE throughput thresholds. Shall be supplied for the 5QI ("5qi" in "qosRequ") or resource type ("resType" in "qosRequ") of non-GBR resource type.(NOTE 4)	QoSSustainability
repetitionPeriod	DurationSec	C	0..1	Shall be supplied for notification Method "PERIODIC" by the "notificationMethod" attribute.	
snssais	array(Snssai)	C	1..N	Identification(s) of network slice to which the subscription applies. (NOTE 1), (NOTE 8)	
tgtUe	TargetUeInformation	O	0..1	Identifies target UE information	(NOTE 3)
congThresholds	array(ThresholdLevel)	C	1..N	Represents the congestion threshold levels. (NOTE 4)	UserDataCongestion
nwPerfRequs	array(NetworkPerfRequirement)	C	1..N	Represents the network performance requirements. This attribute shall be included when subscribed eventis "NETWORK_PERFORMANCE".	NetworkPerformance
bwRequs	array(BwRequirement)	O	1..N	Represents the bandwidth requirement for each application.	ServiceExperience
excepRequs	array(Exception)	C	1..N	Represents a list of Exception Ids with associated thresholds. May only be present when subscribed event is "ABNORMAL_BEHAVIOUR". (NOTE 5, NOTE 6)	AbnormalBehaviour
exptAnaType	ExpectedAnalyticsType	C	0..1	Represents expected UE	AbnormalBehavi

				analytics type. It shall not be present if the "excepRequs" attribute is provided. (NOTE 6)	our
exptUeBehav	ExpectedUeBehaviourData	O	0..1	Represents expected UE behaviour.	AbnormalBehaviour

NOTE 1: The "anySlice" attribute is not applicable to features "UeMobility" and "NetworkPerformance". The "snssais" attribute is not applicable to features "ServiceExperience", "NsiLoad", "UeMobility" and "NetworkPerformance". When subscribed event is "SLICE_LOAD_LEVEL", the identifications of network slices, either information about slice(s) identified by "snssais", or "anySlice" set to "TRUE" shall be included. When subscribed event is "QOS_SUSTAINABILITY", "NF_LOAD", "UE_COMM", "ABNORMAL_BEHAVIOUR" or "USER_DATA_CONGESTION", the identifications of network slices identified by "snssais" is optional. When subscribed event is "NSI_LOAD_LEVEL" or "SERVICE_EXPERIENCE", either the "nsiIdInfos" attribute or "anySlice" set to "TRUE" shall be included.
NOTE 2: When notificationMethod is not supplied, the default value is "THRESHOLD".
NOTE 3: Applicability is further described in the corresponding data type.
NOTE 4: This property shall be provided if the "notifMethod" in "evtReq" is set to "ON_EVENT_DETECTION" or "notificationMethod" in "eventSubscriptions" is set to "THRESHOLD" or omitted.
NOTE 5: Only "excepId" and "excepLevel" within the Exception data type apply to the "excepRequs" attribute within EventSubscription data type.
NOTE 6: Either "excepRequs" or "exptAnaType" shall be provided if subscribed event is "ABNORMAL_BEHAVIOUR".
NOTE 7: For "NETWORK_PERFORMANCE", "SERVICE_EXPERIENCE" or "USER_DATA_CONGESTION" event, this attribute shall be provided if the event applied for all UEs (i.e. "anyUe" attribute set to true within the "tgtUe" attribute). For "QOS_SUSTAINABILITY", this attribute shall be provided.
NOTE 8: For "ABNORMAL_BEHAVIOUR" event with "anyUe" attribute in "tgtUe" attribute sets to true,
- at least one of the "networkArea" and the "snssais" attribute should be included, if the expected analytics type via the"exptAnaType" attribute or the list of Exception Ids via the "excepRequs" attribute is mobility related;
- at least one of the "networkArea", "appIds", "dnns" and "snssais" attribute should be included, if the expected analytics type via the"exptAnaType" attribute or the list of Exception Ids via the "excepRequs" attribute is communication related;
- the expected analytics type via the"exptAnaType" attribute or the list of Exception Ids via "excepRequs" attribute shall not be requested for both mobility and communication related analytics at the same time.

Editor's Note: It's FFS whether the "nfTypes", "nfSetIds", "nfInstanceIds" or "nfLoadLvlThds" attirbutes are applicable for the NsiLoadExt feature.

5.1.6.2.4 Type NnwdafEventsSubscriptionNotification

Table 5.1.6.2.4-1: Definition of type NnwdafEventsSubscriptionNotification

Attribute name	Data type	P	Cardinality	Description	Applicability
eventNotifications	array(EventNotification)	M	1..N	Notifications about Individual Events	
subscriptionId	string	M	1	String identifying a subscription to the Nnwdaf_EventsSubscription Service	

5.1.6.2.5 Type EventNotification

Table 5.1.6.2.5-1: Definition of type EventNotification

Attribute name	Data type	P	Cardinality	Description	Applicability
event	NwdafEvent	M	1	Event that is notified.	
start	DateTime	O	0..1	It defines the start time of which the analytics information will become valid. (NOTE 1)	
expiry	DateTime	O	0..1	It defines the expiration time after which the analytics information will become invalid. (NOTE 1)	
timeStampGen	DateTime	O	0..1	It defines the timestamp of analytics generation.	
failNotifyCode	NwdafFailureCode	C	0..1	Identifies the failure reason for the event notification. It shall only be included if the event notification is failed or the analytics information is not ready. (NOTE 2)	EneNA
rvWaitTime	DateTime	O	0..1	UTC time indicating a recommended time which is used to determine the time when analytics information is needed in similar future event subscriptions. It may only be included if the "failNotifyCode" attribute sets to "UNSATISFIED_REQUESTED_ANALYTICS_TIME".	EneNA
anaMetaInfo	AnalyticsMetadataInfo	C	0..1	Contains information about analytics metadata required to aggregate the analytics. It shall be present if the "anaMeta" attribute was included in the subscription, containing the information indicated by the "anaMeta" attribute.	Aggregation
nwPerfs	array(NetworkPerfInfo)	C	1..N	The network performance information.	NetworkPerformance
nfLoadLevelInfos	array(NfLoadLevelInformation)	C	1..N	The NF load level information. When subscribed event is "NF_LOAD", the nfLoadLevelInfos shall be included.	NfLoad
nsiLoadLevelInfos	array(NsiLoadLevelInfo)	C	1..N	Each element identifies the load level information for each S-NSSAI and the optionally associated network slice instance. Shall be included when subscribed event is "NSI_LOAD_LEVEL".	NsiLoad NsiLoadExt
qosSustainInfos	array(QosSustainabilityInfo)	C	1..N	The QoS sustainability information. When subscribed event is “QOS_SUSTAINABILITY”, the qosSustainInfos shall be included.	QoSSustainability
sliceLoadLevelInfo	SliceLoadLevelInformation	C	0..1	The slices and the load level information. When subscribed event is "SLICE_LOAD_LEVEL", the sliceLoadLevelInfo shall be included.	
svcExps	array(ServiceExperienceInfo)	C	1..N	The service experience information. When subscribed event is	ServiceExperience

				"SERVICE_EXPERIENCE", the svcExps shall be included.	
ueComms	array(UeCommunication)	C	1..N	The UE communication information. When subscribed event is "UE_COMM", the ueComms shall be included.	UeCommunication
ueMobs	array(UeMobility)	C	1..N	The UE mobility information. When subscribed event is "UE_MOBILITY", the ueMobs shall be included.	UeMobility
abnorBehavrs	array(AbnormalBehaviour)	C	1..N	The Abnormal Behaviour information. When subscribed event is "ABNORMAL_BEHAVIOUR", the abnorBehavrs shall be included.	AbnormalBehaviour
userDataCongInfos	array(UserDataCongestionInfo)	C	1..N	The location and user data congestion information. Shall be present if the subscribed event is "USER_DATA_CONGESTION".	UserDataCongestion
NOTE 1: If the "start" attribute and the "expiry" attribute are both provided, the DateTime of the "expiry" attribute shall not be earlier than the DateTime of the "start" attribute. NOTE 2: The values of "UNAVAILABLE_DATA" and "BOTH_STAT_PRED_NOT_ALLOWED" of the NwdafFailureCode data type are not applicable for the "failNotifyCode" attribute.					

5.1.6.2.6 Type SliceLoadLevelInformation

Table 5.1.6.2.6-1: Definition of type SliceLoadLevelInformation

Attribute name	Data type	P	Cardinality	Description	Applicability
loadLevelInformation	LoadLevelInformation	M	1	Load level information which applies for each network slice identified by snssais.	
snssais	array(Snssai)	M	1..N	Identification(s) of network slice to which the subscription applies.	

5.1.6.2.7 Type EventReportingRequirement

Table 5.1.6.2.7-1: Definition of type EventReportingRequirement

Attribute name	Data type	P	Cardinality	Description	Applicability
accuracy	Accuracy	O	0..1	Preferred level of accuracy of the analytics.	
startTs	DateTime	O	0..1	UTC time indicating the start time of the observation period. The absence of this attribute means subscription at the present time.	
endTs	DateTime	O	0..1	UTC time indicating the end time of the observation period. The absence of this attribute means subscription at the present time. If provided, it shall not be less than the start time.	
sampRatio	SamplingRatio	O	0..1	Percentage of sampling (1%...100%) among impacted UEs. Applicable to event targeting a group of UEs or any UE. (NOTE 1)	
maxSupiNbr	Uinteger	O	0..1	Represents the maximum number of SUPIs expected in an object. Applicable for the event(s) providing a list of SUPIs during the analytics response.	
maxObjectNbr	Uinteger	O	0..1	Maximum number of objects expected for an analytics report. It's only applicable for the event(s) which may provide more than one entries or objects during event notification.	
timeAnaNeeded	DateTime	O	0..1	UTC time indicating the time when analytcs information is needed. (NOTE 2)	
anaMeta	array(AnalyticsMetadata)	O	1..N	List of analytics metadata that are requested to be included.	Aggregation
anaMetaInd	AnalyticsMetadataIndication	O	0..1	Contains values for the analytics metadata that the NF service consumer wants to be used for generating the analytics.	Aggregation

NOTE 1: The "sampRatio" attribute within EventReportingRequirement data type is not applicable for the Nnwdaf_EventsSubscription API.
NOTE 2: For the Nnwdaf_EventsSubscription API, the "timeAnaNeeded" attribute is only applicable when the feature EneNA is supported.

5.1.6.2.8 Type TargetUeInformation

Table 5.1.6.2.8-1: Definition of type TargetUeInformation

Attribute name	Data type	P	Cardinality	Description	Applicability
anyUe	boolean	O	0..1	Identifies any UE when setting to true.	ServiceExperience NetworkPerformance NfLoad UserDataCongestion AbnormalBehaviour QoSSustainability
supis	array(Supi)	O	1..N	Identifies a SUPI for an UE. (NOTE 2)	UeMobility UeCommunication NetworkPerformance AbnormalBehaviour UserDataCongestion NfLoad ServiceExperience
gpsis	array(Gpsi)	O	1..N	Identifies a GPSI for an UE.	UserDataCongestion Ext
intGroupIds	array(GroupId)	O	1..N	Represents an internal group identifier and identifies a group of UEs. (NOTE 2)	UeMobility UeCommunication NetworkPerformance AbnormalBehaviour ServiceExperience
NOTE 1: For an applicable feature or UserDataCongestion and UserDataCongestionExt features are both applicable, only one attribute identifying the target UE shall be provided. NOTE 2: Only one element in the attribute shall be provided for the applicable events except the "SERVICE_EXPERIENCE" event.					

5.1.6.2.9 Void

5.1.6.2.10 Type UeMobility

Table 5.1.6.2.10-1: Definition of type UeMobility

Attribute name	Data type	P	Cardinality	Description	Applicability
ts	DateTime	O	0..1	This attribute identifies the timestamp when the UE arrives the location. (NOTE 1)	
recurringTime	ScheduledCommunicationTime	O	0..1	Identifies time of the day and day of the week which are valid within the observation period when the UE moves. (NOTE 1, NOTE 2)	
duration	DurationSec	M	1	This attribute identifies the time duration the UE stays in the location. If the analytics result applies for a group of UEs, it indicates the average duration for the group of UEs.	
durationVariance	Float	C	0..1	This attribute indicates the variance of the analysed durations for the group of UEs. It shall be provided if the analytics result applies for a group of UEs.	
locInfos	array(LocationInfo)	M	1..N	This attribute includes a list of UE location information during the time duration.	
NOTE 1: Either ts or recurringTime shall be provided. NOTE 2: If this attribute is present, it indicates the UE movement is periodic. This attribute is suitable to be present for a recurring mobility in a long observation time.					

5.1.6.2.11 Type LocationInfo

Table 5.1.6.2.11-1: Definition of type LocationInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
loc	UserLocation	M	1	This attribute contains the detailed location, the ueLocationTimestamp attribute in the 3GPP access type of UserLocation data type shall not be provided.	
ratio	SamplingRatio	C	0..1	This attribute contains the percentage of UEs with same analytics result in the group. Shall be present if the analytics result applies for a group of UEs.	
confidence	Uinteger	C	0..1	Indicates the confidence of the prediction. (NOTE) Shall be present if the analytics result is a prediction. Minimum = 0. Maximum = 100.	
NOTE: If the requested period identified by the "startTs" and "endTs" attributes in the "EventReportingRequirement" type is a future time period, which means the analytics result is a prediction. If no sufficient data is collected to provide the confidence of the prediction before the time deadline, the NWDAF shall return a zero confidence.					

5.1.6.2.12 Void

5.1.6.2.13 Type UeCommunication

Table 5.1.6.2.13-1: Definition of type UeCommunication

Attribute name	Data type	P	Cardinality	Description	Applicability
commDur	DurationSec	M	0..1	Identifies the duration of the communication. If the analytics result applies for a group of UEs, it indicates the average duration for the subset of UEs indicated by a given ratio in the group.	
commDurVariance	Float	C	0..1	This attribute indicates the variance of the analysed durations for the subset of UEs indicated by a given ratio in the group. It shall be provided if the analytics result applies for a group of UEs.	
perioTime	DurationSec	O	0..1	Identifies interval time of periodic communication, e.g. every 10 minutes or 1 hour. (NOTE 2) If the analytics result applies for a group of UEs, it indicates the average interval time of periodic communication for the subset of UEs indicated by a given ratio in the group.	
perioTimeVariance	Float	C	0..1	This attribute indicates the variance of the analysed intervals of periodic communication for the subset of UEs indicated by a given ratio in the group. It shall be provided if the analytics result applies for a group of UEs.	
ts	DateTime	C	0..1	Identifies the start time of the communication. (NOTE 1)	
tsVariance	Float	O	0..1	This attribute indicates the variance of the analysed start time for the subset of UEs indicated by a given ratio in the group. It may only be provided if the ts attribute is provided.	
recurringTime	ScheduledCommunicationTime	C	0..1	Identifies time of the day and day of the week which are valid within the observation period when the UE has communication. Providing the end time in ScheduledCommunicationTime data type is not required. (NOTE 1, NOTE 3)	
trafChar	TrafficCharacterization	M	1	Identifies the detailed traffic characterization.	
ratio	SamplingRatio	C	0..1	This attribute contains the percentage of UEs with same analytics result in the group. Shall be present if the analytics result applies for a group of UEs.	
confidence	Uinteger	C	0..1	Indicates the confidence of the prediction. (NOTE 4) Shall be present if the analytics result is a prediction. Minimum = 0. Maximum = 100.	
NOTE 1: Either ts or recurringTime shall be provided. NOTE 2: If this attribute is present, it indicates the communication is periodic and its value shall be larger than the					

commDur value. If this attribute is present with the ts attribute, it indicates the periodic communication time valid within the observation period; if it is present with the recurringTime attribute, it indicates the periodic communication time valid within the day(s).
NOTE 3: If this attribute is present, it indicates the communication is periodic. This attribute is suitable to be present for a recurring communication in a long observation time.
NOTE 4: If the requested period identified by the "startTs" and "endTs" attributes in the "EventReportingRequirement" type is a future time period, which means the analytics result is a prediction. If no sufficient data is collected to provide the confidence of the prediction before the time deadline, the NWDAF shall return a zero confidence.

5.1.6.2.14 Type TrafficCharacterization

Table 5.1.6.2.14-1: Definition of type TrafficCharacterization

Attribute name	Data type	P	Cardinality	Description	Applicability
appId	ApplicationId	O	0..1	Contains the application identifier.	
dnn	Dnn	O	0..1	Identifies DNN, a full DNN with both the Network Identifier and Operator Identifier, or a DNN with the Network Identifier only. Shall be present if the "dnns" was provided within EventSubscription during the subscription for event notification procedure.	
snssai	Snssai	C	0..1	Identifies the network slice. Shall be present if the "snssais" was provided within EventSubscription during the subscription for event notification procedure.	
fDescs	array(IpEthFlowDescription)	O	1..2	Contains the flow description for the Uplink and/or Downlink flows.	
ulVol	Volume	O	0..1	Identifies the uplink traffic volume. (NOTE) If the analytics result applies for a group of UEs, it indicates the average uplink traffic volume for the subset of UEs indicated by a given ratio in the group.	
ulVolVariance	Float	C	0..1	This attribute indicates the variance of the uplink traffic volumes for the subset of UEs indicated by a given ratio in the group. It shall be provided if the analytics result applies for a group of UEs.	
dlVol	Volume	O	0..1	Identifies the downlink traffic volume. (NOTE) If the analytics result applies for a group of UEs, it indicates the average downlink traffic volume for the subset of UEs indicated by a given ratio in the group.	
dlVolVariance	Float	C	0..1	This attribute indicates the variance of the downlink traffic volumes for the subset of UEs indicated by a given ratio in the group. It shall be provided if the analytics result applies for a group of UEs.	
NOTE: At least one of ulVol or dlVol shall be provided.					

5.1.6.2.15 Type AbnormalBehaviour

Table 5.1.6.2.15-1: Definition of type AbnormalBehaviour

Attribute name	Data type	P	Cardinality	Description	Applicability
supis	array(Supi)	C	1..N	Each element identifies a UE which is affected with the Exception. Shall be present if the subscription request applies to more than one UE.	
dnn	Dnn	C	0..1	Identifies DNN, a full DNN with both the Network Identifier and Operator Identifier, or a DNN with the Network Identifier only. Shall be present if the "dnns" was provided within EventSubscription during the subscription for event notification procedure.	
excep	Exception	M	1	Contains the exception information.	
snssai	Snssai	C	0..1	Identifies the network slice information. Shall be present if the "snssais" was provided within EventSubscription during the subscription for event notification procedure.	
ratio	SamplingRatio	C	0..1	Contains the percentage of UEs with same analytics result in the group or among all UEs. Shall be present if the analytics result applies for a group of UEs or any UE.	
confidence	Uinteger	C	0..1	Indicates the confidence of the prediction. (NOTE) Shall be present if the analytics result is a prediction. Minimum = 0. Maximum = 100.	
addtMeasInfo	AdditionalMeasurement	O	0..1	Additional measurement.	
NOTE: If the requested period identified by the "startTs" and "endTs" attributes in the "EventReportingRequirement" type is a future time period, which means the analytics result is a prediction. If no sufficient data is collected to provide the confidence of the prediction before the time deadline, the NWDAF shall return a zero confidence.					

