**SA WG2 Meeting #139ES2-2003668**

**June 1 - 12, 2020, Elbonia (merge with S2-2003867, revision of S2-20xxxxx)**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **23.288** | **CR** | **0176** | **rev** | **1** | **Current version:** | **16.3.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network |  | Core Network | **X** |

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|  | | | | | | | | | | |
| ***Title:*** | Corrections for maximum number of objects and Maximum number of SUPIs | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia, Nokia Shanghai Bell, Huawei, Samsung | | | | | | | | | |
| ***Source to TSG:*** | S2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | eNA | | | | |  | ***Date:*** | | | 2020-05-22 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-16 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) Rel-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | 1/ As defined in TS 23.288 clasue 6.1.3, Maximum number of objects requested by the consumer (max) and Maximum number of SUPIs (SUPImax) requested by the consumer are part of the Analytics Reporting Information: *6.1.3 Contents of Analytics Exposure* *The consumers of the Nnwdaf\_AnalyticsSubscription or Nnwdaf\_AnalyticsInfo service operations described in clause 7 provide the following input parameters listed below.*  *- A list of Analytics ID(s): identifies the requested analytics.*  *- Analytics Filter Information: indicates the conditions to be fulfilled for reporting Analytics Information. This set of optional parameter types and values enables to select which type of analytics information is requested. Analytics Filter Information are defined in procedures.*  *- Target of Analytics Reporting: indicates the object(s) for which Analytics information is requested, entities such as specific UEs, a group of UE(s) or any UE (i.e. all UEs).*  *- (Only for Nnwdaf\_AnalyticsSubscription) A Notification Target Address (+ Notification Correlation ID) as defined in TS 23.502 [3] clause 4.15.1, allowing to correlate notifications received from NWDAF with this subscription.*  *- Analytics Reporting Information with the following parameters:*  *- (Only for Nnwdaf\_AnalyticsSubscription) Analytics Reporting Parameters as per Event Reporting parameters defined in Table 4.15.1-1, TS 23.502 [3].*  *- (Only for Nnwdaf\_AnalyticsSubscription) Reporting Thresholds, which indicate conditions on the level of each requested analytics that when reached shall be notified by the NWDAF. A matching direction may be provided such as below, above, or crossed. If no matching direction is provided, the default direction is crossed.*  *- Analytics target period: time interval [start..end], either in the past (both start time and end time in the past) or in the future (both start time and end time in the future). An Analytics target period in the past is a request or subscription for statistics. An Analytics target period in the future is a request or subscription for predictions. The time interval is expressed with actual start time and actual end time (e.g. via UTC time). When the Analytics Reporting Parameters indicate a periodic reporting mode, the time interval can also be expressed as positive or negative offsets to the reporting time. By setting start time and end time to the same value, the consumer of the analytics can request analytics or subscribe to analytics for a specific time rather than for a time interval.*  *- Preferred level of accuracy of the analytics (e.g. Low/High).*  *- (Only for Nnwdaf\_AnalyticsInfo\_Request) Time when analytics information is needed (if applicable). If the time is reached the consumer does not need to wait for the analytics information any longer, yet the NWDAF may send an error response to the consumer.*  *- [OPTIONAL] Maximum number of objects requested by the consumer (max) to limit the number of objects in a list of analytics per Nnwdaf\_AnalyticsSubscription\_Notify or Nnwdaf\_AnalyticsInfo\_Request response.*  *- [OPTIONAL] Maximum number of SUPIs (SUPImax) requested by the consumer to limit the number of SUPIs in an object. When SUPImax is not provided, the NWDAF shal return all SUPIs concerned by the analytics object. When SUPImax is set to 0, the NWDAF shall not provide any SUPI.*  *NOTE: The feasibility of the parameter "Time when analytics are needed" will be checked by stage 3.*  However, in different places, TS 23.288 incorrectly specifies that these parameters can be part of Analytics filters.  This inconsistency has been raised by CT3 in their LS in S2-2003544 / C3-202507.  2/ The Maximum number of objects is not listed as an optional parameter for expected UE behavioural parameters analytics. However, to provide such analytics the NWDAF combine UE mobility and UE communication analytics for which Maximum number of objects is defined. It would make sense to also have this parameter for expected UE behavioural parameters analytics. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1/ Make sure that maximum number of objects and maximum number of SUPIs are independent request parameters from the Analytics filters.  2/ Add Maximum number of objects as an optional parameter for the request for expected UE behavioural parameters analytics. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Unclear for stage 3 how to implement the functionality. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 6.4.1, 6.4.3, 6.5.3, 6.6.1, 6.6.3, 6.7.2.1, 6.7.2.3, 6.7.3.1, 6.7.3.3, 6.7.4.1, 6.7.5.1, 6.7.5.3, 6.8.1, 6.8.3, 6.9.1, 6.9.3 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

*FIRST CHANGE (1)*

## 6.4 Observed Service Experience related network data analytics

### 6.4.1 General

This clause specifies how NWDAF can provide Observed Service Experience (i.e. average observed Service MoS) analytics, in the form of statistics or predictions, to a service consumer.

