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In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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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

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- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 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.

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

shall indicates a mandatory requirement to do something

shall not indicates an interdiction (prohibition) to do something

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

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

should indicates a recommendation to do something

should not indicates a recommendation not to do something

may indicates permission to do something

need not indicates permission not to do something

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

can indicates that something is possible

cannot indicates that something is impossible

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

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

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

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

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

In addition:

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

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

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

1 Scope

The present document specifies detailed call flows of Network Data Analytics over the Nnwdaf, Nsmf, Npcf, Nnsacf, Namf, Nnrf, Nnssf, Nnef, Naf, Ndccf, Nadrf, Nmfaf and Nudm service-based interfaces and their relationship with the flow level signalling in 5G system.

NOTE: The call flows depicted in this Technical Specification do not cover all traffic cases.

The stage 2 definition and procedures of Network Data Analytics are contained in 3GPP TS 23.288 [2] and 3GPP TS 23.502 [3]. The 5G System Architecture is defined in 3GPP TS 23.501 [4].

Detailed definitions of the involved services are provided in 3GPP TS 29.520 [5], 3GPP TS 29.508 [6], 3GPP TS 29.523 [7], 3GPP TS 29.554 [8], 3GPP TS 29.521 [9], 3GPP TS 29.522 [10], 3GPP TS 29.591 [11], 3GPP TS 29.517 [12], 3GPP TS 29.574 [15], 3GPP TS 29.575 [16], 3GPP TS 29.576 [17], 3GPP TS 29.503 [22], 3GPP TS 29.510 [23], 3GPP TS 29.507 [24] and 3GPP TS 29.512 [25].

The Technical Realization of the Service Based Architecture and the Principles and Guidelines for Services Definition of the 5G System are specified in 3GPP TS 29.500 [13] and 3GPP TS 29.501 [14].

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 23.288: "Architecture enhancements for 5G System (5GS) to support network data analytics services".

[3] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[4] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".

[5] 3GPP TS 29.520: "5G System; Network Data Analytics Services; Stage 3".

[6] 3GPP TS 29.508: "5G System; Session Management Event Exposure Service; Stage 3".

[7] 3GPP TS 29.523: "5G System; Policy Control Event Exposure Service; Stage 3".

[8] 3GPP TS 29.554: "5G System; Background Data Transfer Policy Control Service; Stage 3".

[9] 3GPP TS 29.521: "5G System; Binding Support Management Service; Stage 3".

[10] 3GPP TS 29.522: "5G System; Network Exposure Function Northbound APIs; Stage 3".

[11] 3GPP TS 29.591: "5G System; Network Exposure Function Southbound Services; Stage 3".

[12] 3GPP TS 29.517: "5G System; Application Function Event Exposure Service; Stage 3".

[13] 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".

[14] 3GPP TS 29.501: "5G System; Principles and Guidelines for Services Definition; Stage 3".

[15] 3GPP TS 29.574: "5G System; Data Collection Coordination Services; Stage 3".

[16] 3GPP TS 29.575: "5G System; Analytics Data Repository Services; Stage 3".

[17] 3GPP TS 29.576: "5G System; Messaging Framework Adaptor Services; Stage 3".

[18] 3GPP TS 29.518: "5G System; Access and Mobility Management Services; Stage 3".

[19] 3GPP TS 28.532: "Management and orchestration; Generic management services".

[20] 3GPP TS 29.536: "5G System: Network Slice Admission Control Services; Stage 3".

[21] 3GPP TS 29.531: "5G System: Network Slice Selection Services; Stage 3".

[22] 3GPP TS 29.503: "5G System; Unified Data Management Services; Stage 3".

[23] 3GPP TS 29.510: "5G System; Network Function Repository Services; Stage 3".

[24] 3GPP TS 29.507: "5G System; Access and Mobility Policy Control Service; Stage 3".

[25] 3GPP TS 29.512: "5G System; Session Management Policy Control Service; Stage 3".

[26] 3GPP TS 29.510: "5G System: Network function repository services; Stage 3".