5.1.6.2.16 Type Exception

Table 5.1.6.2.16-1: Definition of type Exception

Attribute name	Data type	P	Cardinality	Description	Applicability
excepId	ExceptionId	M	1	Indicating the Exception ID.	
excepLevel	integer	O	0..1	Measured level, compared to the threshold	
excepTrend	ExceptionTrend	O	0..1	Measured trend	

5.1.6.2.17 Type UserDataCongestionInfo

Table 5.1.6.2.17-1: Definition of type UserDataCongestionInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
networkArea	NetworkAreaInfo	M	1	Identification of network area to which the subscription applies.	
congestionInfo	CongestionInfo	M	1	The congestion information of the specific location.	
snssai	Snssai	C	0..1	Identifies an S-NSSAI. Shall be present if the "snssais" was provided within EventSubscription during the subscription for event notification procedure.	

5.1.6.2.18 Type CongestionInfo

Table 5.1.6.2.18-1: Definition of type CongestionInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
congType	CongestionType	M	1	Identification congestion analytics type.	
timeIntev	TimeWindow	M	1	Represents a start time and a stop time requested for the congestion information.	
nsi	ThresholdLevel	M	1	Network Status Indication.	
confidence	Uinteger	C	0..1	Indicates the confidence of the prediction. (NOTE) Shall be present if the analytics result is a prediction. Minimum = 0. Maximum = 100.	
topAppListUl	array(TopApplication)	C	0..N	List of top applications in Uplink. Shall be present if the "topAppListUlInd" attribute is included and set to true in the event subscription or analytics request.	UserDataCongestionExt
topAppListDl	array(TopApplication)	C	0..N	List of top applications in Downlink. Shall be present if the "topAppListDlInd" attribute is included and set to true in the event subscription or analytics request.	UserDataCongestionExt
NOTE: If the requested period identified by the "startTs" and "endTs" attributes in the EventReportingRequirement type is a future time period, which means the analytics result is a prediction. If no sufficient data is collected to provide the confidence of the prediction before the time deadline, the NWDAF shall return a zero confidence.					

5.1.6.2.19 Type QosSustainabilityInfo

Table 5.1.6.2.19-1: Definition of type QosSustainabilityInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
areaInfo	NetworkAreaInfo	M	1	Identification(s) of applicable location areas to which the subscription.	
startTs	DateTime	M	1	Represents the start time of the applicable observing period.	
endTs	DateTime	M	1	Represents the end time of the applicable observing period.	
qosFlowRetThd	RetainabilityThreshold	O	0..1	The reporting QoS Flow Retainability Threshold that are met or crossed for 5QI of GBR resource type. (NOTE 1)	
ranUeThrouThd	BitRate	O	0..1	The reporting RAN UE Throughput Threshold that are met or crossed for 5QI of non-GBR resource type. (NOTE 1)	
snssai	Snssai	C	0..1	Identifies an S-NSSAI. Shall be present if the "snssais" was provided within EventSubscription during the subscription for event notification procedure.	
confidence	Uinteger	C	0..1	Indicates the confidence of the prediction. (NOTE 2) Shall be present if the analytics result is a prediction. Minimum = 0. Maximum = 100.	

NOTE 1: Either qosFlowRetThd or ranUeThrouThd shall be provided.
NOTE 2: If the requested period identified by the "startTs" and "endTs" attributes in the "EventReportingRequirement" type is a future time period, which means the analytics result is a prediction. If no sufficient data is collected to provide the confidence of the prediction before the time deadline, the NWDAF shall return a zero confidence.

5.1.6.2.20 Type QosRequirement

Table 5.1.6.2.20-1: Definition of type QosRequirement

Attribute name	Data type	P	Cardinality	Description	Applicability
5qi	5Qi	C	1	Represents a 5G QoS Identifier. It shall be included for standardized or preconfigured 5QIs. (NOTE)	
gfbrUl	BitRate	C	0..1	Indicates GFBR in the uplink. It shall be included for GBR 5QIs.	
gfbrDl	BitRate	C	0..1	Indicates GFBR in the downlink. It shall be included for GBR 5QIs.	
resType	QosResourceType	C	0..1	Resource type. Shall be provided for the non-standardized and non-preconfigured QoS characteristics. (NOTE)	
pdb	PacketDelBudget	C	0..1	Packet Delay Budget. May be supplied for the non-standardized and non-pre-configured QoS characteristics.	
per	PacketErrRate	C	0..1	Packet Error Rate. May be supplied for the non-standardized and non-pre-configured QoS characteristics.	
NOTE: Either 5QI within "5qi" attribute or the resource type within "resType" attribute shall be provided.					

5.1.6.2.21 Type RetainabilityThreshold

Table 5.1.6.2.21-1: Definition of type RetainabilityThreshold

Attribute name	Data type	P	Cardinality	Description	Applicability
relFlowNum	Uinteger	O	0..1	Represents the number of abnormally released QoS flows. (NOTE)	
relTimeUnit	TimeUnit	C	0..1	Represents the unit for the session active time, shall be present if relFlowNum is present. (NOTE)	
relFlowRatio	SamplingRatio	O	0..1	Represents the ratio of abnormally released QoS flows to the total released QoS flows, expressed in percentage. (NOTE)	
NOTE: Either relFlowNum and its associated relTimeUnit or relFlowRatio shall be provided. relFlowNum and relTimeUnit together represents the number of abnormally released QoS flows (i.e. relFlowNum) within the time unit (i.e. relTimeUnit).					

5.1.6.2.22 Type NetworkPerfRequirement

Table 5.1.6.2.22-1: Definition of type NetworkPerfRequirement

Attribute name	Data type	P	Cardinality	Description	Applicability
nwPerfType	NetworkPerfType	M	1	The type of the network performance.	
relativeRatio	SamplingRatio	C	0..1	The relative ratio expressed in percentage. (NOTE)	
absoluteNum	Uinteger	C	0..1	The absolute number (NOTE)	
NOTE: Either relativeRatio or absoluteNum shall be provided if the "notifMethod" in "evtReq" is set to "ON_EVENT_DETECTION" or "notificationMethod" in "eventSubscriptions" is set to "THRESHOLD" or omitted.					

5.1.6.2.23 Type NetworkPerfInfo

Table 5.1.6.2.23-1: Definition of type NetworkPerfInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
networkArea	NetworkAreaInfo	M	1	Identification of network area to which the subscription applies.	
nwPerfType	NetworkPerfType	M	1	The type of the network performance	
relativeRatio	SamplingRatio	O	0..1	The reported relative ratio expressed in percentage. (NOTE 1)	
absoluteNum	Uinteger	O	0..1	The reported absolute number (NOTE 1)	
confidence	Uinteger	C	0..1	Indicates the confidence of the prediction. (NOTE 2) Shall be present if the analytics result is a prediction. Minimum = 0. Maximum = 100.	

NOTE 1: Either relativeRatio or absoluteNum shall be provided.
NOTE 2: If the requested period identified by the "startTs" and "endTs" attributes in the "EventReportingRequirement" type is a future time period, which means the analytics result is a prediction. If no sufficient data is collected to provide the confidence of the prediction before the time deadline, the NWDAF shall return a zero confidence.

5.1.6.2.24 Type ServiceExperienceInfo

Table 5.1.6.2.24-1: Definition of type ServiceExperienceInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
svcExprc	SvcExperience	M	1	Service experience	
svcExprcVariance	Float	O	0..1	This attribute indicates the variance .	
supis	array(Supi)	O	1..N	Each element identifies a UE. May only be present if the subscription request applies to more than one UE.	
snssai	Snssai	C	0..1	Identifies an S-NSSAI. Shall be presented if the "snssais" was provided within EventSubscription during the subscription for event notification procedure.	
appId	ApplicationId	C	0..1	Identifies an application. Shall be present if the "appIds" was provided within EventSubscription during the subscription for event notification procedure.	
confidence	Uinteger	C	0..1	Indicates the confidence of the prediction. (NOTE) Shall be present if the analytics result is a prediction. Minimum = 0. Maximum = 100.	
dnn	Dnn	C	0..1	Identifies DNN, a full DNN with both the Network Identifier and Operator Identifier, or a DNN with the Network Identifier only. Shall be present if the "dnns" was provided within EventSubscription during the subscription for event notification procedure.	
networkArea	NetworkAreaInfo	C	0..1	Identifies the network area where the service experience applies. Shall be presented if the "networkArea" was provided within EventSubscription during the subscription for event notification procedure.	
nsiId	NsiId	C	0..1	Identifies a network slice instance which is associated with the S-NSSAI identified by the "snssai" attribute. Shall be presented if the "nsiIds" was provided within the NsiIdInfo data in the EventSubscription data during the subscription.	
ratio	SamplingRatio	C	0..1	Contains the percentage of UEs with same analytics result in the group or among all UEs. Shall be present if the analytics result applies for a group of UEs or any UE.	
NOTE: If the requested period identified by the "startTs" and "endTs" attributes in the "EventReportingRequirement" type is a future time period, which means the analytics result is a prediction. If no sufficient data is collected to provide the confidence of the prediction before the time deadline, the NWDAF shall return a zero confidence.					

5.1.6.2.25 Type BwRequirement

Table 5.1.6.2.25-1: Definition of type BwRequirement

Attribute name	Data type	P	Cardinality	Description	Applicability
appId	ApplicationId	M	1	Represents an application. (NOTE)	
marBwUl	BitRate	O	0..1	Maximum requested bandwidth for the Uplink.	
marBwDl	BitRate	O	0..1	Maximum requested bandwidth for the Downlink.	
mirBwUl	BitRate	O	0..1	Minimum requested bandwidth for the Uplink.	
mirBwDl	BitRate	O	0..1	Minimum requested bandwidth for the Downlink.	
NOTE: If the "appIds" attribute is provided within EventSubscription data, this attribute shall be indicated by the "appIds" attribute.					

5.1.6.2.26 Type AdditionalMeasurement

Table 5.1.6.2.26-1: Definition of type AdditionalMeasurement

Attribute name	Data type	P	Cardinality	Description	Applicability
unexpLoc	NetworkAreaInfo	C	0..1	The unexpected locations which the UE stays. It may only be present when the "excepId" within the Exception data sets to "UNEXPECTED_UE_LOCATION"	
unexpFlowTeps	array(IpEthFlowDescription)	C	1..N	Unexpected IP or Ethernet flow templates. It may only be present when the "excepId" within the Exception data sets to "UNEXPECTED_LONG_LIVE_FLOW" or "UNEXPECTED_LARGE_RATE_FLOW".	
unexpWakes	array(DateTime)	C	1..N	Unexpected wake up times. It may only be present when the "excepId" within the Exception data sets to "UNEXPECTED_WAKEUP".	
ddosAttack	AddressList	C	0..1	Victim's address list. It may only be present when the "excepId" within the Exception data sets to "SUSPICION_OF_DDOS_ATTACK".	
wrgDest	AddressList	C	0..1	Wrong destination address list. It may only be present when the "excepId" within the Exception data sets to "WRONG_DESTINATION_ADDRESS".	
circums	array(CircumstanceDescription)	C	1..N	The description of circumstances. It may only be present when the "excepId" within the Exception data sets to "TOO_FREQUENT_SERVICE_ACCESS", "UNEXPECTED_RADIO_LINK_FAILURES" or "PING_PONG_ACROSS_CELLS".	

5.1.6.2.27 Type IpEthFlowDescription

Table 5.1.6.2.27-1: Definition of type FlowDescription

Attribute name	Data type	P	Cardinality	Description	Applicability
ipTrafficFilter	FlowDescription	O	0..1	Identifies IP packet filter.(NOTE)	
ethTrafficFilter	EthFlowDescription	O	0..1	Identifies Ethernet packet filter.(NOTE)	
NOTE: Either "ipTrafficFilter" or "ethTrafficFilter" shall be provided.					

5.1.6.2.28 Type AddressList

Table 5.1.6.2.28-1: Definition of type AddressList

Attribute name	Data type	P	Cardinality	Description	Applicability
ipv4Addrs	array(Ipv4Addr)	O	1..N	Each element identifies an IPv4 address.	
ipv6Addrs	array(Ipv6Addr)	O	1..N	Each element identifies an IPv6 address.	
NOTE: At least one of "ipv4Addrs" or "ipv6Addrs" shall be provided.					

5.1.6.2.29 Type CircumstanceDescription

Table 5.1.6.2.29-1: Definition of type CircumstanceDescription

Attribute name	Data type	P	Cardinality	Description	Applicability
freq	Float	O	0..1	Communication frequency of the UE in units of MHz.	
tm	DateTime	O	0..1	Time when UE enters the location.	
locArea	NetworkAreaInfo	C	0..1	The location of the UE. It shall be present when the "excepId" within the Exception data sets to "UNEXPECTED_RADIO_LINK_FAILURES" or "PING_PONG_ACROSS_CELLS".	
vol	Volume	C	0..1	The traffic volume. It shall be present when the "excepId" within the Exception data sets to "TOO_FREQUENT_SERVICE_ACCESS" or "UNEXPECTED_LARGE_RATE_FLOW ".	

5.1.6.2.30 Type ThresholdLevel

Table 5.1.6.2.30 -1: Definition of type ThresholdLevel

Attribute name	Data type	P	Cardinality	Description	Applicability
congLevel	integer	C	0..1	Value of Congestion that triggers notification (NOTE 1)	UserDataCongestion
nfLoadLevel	integer	C	0..1	Value of NF Load that triggers notification (NOTE 2)	NfLoad
nfCpuUsage	integer	C	0..1	Value of NF CPU Usage that triggers notification (NOTE 2)	NfLoad
nfMemoryUsage	integer	C	0..1	Average usage of memory (NOTE 2)	NfLoad
nfStorageUsage	integer	C	0..1	Average usage of storage (NOTE 2)	NfLoad
NOTE 1: This attribute shall be provided when subscribed event is "USER_DATA_CONGESTION". NOTE 2: At least one attribute should be provided when subscribed event is "NF_LOAD".					

5.1.6.2.31 Type NfLoadLevelInformation

Table 5.1.6.2.31-1: Definition of type NfLoadLevelInformation

Attribute name	Data type	P	Cardinality	Description	Applicability
nfType	NFType	M	1	Type of the NF instance	
nfInstanceId	NfInstanceId	M	1	Identification of the NF instance	
nfSetId	NfSetId	O	0..1	Identification of the NF instance set	
nfStatus	NfStatus	O	0..1	Availability status of the NF	
nfCpuUsage	integer	C	0..1	Average usage CPU (NOTE 1) (NOTE 2)	
nfMemoryUsage	integer	C	0..1	Average usage of memory (NOTE 1) (NOTE 2)	
nfStorageUsage	integer	C	0..1	Average usage of storage (NOTE 1) (NOTE 2)	
nfLoadLevelAverage	integer	C	0..1	Average load information (NOTE 1) (NOTE 2)	
nfLoadLevelPeak	integer	O	0..1	Peak load information(NOTE 2)	
snssai	Snssai	C	0..1	Identifies an S-NSSAI. Shall be present if the "snssais" was provided within EventSubscription during the subscription for event notification procedure.	
confidence	Uinteger	C	0..1	Indicates the confidence of the prediction. (NOTE 3) Shall be present if the analytics result is a prediction. Minimum = 0. Maximum = 100.	
NOTE 1: At least one value shall be provided. NOTE 2: The values are percentages which are provided as estimated over a given period. NOTE 3: If the requested period identified by the "startTs" and "endTs" attributes in the "EventReportingRequirement" type is a future time period, which means the analytics result is a prediction. If no sufficient data is collected to provide the confidence of the prediction before the time deadline, the NWDAF shall return a zero confidence.					

5.1.6.2.32 Type NfStatus

Table 5.1.6.2.32-1: Definition of type NfStatus

Attribute name	Data type	P	Cardinality	Description	Applicability
statusRegistered	SamplingRatio	C	0..1	Percentage of time with status “registered” (NOTE)	
statusUnregistered	SamplingRatio	C	0..1	Percentage of time with status “unregistered” (NOTE)	
statusUndiscoverable	SamplingRatio	C	0..1	Percentage of time with status “undiscoverable” (NOTE)	
NOTE: The availability statuses of the NF on the Analytics target period are expressed as a percentage of time. The total of status values should be equal or lower than 100%. At least one value shall be provided.					

5.1.6.2.33 Type NsiIdInfo

Table 5.1.6.2.33-1: Definition of type NsiIdInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
snssai	Snssai	M	1	Identification of network slice to which the subscription for event notification procedure applies.	
nsiIds	array(NsiId)	O	1..N	Identification of network slice instance(s) associated with the subscribed S-NSSAI identified by the "snssai" attribute. May be included when subscribed event is "NSI_LOAD_LEVEL" or "SERVICE_EXPERIENCE". (NOTE)	
NOTE: This attribute is not applicable when the NF service consumer is CEF or PCF.					

5.1.6.2.34 Type NsiLoadLevelInfo

Table 5.1.6.2.34-1: Definition of type NsiLoadLevelInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
loadLevelInformation	LoadLevelInformation	M	1	Load level information of the network slice identified by the "snssai" attribute and if provided, the associated NSI ID identified by the "nsiId" attribute.	
snssai	Snssai	M	1	Identification of network slice to which the subscription applies.	
nsiId	NsiId	C	0..1	Identification of network slice instance associated with the S-NSSAI identified by the "snssai" attribute. Shall be presented if the "nsiIds" attribute was provided within the NsiIdInfo data in the EventSubscription data during the subscription.	
networkArea	NetworkAreaInfo	O	0..1	Identification of network area to which the subscription applies.	NsiLoadExt
timePeriod	TimeWindow	O	0..1	Indicates a start time and a stop time of the load level information identified by the "loadLevelInformation" attribute.	NsiLoadExt
numOfUes	NumberAverage	O	0..1	Indicates the number of UE registrations at the S-NSSAI and the optionally associated network slice instance.	NsiLoadExt
numOfPduSess	NumberAverage	O	0..1	Indicates the number of PDU session establishments at the S-NSSAI and the optionally associated network slice instance.	NsiLoadExt
confidence	Uinteger	C	0..1	Indicates the confidence of the prediction. (NOTE Y) Shall be present if the analytics result is a prediction. Minimum = 0. Maximum = 100.	NsiLoadExt
NOTE: If the requested period identified by the "startTs" and "endTs" attributes in the "EventReportingRequirement" type is a future time period, which means the analytics result is a prediction. If no sufficient data is collected to provide the confidence of the prediction before the time deadline, the NWDAF shall return a zero confidence.					

Editor's Note: It's FFS that whether the "numOfUes" and "numOfPduSess" attirbutes are optional or conditional provided under the new NsiLoadExt feature.

Editor's Note: It's FFS that whether the "timePeriod" attribute is a time interval or time duration for the load level information of the network slice (instance).

5.1.6.2.35 Type FailureEventInfo

Table 5.1.6.2.35-1: Definition of type FailureEventInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
event	NwdafEvent	M	1	Event that is subscribed.	
failureCode	NwdafFailureCode	M	1	Identifies the failure reason	

5.1.6.2.36 Type AnalyticsMetadataIndication

Table 5.1.6.2.36-1: Definition of type AnalyticsMetadataIndication

Attribute name	Data type	P	Cardinality	Description	Applicability
dataWindow	TimeWindow	O	0..1	Data time window of the data samples.	
dataStatProps	array(DatasetStatisticalProperty)	O	1..N	List of dataset statistical properties of the data to be used to generate the analytics.	
strategy	OutputStrategy	O	0..1	Output strategy to be used for the reporting of the analytics.	
aggrNwdafIds	array(NfInstanceId)	O	1..N	NWDAF identifiers of NWDAF instances used by the NWDAF service consumer when aggregating multiple analytics subscriptions.	