The Observed Service Experience analytics may provide one or both of the following:

- Service Experience for a Network Slice: Service Experience for UEs (for a UE or a group of or any UE) for a given Application or a set of Applications or any Application (i.e. all Applications) in a Network Slice;

- Service Experience for an Application: Service Experience (i.e. for a UE or a group of UEs or any UE) in an Application.

Therefore, Observed Service experience may be provided individually per UE or group of UEs, or globally, averaged per Application or averaged across a set of Applications on a Network Slice.

The service consumer may be an NF (e.g. PCF), or the OAM.

The consumer of these analytics shall indicate in the request or subscription:

- Analytics Id set to "Service Experience";

- The Target of Analytics Reporting: one or more SUPI(s) or Internal Group Identifier(s), or "any UE";

- Analytics Filter Information as defined in Table 6.4.1-1;

- optionally, maximum number of objects and maximum number of SUPIs;

Table 6.4.1-1: Analytics Filter Information related to the observed service experience

|  |  |
| --- | --- |
| Information | Description |
| Application ID (1..n)  (NOTE 1) | The identification of the application(s) for which the analytics information is subscribed or requested. |
| S-NSSAI  (NOTE 2) | Identifies the Network Slice for which analytics information is subscribed or requested. |
| Area of Interest | Identifies the Area (i.e. set of TAIs), as defined in TS 23.501 [2] where the analytics information is subscribed or requested. |
| Media/application bandwidth | Identifies the Media/application bandwidth requirement of the application. |
| DNN | DNN to access the application. |
| DNAI | Identifier of a user plane access to one or more DN(s) where applications are deployed as defined in TS 23.501 [2] |
| NOTE 1: If no Application ID is provided, the Analytics Filter information applies to any application (i.e. all applications) in the Network Slice.  NOTE 2: The S-NSSAI is mandatory if the NWDAF Service Consumer subscribes or requests the Service Experience in a Network Slice. Optionally, when multiple Network Slice instances of the same Network Slice (i.e. S-NSSAI) are deployed, associated NSI ID is used in addition to S-NSSAI. | |

- An Analytics target period that indicates the time window for which the statistics or predictions are requested;

- In a subscription, the Notification Correlation Id and the Notification Target Address.

The NWDAF shall notify the result of the analytics to the consumer as specified in clause 6.4.3.

NWDAF collects the network data from AF (directly or via NEF) and from other 5GC NF(s) in order to calculate and provides statistics and predictions on the observed service experience to a consumer NF or to OAM.

*NEXT CHANGE (2) (merge from S2-2003867)*

### 6.4.3 Output Analytics

The NWDAF services as defined in the clause 7.2 and 7.3 are used to expose the analytics.

- Service Experience statistics information is defined in Table 6.4.3-1.

- Service Experience predictions information is defined in Table 6.4.3-2.

Table 6.4.3-1: Service Experience statistics

|  |  |
| --- | --- |
| Information | Description |
| S-NSSAI | Identifies the Network Slice for which analytics information is provided. |
| Service experiences (1…n) (NOTE) | List of observed service experience information for each Network Slice instance. |
| > NSI ID | Identifies the Network Slice instance within the Network Slice. |
| > Slice instance service experience | Service experience across Applications on a Network Slice instance instance over the Analytics target period (average, variance). |
| > Application ServiceExperiences (1..max) | List of observed service experience information for each Application. |
| >> Application ID | Identification of the application. |
| >> Service Experience Type | Type of Service Experience analytics, e.g. on voice, video, other. |
| >> Service Experience | Service Experience over the Analytics target period (average, variance). |
| >> SUPI list (0..SUPImax) | List of SUPI(s) for each application service experience. |
| >> Ratio | Estimated percentage of UEs with similar service experience (in the group, or among all UEs). |
| >> Spatial validity | Area where the estimated Service Experience applies.  If Area of Interest information was provided in the request or subscription, spatial validity should be the requested Area of Interest. |
| >> Validity period | Validity period as defined in clause 6.1.3. |
| Slice service experience | Service experience across applications on a Network Slice over the Analytics target period (average, variance). |
| NOTE: If multiple Network Slice instances are not deployed for the S-NSSAI or NSI IDs are not available, only one Service experience entry is provided (i.e. n=1). In that case, the NSI ID is not provided and the Slice instance service experience indicates the service experience for the S-NSSAI. | |

Table 6.4.3-2: Service Experience predictions

|  |  |
| --- | --- |
| Information | Description |
| S-NSSAI | Identifies the Network Slice for which analytics information is provided. |
| Service experiences (1…n) (NOTE) | List of observed service experience information for each Network Slice instance. |
| > NSI ID | Identifies the Network Slice instance within the Network Slice. |
| > Slice instance service experience | Service experience across Applications on a Network Slice instance instance over the Analytics target period (average, variance). |
| > Application ServiceExperiences (1..max) | List of predicted service experience information for each Application. |
| >> Application ID | Identification of the application. |
| >> Service Experience Type | Type of Service Experience analytics, e.g. on voice, video, other. |
| >> Service Experience | Service Experience over the Analytics target period (average, variance). |
| >> SUPI list (0..SUPImax) | List of SUPI(s) for each application service experience. |
| >> Ratio | Estimated percentage of UEs with similar service experience (in the group, or among all UEs). |
| >> Spatial validity | Area, where the estimated Service Experience applies.  If Area of Interest information was provided in the request or subscription, spatial validity should be the requested Areas of Interest. |
| >> Validity period | Validity period as defined in clause 6.1.3. |
| >> Probability assertion | Confidence of this prediction. |
| Slice service experience | Service experience across applications on a Network Slice over the Analytics target period (average, variance). |
| NOTE: If multiple Network Slice instances are not deployed for the S-NSSAI or NSI IDs are not available, only one Service experience entry is provided (i.e. n=1). In that case, the NSI ID is not provided and the Slice instance service experience indicates the service experience for the S-NSSAI. | |