[27] 3GPP TS 28.552: "Management and orchestration; 5G performance measurements".

[28] 3GPP TS 28.533: "Management and orchestration; Architecture framework".

[29] 3GPP TS 37.320: " Radio measurement collection for Minimization of Drive Tests (MDT); Overall description".

[30] 3GPP TS 28.554: " Management and orchestration; 5G end to end Key Performance Indicators (KPI)".

[31] 3GPP TS 28.550: "Management and orchestration; Performance assurance".

[32] 3GPP TS 37.320: "Radio measurement collection for Minimization of Drive Tests (MDT); Overall description; stage 2".

[33] 3GPP TS 38.331: "NR; Radio Resource Control (RRC) protocol specification".

[34] 3GPP TS 36.331: "Radio Resource Control (RRC); Protocol specification".

[35] 3GPP TS 38.215: "NR; Physical layer measurements".

[36] 3GPP TS 28.310: "Management and orchestration; Energy efficiency of 5G".

[37] 3GPP TS 28.545: "Management and orchestration; Fault Supervision (FS)".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms 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 Symbols

None.

3.3 Abbreviations

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

ADRF	Analytics Data Repository Function
AF	Application Function
AMF	Access and Mobility Management Function
AnLF	Analytics Logical Function
DCCF	Data Collection Coordination Function
MFAF	Messaging Framework Adaptor Function
MDT	Minimization of Drive Tests
ML	Machine Learning
MTLF	Model Training Logical Function
NEF	Network Exposure Function
NRF	Network Repository Function
NSACF	Network Slice Admission Control Function
NWDAF	Network Data Analytics Function
PCF	Policy Control Function
SMF	Session Management Function
UDM	Unified Data Management

4 Reference Architecture for Data Analytics

4.1 General

For the enablement of network data analytics services, the NWDAF interacts with different entities for different purposes:

- Data Collection:
  a) collecting Data from OAM and/or 5GC NFs (e.g. AMF);
  b) collecting Data from untrusted AF via NEF; and/or
  c) collecting Analytics and/or Data from 5GC NFs via DCCF or via DCCF together with ADRF and/or MFAF or via NWDAF hosting DCCF i.e. an NWDAF that implements DCCF functionality internally and supports the Nnwdaf_DataManagement API;
- Analytics Exposure:
  a) Exposing Analytics to 5GC NFs;
  b) Exposing Analytics to untrusted AF via NEF; and/or
  c) Exposing Analytics to 5GC NFs via DCCF or via DCCF together with ADRF and/or MFAF or via NWDAF hosting DCCF and/or ADRF i.e. an NWDAF that implements DCCF and/or ADRF functionality internally and supports the Nnwdaf_DataManagement API;
- Storing and Retrieving data in ADRF.

The entities mentioned above interact also with each other as described in the procedures of clause 5.

4.2 Data Collection

As depicted in Figure 4.2-1, the 5G System architecture allows NWDAF to collect data from any 5GC NF (e.g. AMF, SMF) and/or OAM directly or via DCCF, DCCF together with ADRF and/or MFAF, or via NWDAF.