5.1.6.2.37 Type AnalyticsMetadataInfo

Table 5.1.6.2.37-1: Definition of type AnalyticsMetadataInfo

Attribute name	Data type	P	Cardinality	Description	Applicability
numSamples	Uinteger	O	0..1	Number of data samples used for the generation of the output analytics.	
dataWindow	TimeWindow	O	0..1	Data time window of the data samples.	
dataStatProps	array(DatasetStatisticalProperty)	O	1..N	List of dataset statistical properties of the data used to generate the analytics.	
strategy	OutputStrategy	O	0..1	Output strategy used for the reporting of the analytics.	
accuracy	Accuracy	O	0..1	Level of accuracy reached for the analytics.	

5.1.6.2.38 Type NumberAverage

Table 5.1.6.2.38-1: Definition of type NumberAverage

Attribute name	Data type	P	Cardinality	Description	Applicability
number	integer	M	1	The average number.	
variance	Float	M	1	Identifies the variance.	

5.1.6.2.39 Type TopApplication

Table 5.1.6.2.39-1: Definition of type TopApplication

Attribute name	Data type	P	Cardinality	Description	Applicability
appId	ApplicationId	C	0..1	Indicates an application identifier. (NOTE)	
ipTrafficFilter	FlowInfo	C	0..1	Identifies IP packet filter. (NOTE)	
ratio	SamplingRatio	O	0..1	The application's throughput as a percentage of the total throughput in the Area of Interest.	
NOTE: Either "appId" or "ipTrafficFilter" shall be provided.					

5.1.6.3 Simple data types and enumerations

5.1.6.3.1 Introduction

This subclause defines simple data types and enumerations that can be referenced from data structures defined in the previous subclauses.

5.1.6.3.2 Simple data types

The simple data types defined in table 5.1.6.3.2-1 shall be supported.

Table 5.1.6.3.2-1: Simple data types

Type Name	Type Definition	Description	Applicability
AnySlice	boolean	"FALSE" represents not applicable for all slices. "TRUE" represents applicable for all slices.	
LoadLevelInformation	integer	Load level information of the network slice and the optionally associated network slice instance.	

5.1.6.3.3 Enumeration: NotificationMethod

Table 5.1.6.3.3-1: Enumeration NotificationMethod

Enumeration value	Description	Applicability
PERIODIC	The subscription of NWDAF Event is peridodicly. The periodic of the notification is identified by repetitionPeriod defined in subclause 5.1.6.2.3.	
THRESHOLD	The subscription of NWDAF Event is upon threshold exceeded.	

5.1.6.3.4 Enumeration: NwdafEvent

Table 5.1.6.3.4-1: Enumeration NwdafEvent

Enumeration value	Description	Applicability
NF_LOAD	Indicates that the event subscribed is NF Load.	NfLoad
QOS_SUSTAINABILITY	Indicates that the event subscribed is QoS sustainability.	QoSSustainability
SLICE_LOAD_LEVEL	Indicates that the event subscribed is load level information of Network Slice	
SERVICE_EXPERIENCE	Indicates that the event subscribed is service experience.	ServiceExperience
UE_MOBILITY	Indicates that the event subscribed is UE mobility information.	UeMobility
UE_COMM	Indicates that the event subscribed is UE communication information.	UeCommunication
ABNORMAL_BEHAVIOUR	Indicates that the event subscribed is abnormal behaviour information.	AbnormalBehaviour
USER_DATA_CONGESTION	Indicates that the event subscribed is user data congestion information	UserDataCongestion
NETWORK_PERFORMANCE	Indicates that the event subscribed is network performance information	NetworkPerformance
NSI_LOAD_LEVEL	Indicates that the event subscribed is load level information of Network Slice and the optionally associated Network Slice Instance	NsiLoad

5.1.6.3.5 Enumeration: Accuracy

Table 5.1.6.3.5-1: Enumeration Accuracy

Enumeration value	Description	Applicability
LOW	Low accuracy.	
HIGH	High accuracy.	

5.1.6.3.6 Enumeration: ExceptionId

Table 5.1.6.3.6-1: Enumeration ExceptionId

Enumeration value	Description	Applicability
UNEXPECTED_UE_LOCATION	Unexpected UE location	
UNEXPECTED_LONG_LIVE_FLOW	Unexpected long-live rate flows	
UNEXPECTED_LARGE_RATE_FLOW	Unexpected large rate flows	
UNEXPECTED_WAKEUP	Unexpected wakeup	
SUSPICION_OF_DDOS_ATTACK	Suspicion of DDoS attack	
WRONG_DESTINATION_ADDRESS	Wrong destination address	
TOO_FREQUENT_SERVICE_ACCESS	Too frequent Service Access	
UNEXPECTED_RADIO_LINK_FAILURES	Unexpected radio link failures	
PING_PONG_ACROSS_CELLS	Ping-ponging across neighbouring cells	

5.1.6.3.7 Enumeration: ExceptionTrend

Table 5.1.6.3.7-1: Enumeration ExceptionTrend

Enumeration value	Description	Applicability
UP	Up trend of the exception level.	
DOWN	Down trend of the exception level.	
UNKNOWN	Unknown trend of the exception level.	
STABLE	Stable trend of the exception level.	

5.1.6.3.8 Enumeration: CongestionType

Table 5.1.6.3.8-1: Enumeration CongestionType

Enumeration value	Description	Applicability
USER_PLANE	The congestion analytics type is User Plane.	
CONTROL_PLANE	The congestion analytics type is Control Plane.	
USER_AND_CONTROL_PLANE	The congestion analytics type is User Plane and Control Plane.	

5.1.6.3.9 Enumeration: TimeUnit

Table 5.1.6.3.9-1: Enumeration TimeUnit

Enumeration value	Description	Applicability
MINUTE	Time unit is per minute.	
HOUR	Time unit is per hour.	
DAY	Time unit is per day.	

5.1.6.3.10 Enumeration: NetworkPerfType

Table 5.1.6.3.10-1: Enumeration NetworkPerfType

Enumeration value	Description	Applicability
GNB_ACTIVE_RATIO	Indicates the ratio of gNB active (i.e. up and running) number to the total number of gNB.	
GNB_COMPUTING_USAGE	Indicates gNodeB computing resource usage.	
GNB_MEMORY_USAGE	Indicates gNodeB memory usage.	
GNB_DISK_USAGE	Indicates gNodeB disk usage.	
NUM_OF_UE	Indicates number of UEs.	
SESS_SUCC_RATIO	Indicates ratio of successful setup of PDU sessions to total PDU session setup attempts.	
HO_SUCC_RATIO	Indicates Ratio of successful handovers to the total handover attempts.	

5.1.6.3.11 Enumeration: ExpectedAnalyticsType

Table 5.1.6.3.11-1: Enumeration ExpectedAnalyticsType

Enumeration value	Description	Applicability
MOBILITY	Mobility related abnormal behaviour analytics is expected by the consumer	
COMMUN	Communication related abnormal behaviour analytics is expected by the consumer	
MOBILITY_AND_COMMUN	Both mobility and communication related abnormal behaviour analytics is expected by the consumer	

5.1.6.3.12 Enumeration: MatchingDirection

Table 5.1.6.3.12-1: Enumeration MatchingDirection

Enumeration value	Description	Applicability
ASCENDING	Threshold is crossed in ascending direction.	
DESCENDING	Threshold is crossed in descending direction.	
CROSSED	Threshold is crossed either in ascending or descending direction.	

5.1.6.3.13 Enumeration: NwdafFailureCode

Table 5.1.6.3.13-1: Enumeration NwdafFailureCode

Enumeration value	Description	Applicability
UNAVAILABLE_DATA	Indicates the requested statistics information for the event is rejected since necessary data to perform the service is unavailable.	
BOTH_STAT_PRED_NOT_ALLOWED	Indicates the requested analysis information for the event is rejected since the start time is in the past and the end time is in the future, which means the NF service consumer requested both statistics and prediction for the analytics.	
UNSATISFIED_REQUESTED_ANALYTICS_TIME	Indicates that the requested event is rejected since the analytics information is not ready when the time indicated by the "timeAnaNeeded" attribute (as provided during the creation or modification of subscription) is reached.	EneNA
OTHER	Indicates the requested analysis information for the event is rejected due to other reasons.	

5.1.6.3.14 Enumeration: AnalyticsMetadata

Table 5.1.6.3.14-1: Enumeration AnalyticsMetadata

Enumeration value	Description	Applicability
NUM_OF_SAMPLES	Number of data samples used for the generation of the output analytics.	
DATA_WINDOW	Data time window of the data samples.	
DATA_STAT_PROPS	Dataset statistical properties of the data used to generate the analytics.	
STRATEGY	Output strategy used for the reporting of the analytics.	
ACCURACY	Level of accuracy reached for the analytics.	

5.1.6.3.15 Enumeration: DatasetStatisticalProperty

Table 5.1.6.3.15-1: Enumeration DatasetStatisticalProperty

Enumeration value	Description	Applicability
UNIFORM_DIST_DATA	Indicates the use of data samples that are uniformly distributed according to the different aspects of the requested analytics.	
NO_OUTLIERS	Indicates that the data samples shall disregard data samples that are at the extreme boundaries of the value range.	

5.1.6.3.16 Enumeration: OutputStrategy

Table 5.1.6.3.16-1: Enumeration OutputStrategy

Enumeration value	Description	Applicability
BINARY	Indicates that the analytics shall only be reported when the requested level of accuracy is reached within a cycle of periodic notification as defined in the analytics reporting information (i.e. in the ReportingInformation data type or the EventSubscription data type).	
GRADIENT	Indicates that the analytics shall be reported according with the periodicity defined in the analytics reporting information (i.e. in the ReportingInformation data type or the EventSubscription data type) irrespective of whether the requested level of accuracy has been reached or not.	

5.1.7 Error handling

5.1.7.1 General

HTTP error handling shall be supported as specified in subclause 5.2.4 of 3GPP TS 29.500 [6].

For the Nnwdaf_EventsSubscription API, HTTP error responses shall be supported as specified in subclause 4.8 of 3GPP TS 29.501 [7].

Protocol errors and application errors specified in table 5.2.7.2-1 of 3GPP TS 29.500 [6] 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 [6].

In addition, the requirements in the following subclauses shall apply.

5.1.7.2 Protocol Errors

In this Release of the specification, there are no additional protocol errors applicable for the Nnwdaf_EventsSubscription API.

5.1.7.3 Application Errors

The application errors defined for the Nnwdaf_EventsSubscription API are listed in table 5.1.7.3-1. The NWDAF shall include in the HTTP status code a "ProblemDetails" data structure with the "cause" attribute indicating the application error as listed in table 5.1.7.3-1.

Table 5.1.7.3-1: Application errors

Application Error	HTTP status code	Description
SUBSCRIPTION_NOT_FOUND	404 Not Found	Indicates the Individual NWDAF Event Subscription resource does not exist. (NOTE)
BOTH_STAT_PRED_NOT_ALLOWED	400 Bad Request	For the requested observation period, the start time is in the past and the end time is in the future, which means the NF service consumer requested both statistics and prediction for the analytics.
UNAVAILABLE_DATA	500 Internal Server Error	Indicates the requested statistics in the past is rejected since necessary data to perform the service is unavailable.
NOTE: This application error is only applicable for the responses to the PUT request (see subclause 4.2.2.2.3)and the DELETE request (see subclause 4.2.2.3.2).		

5.1.8 Feature negotiation

The optional features in table 5.1.8-1 are defined for the Nnwdaf_EventsSubscription API. They shall be negotiated using the extensibility mechanism defined in subclause 6.6 of 3GPP TS 29.500 [6].

Table 5.1.8-1: Supported Features

Feature number	Feature Name	Description
1	ServiceExperience	This feature indicates support for the event related to service experience.
2	UeMobility	This feature indicates the support of analytics based on UE mobility information.
3	UeCommunication	This feature indicates the support of analytics based on UE communication information.
4	QoSSustainability	This feature indicates support for the event related to QoS sustainability.
5	AbnormalBehaviour	This feature indicates support for the event related to abnormal behaviour information.
6	UserDataCongestion	This feature indicates support for the event related to user data congestion.
7	NfLoad	This feature indicates the support of the analytics related to the load of NF instances.
8	NetworkPerformance	This feature indicates the support of analytics based on network performance.
9	NsiLoad	This feature indicates the support of the event related to the load level of Network Slice and the optionally associated Network Slice Instance.
10	ES3XX	Extended Support for 3xx redirections. This feature indicates the support of redirection for any service operation, according to Stateless NF procedures as specified in subclauses 6.5.3.2 and 6.5.3.3 of 3GPP TS 29.500 [6] and according to HTTP redirection principles for indirect communication, as specified in subclause 6.10.9 of 3GPP TS 29.500 [6].
11	EneNA	This feature indicates support for the enhancements of network data analytics requirements.
12	UserDataCongestionExt	This feature indicates support for the extensions to the event related to user data congestion. Supporting this feature also requires the support of feature UserDataCongestion.
13	Aggregation	This feature indicates support for analytics aggregation. Supporting this feature also requires the support of feature EneNA.
14	NsiLoadExt	This feature indicates support for the extensions to the event related to the load level of Network Slice and the optionally associated Network Slice Instance. Supporting this feature also requires the support of feature NsiLoad.

5.1.9 Security

As indicated in 3GPP TS 33.501 [13] and 3GPP TS 29.500 [6], the access to the Nnwdaf_EventsSubscription API may be authorized by means of the OAuth2 protocol (see IETF RFC 6749 [14]), based on local configuration, using the "Client Credentials" authorization grant, where the NRF (see 3GPP TS 29.510 [12]) plays the role of the authorization server.

If OAuth2 is used, a n NF Service Consumer, prior to consuming services offered by the Nnwdaf_EventsSubscription API, shall obtain a "token" from the authorization server, by invoking the Access Token Request service, as described in 3GPP TS 29.510 [12], subclause 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 Nnwdaf_EventsSubscription service.

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

5.2 Nnwdaf_AnalyticsInfo Service API

5.2.1 Introduction

The Nnwdaf_AnalyticsInfo Service shall use the Nnwdaf_AnalyticsInfo API.

The request URIs used in each HTTP requests from the NF service consumer towards the NWDAF shall have the Resource URI structure defined in subclause 4.4.1 of 3GPP TS 29.501 [7], i.e.:

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

with the following components:

- The {apiRoot} shall be set as described in 3GPP TS 29.501 [7].
- The<apiName> shall be "nnwdaf-analyticsinfo".
- The <apiVersion> shall be "v1".
- The <apiSpecificResourceUriPart> shall be set as described in subclause 5.2.3.

5.2.2 Usage of HTTP

5.2.2.1 General

HTTP/2, IETF RFC 7540 [9], shall be used as specified in clause 5 of 3GPP TS 29.500 [6].

HTTP/2 shall be transported as specified in subclause 5.3 of 3GPP TS 29.500 [6].

The OpenAPI [11] specification of HTTP messages and content bodies for the Nnwdaf_AnalyticsInfo is contained in Annex A.

5.2.2.2 HTTP standard headers

5.2.2.2.1 General

See subclause 5.2.2 of 3GPP TS 29.500 [6] for the usage of HTTP standard headers.

5.2.2.2.2 Content type

JSON, IETF RFC 8259 [10], shall be used as content type of the HTTP bodies specified in the present specification as specified in subclause 5.4 of 3GPP TS 29.500 [6]. 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 [15].

5.2.2.3 HTTP custom headers

The Nnwdaf_AnalyticsInfo Service API shall support the mandatory HTTP custom header fields specified in subclause 5.2.3.2 of 3GPP TS 29.500 [6] and may support the optional HTTP custom header fields specified in subclause 5.2.3.3 of 3GPP TS 29.500 [6].

In this release of the specification, no specific custom headers are defined for the Nnwdaf_AnalyticsInfo Service API.

5.2.3 Resources

5.2.3.1 Resource Structure

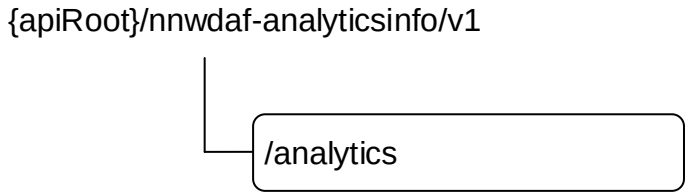

Figure 5.2.3.1-1: Resource URI structure of the Nnwdaf_AnalyticsInfo API

Table 5.2.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 5.2.3.1-1: Resources and methods overview

Resource name	Resource URI	HTTP method or custom operation	Description
NWDAF Analytics	/analytics	GET	Retrieve the NWDAF analytics

5.2.3.2 Resource: NWDAF Analytics

5.2.3.2.1 Description

The NWDAF Analytics resource represents the analytics to the Nnwdaf_AnalyticsInfo Service at a given NWDAF.

5.2.3.2.2 Resource definition

Resource URI: {apiRoot}/nnwdaf-analyticsinfo/v1/analytics

This resource shall support the resource URI variables defined in table 5.2.3.2.2-1.

Table 5.2.3.2.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See subclause 5.2.1

5.2.3.2.3 Resource Standard Methods

5.2.3.2.3.1 GET

This method shall support the URI query parameters specified in table 5.2.3.2.3.1-1.

Table 5.2.3.2.3.1-1: URI query parameters supported by the GET method on this resource

Name	Data type	P	Cardinality	Description
ana-req	EventReportingRequirement	O	0..1	Identifies the analytics reporting requirement information.
event-id	EventId	M	1	Shall be included to identify the analytics.
event-filter	EventFilter	C	0..1	Shall be included to identify the analytics when filter information is needed for the related event.
supported-features	SupportedFeatures	O	0..1	To filter irrelevant responses related to unsupported features.
tgt-ue	TargetUeInformation	O	0..1	Identifies the target UE information.

This method shall support the request data structures specified in table 5.2.3.2.3.1-2 and the response data structures and response codes specified in table 5.2.3.2.3.1-3.

Table 5.2.3.2.3.1-2: Data structures supported by the GET Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 5.2.3.2.3.1-3: Data structures supported by the GET Response Body on this resource

Data type	P	Cardinality	Response codes	Description
AnalyticsData	M	1	200 OK	Containing the analytics with parameters as relevant for the requesting NF service consumer
n/a			204 No Content	If the request NWDAF Analytics data does not exist, the NWDAF shall respond with "204 No Content ".
ProblemDetailsAnalyticsInfoRequest	O	0..1	500 Internal Server Error	The request is rejected by the NWDAF and more details (not only the ProblemDetails) are returned.
NOTE: The mandatory HTTP error status codes for the GET method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply.				

5.2.3.2.4 Resource Custom Operations

None in this release of the specification.

5.2.4 Custom Operations without associated resources

None in this release of the specification.

5.2.5 Notifications

None in this release of the specification.

5.2.6 Data Model

5.2.6.1 General

This subclause specifies the application data model supported by the API.