The number of Service Experiences and SUPIs are limited respectively by the maximum number of objects and the Maximum number of SUPIs provided as part of Analytics Reporting Information.

*NEXT CHANGE (3) (merge from S2-2003867)*

### 6.5.3 Output analytics

The NWDAF services as defined in the clause 7.2 and 7.3 are used to expose the analytics. NF load statistics information are defined in Table 6.5.3-1. NF load predictions information are defined in Table 6.5.3-2.

Table 6.5.3-1: NF load statistics

|  |  |
| --- | --- |
| Information | Description |
| List of resource status (1..max) | List of observed load information for each NF instance along with the corresponding NF id / NF Set ID (as applicable) |
| > NF type | Type of the NF instance |
| > NF instance ID | Identification of the NF instance |
| > NF status | The availability status of the NF on the Analytics target period, expressed as a percentage of time per status value (registered, suspended, undiscoverable) |
| > NF resource usage | The average usage of assigned resources (CPU, memory, disk) |
| > NF load | The average load of the NF instance over the Analytics target period |
| > NF peak load (optional) | The maximum load of the NF instance over the Analytics target period |

Table 6.5.3-2: NF load predictions

|  |  |
| --- | --- |
| Information | Description |
| List of resource status (1..max) | List of predicted load information for each NF instance along with the corresponding NF id / NF Set ID (as applicable) |
| > NF type | Type of the NF instance |
| > NF instance ID | Identification of the NF instance |
| > NF status | The availability status of the NF on the Analytics target period, expressed as a percentage of time per status value (registered, suspended, undiscoverable) |
| > NF resource usage | The average usage of assigned resources (CPU, memory, disk) |
| > NF load | The average load of the NF instance over the Analytics target period |
| > NF peak load (optional) | The maximum load of the NF instance over the Analytics target period |
| > Confidence | Confidence of this prediction |

NOTE: The variations on per-instance NF load and resource usage could be influenced by the number of running NF instances in addition to the load itself.

The predictions are provided with a Validity Period, as defined in clause 6.1.3.

The number of resource status is limited by the maximum number of objects provided as part of Analytics Reporting Information.

*NEXT CHANGE (4)*

## 6.6 Network Performance Analytics

### 6.6.1 General

With Network Performance Analytics, NWDAF provides either statistics or predictions on the load, communication and mobility performance in an Area of Interest; in addition, NWDAF it may provide statistics or predictions on the number of UEs that are located in that Area of Interest.

The service consumer may be an NF (e.g. PCF, NEF, AF), or the OAM.

The consumer of these analytics may indicate in the request:

- Analytics ID set to "Network Performance";

- Target of Analytics Reporting containing either a UE, or Internal Group Identifier that refers to the group for which the analytics on the number of UEs that are located in the Area of Interest at the time indicated in the Analytics target period is requested or any UE;

- Analytics Filter Information containing:

- Area of Interest (list of TA or Cells) which restricts the area in focus (mandatory if Target Of Event Reporting is set to "any UE", optional otherwise);

- Optionally, the subset of analytics that are requested among those specified in clause 6.6.3;

- Optionally, Reporting Thresholds, which apply only for subscriptions and indicate conditions on the level to be reached for respective analytics information (see clause 6.6.3) in order to be notified by the NWDAF;

- An Analytics target period indicates the time period over which the statistics or prediction are requested; and

- In a subscription, the Notification Correlation Id and the Notification Target Address are included.

The NWDAF notifies the result of the analytics to the consumer as indicated in clause 6.6.3.

*NEXT CHANGE (5) (merge from S2-2003867)*

### 6.6.3 Output Analytics

The NWDAF shall be able to provide both statistics and predictions on Network Performance.

Network performance statistics are defined in Table 6.6.3-1.

Table 6.6.3-1: Network performance statistics

|  |  |
| --- | --- |
| Information | Description |
| List of network performance information (1..max) | Observed statistics during the Analytics target period |
| > Area subset | TA or Cell ID within the requested area of interest as defined in clause 6.6.1 |
| > gNB status information | Ratio of gNBs that have been up and running during the entire Analytics target period in the area subset |
| > gNB resource usage | Average usage of assigned resources (CPU, memory, disk) |
| > Number of UEs | Number of UEs observed in the area subset |
| > Communication performance | Ratio of successful setup of PDU Sessions |
| > Mobility performance | Ratio of successful handover |

Network performance predictions are defined in Table 6.6.3-2.