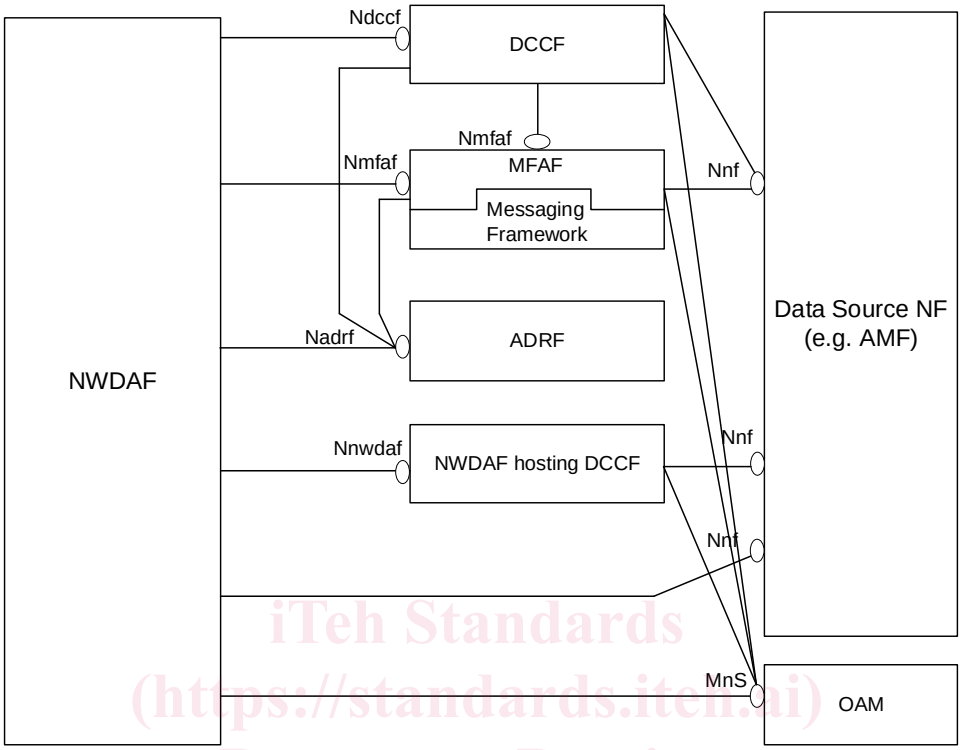

Figure 4.2-1: Data Collection Architecture

When DCCF, ADRF, MFAF or NWDAF hosting DCCF are present in the network, whether the NWDAF directly contacts the Data Source NF or goes via the DCCF, or NWDAF hosting DCCF is based on configuration of the NWDAF.

The Data Source NF may be AMF, SMF, UDM, AF, NSACF, NRF and/or NEF with the related data collection procedures described in clause 5.5. The Data Source NF may also be UPF while how to collect data from UPF is not defined in this release of the specification. If the Data Source is OAM, The NWDAF may collect relevant management data from the services in the OAM as configured by the PLMN operator. The NWDAF may use the OAM services e.g. generic performance assurance and fault supervision management services as defined in TS 28.532 [19], PM (Performance Management) services as defined in TS 28.550 [31] and/or FS (Fault Supervision) services as defined in TS 28.545 [37].

For the specific analytics event, the applicable Data Source NF(s) and the related data collection procedures and scope are descibed in the corresponding analytics event subcluase within clause 5.7.

4.3 Analytics Exposure

As depicted in Figure 4.3-1, the 5G System architecture allows NWDAF to expose data to any 5GC NF (e.g. AMF) directly or via DCCF/MFAF.