Table 5.2.6.1-1 specifies the data types defined for the Nnwdaf_AnalyticsInfo service based interface protocol.

Table 5.2.6.1-1: Nnwdaf_AnalyticsInfo specific Data Types

Data type	Section defined	Description	Applicability
AnalyticsData	5.2.6.2.2	Describes analytics with parameters indicated in the request.	
EventFilter	5.2.6.2.3	Represents the event filters used to identify the requested analytics.	
EventId	5.2.6.3.3	Describes the type of analytics.	
ProblemDetailsAnalyticsInfoRequest	5.2.6.4.1	Data type that extends ProblemDetails.	EneNA
AdditionInfoAnalyticsInfoRequest	5.2.6.2.5	Contains more details (not only the ProblemDetails) in case an Nnwdaf_AnalyticsInfo request is rejected.	EneNA

Table 5.2.6.1-2 specifies data types re-used by the Nnwdaf_AnalyticsInfo 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 Nnwdaf service based interface.

Table 5.2.6.1-2: Nnwdaf_AnalyticsInfo re-used Data Types

Data type	Reference	Comments	Applicability
AnalyticsMetadataInfo	5.1.6.2.37	Contains analytics metadata information required for analytics aggregation.	Aggregation
AnySlice	5.1.6.3.2		
ApplicationId	3GPP TS 29.571 [8]	Identifies the application.	ServiceExperience UeCommunication AbnormalBehaviour
BwRequirement	5.1.6.2.25		ServiceExperience
DateTime	3GPP TS 29.571 [8]	Identifies the time.	
Dnn	3GPP TS 29.571 [8]	Identifies the DNN.	ServiceExperience AbnormalBehaviour UeCommunication
Dnai	3GPP TS 29.571 [8]	Identifies a user plane access to one or more DN(s).	ServiceExperience
EventReportingRequirement	5.1.6.2.7		
ExceptionId	5.1.6.3.6		AbnormalBehaviour
ExpectedUeBehaviourData	3GPP TS 29.503 [23]		AbnormalBehaviour
ExpectedAnalyticsType	5.1.6.3.11		AbnormalBehaviour
GroupId	3GPP TS 29.571 [8]	Internal Group Identifier of a group of UEs.	UeMobility UeCommunication NetworkPerformance AbnormalBehaviour ServiceExperience
NetworkAreaInfo	3GPP TS 29.554 [18]	The network area information.	UeMobility NetworkPerformance QoSSustainability ServiceExperience UserDataCongestion AbnormalBehaviour NsiLoadExt
NetworkPerfInfo	5.1.6.2.23		NetworkPerformance
NetworkPerfType	5.1.6.3.10	Represents the network performance types.	NetworkPerformance
NfLoadLevelInformation	5.1.6.2.31	Represents load level information of a given NF instance.	NfLoad
NfInstanceId	3GPP TS 29.571 [8]	Identifies an NF instance	NfLoad
NfSetId	3GPP TS 29.571 [8]	Identifies an NF Set instance.	NfLoad
NFType	3GPP TS 29.510 [12]	Indentifies a type of NF.	NfLoad
NsiId	3GPP TS 29.531 [24]	Identifies a Network Slice Instance.	ServiceExperience NsiLoad NsiLoadExt
NsiIdInfo	5.1.6.2.33	Identify the S-NSSAI and the associated Network Slice Instance(s).	ServiceExperience NsiLoad NsiLoadExt
NsiLoadLevelInfo	5.1.6.2.34	Represents the load level information for an S-NSSAI and the associated network slice instance.	NsiLoad NsiLoadExt
ProblemDetails	3GPP TS 29.571 [8]	Used in error responses to provide more detailed information about an error.	
QosRequirement	5.1.6.2.20		QoSSustainability
QosSustainabilityInfo	5.1.6.2.19		QoSSustainability
SamplingRatio	3GPP TS 29.571 [8]		
ServiceExperienceInfo	5.1.6.2.24		ServiceExperience
Supi	3GPP TS 29.571 [8]	Identifies the UE.	ServiceExperience, NfLoad NetworkPerformance

			UserDataCongestion UeMobility UeCommunication AbnormalBehaviour
SupportedFeatures	3GPP TS 29.571 [8]	Used to negotiate the applicability of the optional features defined in table 5.2.8-1.	
Snssai	3GPP TS 29.571 [8]		
SliceLoadLevelInformation	5.1.6.2.6		
TargetUeInformation	5.1.6.2.8	Identifies the target UE information.	ServiceExperience NfLoad NetworkPerformance UserDataCongestion UserDataCongestionExt UeMobility UeCommunication AbnormalBehaviour QoSSustainability
UeCommunication	5.1.6.2.13		UeCommunication
UeMobility	5.1.6.2.10		UeMobility
Uinteger	3GPP TS 29.571 [8]	Unsigned Integer, i.e. only value 0 and integers above 0 are permissible.	
UserDataCongestionInfo	5.1.6.2.17		UserDataCongestion
AbnormalBehaviour	5.1.6.2.15	Represents the abnormal behaviour information.	AbnormalBehaviour

5.2.6.2 Structured data types

5.2.6.2.1 Introduction

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

5.2.6.2.2 Type AnalyticsData

Table 5.2.6.2.2-1: Definition of type AnalyticsData

Attribute name	Data type	P	Cardinality	Description	Applicability
start	DateTime	O	0..1	It defines the start time of which the analytics information will become valid. (NOTE)	
expiry	DateTime	O	0..1	It defines the expiration time after which the analytics information will become invalid. (NOTE)	
timeStampGen	DateTime	O	0..1	It defines the timestamp of analytics generation.	
anaMetaInfo	AnalyticsMetadataInfo	C	0..1	Contains information about analytics metadata required to aggregate the analytics. It shall be present if the "anaMeta" attribute was included in the request, containing the information indicated by the "anaMeta" attribute.	Aggregation
sliceLoadLevelInfos	array(SliceLoadLevelInformation)	C	1..N	The slices and the load level information. Shall be present when the requested event is "LOAD_LEVEL_INFORMATION".	
nsiLoadLevelInfos	array(NsiLoadLevelInfo)	C	1..N	Each element identifies the load level information for an S-NSSAI and the optionally associated network slice instance. Shall be presented when the requested event is "NSI_LOAD_LEVEL"	NsiLoad NsiLoadExt
nwPerfs	array(NetworkPerfInfo)	C	1..N	The network performance information. Shall be present when the requested event is "NETWORK_PERFORMANCE".	NetworkPerformance
nfLoadLevelInfos	array(NfLoadLevelInformation)	C	1..N	The NF load information. When the requestedevent is "NF_LOAD", the nfLoadLevelInfos shall be included.	NfLoad
qosSustainInfos	array(QosSustainabilityInfo)	C	1..N	The QoS sustainability informations in the certain geographic areas. It shall present if the requested eventis "QOS_SUSTAINABILITY"	QoSSustainability
ueMobs	array(UeMobility)	C	1..N	The UE mobility information. When the requested event is "UE_MOBILITY", the "ueMobs" attribute shall be included.	UeMobility
ueComms	array(UeCommunication)	C	1..N	The UE communication information. When the requested event is "UE_COMM", the "ueComms" attribute shall be included.	UeCommunication
userDataCongInfos	array(UserDataCongestionInfo)	C	1..N	The user data congestion information. Shall be present when the requested event is "USER_DATA_CONGESTION".	UserDataCongestion
suppFeat	SupportedFeatures	C	0..1	List of Supported features used as described in subclause 5.2.8. This parameter shall be supplied by NWDAF in the reply of GET request that request the analytics	

				resource, if the consumer includes "supported-features" in the GET request.	
svcExps	array(ServiceExperienceInfo)	C	1..N	The service experience information.	ServiceExperience
abnorBehavrs	array(AbnormalBehaviour)	C	1..N	The abnormal behaviour information.	AbnormalBehaviour
NOTE: If the "start" attribute and the "expiry" attribute are both provided, the DateTime of the "expiry" attribute shall not be earlier than the DateTime of the "start" attribute.					

5.2.6.2.3 Type EventFilter

Table 5.2.6.2.3-1: Definition of type EventFilter

Attribute name	Data type	P	Cardinality	Description	Applicability
anySlice	AnySlice	C	0..1	Default is "FALSE". (NOTE 1)	
appIds	array(ApplicationId)	C	1..N	Identification(s) of application. The absence of appIds means applicable to all applications. (NOTE 4)	ServiceExperience UeCommunication AbnormalBehaviour
dnns	array(Dnn)	C	1..N	Identification(s) of DNN. Each DNN is a full DNN with both the Network Identifier and Operator Identifier, or a DNN with the Network Identifier only. The absence of dnns means applicable to all DNNs. (NOTE 4)	ServiceExperience UeCommunication AbnormalBehaviour
dnais	array(Dnai)	C	1..N	Identification(s) of user plane accesses to DN(s) which the subscription applies. It may be included when event-id is "SERVICE_EXPERIENCE".	ServiceExperience
snssais	array(Snssai)	C	1..N	Identification(s) of network slice to which the subscription belongs. (NOTE 1), (NOTE 4)	
nfInstanceIds	array(NfInstanceId)	O	1..N	Identification(s) of NF instances.	NfLoad
nfSetIds	array(NfSetId)	O	1..N	Identification(s) of NF instance sets.	NfLoad
nfTypes	array(NFType)	O	1..N	Identification(s) of NF types.	NfLoad
networkArea	NetworkAreaInfo	C	0..1	This IE represents the network area where the NF service consumer wants to know the analytics result. (NOTE 2), (NOTE 4)	UeMobility UeCommunication NetworkPerformance QoSSustainability ServiceExperience UserDataCongestion AbnormalBehaviour NsiLoadExt
topAppListUlInd	boolean	O	0..1	Indicates that the list of top applications that contribute the most to the traffic in Uplink direction is requested, if it is included and set to "true". Default value is "false".	UserDataCongestionExt
topAppListDlInd	boolean	O	0..1	Indicates that the list of top applications that contribute the most to the traffic in Downlink direction is requested, if it is included and set to "true". Default value is "false".	UserDataCongestionExt
nsiIdInfos	array(NsiIdInfo)	O	1..N	Each element identifies the S-NSSAI and the optionally associated network slice instance(s). May be included when subscribed event is "NSI_LOAD_LEVEL" or "SERVICE_EXPERIENCE". (NOTE 1)	ServiceExperience NsiLoad NsiLoadExt
nwPerfTypes	array(NetworkPerfType)	C	1..N	Represents the network performance types. This attribute shall be included when event-id is "NETWORK_PERFORMANCE".	NetworkPerformance
qosRequ	QoSRequirement	C	0..1	Represents the QoS requirements. This attribute shall be included when event-id is "QOS_SUSTAINABILITY".	QoSSustainability

bwRequs	array(BwRequirement)	O	1..N	Represents the media/application bandwidth requirement for each application. It may only be present if "appIds" attribute is provided.	ServiceExperience
excepIds	array(ExceptionId)	C	1..N	Represents a list of Exception Ids. (NOTE 3)	AbnormalBehaviour
exptAnaType	ExpectedAnalyticsType	C	0..1	Represents expected UE analytics type. (NOTE 3)	AbnormalBehaviour
exptUeBehav	ExpectedUeBehaviourData	O	0..1	Represents expected UE behaviour.	AbnormalBehaviour

NOTE 1: The "anySlice" attribute is not applicable to features "UeMobility" and "NetworkPerformance". The "snssais" attribute is not applicable to features "ServiceExperience", "NsiLoad", "UeMobility" and "NetworkPerformance". When event-id in the request is "LOAD_LEVEL_INFORMATION", the identifications of network slices, either information about slice(s) identified by the "snssais" attribute, or "anySlice" set to "TRUE", shall be included. When subscribed event is "NSI_LOAD_LEVEL" or "SERVICE_EXPERIENCE", either the "nsiIdInfos" attribute or anySlice set to "TRUE" shall be included. When subscribed event is "QOS_SUSTAINABILITY", "NF_LOAD", "UE_COMM", "ABNORMAL_BEHAVIOUR" or "USER_DATA_CONGESTION", the identifications of network slices identified by the "snssais" attribute is optional.

NOTE 2: For "NETWORK_PERFORMANCE", "SERVICE_EXPERIENCE" or "USER_DATA_CONGESTION" event, this attribute shall be provided if the event applied for all UEs (i.e. "anyUe" attribute set to true). For "QOS_SUSTAINABILITY", this attribute shall be provided.

NOTE 3: Either "excepIds" or "exptAnaType" shall be provided if event-id in the request is "ABNORMAL_BEHAVIOUR".

NOTE 4: For "ABNORMAL_BEHAVIOUR" event with "anyUe" attribute in "tgt-ue" attribute sets to true,

- at least one of the "networkArea" and the "snssais" attribute should be included, if the expected analytics type via the"exptAnaType" attribute or the list of Exception Ids via the "excepIds" attribute is mobility related;
- at least one of the "networkArea", "appIds", "dnns" and "snssais" attribute should be included, if the expected analytics type via the"exptAnaType" attribute or the list of Exception Ids via the "excepIds" attribute is communication related;
- the expected analytics type via the"exptAnaType" attribute or the list of Exception Ids via "excepIds" attribute shall not be requested for both mobility and communication related analytics at the same time.

Editor's Note: It's FFS whether the "nfTypes", "nfSetIds" and "nfInstanceIds" attirbutes are applicable for the NsiLoadExt feature.

5.2.6.2.4 Void

5.2.6.2.5 Type AdditionInfoAnalyticsInfoRequest

Table 5.2.6.2.5-1: Definition of type AdditionInfoAnalyticsInfoRequest

Attribute name	Data type	P	Cardinality	Description	Applicability
rvWaitTime	DateTime	O	0..1	Recommended minimum time interval (in seconds) to be used to determine the time when analytics information is needed in similar future requests. It may only be included if the "cause" attribute within the ProblemDetails data type is set to "UNSATISFIED_REQUESTED_ANALYTICS_TIME".	

5.2.6.3 Simple data types and enumerations

5.2.6.3.1 Introduction

This subclause defines simple data types and enumerations that can be referenced from data structures defined in the previous subclauses.

5.2.6.3.2 Simple data types

The simple data types defined in table 5.2.6.3.2-1 shall be supported.

Table 5.2.6.3.2-1: Simple data types

Type Name	Type Definition	Description	Applicability
n/a			

5.2.6.3.3 Enumeration: EventId

Table 5.2.6.3.3-1: Enumeration EventId

Enumeration value	Description	Applicability
LOAD_LEVEL_INFORMATION	Represents the analytics of load level information of corresponding network slice.	
NETWORK_PERFORMANCE	Represents the analytics of network performance information	NetworkPerformance
NF_LOAD	Represents the analytics of NF Load information.	NfLoad
QOS_SUSTAINABILITY	Represents the analytics of QoS sustainability in the certain area.	QoSSustainability
SERVICE_EXPERIENCE	Represents the analytics of service experience of corresponding application and/or network slice.	ServiceExperience
UE_MOBILITY	Represents the analytics of UE mobility.	UeMobility
UE_COMM	Represents the analytics of UE communication.	UeCommunication
USER_DATA_CONGESTION	Represents the analytics of the user data congestion in the certain area.	UserDataCongestion
ABNORMAL_BEHAVIOUR	Represents the analytics of abnormal behaviour information.	AbnormalBehaviour
NSI_LOAD_LEVEL	Represents the analytics of load level information of Network Slice and the optionally associated Network Slice Instance	NsiLoad

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

5.2.6.4.1 Type ProblemDetailsAnalyticsInfoRequest

Table 5.2.6.4.1-1: Definition of type ProblemDetailsAnalyticsInfoRequest as a list of to be combined data types

Data type	Cardinality	Description	Applicability
ProblemDetails	1	Details of the problem as defined in TS 29.571 [8].	
AdditionInfoAnalyticsInfoRequest	1	Contains additional information why the analytics request is rejected.	

5.2.7 Error handling

5.2.7.1 General

HTTP error handling shall be supported as specified in subclause 5.2.4 of 3GPP TS 29.500 [6].

For the Nnwdaf_AnalyticsInfo API, HTTP error responses shall be supported as specified in subclause 4.8 of 3GPP TS 29.501 [7]. Protocol errors and application errors specified in table 5.2.7.2-1 of 3GPP TS 29.500 [6] 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 [6]. In addition, the requirements in the following subclauses shall apply.

5.2.7.2 Protocol Errors

In this Release of the specification, there are no additional protocol errors applicable for the Nnwdaf_AnalyticsInfo API.

5.2.7.3 Application Errors

The application errors defined for the Nnwdaf_AnalyticsInfo API are listed in table 5.2.7.3-1. The NWDAF shall include in the HTTP status code a "ProblemDetails" data structure with the "cause" attribute indicating the application error as listed in table 5.2.7.3-1.

Table 5.2.7.3-1: Application errors

Application Error	HTTP status code	Description
BOTH_STAT_PRED_NOT_ALLOWED	400 Bad Request	For the requested observation period, the start time is in the past and the end time is in the future, which means the NF service consumer requested both statistics and prediction for the analytics.
UNAVAILABLE_DATA	500 Internal Server Error	Indicates the requested statistics in the past is rejected since necessary data to perform the service is unavailable.
UNSATISFIED_REQUESTED_ANALYTICS_TIME	500 Internal Server Error	Indicates that the requested event is rejected since the analytics information is not ready when the time indicated by the "timeAnaNeeded" attribute (as provided during the request) is reached.

5.2.8 Feature negotiation

The optional features in table 5.2.8-1 are defined for the Nnwdaf_AnalyticsInfo API. They shall be negotiated using the extensibility mechanism defined in subclause 6.6 of 3GPP TS 29.500 [6].

Table 5.2.8-1: Supported Features

Feature number	Feature Name	Description
1	UeMobility	This feature indicates the support of analytics based on UE mobility information.
2	UeCommunication	This feature indicates the support of analytics based on UE communication information.
3	NetworkPerformance	This feature indicates the support of analytics based on network performance.
4	ServiceExperience	This feature indicates support for the event related to service experience.
5	QoSSustainability	This feature indicates support for the event related to QoS sustainability.
6	AbnormalBehaviour	This feature indicates support for the event related to abnormal behaviour information.
7	UserDataCongestion	This feature indicates the support of the analytics related on user data congestion.
8	NfLoad	This feature indicates the support of the analytics related to the load of NF instances.
9	NsiLoad	This feature indicates the support of the analytics related to the load level of Network Slice and the optionally associated Network Slice Instance.
10	EneNA	This feature indicates support for the enhancements of network data analytics requirements.
11	UserDataCongestionExt	This feature indicates support for the extensions to the event related to user data congestion. Supporting this feature also requires the support of feature UserDataCongestion.
12	Aggregation	This feature indicates support for analytics aggregation. Supporting this feature also requires the support of feature EneNA.
13	NsiLoadExt	This feature indicates support for the extensions to the event related to the load level of Network Slice and the optionally associated Network Slice Instance. Supporting this feature also requires the support of feature NsiLoad.

5.2.9 Security

As indicated in 3GPP TS 33.501 [13] and 3GPP TS 29.500 [6], the access to the Nnwdaf_AnalyticsInfo API may be authorized by means of the OAuth2 protocol (see IETF RFC 6749 [14]), based on local configuration, using the "Client Credentials" authorization grant, where the NRF (see 3GPP TS 29.510 [12]) plays the role of the authorization server.