Table 6.6.3-2: Network performance predictions

|  |  |
| --- | --- |
| Information | Description |
| List of network performance information (1..max) | Predicted analytics during the Analytics target period |
| > Area subset | TA or Cell ID within the requested area of interest as defined in clause 6.6.1 |
| > gNB status information | Ratio of gNBs that will be up and running during the entire Analytics target period in the area subset |
| > gNB resource usage | Usage of assigned resources (CPU, memory, disk) (average, peak) |
| > Number of UEs | Number of UEs predicted in the area subset |
| > Communication performance | Ratio of successful setup of PDU Sessions |
| > Mobility performance | Ratio of successful handover |
| > Confidence | Confidence of this prediction |

NOTE 1: The predictions are provided with a Validity Period, as defined in clause 6.1.3.

NOTE 2: The analytics on number of UEs are related to the information retrieved from the AMFs.

The number of network performance information entries is limited by the maximum number of objects provided as part of Analytics Reporting Information.

The NWDAF provides Network Performance Analytics to a consumer that includes the load in the area of interest and the number of UEs located in the area of interest or both at the time requested by the consumer in the Analytics target period:

- Analytics ID set to "Network Performance".

- Notification Target Address including the address of the consumer.

- Notification Correlation Id, for the consumer to correlate notifications from NWDAF if subscription applies.

- Analytics specific parameters including the load in the Area of Interest and the number of UEs in the Area of Interest, at the time indicated in the Analytics target period**.**

*NEXT CHANGE (6)*

### 6.7.2 UE mobility analytics

#### 6.7.2.1 General

NWDAF supporting UE mobility statistics or predictions shall be able to collect UE mobility related information from NF, OAM, and to perform data analytics to provide UE mobility statistics or predictions.

The service consumer may be a NF (e.g. AMF).

The consumer of these analytics may indicate in the request:

- The Target of Analytics Reporting which is a single UE or a group of UEs.

- Analytics Filter Information optionally containing:

- Area of Interest;

- An Analytics target period indicates the time period over which the statistics or predictions are requested.

Optionally,

- Preferred level of accuracy of the analytics (low/high).

- In a subscription, the Notification Correlation Id and the Notification Target Address are included.

*NEXT CHANGE (7) (merge from S2-2003867)*

#### 6.7.2.3 Output Analytics

The NWDAF supporting data analytics on UE mobility shall be able to provide UE mobility analytics to consumer NFs or AFs. The analytics results provided by the NWDAF could be UE mobility statistics as defined in table 6.7.2.3-1, UE mobility predictions as defined in Table 6.7.2.3-2:

Table 6.7.2.3-1: UE mobility statistics

|  |  |
| --- | --- |
| Information | Description |
| UE group ID or UE ID | Identifies a UE or a group of UEs, e.g. internal group ID defined in TS 23.501 [2] clause 5.9.7, SUPI (see NOTE). |
| Time slot entry (1..max) | List of time slots during the Analytics target period |
| > Time slot start | Time slot start within the Analytics target period |
| > Duration | Duration of the time slot (average and variance) |
| > UE location (1..max) | Observed location statistics |
| >> UE location | TA or cells which the UE stays |
| >> Ratio | Percentage of UEs in the group (in the case of an UE group) |

Table 6.7.2.3-2: UE mobility predictions

|  |  |
| --- | --- |
| Information | Description |
| UE group ID or UE ID | Identifies an UE or a group of UEs, e.g. internal group ID defined in TS 23.501 [2] clause 5.9.7, or SUPI (see NOTE). |
| Time slot entry (1..max) | List of predicted time slots |
| >Time slot start | Time slot start time within the Analytics target period |
| > Duration | Duration of the time slot |
| > UE location (1..max) | Predicted location prediction during the Analytics target period |
| >> UE location | TA or cells where the UE or UE group may move into |
| >> Confidence | Confidence of this prediction |
| >> Ratio | Percentage of UEs in the group (in the case of an UE group) |

NOTE: When target of analytics reporting is an individual UE, one UE ID (i.e. SUPI) will be included, the NWDAF will provide the analytics mobility result (i.e. list of (predicted) time slots) to NF service consumer(s) for the UE.

The results for UE groups address the group globally. The ratio is the proportion of UEs in the group at a given location at a given time.

The number of time slots and UE locations is limited by the maximum number of objects provided as part of Analytics Reporting Information.

The time slots shall be provided by order of time, possibly overlapping. The locations shall be provided by decreasing value of ratio for a given time slot. The sum of all ratios on a given time slot must be equal or less than 100%. Depending on the list size limitation, the least probable locations on a given Analytics target period may not be provided.

*NEXT CHANGE (8)*

### 6.7.3 UE Communication Analytics

#### 6.7.3.1 General

In order to support some optimized operations, e.g. customized mobility management, traffic routing handling, or QoS improvement, in 5GS, an NWDAF may perform data analytics on UE communication pattern and user plane traffic, and provide the analytics results (i.e. UE communication statistics or prediction) to NFs in the 5GC.

An NWDAF supporting UE Communication Analytics collects per-application communication description from AFs. If consumer NF provides an Application ID, the NWDAF only considers the data from AF, SMF and UPF that corresponds to this application ID.