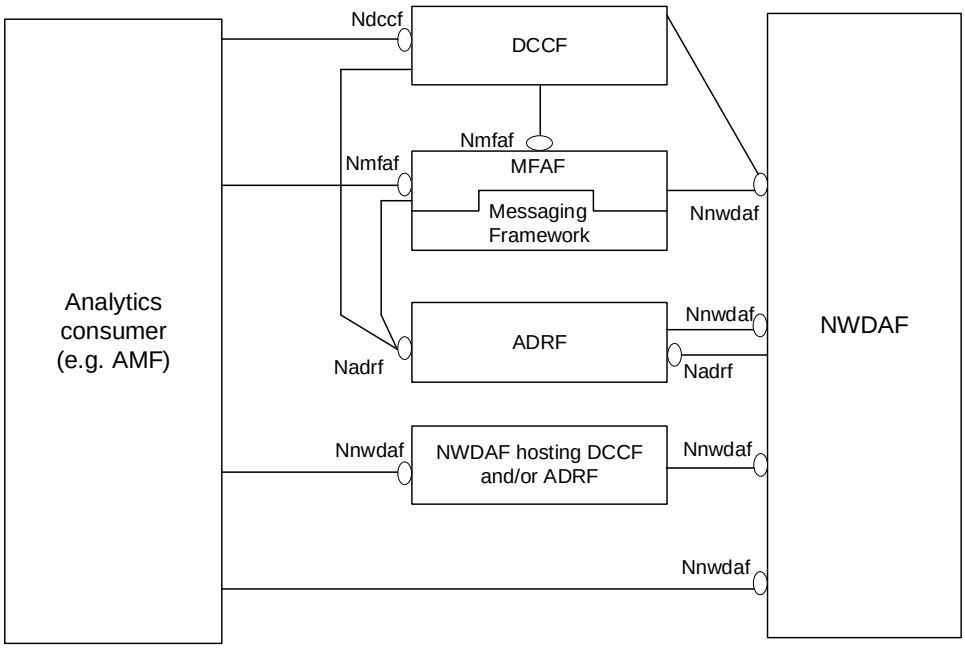

Figure 4.3-1: Analytics Exposing Architecture

When DCCF, ADRF, MFAF or NWDAF are present in the network, whether the Analytics consumer directly contacts the NWDAF or goes via the DCCF or via the NWDAF hosting DCCF and/or ADRF is based on configuration of the Analytics consumer.

The Analytics consumer may be AMF, SMF, NSSF, PCF, AF, NEF, OAM and/or CEF when directly contacts NWDAF with the related analytics exposure procedures described in clause 5.2.2 and clause 5.2.3. The Analytics consumers may be AMF, SMF, NSSF, PCF AF and/or NEF when contacts via the DCCF with the related analytics exposure procedures described in clause 5.2.4 and clause 5.2.5.

For the specific analytics event, the applicable Analytics consumer(s) and the related analytics exposure procedures and scope are descibed in the corresponding analytics event subcluase within clause 5.7.

4.4 Data Storage and Retrieval

As depicted in Figure 4.4-1, the 5G System architecture allows the consumer to store and retrieve the collected data in the ADRF directly or via DCCF/MFAF.

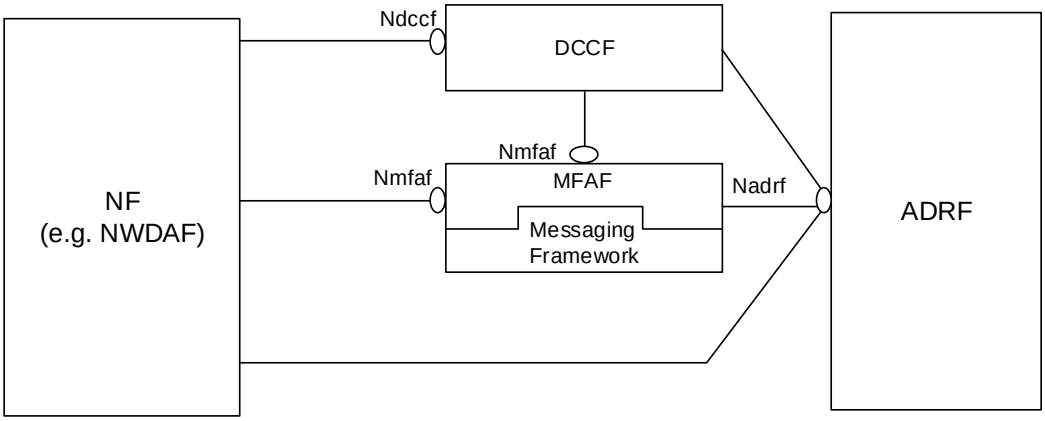

Figure 4.4-1: Data Storage and Retrieval Architecture

5 Signalling Flows for the Network Data Analytics Framework

5.1 General

This clause describes the Network Data Analytics related Signalling Flows, including the procedures for analytics exposure, analytics aggregation from multiple NWDAFs, analytics context and analytics subscription transferring between different NWDAFs, ML model provisioning, data collection, specified Network Data Analytics generation and the NWDAF discovery and selection. The specific NF service operations which are used in these procedures are also provided in the procedure descriptions.

5.2 Analytics Exposure Procedures

5.2.1 General

The analytics exposure procedures allow the NF service consumers (i.e. NFs, OAM and AFs) to obtain the analytics information from the NWDAF.