If OAuth2 is used, a n NF Service Consumer, prior to consuming services offered by the Nnwdaf_AnalyticsInfo API, shall obtain a "token" from the authorization server, by invoking the Access Token Request service, as described in 3GPP TS 29.510 [12], subclause 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 Nnwdaf_AnalyticsInfo service.

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

5.3 Nnwdaf_DataManagement Service API

5.3.1 Introduction

The Nnwdaf_DataManagement Service shall use the Nnwdaf_DataManagement API.

The request URIs used in each HTTP requests from the NF service consumer towards the NWDAF shall have the Resource URI structure defined in subclause 4.4.1 of 3GPP TS 29.501 [7], i.e.:

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

with the following components:

- The {apiRoot} shall be set as described in 3GPP TS 29.501 [7].
- The<apiName> shall be "nnwdaf-datamanagement".
- The <apiVersion> shall be "v1".
- The <apiSpecificResourceUriPart> shall be set as described in subclause 5.2.3.

5.3.2 Usage of HTTP

5.3.2.1 General

HTTP/2, IETF RFC 7540 [9], shall be used as specified in clause 5 of 3GPP TS 29.500 [6].

HTTP/2 shall be transported as specified in subclause 5.3 of 3GPP TS 29.500 [6].

The OpenAPI [11] specification of HTTP messages and content bodies for the Nnwdaf_DataManagement is contained in Annex A.

5.3.2.2 HTTP standard headers

5.3.2.2.1 General

See subclause 5.2.2 of 3GPP TS 29.500 [6] for the usage of HTTP standard headers.

5.3.2.2.2 Content type

JSON, IETF RFC 8259 [10], shall be used as content type of the HTTP bodies specified in the present specification as specified in subclause 5.4 of 3GPP TS 29.500 [6]. 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 [15].

5.3.2.3 HTTP custom headers

The Nnwdaf_DataManagement Service API shall support mandatory HTTP custom header fields specified in subclause 5.2.3.2 of 3GPP TS 29.500 [6] and may support HTTP custom header fields specified in subclause 5.2.3.3 of 3GPP TS 29.500 [6].

In this release of the specification, no specific custom headers are defined for the Nnwdaf_DataManagement Service API.

5.3.3 Resources

5.3.3.1 Resource Structure

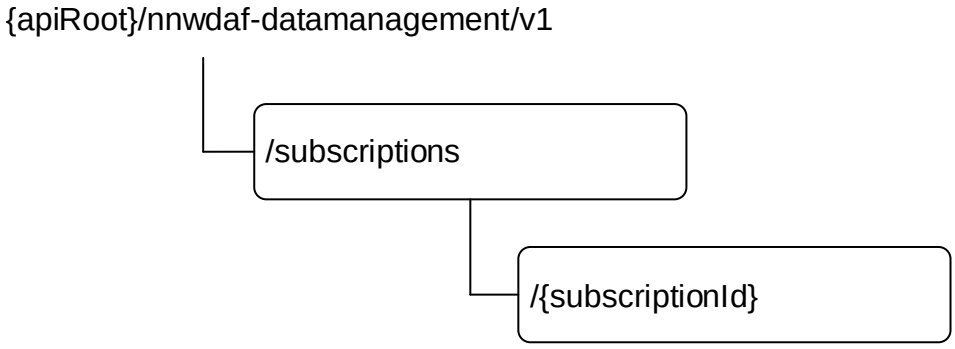

Figure 5.3.3.1-1: Resource URI structure of the Nnwdaf_DataManagement API

Table 5.3.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 5.3.3.1-1: Resources and methods overview

Resource name	Resource URI	HTTP method or custom operation	Description
NWDAF Data Management Subscriptions	/subscriptions	POST	Creates a new Individual NWDAF Data Management Subscription resource.
Individual NWDAF Data Management Subscription	/subscriptions/{subscriptionId}	DELETE	Deletes an Individual NWDAF Data Management Subscription identified by subresource {subscriptionId}.
		PUT	Modifies an existing Individual NWDAF Data Management Subscription identified by subresource {subscriptionId}.

5.3.3.2 Resource: NWDAF Data Management Subscriptions

5.3.3.3 Resource: Individual NWDAF Data Management Subscription

5.3.4 Custom Operations without associated resources

5.3.5 Notifications

5.3.6 Data Model

5.3.7 Error handling

5.3.8 Feature negotiation

The optional features in table 5.3.8-1 are defined for the Nnwdaf_DataManagement API. They shall be negotiated using the extensibility mechanism defined in subclause 6.6 of 3GPP TS 29.500 [6].

Table 5.3.8-1: Supported Features

Feature number	Feature Name	Description

5.3.9 Security

5.4 Nnwdaf_MLModelProvision Service API

5.4.1 Introduction

The Nnwdaf_MLModelProvision Service shall use the Nnwdaf_MLModelProvision API.

The request URIs used in each HTTP requests from the NF service consumer towards the NWDAF shall have the Resource URI structure defined in subclause 4.4.1 of 3GPP TS 29.501 [7], i.e.:

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

with the following components:

- The {apiRoot} shall be set as described in 3GPP TS 29.501 [7].
- The<apiName> shall be "nnwdaf-mlmodelprovision".
- The <apiVersion> shall be "v1".
- The <apiSpecificResourceUriPart> shall be set as described in subclause 5.2.3.

5.4.2 Usage of HTTP

5.4.2.1 General

HTTP/2, IETF RFC 7540 [9], shall be used as specified in clause 5 of 3GPP TS 29.500 [6].

HTTP/2 shall be transported as specified in subclause 5.3 of 3GPP TS 29.500 [6].

The OpenAPI [11] specification of HTTP messages and content bodies for the Nnwdaf_MLModelProvision is contained in Annex A.

5.4.2.2 HTTP standard headers

5.4.2.2.1 General

See subclause 5.2.2 of 3GPP TS 29.500 [6] for the usage of HTTP standard headers.

5.4.2.2.2 Content type

JSON, IETF RFC 8259 [10], shall be used as content type of the HTTP bodies specified in the present specification as specified in subclause 5.4 of 3GPP TS 29.500 [6]. 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 [15].

5.4.2.3 HTTP custom headers

The Nnwdaf_MLModelProvision Service API shall support mandatory HTTP custom header fields specified in subclause 5.2.3.2 of 3GPP TS 29.500 [6] and may support HTTP custom header fields specified in subclause 5.2.3.3 of 3GPP TS 29.500 [6].

In this release of the specification, no specific custom headers are defined for the Nnwdaf_MLModelProvision Service API.

5.4.3 Resources

5.4.3.1 Resource Structure

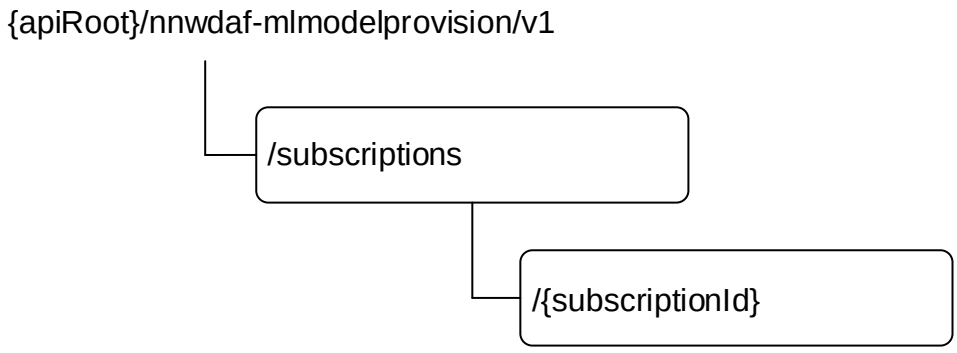

Figure 5.4.3.1-1: Resource URI structure of the Nnwdaf_MLModelProvision API

Table 5.4.3.1-1 provides an overview of the resources and applicable HTTP methods.

Table 5.4.3.1-1: Resources and methods overview

Resource name	Resource URI	HTTP method or custom operation	Description
NWDAF ML Model Provision Subscriptions	/subscriptions	POST	Creates a new Individual NWDAF ML Model Provision Subscription resource.
Individual NWDAF ML Model Provision Subscription	/subscriptions/{subscriptionId}	DELETE	Deletes an Individual NWDAF ML Model Provision Subscription identified by subresource {subscriptionId}.
		PUT	Modifies an existing Individual NWDAF ML Model Provision Subscription identified by subresource {subscriptionId}.

5.4.3.2 Resource: NWDAF ML Model Provision Subscriptions

5.4.3.2.1 Description

The NWDAF ML Model Provision Subscriptions resource represents all subscriptions to the Nnwdaf_MLModelProvision Service at a given NWDAF. The resource allows an NF service consumer to create a new Individual NWDAF ML Model Provision Subscription resource.

5.4.3.2.2 Resource definition

Resource URI: **{apiRoot}/nnwdaf-mlmodelprovision/v1/subscriptions**

This resource shall support the resource URI variables defined in table 5.4.3.2.2-1.

Table 5.4.3.2.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See subclause 5.4.1

5.4.3.2.3 Resource Standard Methods

5.4.3.2.3.1 POST

This method shall support the URI query parameters specified in table 5.4.3.2.3.1-1.

Table 5.4.3.2.3.1-1: URI query parameters supported by the POST method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 5.4.3.2.3.1-2 and the response data structures and response codes specified in table 5.4.3.2.3.1-3.

Table 5.4.3.2.3.1-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
NwdafMLModelProvSubsc	M	1	Create a new Individual NWDAF ML Model Provision Subscription resource.

Table 5.4.3.2.3.1-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
NwdafMLModelProvSubsc	M	1	201 Created	The creation of an Individual NWDAF ML Model Provision Subscription resource is confirmed and a representation of that resource is returned.
NOTE: The mandatory HTTP error status codes for the POST method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply.				

Table 5.4.3.2.3.1-4: Headers supported by the 201 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	Contains the URI of the newly created resource, according to the structure: {apiRoot}/nnwdaf-mlmodelprovision/v1/subscriptions/{subscriptionId}

5.4.3.2.4 Resource Custom Operations

None in this release of the specification.

5.4.3.3 Resource: Individual NWDAF ML Model Provision Subscription

5.4.3.3.1 Description

The Individual NWDAF ML Model Provision Subscription resource represents a single subscription to the Nnwdaf_MLModelProvision Service at a given NWDAF.

5.4.3.3.2 Resource definition

Resource URI: **{apiRoot}/nnwdaf-mlmodelprovision/v1/subscriptions/{subscriptionId}**

This resource shall support the resource URI variables defined in table 5.4.3.3.2-1.

Table 5.4.3.3.2-1: Resource URI variables for this resource

Name	Data type	Definition
apiRoot	string	See subclause 5.4.1
subscriptionId	string	Identifies a subscription to the Nnwdaf_MLModelProvision Service

5.4.3.3.3 Resource Standard Methods

5.4.3.3.3.1 PUT

This method shall support the URI query parameters specified in table 5.4.3.3.3.1-1.

Table 5.4.3.3.3.1-1: URI query parameters supported by the PUT method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 5.4.3.3.3.1-2 and the response data structures and response codes specified in table 5.4.3.3.3.1-3.

Table 5.4.3.3.3.1-2: Data structures supported by the PUT Request Body on this resource

Data type	P	Cardinality	Description
NwdafMLModelProvSubsc	M	1	Parameters to replace a subscription to NWDAF ML Model Provision Subscription resource.

Table 5.4.3.3.3.1-3: Data structures supported by the PUT Response Body on this resource

Data type	P	Cardinality	Response codes	Description
NwdafMLModelProvSubsc	M	1	200 OK	The Individual NWDAF ML Model Provision Subscription resource was modified successfully and a representation of that resource is returned.
n/a			204 No Content	The Individual NWDAF ML Model Provision Subscription resource was modified successfully.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection, during Individual NWDAF ML Model Provision Subscription modification. The response shall include a Location header field containing an alternative URI of the resource located in an alternative NWDAF (service) instance. Applicable if the feature "ES3XX" is supported.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection, during Individual NWDAF ML Model Provision Subscription modification. The response shall include a Location header field containing an alternative URI of the resource located in an alternative NWDAF (service) instance. Applicable if the feature "ES3XX" is supported.
NOTE: The mandatory HTTP error status codes for the PUT method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply.				

Table 5.4.3.3.3.1-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative NWDAF (service) instance.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance towards which the request is redirected

Table 5.4.3.3.3.1-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative NWDAF (service) instance.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance towards which the request is redirected

5.4.3.3.3.2 DELETE

This method shall support the URI query parameters specified in table 5.4.3.3.3.2-1.

Table 5.4.3.3.3.2-1: URI query parameters supported by the DELETE method on this resource

Name	Data type	P	Cardinality	Description
n/a				

This method shall support the request data structures specified in table 5.4.3.3.3.2-2 and the response data structures and response codes specified in table 5.4.3.3.3.2-3.

Table 5.4.3.3.3.2-2: Data structures supported by the DELETE Request Body on this resource

Data type	P	Cardinality	Description
n/a			

Table 5.4.3.3.3.2-3: Data structures supported by the DELETE Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	Successful case: The Individual NWDAF ML Model Provision Subscription resource matching the subscriptionId was deleted.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection, during Individual NWDAF ML Model Provision Subscription deletion. The response shall include a Location header field containing an alternative URI of the resource located in an alternative NWDAF (service) instance. Applicable if the feature "ES3XX" is supported.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection, during Individual NWDAF ML Model Provision Subscription deletion. The response shall include a Location header field containing an alternative URI of the resource located in an alternative NWDAF (service) instance. Applicable if the feature "ES3XX" is supported.
NOTE: The mandatory HTTP error status codes for the DELETE method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply.				

Table 5.4.3.3.3.2-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative NWDAF (service) instance.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance towards which the request is redirected

Table 5.4.3.3.3.2-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI of the resource located in an alternative NWDAF (service) instance.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance towards which the request is redirected

5.4.3.3.4 Resource Custom Operations

None in this release of the specification.

5.4.4 Custom Operations without associated resources

None in this release of the specification.

5.4.5 Notifications

5.4.5.1 General

Notifications shall comply with subclause 6.2 of 3GPP TS 29.500 [6] and subclause 4.6.2.3 of 3GPP TS 29.501 [7].

Table 5.4.3.4.1-1: Notifications overview

Notification	Callback URI	HTTP method or custom operation	Description (service operation)
Event Notification	{notifUri}	POST	Report one or several observed Events.

5.4.5.2 Event Notification

5.4.5.2.1 Description

The Event Notification is used by the NWDAF to report one or several observed Events to a NF service consumer that has subscribed to such Notifications via the Individual NWDAF ML Model Provision Subscription Resource.

5.4.5.2.2 Operation Definition

Callback URI: **{notifUri}**

The operation shall support the callback URI variables defined in table 5.4.5.2.2-1, the request data structures specified in table 5.4.5.2.2-2 and the response data structure and response codes specified in table 5.4.5.2.2-3.

Table 5.4.5.2.2-1: Callback URI variables

Name	Data type	Definition
notifUri	Uri	The Notification Uri as assigned within the Individual NWDAF ML Model Provision Subscription and described within the NwdafMLModelProvSubsc type (see table 5.4.6.2.2-1).

Table 5.4.5.2.2-2: Data structures supported by the POST Request Body on this resource

Data type	P	Cardinality	Description
NwdafMLModelProvNotif	M	1..N	Provides Information about observed events

Table 5.4.5.2.2-3: Data structures supported by the POST Response Body on this resource

Data type	P	Cardinality	Response codes	Description
n/a			204 No Content	The receipt of the Notification is acknowledged.
RedirectResponse	O	0..1	307 Temporary Redirect	Temporary redirection, during the event notification. The response shall include a Location header field containing an alternative URI representing the end point of an alternative NF consumer (service) instance where the notification should be sent. Applicable if the feature "ES3XX" is supported.
RedirectResponse	O	0..1	308 Permanent Redirect	Permanent redirection, during the event notification. The response shall include a Location header field containing an alternative URI representing the end point of an alternative NF consumer (service) instance where the notification should be sent. Applicable if the feature "ES3XX" is supported.
NOTE: The mandatory HTTP error status codes for the POST method listed in table 5.2.7.1-1 of 3GPP TS 29.500 [6] also apply.				

Table 5.4.5.2.2-4: Headers supported by the 307 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI representing the end point of an alternative NF consumer (service) instance towards which the notification should be redirected.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance towards which the notification request is redirected

Table 5.4.5.2.2-5: Headers supported by the 308 Response Code on this resource

Name	Data type	P	Cardinality	Description
Location	string	M	1	An alternative URI representing the end point of an alternative NF consumer (service) instance towards which the notification should be redirected.
3gpp-Sbi-Target-Nf-Id	string	O	0..1	Identifier of the target NF (service) instance towards which the notification request is redirected

5.4.6 Data Model

5.4.6.1 General

This subclause specifies the application data model supported by the API.

Table 5.4.6.1-1 specifies the data types defined for the Nnwdaf_ service based interface protocol.

Table 5.4.6.1-1: Nnwdaf_MLModelProvision specific Data Types

Data type	Section defined	Description	Applicability
NwdafMLModelProvSubsc	5.4.6.2.2		
NwdafMLModelProvNotif	5.4.6.2.5		
MLEventSubscription	5.4.6.2.3		
MLEventNotif	5.4.6.2.6		
MLAnalyticsFilter	5.4.6.2.4		

Table 5.4.6.1-2 specifies data types re-used by the Nnwdaf_MLModelProvision 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 Nnwdaf service based interface.

Table 5.4.6.1-2: Nnwdaf_MLModelProvision re-used Data Types

Data type	Reference	Comments	Applicability
NwdafEvent	5.1.6.3.4		
RedirectResponse	3GPP TS 29.571 [8]		
SupportedFeatures	3GPP TS 29.571 [8]		
TargetUeInformation	5.1.6.2.8		
Uri	3GPP TS 29.571 [8]		

5.4.6.2 Structured data types

5.4.6.2.1 Introduction

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

5.4.6.2.2 Type NwdafMLModelProvSubsc

Table 5.4.6.2.2-1: Definition of type NwdafMLModelProvSubsc

Attribute name	Data type	P	Cardinality	Description	Applicability
mLEventSubscs	array(MLEventSubscription)	M	1..N	Each element identifies the subscription for each event.	
notifUri	Uri	M	1	Identifies the recipient of Notifications sent by the NWDAF.	
mLEventNotifs	array(MLEventNotif)	C	1..N	Notifications about Individual Events. Shall only be present if the immediate reporting indication in the "immRep" attribute within the "evtReq" attribute sets to true in the event subscription, and the reports are available.	
suppFeats	SupportedFeatures	C	0..1	List of Supported features used as described in subclause 5.4.8. It shall be supplied by NF service consumer in the POST requests that request the creation of an NWDAF ML Model Provision Subscriptions resource, and shall be supplied by the NWDAF in the reply of corresponding request.	

Editor's Note: It's FFS for partial failure events handling.

Editor's Note: It's FFS whether Event Reproting Information or Requirement is needed.