The consumer of these analytics may indicate in the request:

- The Target of Analytics Reporting which is a single UE or a group of UEs.

- Analytics Filter Information optionally including:

- S-NSSAI;

- DNN;

- Application ID;

- Area of Interest.

- An Analytics target period indicates the time period over which the statistics or predictions are requested.

- Preferred level of accuracy of the analytics (low/high).

Optionally,

- In a subscription, the Notification Correlation Id and the Notification Target Address are included.

*NEXT CHANGE (9) (merge from S2-2003867)*

#### 6.7.3.3 Output Analytics

The NWDAF supporting UE Communication Analytics provides the analytics results to consumer NFs. The analytics results provided by the NWDAF include the UE communication statistics as defined in Table 6.7.3.3-1 or predictions as defined in Table 6.7.3.3-2.

Table 6.7.3.3-1: UE Communication Statistics

|  |  |
| --- | --- |
| Information | Description |
| UE group ID or UE ID | Identifies an UE or a group of UEs, e.g. internal group ID defined in TS 23.501 [2] clause 5.9.7 or SUPI (see NOTE). |
| UE communications (1..max) | List of communication time slots. |
| > Periodic communication indicator | Identifies whether the UE communicates periodically or not. |
| > Periodic time | Interval Time of periodic communication (average and variance) if periodic.  Example: every hour |
| > Start time | Start time observed (average and variance) |
| > Duration time | Duration interval time of communication (average and variance). |
| > Traffic characterization | S-NSSAI, DNN, ports, other useful information. |
| > Traffic volume | Volume UL/DL (average and variance). |
| > Ratio | Percentage of UEs in the group (in the case of an UE group). |

Table 6.7.3.3-2: UE Communication Predictions

|  |  |
| --- | --- |
| Information | Description |
| UE group ID or UE ID | Identifies an UE or a group of UEs, e.g. internal group ID defined in TS 23.501 [2] clause 5.9.7 or SUPI (see NOTE). |
| UE communications (1..max) | List of communication time slots. |
| > Periodic communication indicator | Identifies whether the UE communicates periodically or not. |
| > Periodic time | Interval Time of periodic communication (average and variance) if periodic.  Example: every hour. |
| > Start time | Start time predicted (average and variance). |
| > Duration time | Duration interval time of communication. |
| > Traffic characterization | S-NSSAI, DNN, ports, other useful information. |
| > Traffic volume | Volume UL/DL (average and variance). |
| > Confidence | Confidence of the prediction. |
| > Ratio | Percentage of UEs in the group (in the case of an UE group). |

NOTE: When target of analytics reporting is an individual UE, one UE ID (i.e. SUPI) will be included, the NWDAF will provide the analytics communication result (i.e. list of (predicted) communication time slots) to NF service consumer(s) for the UE.

The results for UE groups address the group globally. The ratio is the proportion of UEs in the group for a given communication at a given time and duration.

The number of UE communication entries (1..max) is limited by the maximum number of objects provided as part of Analytics Reporting Information. The communications shall be provided by order of time, possibly overlapping.

Depending on the list size limitation, the least probable communications on a given Analytics target period may not be provided.

*NEXT CHANGE (10)*

### 6.7.4 Expected UE behavioural parameters related network data analytics

#### 6.7.4.1 General

The clause 6.7.4 defines how a service consumer learns from the NWDAF the expected UE behaviour parameters as defined in clause 4.15.6.3, TS 23.502 [3] for a group of UEs or a specific UE.

The service consumer may be an NF (e.g. AMF, UDM, AF), or the OAM.

The consumer of these analytics shall indicate in the request:

- Analytics ID set to "UE Mobility" or "UE Communication".

- The Target of Analytics Reporting can be a UE or an Internal Group Identifier.

NOTE: In the case of untrusted AF the Target of Analytics Reporting can be a GPSI or an External Group Identifier that is mapped in the 5GC to a SUPI or an Internal Group Identifier

- An Analytics target period, which indicates the time period over which the statistics or predictions are requested.

- Optional maximum number of objects;

- In a subscription, the Notification Correlation Id and the Notification Target Address are included.

The NWDAF shall notify the result of the analytics to the consumer as indicated in clause 6.7.4.3.

*NEXT CHANGE (11)*

### 6.7.5 Abnormal behaviour related network data analytics

#### 6.7.5.1 General

This clause defines how to identify a group of UEs or a specific UE with abnormal behaviour, e.g. being misused or hijacked, with the help of NWDAF.

NOTE 1: The misused or hijacked UEs are UEs in which there are malicious applications running or UEs which have been stolen.

The consumer of this analytics could be a 5GC NF. The 5GC NF subscribes analytics on abnormal behaviour from a NWDAF based on the UE subscription, network configuration or application layer request.

The NWDAF performs data analytics on abnormal behaviour if there is a related subscription.

The consumer of this analytics shall indicate in the request:

- Analytics ID set to "Abnormal behaviour";

- The Target of Analytics Reporting can be one UE, any UE or an Internal Group Identifier;

- An Analytics target period indicates the time period over which the statistics or predictions are requested;

- Analytics Filter Information optionally including:

- expected UE behaviour;

- expected analytics type or list of Exception IDs with associated thresholds, where the expected analytics type can be mobility related, communication related or both;

- Area of interest;

- Application ID;

- DNN;

- S-NSSAI.