5.2.2 Network data analytics Subscribe/Unsubscribe/Notify

5.2.2.1 Analytics Subscribe/Unsubscribe/Notify initiated by 5GC NFs, OAM or AFs

This procedure is used by the NF service consumers (i.e. NFs, OAM and AFs) to subscribe to/unsubscribe from analytics information directly from the NWDAF, it is also used by the NWDAF to notify the observed analytics event(s) to the NF service consumer if subscribed before.

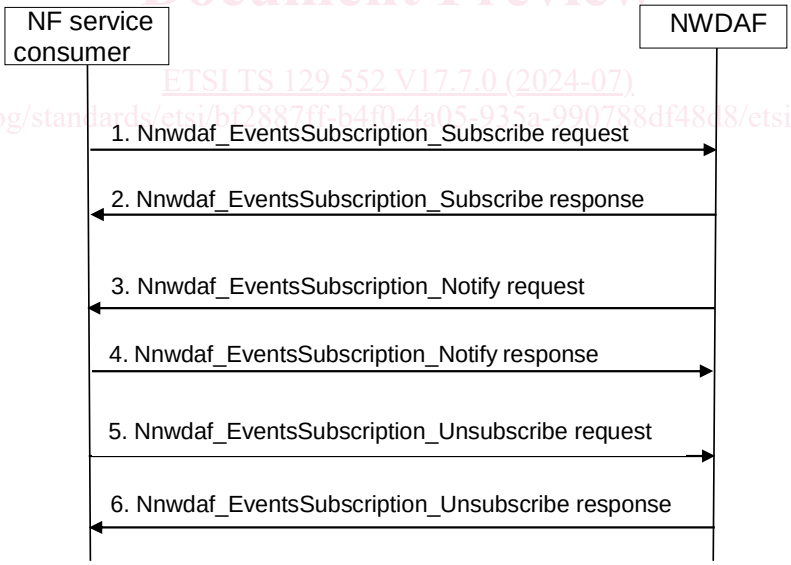

Figure 5.2.2.1-1: Analytics Subscribe/Unsubscribe/Notify initiated by 5GC NFs, OAM or AFs

1. In order to subscribe to notification(s) of analytics information from the NWDAF, the NF service consumer invokes Nnwdaf_EventsSubscription_Subscribe service operation by sending an HTTP POST request targeting the resource "NWDAF Events Subscriptions". The request includes the subscribed events and may include event filter information.

   In order to update the existing subscription, the NF service consumer invokes Nnwdaf_EventsSubscription_Subscribe service operation by sending an HTTP PUT request with Resource URI of the resource "Individual NWDAF Event Subscription".

2. The NWDAF responds to the Nnwdaf_EventsSubscription_Subscribe service operation. Upon receipt of the HTTP POST request, if the subscription is accepted to be created, the NWDAF responds to the NF service consumer with "201 Created", and the URI of the created subscription is included in the Location header field.

   Upon receipt of the HTTP PUT request, if the subscription is accepted to be updated, the NWDAF responds to the NF service consumer with "200 OK" or "204 No Content"

3. If the NWDAF observes the subscribed event(s), the NWDAF invokes Nnwdaf_EventsSubscription_Notify service operation to report the event(s) by sending an HTTP POST request with {notificationURI} as Notification URI.

4. The NF service consumer sends an HTTP "204 No Content" response to the NWDAF.

5. In order to unsubscribe to the notification(s) of analytics information from the NWDAF, the NF service consumer invokes Nnwdaf_EventsSubscription_Unsubscribe service operation by sending an HTTP DELETE request targeting the resource "Individual NWDAF Event Subscription", to the NWDAF to unsubscribe from analytics information. The request includes the event subscriptionId of the existing subscription that is to be deleted.

6. The NWDAF responds to the Nnwdaf_EventsSubscription_Unsubscribe service operation. If the unsubscription is accepted, the NWDAF responds with "204 No Content".

NOTE: For details of Nnwdaf_EventsSubscription_Subscribe/Unsubscribe/Notify service operations refer to 3GPP TS 29.520 [5].