5.4.6.2.3 Type MLEventSubscription

Table 5.4.6.2.3-1: Definition of type MLEventSubscription

Attribute name	Data type	P	Cardinality	Description	Applicability
mLEvent	NwdafEvent	M	1..N	Identifies the subscribed event.	
mLEventFilter	MLAnalyticsFilter	M	1..N	Identifies the analytics filter for the subscribed event.	
tgtUe	TargetUeInformation	O	0..1	Identifies target UE information	

5.4.6.2.4 Type MLAnalyticsFilter

Editor's Note: the definition of MLAnalyticsFilter data type is FFS.

5.4.6.2.5 Type NwdafMLModelProvNotif

Table 5.4.6.2.5-1: Definition of type NwdafMLModelProvNotif

Attribute name	Data type	P	Cardinality	Description	Applicability
eventNotifs	array(MLEventNotif)	M	1..N	Notifications about Individual Events	
subscriptionId	string	M	1	String identifying a subscription to the Nnwdaf_MLModelProvision Service	

5.4.6.2.6 Type MLEventNotif

Table 5.4.6.2.6-1: Definition of type MLEventNotif

Attribute name	Data type	P	Cardinality	Description	Applicability
event	NwdafEvent	M	1	Identifies the subscribed event.	

Editor's Note: Definition of more information will be updated later.

5.4.6.3 Simple data types and enumerations

5.4.6.3.1 Introduction

This subclause defines simple data types and enumerations that can be referenced from data structures defined in the previous subclauses.

5.4.6.3.2 Simple data types

The simple data types defined in table 5.1.6.3.2-1 shall be supported.

Table 5.4.6.3.2-1: Simple data types

Type Name	Type Definition	Description	Applicability

5.4.7 Error handling

5.4.7.1 General

HTTP error handling shall be supported as specified in subclause 5.2.4 of 3GPP TS 29.500 [6].

For the Nnwdaf_MLModelProvision API, HTTP error responses shall be supported as specified in subclause 4.8 of 3GPP TS 29.501 [7].

Protocol errors and application errors specified in table 5.2.7.2-1 of 3GPP TS 29.500 [6] 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 [6].

Protocol errors and application errors specified in table 5.2.7.2-1 of 3GPP TS 29.500 [6] for HTTP redirections shall be supported if the feature "ES3XX" is supported.

In addition, the requirements in the following subclauses shall apply.

5.4.7.2 Protocol Errors

In this Release of the specification, there are no additional protocol errors applicable for the Nnwdaf_MLModelProvision API.

5.4.7.3 Application Errors

The application errors defined for the Nnwdaf_MLModelProvision API are listed in table 5.4.7.3-1. The NWDAF shall include in the HTTP status code a "ProblemDetails" data structure with the "cause" attribute indicating the application error as listed in table 5.4.7.3-1.

Table 5.4.7.3-1: Application errors

Application Error	HTTP status code	Description

5.4.8 Feature negotiation

The optional features in table 5.4.8-1 are defined for the Nnwdaf_MLModelProvision API. They shall be negotiated using the extensibility mechanism defined in subclause 6.6 of 3GPP TS 29.500 [6].

Table 5.4.8-1: Supported Features

Feature number	Feature Name	Description
1	ServiceExperience	This feature indicates support for the event related to service experience.
2	UeMobility	This feature indicates the support of analytics based on UE mobility information.
3	UeCommunication	This feature indicates the support of analytics based on UE communication information.
4	QoSSustainability	This feature indicates support for the event related to QoS sustainability.
5	AbnormalBehaviour	This feature indicates support for the event related to abnormal behaviour information.
6	UserDataCongestion	This feature indicates support for the event related to user data congestion.
7	NfLoad	This feature indicates the support of the analytics related to the load of NF instances.
8	NetworkPerformance	This feature indicates support of analytics based on network performance.
9	NsiLoad	This feature indicates support of the event related to the load level of Network Slice and the optionally associated Network Slice Instance.
10	SMCongestion	This feature indicates support for the event related to SM congestion control experience.
11	RedundantTransmission	This feature indicates support for the event related to redundant transmission.
12	WLANPerformance	This feature indicates support for the event related to WLAN performance.
13	ES3XX	Extended Support for 3xx redirections. This feature indicates the support of redirection for any service operation, according to Stateless NF procedures as specified in subclauses 6.5.3.2 and 6.5.3.3 of 3GPP TS 29.500 [6] and according to HTTP redirection principles for indirect communication, as specified in subclause 6.10.9 of 3GPP TS 29.500 [6].

5.4.9 Security

As indicated in 3GPP TS 33.501 [13] and 3GPP TS 29.500 [6], the access to the Nnwdaf_MLModelProvision API may be authorized by means of the OAuth2 protocol (see IETF RFC 6749 [14]), based on local configuration, using the "Client Credentials" authorization grant, where the NRF (see 3GPP TS 29.510 [12]) plays the role of the authorization server.

If OAuth2 is used, a n NF Service Consumer, prior to consuming services offered by the Nnwdaf_MLModelProvision API, shall obtain a "token" from the authorization server, by invoking the Access Token Request service, as described in 3GPP TS 29.510 [12], subclause 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 Nnwdaf_MLModelProvision service.

The Nnwdaf_MLModelProvision API defines a single scope "nnwdaf-mlmodelprovision" 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

The present Annex contains an OpenAPI [11] specification of HTTP messages and content bodies used by the Nnwdaf_EventsSubscription, the Nnwdaf_AnalyticsInfo, Nnwdaf_DataManagement and Nnwdaf_MLModelProvision APIs.

This Annex shall take precedence when being discrepant to other parts of the specification with respect to the encoding of information elements and methods within the API(s).

NOTE: The semantics and procedures, as well as conditions, e.g. for the applicability and allowed combinations of attributes or values, not expressed in the OpenAPI definitions but defined in other parts of the specification also apply.

Informative copies of the OpenAPI specification files contained in this 3GPP Technical Specification are available on a Git-based repository, that uses the GitLab software version control system (see clause 5B of the 3GPP TR 21.900 [16] and subclause 5.3.1 of the 3GPP TS 29.501 [7] for further information).