NOTE 2: The expected analytics type generally indicates whether mobility or communication related abnormal behaviour analytics or both are expected by the consumer, and the list of exception IDs indicates what specific analytics are expected by the consumer. Either the expected analytics type or the list of Exception IDs needs to be indicated, but they are not presented simultaneously. When the expected analytics type is indicated, the NWDAF performs corresponding abnormal behaviour analytics which are supported by the NWDAF. The relation between the expected analytics type and Exception IDs is defined in Table 6.7.5.1-1.

- Optionally, maximum number of objects and maximum number of SUPIs;

- In a subscription, the Notification Correlation Id and the Notification Target Address are included.

Table 6.7.5.1-1: Relation between expected analytics type and Exception IDs

|  |  |
| --- | --- |
| Expected analytics type | Exception IDs matching the expected analytics type |
| mobility related | Unexpected UE location, Ping-ponging across neighbouring cells. |
| communication related | Unexpected long-live/large rate flows, Unexpected wakeup, Suspicion of DDoS attack, Wrong destination address, Too frequent Service Access/Abnormal traffic volume, Unexpected radio link failures. |

When the NWDAF detects those UEs that deviate from the expected UE behaviour, e.g. unexpected UE location, abnormal traffic pattern, wrong destination address etc., the NWDAF shall notify the result of the analytics to the consumer as specified in clause 6.7.5.3.

*NEXT CHANGE (12) (merge from S2-2003867)*

#### 6.7.5.3 Output Analytics

The NWDAF services as defined in the clauses 7.2 and 7.3 are invoked to notify consumer NFs. A new Analytics ID named "Abnormal behaviour" is defined.

Corresponding to the Analytics ID, the analytics result provided by the NWDAF is defined in Table 6.7.5.3-1 and Table 6.7.5.3-2. When the level of an exception trespasses above or below the threshold, the NWDAF shall notify the consumer with the exception ID associated with the exception if the exception ID is within the list of exception IDs indicated by the consumer or matches the expected analytics type indicated by the consumer. The NWDAF shall provide the Exception Level and determine which of the other information elements to provide, depending on the observed exception.

Abnormal behaviour statistics information is defined in Table 6.7.5.3-1.

Table 6.7.5.3-1: Abnormal behaviour statistics

|  |  |
| --- | --- |
| Information | Description |
| Exceptions (1..max) | List of observed exceptions |
| > Exception ID | The risk detected by NWDAF |
| > Exception Level | Measured level, compared to the threshold |
| > Exception trend | Measured trend (up/down/unknown/stable) |
| > UE characteristics | Internal Group Identifier, TAC |
| > SUPI list (1..SUPImax) | SUPI(s) of the UE(s) affected with the Exception |
| > Ratio | Estimated percentage of UEs affected by the Exception within the Target of Analytics Reporting |
| > Amount | Estimated number of UEs affected by the Exception (applicable when the Target of Analytics Reporting = "any UE") |
| > Additional measurement | Specific information for each risk |

Abnormal behaviour predictions information is defined in Table 6.7.5.3-2.

Table 6.7.5.3-2: Abnormal behaviour predictions

|  |  |
| --- | --- |
| Information | Description |
| Exceptions (1..max) | List of predicted exceptions |
| > Exception ID | The risk detected by NWDAF |
| > Exception Level | Measured level, compared to the threshold |
| > Exception trend | Measured trend (up/down/unknown/stable) |
| > UE characteristics | Internal Group Identifier, TAC |
| > SUPI list (1..SUPImax) | SUPI(s) of the UE(s) affected with the Exception |
| > Ratio | Estimated percentage of UEs affected by the Exception within the Target of Analytics Reporting |
| > Amount | Estimated number of UEs affected by the Exception (applicable when the Target of Analytics Reporting = "any UE") |
| > Additional measurement | Specific information for each risk |
| > Confidence | Confidence of this prediction |

The UE characteristics may provide a set of features common to all UEs affected with the exception.

The number of exceptions and the length of the SUPI list shall respectively be lower than the parameters maximum number of objects and Maximum number of SUPIs provided as part of Analytics Reporting Information.

If PCF subscribes notifications on "Abnormal behaviour", the NWDAF shall send the PCF notifications about the risk, which may trigger the PCF to update the AM/SM policies.

The NWDAF also sends the notification directly to the AMF or SMF, if the AMF or SMF subscribes the notification, so that the AMF or SMF may, based on operator local policies defined on a per S-NSSAI or per (DNN,S-NSSAI), take actions for risk solving. The following Table 6.7.5.3-2 gives examples of additional measurement, AM/SM policies and corresponding actions for solving each risk.