5.2.2.2 Analytics Subscribe/Unsubscribe/Notify initiated by AFs via the NEF

This procedure is used by the AF to subscribe to/unsubscribe from analytics information from the NWDAF via the NEF, it is also used by the NWDAF to notify the analytics event(s) to the AF via the NEF, if subscribed before.

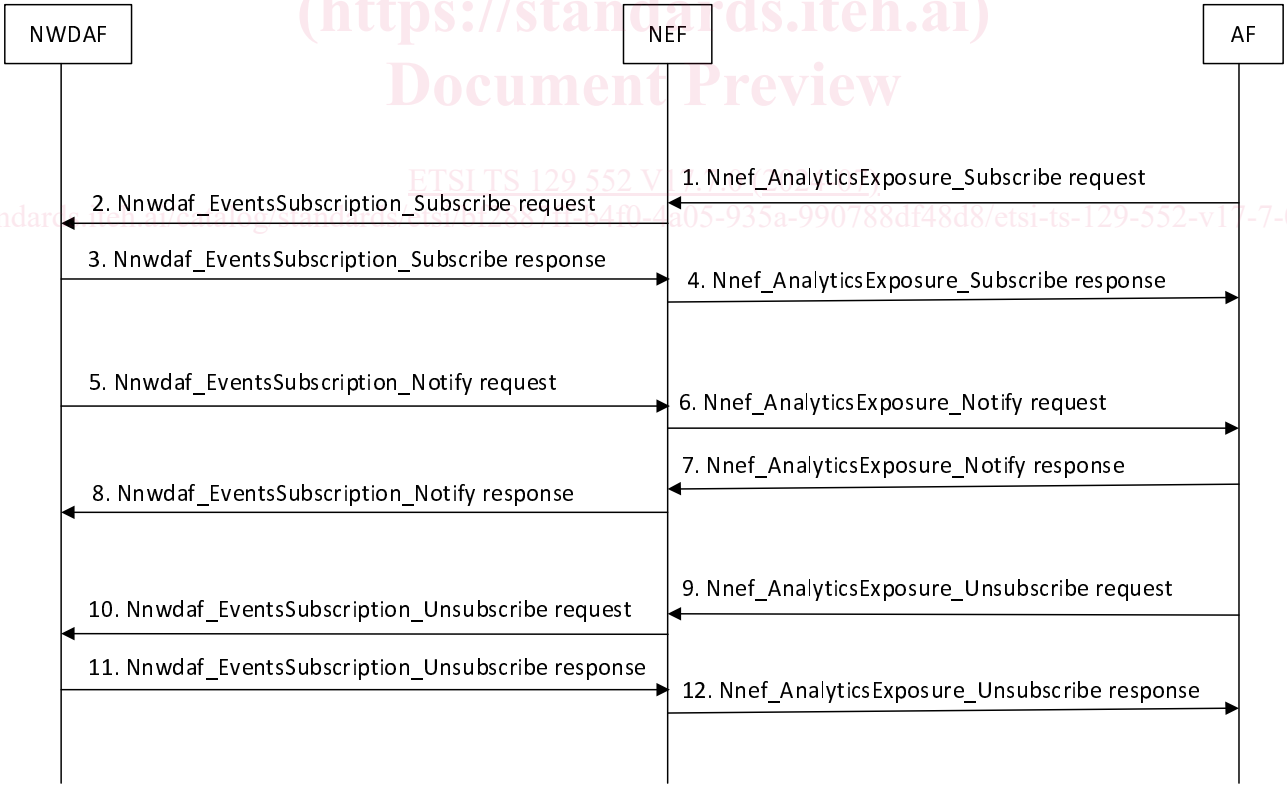

Figure 5.2.2.2-1: Analytics Subscribe/Unsubscribe/Notify initiated by AFs via the NEF

1. In order to subscribe to notification(s) of analytics exposure via the NEF, the AF invokes the Nnef_AnalyticsExposure_Subscribe request by sending an HTTP POST request message targeting the resource "Analytics Exposure Subscriptions" as defined in clause 4.4.14.1 of 3GPP TS 29.522 [10].