A.2 Nnwdaf_EventsSubscription API

```
openapi: 3.0.0
info:
  version: 1.2.0-alpha.5
  title: Nnwdaf_EventsSubscription
  description: |
    Nnwdaf_EventsSubscription Service API.
    © 2021, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
externalDocs:
  description: 3GPP TS 29.520 V17.4.0; 5G System; Network Data Analytics Services.
  url: 'http://www.3gpp.org/ftp/Specs/archive/29_series/29.520/'
security:
  - {}
  - oAuth2ClientCredentials:
    - nnwdaf-eventssubscription
servers:
  - url: '{apiRoot}/nnwdaf-eventssubscription/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in subclause 4.4 of 3GPP TS 29.501.
paths:
  /subscriptions:
    post:
      summary: Create a new Individual NWDAF Events Subscription
      operationId: CreateNWDAFEventsSubscription
      tags:
        - NWDAF Events Subscriptions (Collection)
      requestBody:
        required: true
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/NnwdafEventsSubscription'
      responses:
        '201':
          description: Create a new Individual NWDAF Event Subscription resource.
          headers:
            Location:
              description: 'Contains the URI of the newly created resource, according to the
structure: {apiRoot}/nnwdaf-eventssubscription/v1/subscriptions/{subscriptionId}'
              required: true
              schema:
```

```
            type: string
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/NnwdafEventsSubscription'
      '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'
      '411':
        $ref: 'TS29571_CommonData.yaml#/components/responses/411'
      '413':
        $ref: 'TS29571_CommonData.yaml#/components/responses/413'
      '415':
        $ref: 'TS29571_CommonData.yaml#/components/responses/415'
      '429':
        $ref: 'TS29571_CommonData.yaml#/components/responses/429'
      '500':
        $ref: 'TS29571_CommonData.yaml#/components/responses/500'
      '503':
        $ref: 'TS29571_CommonData.yaml#/components/responses/503'
      default:
        $ref: 'TS29571_CommonData.yaml#/components/responses/default'
    callbacks:
      myNotification:
        '{$request.body#/notificationURI}':
          post:
            requestBody:
              required: true
              content:
                application/json:
                  schema:
                    type: array
                    items:
                      $ref: '#/components/schemas/NnwdafEventsSubscriptionNotification'
                    minItems: 1
            responses:
              '204':
                description: The receipt of the Notification is acknowledged.
              '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'
              '411':
                $ref: 'TS29571_CommonData.yaml#/components/responses/411'
              '413':
                $ref: 'TS29571_CommonData.yaml#/components/responses/413'
              '415':
                $ref: 'TS29571_CommonData.yaml#/components/responses/415'
              '429':
                $ref: 'TS29571_CommonData.yaml#/components/responses/429'
              '500':
                $ref: 'TS29571_CommonData.yaml#/components/responses/500'
              '503':
                $ref: 'TS29571_CommonData.yaml#/components/responses/503'
              default:
                $ref: 'TS29571_CommonData.yaml#/components/responses/default'
  /subscriptions/{subscriptionId}:
    delete:
      summary: Delete an existing Individual NWDAF Events Subscription
      operationId: DeleteNWDAFEventsSubscription
      tags:
        - Individual NWDAF Events Subscription (Document)
      parameters:
        - name: subscriptionId
          in: path
```

```
        description: String identifying a subscription to the Nnwdaf_EventsSubscription Service
        required: true
        schema:
          type: string
      responses:
        '204':
          description: No Content. The Individual NWDAF Event Subscription resource matching the
subscriptionId was deleted.
        '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':
          description: The Individual NWDAF Event Subscription resource does not exist.
          content:
            application/problem+json:
              schema:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/ProblemDetails'
        '429':
          $ref: 'TS29571_CommonData.yaml#/components/responses/429'
        '500':
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '501':
          $ref: 'TS29571_CommonData.yaml#/components/responses/501'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          $ref: 'TS29571_CommonData.yaml#/components/responses/default'
    put:
      summary: Update an existing Individual NWDAF Events Subscription
      operationId: UpdateNWDAFEventsSubscription
      tags:
        - Individual NWDAF Events Subscription (Document)
      requestBody:
        required: true
        content:
          application/json:
            schema:
              $ref: '#/components/schemas/NnwdafEventsSubscription'
      parameters:
        - name: subscriptionId
          in: path
          description: String identifying a subscription to the Nnwdaf_EventsSubscription Service
          required: true
          schema:
            type: string
      responses:
        '200':
          description: The Individual NWDAF Event Subscription resource was modified successfully and
a representation of that resource is returned.
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/NnwdafEventsSubscription'
        '204':
          description: The Individual NWDAF Event Subscription resource was modified successfully.
        '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':
          description: The Individual NWDAF Event Subscription resource does not exist.
          content:
            application/problem+json:
              schema:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/ProblemDetails'
```

```
      '411':
        $ref: 'TS29571_CommonData.yaml#/components/responses/411'
      '413':
        $ref: 'TS29571_CommonData.yaml#/components/responses/413'
      '415':
        $ref: 'TS29571_CommonData.yaml#/components/responses/415'
      '429':
        $ref: 'TS29571_CommonData.yaml#/components/responses/429'
      '500':
        $ref: 'TS29571_CommonData.yaml#/components/responses/500'
      '501':
        $ref: 'TS29571_CommonData.yaml#/components/responses/501'
      '503':
        $ref: 'TS29571_CommonData.yaml#/components/responses/503'
      default:
        $ref: 'TS29571_CommonData.yaml#/components/responses/default'
components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{nrfApiRoot}/oauth2/token'
          scopes:
            nnwdaf-eventssubscription: Access to the Nnwdaf_EventsSubscription API
  schemas:
    NnwdafEventsSubscription:
      description: Represents an Individual NWDAF Event Subscription resource.
      type: object
      properties:
        eventSubscriptions:
          type: array
          items:
            $ref: '#/components/schemas/EventSubscription'
          minItems: 1
          description: Subscribed events
        evtReq:
          $ref: 'TS29523_Npcf_EventExposure.yaml#/components/schemas/ReportingInformation'
        notificationURI:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        supportedFeatures:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
        eventNotifications:
          type: array
          items:
            $ref: '#/components/schemas/EventNotification'
          minItems: 1
        failEventReports:
          type: array
          items:
            $ref: '#/components/schemas/FailureEventInfo'
          minItems: 1
      required:
        - eventSubscriptions
    EventSubscription:
      description: Represents a subscription to a single event.
      type: object
      properties:
        anySlice:
          $ref: '#/components/schemas/AnySlice'
        appIds:
          type: array
          items:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/ApplicationId'
          minItems: 1
          description: Identification(s) of application to which the subscription applies.
        dnns:
          type: array
          items:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/Dnn'
          minItems: 1
          description: Identification(s) of DNN to which the subscription applies.
        dnais:
          type: array
          items:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/Dnai'
          minItems: 1
        event:
```

```
        $ref: '#/components/schemas/NwdafEvent'
      extraReportReq:
        $ref: '#/components/schemas/EventReportingRequirement'
      loadLevelThreshold:
        type: integer
        description: Indicates that the NWDAF shall report the corresponding network slice load
level to the NF service consumer where the load level of the network slice identified by snssais is
reached.
      notificationMethod:
        $ref: '#/components/schemas/NotificationMethod'
      matchingDir:
        $ref: '#/components/schemas/MatchingDirection'
      nfLoadLvlThds:
        type: array
        items:
          $ref: '#/components/schemas/ThresholdLevel'
        minItems: 1
        description: Shall be supplied in order to start reporting when an average load level is
reached.
      nfInstanceIds:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/NfInstanceId'
        minItems: 1
      nfSetIds:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/NfSetId'
        minItems: 1
      nfTypes:
        type: array
        items:
          $ref: 'TS29510_Nnrf_NFManagement.yaml#/components/schemas/NFType'
        minItems: 1
      networkArea:
        $ref: 'TS29554_Npcf_BDTPolicyControl.yaml#/components/schemas/NetworkAreaInfo'
      topAppListUlInd:
        type: boolean
        description: Indicates that the list of top applications that contribute the most to the
traffic in Uplink direction is requested, if it is included and set to "true". Default value is
"false".
      topAppListDlInd:
        type: boolean
        description: Indicates that the list of top applications that contribute the most to the
traffic in Downlink direction is requested, if it is included and set to "true". Default value is
"false".
      nsiIdInfos:
        type: array
        items:
          $ref: '#/components/schemas/NsiIdInfo'
        minItems: 1
      nsiLevelThrds:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
        minItems: 1
      qosRequ:
        $ref: '#/components/schemas/QosRequirement'
      qosFlowRetThds:
        type: array
        items:
          $ref: '#/components/schemas/RetainabilityThreshold'
        minItems: 1
      ranUeThrouThds:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/BitRate'
        minItems: 1
      repetitionPeriod:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'
      snssaia:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
        minItems: 1
        description: Identification(s) of network slice to which the subscription applies. It
corresponds to snssais in the data model definition of 3GPP TS 29.520.
      tgtUe:
```

```
      $ref: '#/components/schemas/TargetUeInformation'
    congThresholds:
      type: array
      items:
        $ref: '#/components/schemas/ThresholdLevel'
      minItems: 1
    nwPerfRequs:
      type: array
      items:
        $ref: '#/components/schemas/NetworkPerfRequirement'
      minItems: 1
    bwRequs:
      type: array
      items:
        $ref: '#/components/schemas/BwRequirement'
      minItems: 1
    excepRequs:
      type: array
      items:
        $ref: '#/components/schemas/Exception'
      minItems: 1
    exptAnaType:
      $ref: '#/components/schemas/ExpectedAnalyticsType'
    exptUeBehav:
      $ref: 'TS29503_Nudm_SDM.yaml#/components/schemas/ExpectedUeBehaviourData'
  required:
    - event
NnwdafEventsSubscriptionNotification:
  description: Represents an Individual NWDAF Event Subscription Notification resource.
  type: object
  properties:
    eventNotifications:
      type: array
      items:
        $ref: '#/components/schemas/EventNotification'
      minItems: 1
      description: Notifications about Individual Events
    subscriptionId:
      type: string
      description: String identifying a subscription to the Nnwdaf_EventsSubscription Service
  required:
    - eventNotifications
    - subscriptionId
EventNotification:
  description: Represents a notification on events that occurred.
  type: object
  properties:
    event:
      $ref: '#/components/schemas/NwdafEvent'
    start:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
    expiry:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
    timeStampGen:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
    failNotifyCode:
      $ref: '#/components/schemas/NwdafFailureCode'
    rvWaitTime:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'
    anaMetaInfo:
      $ref: '#/components/schemas/AnalyticsMetadataInfo'
    nfLoadLevelInfos:
      type: array
      items:
        $ref: '#/components/schemas/NfLoadLevelInformation'
      minItems: 1
    nsiLoadLevelInfos:
      type: array
      items:
        $ref: '#/components/schemas/NsiLoadLevelInfo'
      minItems: 1
    sliceLoadLevelInfo:
      $ref: '#/components/schemas/SliceLoadLevelInformation'
    svcExps:
      type: array
      items:
        $ref: '#/components/schemas/ServiceExperienceInfo'
      minItems: 1
```

```
      qosSustainInfos:
        type: array
        items:
          $ref: '#/components/schemas/QosSustainabilityInfo'
        minItems: 1
      ueComms:
        type: array
        items:
          $ref: '#/components/schemas/UeCommunication'
        minItems: 1
      ueMobs:
        type: array
        items:
          $ref: '#/components/schemas/UeMobility'
        minItems: 1
      userDataCongInfos:
        type: array
        items:
          $ref: '#/components/schemas/UserDataCongestionInfo'
        minItems: 1
      abnorBehavrs:
        type: array
        items:
          $ref: '#/components/schemas/AbnormalBehaviour'
        minItems: 1
      nwPerfs:
        type: array
        items:
          $ref: '#/components/schemas/NetworkPerfInfo'
        minItems: 1
    required:
      - event
  ServiceExperienceInfo:
    description: Represents service experience information.
    type: object
    properties:
      svcExprc:
        $ref: 'TS29517_Naf_EventExposure.yaml#/components/schemas/SvcExperience'
      svcExprcVariance:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Float'
      supis:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Supi'
        minItems: 1
      snssai:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
      appId:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/ApplicationId'
      confidence:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
      dnn:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Dnn'
      networkArea:
        $ref: 'TS29554_Npcf_BDTPolicyControl.yaml#/components/schemas/NetworkAreaInfo'
      nsiId:
        $ref: 'TS29531_Nnssf_NSSelection.yaml#/components/schemas/NsiId'
      ratio:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/SamplingRatio'
    required:
      - svcExprc
  BwRequirement:
    description: Represents bandwidth requirements.
    type: object
    properties:
      appId:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/ApplicationId'
      marBwDl:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/BitRate'
      marBwUl:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/BitRate'
      mirBwDl:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/BitRate'
      mirBwUl:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/BitRate'
    required:
      - appId
  SliceLoadLevelInformation:
```

```
      description: Contains load level information applicable for one or several slices.
      type: object
      properties:
        loadLevelInformation:
          $ref: '#/components/schemas/LoadLevelInformation'
        snssais:
          type: array
          items:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
          minItems: 1
          description: Identification(s) of network slice to which the subscription applies.
      required:
        - loadLevelInformation
        - snssais
    NsiLoadLevelInfo:
      description: Represents the network slice and optionally the associated network slice instance
and the load level information.
      type: object
      properties:
        loadLevelInformation:
          $ref: '#/components/schemas/LoadLevelInformation'
        snssai:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
        nsiId:
          $ref: 'TS29531_Nnssf_NSSelection.yaml#/components/schemas/NsiId'
        networkArea:
          $ref: 'TS29554_Npcf_BDTPolicyControl.yaml#/components/schemas/NetworkAreaInfo'
        timePeriod:
          $ref: 'TS29122_CommonData.yaml#/components/schemas/TimeWindow'
        numOfUes:
          $ref: '#/components/schemas/NumberAverage'
        numOfPduSess:
          $ref: '#/components/schemas/NumberAverage'
        confidence:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
      required:
        - loadLevelInformation
        - snssai
    NsiIdInfo:
      description: Represents the S-NSSAI and the optionally associated Network Slice Instance(s).
      type: object
      properties:
        snssai:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
        nsiIds:
          type: array
          items:
            $ref: 'TS29531_Nnssf_NSSelection.yaml#/components/schemas/NsiId'
          minItems: 1
      required:
        - snssai
    EventReportingRequirement:
      description: Represents the type of reporting that the subscription requires.
      type: object
      properties:
        accuracy:
          $ref: '#/components/schemas/Accuracy'
        startTs:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        endTs:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        sampRatio:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SamplingRatio'
        maxObjectNbr:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
        maxSupiNbr:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
        timeAnaNeeded:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        anaMeta:
          type: array
          items:
            $ref: '#/components/schemas/AnalyticsMetadata'
          minItems: 1
        anaMetaInd:
          $ref: '#/components/schemas/AnalyticsMetadataIndication'
    TargetUeInformation:
      description: Identifies the target UE information.
```

```
    type: object
    properties:
      anyUe:
        type: boolean
      supis:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Supi'
      gpsis:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Gpsi'
      intGroupIds:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/GroupId'
  UeMobility:
    description: Represents UE mobility information.
    type: object
    properties:
      ts:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
      recurringTime:
        $ref: 'TS29122_CpProvisioning.yaml#/components/schemas/ScheduledCommunicationTime'
      duration:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'
      durationVariance:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Float'
      locInfos:
        type: array
        items:
          $ref: '#/components/schemas/LocationInfo'
        minItems: 1
    required:
      - duration
      - locInfos
  LocationInfo:
    description: Represents UE location information.
    type: object
    properties:
      loc:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/UserLocation'
      ratio:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/SamplingRatio'
      confidence:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
    required:
      - loc
  UeCommunication:
    description: Represents UE communication information.
    type: object
    properties:
      commDur:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'
      commDurVariance:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Float'
      perioTime:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'
      perioTimeVariance:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Float'
      ts:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
      tsVariance:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Float'
      recurringTime:
        $ref: 'TS29122_CpProvisioning.yaml#/components/schemas/ScheduledCommunicationTime'
      trafChar:
        $ref: '#/components/schemas/TrafficCharacterization'
      ratio:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/SamplingRatio'
      confidence:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
    required:
      - commDur
      - trafChar
  TrafficCharacterization:
    description: Identifies the detailed traffic characterization.
    type: object
```

```
    properties:
      dnn:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Dnn'
      snssai:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
      appId:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/ApplicationId'
      fDescs:
        type: array
        items:
          $ref: '#/components/schemas/IpEthFlowDescription'
        minItems: 1
        maxItems: 2
      ulVol:
        $ref: 'TS29122_CommonData.yaml#/components/schemas/Volume'
      ulVolVariance:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Float'
      dlVol:
        $ref: 'TS29122_CommonData.yaml#/components/schemas/Volume'
      dlVolVariance:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Float'
  UserDataCongestionInfo:
    description: Represents the user data congestion information.
    type: object
    properties:
      networkArea:
        $ref: 'TS29554_Npcf_BDTPolicyControl.yaml#/components/schemas/NetworkAreaInfo'
      congestionInfo:
        $ref: '#/components/schemas/CongestionInfo'
      snssai:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
  CongestionInfo:
    description: Represents the congestion information.
    type: object
    properties:
      congType:
        $ref: '#/components/schemas/CongestionType'
      timeIntev:
        $ref: 'TS29122_CommonData.yaml#/components/schemas/TimeWindow'
      nsi:
        $ref: '#/components/schemas/ThresholdLevel'
      confidence:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
      topAppListUl:
        type: array
        items:
          $ref: '#/components/schemas/TopApplication'
        minItems: 1
      topAppListDl:
        type: array
        items:
          $ref: '#/components/schemas/TopApplication'
        minItems: 1
    required:
      - congType
      - timeIntev
      - nsi
  TopApplication:
    description: Top application that contributes the most to the traffic.
    type: object
    properties:
      appId:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/ApplicationId'
      ipTrafficFilter:
        $ref: 'TS29122_CommonData.yaml#/components/schemas/FlowInfo'
      ratio:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/SamplingRatio'
  QosSustainabilityInfo:
    description: Represents the QoS Sustainability information.
    type: object
    properties:
      areaInfo:
        $ref: 'TS29554_Npcf_BDTPolicyControl.yaml#/components/schemas/NetworkAreaInfo'
      startTs:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
      endTs:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
      qosFlowRetThd:
```

```
      $ref: '#/components/schemas/RetainabilityThreshold'
    ranUeThrouThd:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/BitRate'
    snssai:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
    confidence:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
QosRequirement:
  description: Represents the QoS requirements.
  type: object
  properties:
    5qi:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/5Qi'
    gfbrUl:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/BitRate'
    gfbrDl:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/BitRate'
    resType:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/QosResourceType'
    pdb:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/PacketDelBudget'
    per:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/PacketErrRate'
ThresholdLevel:
  description: Represents a threshold level.
  type: object
  properties:
    congLevel:
      type: integer
    nfLoadLevel:
      type: integer
    nfCpuUsage:
      type: integer
    nfMemoryUsage:
      type: integer
    nfStorageUsage:
      type: integer
NfLoadLevelInformation:
  description: Represents load level information of a given NF instance.
  type: object
  properties:
    nfType:
      $ref: 'TS29510_Nnrf_NFManagement.yaml#/components/schemas/NFType'
    nfInstanceId:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/NfInstanceId'
    nfSetId:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/NfSetId'
    nfStatus:
      $ref: '#/components/schemas/NfStatus'
    nfCpuUsage:
      type: integer
    nfMemoryUsage:
      type: integer
    nfStorageUsage:
      type: integer
    nfLoadLevelAverage:
      type: integer
    nfLoadLevelpeak:
      type: integer
    snssai:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
    confidence:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
  required:
    - nfType
    - nfInstanceId
NfStatus:
  description: Contains the percentage of time spent on various NF states.
  type: object
  properties:
    statusRegistered:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/SamplingRatio'
    statusUnregistered:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/SamplingRatio'
    statusUndiscoverable:
      $ref: 'TS29571_CommonData.yaml#/components/schemas/SamplingRatio'
AnySlice:
  type: boolean
```

```
     description: FALSE represents not applicable for all slices. TRUE represents applicable for all
slices.
    LoadLevelInformation:
      type: integer
      description: Load level information of the network slice and the optionally associated network
slice instance.
    AbnormalBehaviour:
      description: Represents the abnormal behaviour information.
      type: object
      properties:
        supis:
          type: array
          items:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/Supi'
          minItems: 1
        excep:
          $ref: '#/components/schemas/Exception'
        dnn:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Dnn'
        snssai:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
        ratio:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/SamplingRatio'
        confidence:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
        addtMeasInfo:
          $ref: '#/components/schemas/AdditionalMeasurement'
      required:
        - excep
    Exception:
      description: Represents the Exception information.
      type: object
      properties:
        excepId:
          $ref: '#/components/schemas/ExceptionId'
        excepLevel:
          type: integer
        excepTrend:
          $ref: '#/components/schemas/ExceptionTrend'
      required:
        - excepId
    AdditionalMeasurement:
      description: Represents additional measurement information.
      type: object
      properties:
        unexpLoc:
          $ref: 'TS29554_Npcf_BDTPolicyControl.yaml#/components/schemas/NetworkAreaInfo'
        unexpFlowTeps:
          type: array
          items:
            $ref: '#/components/schemas/IpEthFlowDescription'
          minItems: 1
        unexpWakes:
          type: array
          items:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
          minItems: 1
        ddosAttack:
          $ref: '#/components/schemas/AddressList'
        wrgDest:
          $ref: '#/components/schemas/AddressList'
        circums:
          type: array
          items:
            $ref: '#/components/schemas/CircumstanceDescription'
          minItems: 1
    IpEthFlowDescription:
      description: Contains the description of an Uplink and/or Downlink Ethernet flow.
      type: object
      properties:
        ipTrafficFilter:
          $ref: 'TS29514_Npcf_PolicyAuthorization.yaml#/components/schemas/FlowDescription'
        ethTrafficFilter:
          $ref: 'TS29514_Npcf_PolicyAuthorization.yaml#/components/schemas/EthFlowDescription'
    AddressList:
      description: Represents a list of IPv4 and/or IPv6 addresses.
      type: object
      properties:
```

```
      ipv4Addrs:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv4Addr'
        minItems: 1
      ipv6Addrs:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Ipv6Addr'
        minItems: 1
  CircumstanceDescription:
    description: Contains the description of a circumstance.
    type: object
    properties:
      freq:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Float'
      tm:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
      locArea:
        $ref: 'TS29554_Npcf_BDTPolicyControl.yaml#/components/schemas/NetworkAreaInfo'
      vol:
        $ref: 'TS29122_CommonData.yaml#/components/schemas/Volume'
  RetainabilityThreshold:
    description: Represents a QoS flow retainability threshold.
    type: object
    properties:
      relFlowNum:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
      relTimeUnit:
        $ref: '#/components/schemas/TimeUnit'
      relFlowRatio:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/SamplingRatio'
  NetworkPerfRequirement:
    description: Represents a network performance requirement.
    type: object
    properties:
      nwPerfType:
        $ref: '#/components/schemas/NetworkPerfType'
      relativeRatio:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/SamplingRatio'
      absoluteNum:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
    required:
      - nwPerfType
  NetworkPerfInfo:
    description: Represents the network performance information.
    type: object
    properties:
      networkArea:
        $ref: 'TS29554_Npcf_BDTPolicyControl.yaml#/components/schemas/NetworkAreaInfo'
      nwPerfType:
        $ref: '#/components/schemas/NetworkPerfType'
      relativeRatio:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/SamplingRatio'
      absoluteNum:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
      confidence:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
    required:
      - networkArea
      - nwPerfType
  FailureEventInfo:
    description: Contains information on the event for which the subscription is not successful.
    type: object
    properties:
      event:
        $ref: '#/components/schemas/NwdafEvent'
      failureCode:
        $ref: '#/components/schemas/NwdafFailureCode'
    required:
      - event
      - failureCode
  AnalyticsMetadataIndication:
    description: Contains analytics metadata information requested to be used during analytics
generation.
    type: object
    properties:
      dataWindow:
```

```
        $ref: 'TS29122_CommonData.yaml#/components/schemas/TimeWindow'
      dataStatProps:
        type: array
        items:
          $ref: '#/components/schemas/DatasetStatisticalProperty'
        minItems: 1
      strategy:
        $ref: '#/components/schemas/OutputStrategy'
      aggrNwdafIds:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/NfInstanceId'
        minItems: 1
  AnalyticsMetadataInfo:
    description: Contains analytics metadata information required for analytics aggregation.
    type: object
    properties:
      numSamples:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
      dataWindow:
        $ref: 'TS29122_CommonData.yaml#/components/schemas/TimeWindow'
      dataStatProps:
        type: array
        items:
          $ref: '#/components/schemas/DatasetStatisticalProperty'
        minItems: 1
      strategy:
        $ref: '#/components/schemas/OutputStrategy'
      accuracy:
        $ref: '#/components/schemas/Accuracy'
  NumberAverage:
    description: Represents average and variance information.
    type: object
    properties:
      number:
        type: integer
      variance:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Float'
    required:
      - number
      - variance
  NotificationMethod:
    anyOf:
    - type: string
      enum:
        - PERIODIC
        - THRESHOLD
    - type: string
      description: >
        This string provides forward-compatibility with future
        extensions to the enumeration but is not used to encode
        content defined in the present version of this API.
    description: >
      Possible values are
      - PERIODIC: The subscribe of NWDAF Event is periodically. The periodic of the notification is
identified by repetitionPeriod defined in subclause 5.1.6.2.3.
      - THRESHOLD: The subscribe of NWDAF Event is upon threshold exceeded. The threshold of the
notification is identified by loadLevelThreshold defined in subclause 5.1.6.2.3.
  NwdafEvent:
    anyOf:
    - type: string
      enum:
        - SLICE_LOAD_LEVEL
        - NETWORK_PERFORMANCE
        - NF_LOAD
        - SERVICE_EXPERIENCE
        - UE_MOBILITY
        - UE_COMMUNICATION
        - QOS_SUSTAINABILITY
        - ABNORMAL_BEHAVIOUR
        - USER_DATA_CONGESTION
        - NSI_LOAD_LEVEL
    - type: string
      description: >
        This string provides forward-compatibility with future
        extensions to the enumeration but is not used to encode
        content defined in the present version of this API.
    description: >
```

```
      Possible values are
      - SLICE_LOAD_LEVEL: Indicates that the event subscribed is load level information of Network
Slice
      - NETWORK_PERFORMANCE: Indicates that the event subscribed is network performance
information.
      - NF_LOAD: Indicates that the event subscribed is load level and status of one or several
Network Functions.
      - SERVICE_EXPERIENCE: Indicates that the event subscribed is service experience.
      - UE_MOBILITY: Indicates that the event subscribed is UE mobility information.
      - UE_COMMUNICATION: Indicates that the event subscribed is UE communication information.
      - QOS_SUSTAINABILITY: Indicates that the event subscribed is QoS sustainability.
      - ABNORMAL_BEHAVIOUR: Indicates that the event subscribed is abnormal behaviour.
      - USER_DATA_CONGESTION: Indicates that the event subscribed is user data congestion
information.
      - NSI_LOAD_LEVEL: Indicates that the event subscribed is load level information of Network
Slice and the optionally associated Network Slice Instance
    Accuracy:
      anyOf:
      - type: string
        enum:
          - LOW
          - HIGH
      - type: string
        description: >
          This string provides forward-compatibility with future
          extensions to the enumeration but is not used to encode
          content defined in the present version of this API.
      description: >
        Possible values are
        - LOW: Low accuracy.
        - HIGH: High accuracy.
    CongestionType:
      anyOf:
      - type: string
        enum:
          - USER_PLANE
          - CONTROL_PLANE
          - USER_AND_CONTROL_PLANE
      - type: string
        description: >
          This string provides forward-compatibility with future
          extensions to the enumeration but is not used to encode
          content defined in the present version of this API.
      description: >
        Possible values are
        - USER_PLANE: The congestion analytics type is User Plane.
        - CONTROL_PLANE: The congestion analytics type is Control Plane.
        - USER_AND_CONTROL_PLANE: The congestion analytics type is User Plane and Control Plane.
    ExceptionId:
      anyOf:
      - type: string
        enum:
          - UNEXPECTED_UE_LOCATION
          - UNEXPECTED_LONG_LIVE_FLOW
          - UNEXPECTED_LARGE_RATE_FLOW
          - UNEXPECTED_WAKEUP
          - SUSPICION_OF_DDOS_ATTACK
          - WRONG_DESTINATION_ADDRESS
          - TOO_FREQUENT_SERVICE_ACCESS
          - UNEXPECTED_RADIO_LINK_FAILURES
          - PING_PONG_ACROSS_CELLS
      - type: string
        description: >
          This string provides forward-compatibility with future
          extensions to the enumeration but is not used to encode
          content defined in the present version of this API.
      description: >
        Possible values are
          - UNEXPECTED_UE_LOCATION: Unexpected UE location
          - UNEXPECTED_LONG_LIVE_FLOW: Unexpected long-live rate flows
          - UNEXPECTED_LARGE_RATE_FLOW: Unexpected large rate flows
          - UNEXPECTED_WAKEUP: Unexpected wakeup
          - SUSPICION_OF_DDOS_ATTACK: Suspicion of DDoS attack
          - WRONG_DESTINATION_ADDRESS: Wrong destination address
          - TOO_FREQUENT_SERVICE_ACCESS: Too frequent Service Access
          - UNEXPECTED_RADIO_LINK_FAILURES: Unexpected radio link failures
          - PING_PONG_ACROSS_CELLS: Ping-ponging across neighbouring cells
    ExceptionTrend:
```

```
      anyOf:
      - type: string
        enum:
          - UP
          - DOWN
          - UNKNOW
          - STABLE
      - type: string
        description: >
          This string provides forward-compatibility with future
          extensions to the enumeration but is not used to encode
          content defined in the present version of this API.
      description: >
        Possible values are
          - UP: Up trend of the exception level.
          - DOWN: Down trend of the exception level.
          - UNKNOW: Unknown trend of the exception level.
          - STABLE: Stable trend of the exception level.
    TimeUnit:
      anyOf:
      - type: string
        enum:
          - MINUTE
          - HOUR
          - DAY
      - type: string
        description: >
          This string provides forward-compatibility with future
          extensions to the enumeration but is not used to encode
          content defined in the present version of this API.
      description: >
        Possible values are
        - MINUTE: Time unit is per minute.
        - HOUR: Time unit is per hour.
        - DAY: Time unit is per day.
    NetworkPerfType:
      anyOf:
      - type: string
        enum:
          - GNB_ACTIVE_RATIO
          - GNB_COMPUTING_USAGE
          - GNB_MEMORY_USAGE
          - GNB_DISK_USAGE
          - NUM_OF_UE
          - SESS_SUCC_RATIO
          - HO_SUCC_RATIO
      - type: string
        description: >
          This string provides forward-compatibility with future
          extensions to the enumeration but is not used to encode
          content defined in the present version of this API.
      description: >
        Possible values are
          - GNB_ACTIVE_RATIO: Indicates that the network performance requirement is gNodeB active
(i.e. up and running) rate. Indicates the ratio of gNB active (i.e. up and running) number to the
total number of gNB
          - GNB_COMPUTING_USAGE: Indicates gNodeB computing resource usage.
          - GNB_MEMORY_USAGE: Indicates gNodeB memory usage.
          - GNB_DISK_USAGE: Indicates gNodeB disk usage.
          - NUM_OF_UE: Indicates number of UEs.
          - SESS_SUCC_RATIO: Indicates ratio of successful setup of PDU sessions to total PDU session
setup attempts.
          - SESS_SUCC_RATIO: Indicates Ratio of successful handovers to the total handover attempts.
    ExpectedAnalyticsType:
      anyOf:
      - type: string
        enum:
          - MOBILITY
          - COMMUN
          - MOBILITY_AND_COMMUN
      - type: string
        description: >
          This string provides forward-compatibility with future
          extensions to the enumeration but is not used to encode
          content defined in the present version of this API.
      description: >
        Possible values are
          - MOBILITY: Mobility related abnormal behaviour analytics is expected by the consumer.
```

```
        - COMMUN: Communication related abnormal behaviour analytics is expected by the consumer.
        - MOBILITY_AND_COMMUN: Both mobility and communication related abnormal behaviour analytics
is expected by the consumer.
    MatchingDirection:
      anyOf:
      - type: string
        enum:
          - ASCENDING
          - DESCENDING
          - CROSSED
      - type: string
        description: >
          This string provides forward-compatibility with future
          extensions to the enumeration but is not used to encode
          content defined in the present version of this API.
      description: >
        Possible values are
          - ASCENDING: Threshold is crossed in ascending direction.
          - DESCENDING: Threshold is crossed in descending direction.
          - CROSSED: Threshold is crossed either in ascending or descending direction.
    NwdafFailureCode:
      anyOf:
      - type: string
        enum:
          - UNAVAILABLE_DATA
          - BOTH_STAT_PRED_NOT_ALLOWED
          - UNSATISFIED_REQUESTED_ANALYTICS_TIME
          - OTHER
      - type: string
        description: >
          This string provides forward-compatibility with future
          extensions to the enumeration but is not used to encode
          content defined in the present version of this API.
      description: >
        Possible values are
          - UNAVAILABLE_DATA: Indicates the requested statistics information for the event is rejected
since necessary data to perform the service is unavailable.
          - BOTH_STAT_PRED_NOT_ALLOWED: Indicates the requested analysis information for the event is
rejected since the start time is in the past and the end time is in the future, which means the NF
service consumer requested both statistics and prediction for the analytics.
          - UNSATISFIED_REQUESTED_ANALYTICS_TIME: Indicates that the requested event is rejected since
the analytics information is not ready when the time indicated by the "timeAnaNeeded" attribute (as
provided during the creation or modification of subscription) is reached.
          - OTHER: Indicates the requested analysis information for the event is rejected due to other
reasons.
    AnalyticsMetadata:
      anyOf:
      - type: string
        enum:
          - NUM_OF_SAMPLES
          - DATA_WINDOW
          - DATA_STAT_PROPS
          - STRATEGY
          - ACCURACY
      - type: string
        description: >
          This string provides forward-compatibility with future
          extensions to the enumeration but is not used to encode
          content defined in the present version of this API.
      description: >
        Possible values are
          - NUM_OF_SAMPLES: Number of data samples used for the generation of the output analytics.
          - DATA_WINDOW: Data time window of the data samples.
          - DATA_STAT_PROPS: Dataset statistical properties of the data used to generate the
analytics.
          - STRATEGY: Output strategy used for the reporting of the analytics.
          - ACCURACY: Level of accuracy reached for the analytics.
    DatasetStatisticalProperty:
      anyOf:
      - type: string
        enum:
          - UNIFORM_DIST_DATA
          - NO_OUTLIERS
      - type: string
        description: >
          This string provides forward-compatibility with future
          extensions to the enumeration but is not used to encode
          content defined in the present version of this API.
```

```
      description: >
        Possible values are
          - UNIFORM_DIST_DATA: Indicates the use of data samples that are uniformly distributed
according to the different aspects of the requested analytics.
          - NO_OUTLIERS: Indicates that the data samples shall disregard data samples that are at the
extreme boundaries of the value range.
    OutputStrategy:
      anyOf:
      - type: string
        enum:
          - BINARY
          - GRADIENT
      - type: string
        description: >
          This string provides forward-compatibility with future
          extensions to the enumeration but is not used to encode
          content defined in the present version of this API.
      description: >
        Possible values are
          - BINARY: Indicates that the analytics shall only be reported when the requested level of
accuracy is reached within a cycle of periodic notification.
          - GRADIENT: Indicates that the analytics shall be reported according with the periodicity
irrespective of whether the requested level of accuracy has been reached or not.
```