Table 6.7.5.3-3: Examples of policies and actions for risk solving

|  |  |  |  |
| --- | --- | --- | --- |
| Exception ID and description | Additional measurement | AM/SM policy | Actions of NFs |
| Unexpected UE location | Unexpected UE location (TA or cells which the UE stays) | Add the area of current UE location into mobility restriction | PCF may extend the Service Area Restrictions. AMF may extend the mobility restriction |
| Ping-ponging across neighbouring cells | Numbers, frequency, time and location information, assumption about the possible circumstances of the ping-ponging | NWDAF notifies the AMF or AF (Service Provider) | If the amount of ping-ponging across neighbouring cells is above the thresholds set by the service provider, the service provider may adjust and improve the antenna tilts of the neighbouring cells or the overlapping coverage conditions in the affected location.  If the ping-ponging are per UE, then:  1. the AMF may adjust the UE (e.g. a stationary UE) registration area.  2. the AMF and/or the AF may allow the use of Coverage Enhancement for the affected UE. |
| Unexpected long-live/large rate flows | Unexpected flow template (IP address 5 tuple) | Decrease the MBR for the related QoS flow | SMF updates the QoS rule.  PCF, if dynamic PCC applies for corresponding DNN, S-NSSAI, updates PCC Rules that triggers SMF updates the QoS rule. |
| Unexpected wakeup | Time of unexpected wake-up | Apply MM back-off timer to the UE | AMF applies MM back-off timer to the UE |
| Suspicion of DDoS attack | Victim's address (target IP address list) | Release the PDU session and Apply SM back-off timer | PCF may request SMF to release the PDU session.  SMF may release the PDU session and applies SM back-off timer |
| Wrong destination address | Wrong destination address (target IP address list) | Update the packet filter of the related QoS flow to block the wrong SDF | PCF updates the packet filter in the PCC Rules that triggers the SMF to update the related QoS flow and configures the UPF |
| Too frequent Service Access/Abnormal traffic volume | Volume, frequency, time, assumptions about the possible circumstances | NWDAF notifies AF (Service Provider) |  |
| Unexpected radio link failures | Numbers, frequency, time and location, assumptions about the possible circumstances | Not applicable | If the unexpected radio link failures are per UE location bases, the AMF may allow the use of CE (Coverage Enhancement) in the affected location. Also, the Operator may improve the coverage conditions in the affected location.  If the unexpected radio link failures are per UE bases, then the AMF and/or the AF may allow the use of CE for the affected UE. |

*NEXT CHANGE (13)*

## 6.8 User Data Congestion Analytics

### 6.8.1 General

The NWDAF can provide user data congestion related analytics, by one-time reporting or continuous reporting, in the form of statistics or predictions or both, to another NF. User Data Congestion related analytics can relate to congestion experienced while transferring user data over the control plane or user plane or both. A request for user data congestion analytics relates to a specific area or to a specific user. If the consumer of these analytics provides a UE ID, the NWDAF determines the area where the UE is located. The NWDAF then collects measurements per cell and uses the measurements to determine user data congestion analytics.

The request for user data congestion related analytics indicates the location area information where congestion related analytics is desired or indicates a UE Identity that can be used by the NWDAF to determine the location area information where congestion related analytics is desired. When the consumer of user data congestion related analytics subscribes to user data congestion related analytics, it may indicate a threshold and the NWDAF will provide analytics to the consumer when the congestion level crosses the threshold. The consumer can indicate an S-NSSAI in the request when congestion analytics are needed on a per slice level.

The service consumer may be an NF (e.g. NEF, AF).

The consumer of these analytics may indicate in the request or subscription:

- Analytics ID set to "User Data Congestion".

- Target of Analytics Reporting containing either a SUPI, or "any UE".

- Analytics Filter Information containing:

- Area of Interest (list of TA or Cells) which restricts the area in focus (mandatory if Target Of Event Reporting is set to "any UE", optional otherwise);

- Optional S-NSSAI, in order to obtain congestion analytics only on a given slice.

- Optional Reporting Threshold, which applies only for subscriptions and indicates conditions on the congestion level (Network Status Indication, see clause 6.8.3) to be reached in order to be notified by the NWDAF.

- Optional maximum number of objects;

- An Analytics target period indicates the time period over which the statistics or prediction are requested, either in the past or in the future.

- In a subscription, the Notification Correlation Id and the Notification Target Address are included.

The NWDAF notifies the result of the analytics to the consumer as indicated in clause 6.6.3.

*NEXT CHANGE (14) (merge from S2-2003867)*

### 6.8.3 Output analytics

The NWDAF outputs the user data congestion analytics for transfer over the user plane, for transfer over the control plane, or for both. The output may consist of statistics, predictions, or both. The detailed information provided by the NWDAF is defined in Table 6.8.3-1 for statistics and in Table 6.8.3-2 for predictions.

Table 6.8.3-1: User Data Congestion statistics

|  |  |
| --- | --- |
| Information | Description |
| Area of Interest | A list of TAIs or Cell IDs |
| List of user data congestion Analytics (1..max) |  |
| >Type | User Plane or Control Plane |
| >Applicable Time Window | The time period that the analytics applies to |
| >Network Status Indication | Congestion Level |

Table 6.8.3-2: User Data Congestion predictions

|  |  |
| --- | --- |
| Information | Description |
| Area of Interest | A list of TAIs or Cell IDs |
| List of user data congestion Analytics (1..max) |  |
| >Type | User Plane or Control Plane |
| >Applicable Time Window | The time period that the analytics applies to |
| >Network Status Indication | Congestion Level |
| > Confidence | Confidence of this prediction |

The number of user data congestion analytics entries is limited by the maximum number of objects provided as part of Analytics Reporting Information.