A.3 Nnwdaf_AnalyticsInfo API

```
openapi: 3.0.0
info:
  version: 1.2.0-alpha.4
  title: Nnwdaf_AnalyticsInfo
  description: |
    Nnwdaf_AnalyticsInfo Service API.
    © 2021, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
externalDocs:
  description: 3GPP TS 29.520 V17.4.0; 5G System; Network Data Analytics Services.
  url: 'http://www.3gpp.org/ftp/Specs/archive/29_series/29.520/'
security:
  - {}
  - oAuth2ClientCredentials:
    - nnwdaf-analyticsinfo
servers:
  - url: '{apiRoot}/nnwdaf-analyticsinfo/v1'
    variables:
      apiRoot:
        default: https://example.com
        description: apiRoot as defined in subclause 4.4 of 3GPP TS 29.501.
paths:
  /analytics:
    get:
      summary: Read a NWDAF Analytics
      operationId: GetNWDAFAnalytics
      tags:
        - NWDAF Analytics (Document)
      parameters:
        - name: event-id
          in: query
          description: Identify the analytics.
          required: true
          schema:
            $ref: '#/components/schemas/EventId'
        - name: ana-req
          in: query
          description: Identifies the analytics reporting requirement information.
          required: false
          content:
            application/json:
              schema:
                $ref:
'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/EventReportingRequirement'
        - name: event-filter
          in: query
          description: Identify the analytics.
          required: false
          content:
            application/json:
```

```
            schema:
              $ref: '#/components/schemas/EventFilter'
        - name: supported-features
          in: query
          description: To filter irrelevant responses related to unsupported features
          schema:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
        - name: tgt-ue
          in: query
          description: Identify the target UE information.
          required: false
          content:
            application/json:
              schema:
                $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/TargetUeInformation'
      responses:
        '200':
          description: Containing the analytics with parameters as relevant for the requesting NF
service consumer.
          content:
            application/json:
              schema:
                $ref: '#/components/schemas/AnalyticsData'
        '204':
          description: No Content (The request NWDAF Analytics data does not exist)
        '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':
          description: Indicates that the NWDAF Analytics resource does not exist.
          content:
            application/problem+json:
              schema:
                $ref: 'TS29571_CommonData.yaml#/components/schemas/ProblemDetails'
        '406':
          $ref: 'TS29571_CommonData.yaml#/components/responses/406'
        '414':
          $ref: 'TS29571_CommonData.yaml#/components/responses/414'
        '429':
          $ref: 'TS29571_CommonData.yaml#/components/responses/429'
        '500':
          description: The request is rejected by the NWDAF and more details (not only the
ProblemDetails) are returned.
          content:
            application/problem+json:
              schema:
                $ref: '#/components/schemas/ProblemDetailsAnalyticsInfoRequest'
        '503':
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          $ref: 'TS29571_CommonData.yaml#/components/responses/default'
components:
  securitySchemes:
    oAuth2ClientCredentials:
      type: oauth2
      flows:
        clientCredentials:
          tokenUrl: '{nrfApiRoot}/oauth2/token'
          scopes:
            nnwdaf-analyticsinfo: Access to the Nnwdaf_AnalyticsInfo API
  schemas:
    AnalyticsData:
      description: Represents the description of analytics with parameters as relevant for the
requesting NF service consumer.
      type: object
      properties:
        start:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        expiry:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        timeStampGen:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        anaMetaInfo:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/AnalyticsMetadataInfo'
        sliceLoadLevelInfos:
```

```
        type: array
        items:
          $ref:
'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/SliceLoadLevelInformation'
        minItems: 1
        description: The slices and their load level information.
      nsiLoadLevelInfos:
        type: array
        items:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/NsiLoadLevelInfo'
        minItems: 1
      nfLoadLevelInfos:
        type: array
        items:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/NfLoadLevelInformation'
        minItems: 1
      nwPerfs:
        type: array
        items:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/NetworkPerfInfo'
        minItems: 1
      svcExps:
        type: array
        items:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/ServiceExperienceInfo'
        minItems: 1
      qosSustainInfos:
        type: array
        items:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/QosSustainabilityInfo'
        minItems: 1
      ueMobs:
        type: array
        items:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/UeMobility'
        minItems: 1
      ueComms:
        type: array
        items:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/UeCommunication'
        minItems: 1
      userDataCongInfos:
        type: array
        items:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/UserDataCongestionInfo'
        minItems: 1
      abnorBehavrs:
        type: array
        items:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/AbnormalBehaviour'
        minItems: 1
      suppFeat:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/SupportedFeatures'
  EventFilter:
    description: Represents the event filters used to identify the requested analytics.
    type: object
    properties:
      anySlice:
        $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/AnySlice'
      snssais:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
        minItems: 1
        description: Identification(s) of network slice to which the subscription belongs.
      appIds:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/ApplicationId'
        minItems: 1
      dnns:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Dnn'
        minItems: 1
      dnais:
        type: array
        items:
```

```
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Dnai'
        minItems: 1
      networkArea:
        $ref: 'TS29554_Npcf_BDTPolicyControl.yaml#/components/schemas/NetworkAreaInfo'
      topAppListUlInd:
        type: boolean
        description: Indicates that the list of top applications that contribute the most to the
traffic in Uplink direction is requested, if it is included and set to "true". Default value is
"false".
      topAppListDlReq:
        type: boolean
        description: Indicates that the list of top applications that contribute the most to the
traffic in Downlink direction is requested, if it is included and set to "true". Default value is
"false".
      nfInstanceIds:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/NfInstanceId'
        minItems: 1
      nfSetIds:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/NfSetId'
        minItems: 1
      nfTypes:
        type: array
        items:
          $ref: 'TS29510_Nnrf_NFManagement.yaml#/components/schemas/NFType'
        minItems: 1
      nsiIdInfos:
        type: array
        items:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/NsiIdInfo'
        minItems: 1
      qosRequ:
        $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/QosRequirement'
      nwPerfTypes:
        type: array
        items:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/NetworkPerfType'
        minItems: 1
      bwRequs:
        type: array
        items:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/BwRequirement'
        minItems: 1
      excepIds:
        type: array
        items:
          $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/ExceptionId'
        minItems: 1
      exptAnaType:
        $ref: 'TS29520_Nnwdaf_EventsSubscription.yaml#/components/schemas/ExpectedAnalyticsType'
      exptUeBehav:
        $ref: 'TS29503_Nudm_SDM.yaml#/components/schemas/ExpectedUeBehaviourData'
    not:
      required: [anySlice, snssais]
  ProblemDetailsAnalyticsInfoRequest:
    description: Extends ProblemDetails to indicate more details why the analytics request is
rejected.
    allOf:
      - $ref: 'TS29571_CommonData.yaml#/components/schemas/ProblemDetails'
      - $ref: '#/components/schemas/AdditionInfoAnalyticsInfoRequest'
  AdditionInfoAnalyticsInfoRequest:
    description: Indicates additional information why the analytics request is rejected.
    type: object
    properties:
      rvWaitTime:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'
  EventId:
    anyOf:
    - type: string
      enum:
        - LOAD_LEVEL_INFORMATION
        - NETWORK_PERFORMANCE
        - NF_LOAD
        - SERVICE_EXPERIENCE
        - UE_MOBILITY
```

```
        - UE_COMMUNICATION
        - QOS_SUSTAINABILITY
        - ABNORMAL_BEHAVIOUR
        - USER_DATA_CONGESTION
        - NSI_LOAD_LEVEL
    - type: string
      description: >
        This string provides forward-compatibility with future
        extensions to the enumeration but is not used to encode
        content defined in the present version of this API.
    description: >
      Possible values are
      - LOAD_LEVEL_INFORMATION: Represent the analytics of load level information of corresponding
network slice.
      - NETWORK_PERFORMANCE: Represent the analytics of network performance information.
      - NF_LOAD: Indicates that the event subscribed is NF Load.
      - SERVICE_EXPERIENCE: Represent the analytics of service experience information of the
specific applications.
      - UE_MOBILITY: Represent the analytics of UE mobility.
      - UE_COMMUNICATION: Represent the analytics of UE communication.
      - QOS_SUSTAINABILITY: Represent the analytics of QoS sustainability information in the
certain area.
      - ABNORMAL_BEHAVIOUR: Indicates that the event subscribed is abnormal behaviour information.
      - USER_DATA_CONGESTION: Represent the analytics of the user data congestion in the certain
area.
      - NSI_LOAD_LEVEL: Represent the analytics of Network Slice and the optionally associated
Network Slice Instance.
```

A.4 Nnwdaf_DataManagement API

Editor's Note: The OpenAPI file for the Nnwdaf_DataManagement API needs to be updated later.

A.5 Nnwdaf_MLModelProvision API

Editor's Note: The OpenAPI file for the Nnwdaf_MLModelProvision API needs to be updated later.

Annex B (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New**
2017-10						TS skeleton of Network Data Analytics Services.	0.0.0
2017-11	CT3#92					Inclusion of documents agreed in CT3#92 C3-175356.	0.1.0
2017-12	CT3#93					Inclusion of documents agreed in CT3#93 C3-176166, C3-176260, C3-176324, C3-176325, C3-176326, and C3-176327.	0.2.0
2018-01	CT3#94					Inclusion of documents agreed in CT3#94 C3-180252, C3-180253, C3-180254, C3-180255, C3-180256, C3-180257, C3-180344, C3-180345, C3-180346, C3-180323 and C3-180347.	0.3.0
2018-03	CT3#95					Inclusion of documents agreed in CT3#95 C3-181253, C3-181255, C3-181256, C3-181257, C3-181260, C3-181312, C3-181342 and C3-181343.	0.4.0
2018-03	CT3#96					Inclusion of documents agreed in CT3#96 C3-182379 and C3-182380.	0.5.0
2018-05	CT3#97					Inclusion of documents agreed in CT3#97 C3-183285, C3-183532, C3-183533, C3-183534 and C3-183535.	0.6.0
2018-06	CT#80	CP-181032				TS sent to plenary for approval	1.0.0
2018-06	CT#80	CP-181032				TS approved by plenary	15.0.0
2018-09	CT#81	CP-182015	0001	3	F	Clarification on mandatory HTTP error status codes	15.1.0
2018-09	CT#81	CP-182209	0002	4	B	OpenAPI for TS 29.520	15.1.0
2018-09	CT#81	CP-182015	0003	1	F	Description of Structured data types	15.1.0
2018-09	CT#81	CP-182015	0004	1	F	Resource structure presentation	15.1.0
2018-12	CT#82	CP-183205	0006		F	Default value for apiRoot	15.2.0
2018-12	CT#82	CP-183205	0007	2	F	Correct Nnwdaf service	15.2.0
2018-12	CT#82	CP-183205	0008	1	F	Cardinality	15.2.0
2018-12	CT#82	CP-183205	0009		F	API version	15.2.0
2018-12	CT#82	CP-183205	0010		F	ExternalDocs OpenAPI field	15.2.0
2018-12	CT#82	CP-183205	0011	1	F	Security	15.2.0
2018-12	CT#82	CP-183205	0012	1	F	Supported content types	15.2.0
2018-12	CT#82	CP-183205	0013	2	F	HTTP Error responses	15.2.0
2018-12	CT#82	CP-183205	0014	2	F	Correct NWDAF resource	15.2.0
2018-12	CT#82	CP-183205	0016	1	F	Adding HTTP status code "204 No Content"	15.2.0
2018-12	CT#82	CP-183205	0019		F	Location header field in OpenAPI	15.2.0
2019-03	CT#83	CP-190113	0020		F	Support of NSSF as the service consumer	15.3.0
2019-03	CT#83	CP-190113	0021	1	F	Formatting of structured data types in query	15.3.0
2019-03	CT#83	CP-190113	0022		F	OpenAPI info version update	15.3.0

2019-03	CT#83	CP-190213	0023	1	F	Correction of Location header in Nnwdaf_EventsSubscription OPenAPI	15.3.0
2019-06	CT#84	CP-191078	24	1	F	Correction of Nnwdaf_EventsSubscription OpenAPI	15.4.0
2019-06	CT#84	CP-191078	29	7	F	Corrections on TS 29.520	15.4.0
2019-06	CT#84	CP-191078	35	1	F	Precedence of OpenAPI file	15.4.0
2019-06	CT#84	CP-191078	37	1	F	Copyright Note in YAML files	15.4.0
2019-06	CT#84	CP-191090	25	1	B	Reference update and service representation	16.0.0
2019-06	CT#84	CP-191090	27	3	B	Support of more consumers	16.0.0
2019-06	CT#84	CP-191090	28	1	B	Support of more analytic events	16.0.0
2019-06	CT#84	CP-191225	31	9	B	Subscribing of service experience for the application	16.0.0
2019-06	CT#84	CP-191090	33	2	B	Delete the subscription of service experience for the application	16.0.0
2019-06	CT#84	CP-191090	34	5	B	Notification of service experience for the application	16.0.0
2019-06	CT#84	CP-191090	39	2	F	Copyright Note in YAML files	16.0.0
2019-09	CT#85	CP-192146	0041	2	F	Correct cardinality in NnwdafEventsSubscription	16.1.0
2019-09	CT#85	CP-192157	0042	4	B	UE mobility and communication analytics	16.1.0
2019-09	CT#85	CP-192157	0043	2	B	Support of network performance analytics in Nnwdaf_AnalyticsInfo_Request	16.1.0
2019-09	CT#85	CP-192157	0047	1	B	OAM as service consumer	16.1.0
2019-09	CT#85	CP-192157	0048	1	B	Update Nnwdaf_EventSubscription service for service experience	16.1.0
2019-09	CT#85	CP-192261	0049	1	B	Enhance the Nnwdaf_AnalyticsInfo service to support service experience	16.1.0
2019-09	CT#85	CP-192177	0050	2	B	Enhance the Nnwdaf_EventsSubscription service to support QoS sustainability	16.1.0
2019-09	CT#85	CP-192177	0051	2	B	Enhance the Nnwdaf_AnalyticsInfo service to support QoS sustainability	16.1.0
2019-09	CT#85	CP-192173	0054	2	F	OpenAPI version update TS 29.520 Rel-16	16.1.0
2019-12	CT#86	CP-193198	0055	3	B	Abnormal behaviour analytics	16.2.0
2019-12	CT#86	CP-193198	0056	4	B	Enhance the Nnwdaf_EventsSubscription service to support User Data Congestion	16.2.0
2019-12	CT#86	CP-193198	0057	2	B	Enhance the Nnwdaf_AnalyticsInfo service to support user data congestion	16.2.0
2019-12	CT#86	CP-193198	0058	1	B	Definination of QoS sustainability information	16.2.0
2019-12	CT#86	CP-193198	0059	4	B	Inclusion of QoS requirements and thresholds for QoS Sustainability	16.2.0
2019-12	CT#86	CP-193198	0062	2	F	Clarify references to QoS sustainability analytics	16.2.0
2019-12	CT#86	CP-193198	0063	2	F	Clarifications on NWDAF generalities	16.2.0
2019-12	CT#86	CP-193267	0102	3	B	OpenAPI file Update for Nnwdaf_EventsSubscription API	16.2.0
2019-12	CT#86	CP-193198	0103		B	OpenAPI file Update for Nnwdaf_AnalyticsInfo API	16.2.0
2019-12	CT#86	CP-193198	0104	1	B	Slice identification for all analytics types	16.2.0
2019-12	CT#86	CP-193234	0106	2	B	NF Load analytics generalities	16.2.0
2019-12	CT#86	CP-193212	0107	1	F	Update of API version and TS version in OpenAPI file	16.2.0

2020-03	CT#87e	CP-200208	0109	1	B	Definition of QoS Requirement	16.3.0
2020-03	CT#87e	CP-200208	0110	1	B	Description of consumer functionalities	16.3.0
2020-03	CT#87e	CP-200208	0111	1	B	Update the types of analytics events	16.3.0
2020-03	CT#87e	CP-200207	0114		B	DNN Clarification	16.3.0
2020-03	CT#87e	CP-200208	0115	1	F	Update Feature applicability for Rel-16 new data types	16.3.0
2020-03	CT#87e	CP-200208	0118	2	D	Corrections in TS29.520	16.3.0
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