*NEXT CHANGE (15)*

## 6.9 QoS Sustainability Analytics

### 6.9.1 General

The consumer of QoS Sustainability analytics may request the NWDAF analytics information regarding the QoS change statistics for an Analytics target period in the past in a certain area or the likelihood of a QoS change for an Analytics target period in the future in a certain area. The consumer can request either to subscribe to notifications (i.e. a Subscribe-Notify model) or to a single notification (i.e., a Request-Response model).

The service consumer may be a NF (e.g. AF).

The request includes the following parameters:

- Analytics ID = "QoS Sustainability";

- Target of Analytics Reporting: "any UE";

- Analytics Filter Information containing:

- QoS requirements:

- 5QI (standardized or pre-configured), and applicable additional QoS parameters and the corresponding values (conditional, i.e. it is needed for GBR 5QIs to know the GFBR); or

- the QoS Characteristics attributes including Resource Type, PDB, PER and their values;

- Location information: an area or a path of interest. The location information could reflect a list of waypoints;

NOTE: In this Release, the consumer of the "QoS Sustainability" Analytics ID will provide location information in the area of interest format (TAIs or Cell IDs) which is understandable by NWDAF.

- S-NSSAI (optional);

- Optional maximum number of objects;

- Analytics target period: relative time interval, either in the past or in the future, that indicates the time period for which the QoS Sustainability analytics is requested;

- Reporting Threshold(s), which apply only for subscriptions and indicate conditions on the level to be reached for the reporting of the analytics, i.e. to discretize the output analytics and to trigger the notification when the threshold(s) provided in the analytics subscription are crossed by the expected QoS KPIs. The level(s) relate to value(s) of the QoS KPIs defined in TS 28.554 [10], for the relevant 5QI:

- for a 5QI of GBR resource type, the Reporting Threshold(s) refer to the QoS flow Retainability KPI;

- for a 5QI of non-GBR resource type, the Reporting Threshold(s) refer to the RAN UE Throughput KPI.

An acceptable deviation from the threshold level in the non-critical direction (i.e. in which the QoS is improving) may be set to limit the amount of signaling.

- In a subscription, the Notification Correlation Id and the Notification Target Address.

The NWDAF collects the corresponding statistics information on the QoS KPI for the relevant 5QI of interests from the OAM, i.e. the QoS flow Retainability or the RAN UE Throughput as defined in TS 28.554 [10].

If the Analytics target period refers to the past:

- The NWDAF verifies whether the triggering conditions for the notification of QoS change statistics are met and if so, generates for the consumer one or more notifications.

- The analytics feedback contains the information on the location and the time for the QoS change statistics and the Reporting Threshold(s) that were crossed.

If the Analytics target period is in the future:

- The NWDAF detects the need for notification about a potential QoS change based on comparing the expected values for the KPI of the target 5QI against the Reporting Threshold(s) provided by the consumer in any cell in the requested area for the requested Analytics target period. The expected KPI values are derived from the statistics for the 5QI obtained from OAM. OAM information may also include planned or unplanned outages detection and other information that is not in scope for 3GPP to discuss in detail.

- The analytics feedback contains the information on the location and the time when a potential QoS change may occur and what Reporting Threshold(s) may be crossed.

*NEXT CHANGE (16) (merge from S2-2003867)*

### 6.9.3 Output analytics

The NWDAF outputs the QoS Sustainability analytics. Depending on the Analytics target period, the output consists of statistics or predictions. The detailed information provided by the NWDAF is defined in Table 6.9.3-1 for statistics and Table 6.9.3-2 for predictions.

Table 6.9.3-1: "QoS Sustainability" statistics

|  |  |
| --- | --- |
| Information | Description |
| List of QoS sustainability Analytics (1..max) |  |
| >Applicable Area | A list of TAIs or Cell IDs within the Location information that the analytics applies to. |
| >Applicable Time Period | The time period within the Analytics target period that the analytics applies to. |
| >Crossed Reporting Threshold(s) | The Reporting Threshold(s) that are met or exceeded by the statistics value or the expected value of the QoS KPI. |

Table 6.9.3-2: "QoS Sustainability" predictions

|  |  |
| --- | --- |
| Information | Description |
| List of QoS sustainability Analytics (1..max) |  |
| >Applicable Area | A list of TAIs or Cell IDs within the Location information that the analytics applies to. |
| >Applicable Time Period | The time period within the Analytics target period that the analytics applies to. |
| >Crossed Reporting Threshold(s) | The Reporting Threshold(s) that are met or exceeded by the statistics value or the expected value of the QoS KPI. |
| >Confidence | Confidence of the analytics. |

NOTE 1: The meaning of Confidence is based on the SLA, i.e. the consumer has to understand the meaning of the different values of Confidence.

NOTE 2: The Analytics can contain multiple sets of the above information if the location information reflected a list of waypoints.

The number of QoS sustainability analytics entries is limited by the maximum number of objects provided as part of Analytics Reporting Information.

*END OF CHANGES*