**3GPP TSG-WG SA2 Meeting #151E S2-** **2203747r01**

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**Source: Ericsson**

**Title: KI #2, Sol #7: Updates to resolve editor’s notes**

**Document for: Approval**

**Agenda Item: 9.25**

**Work Item / Release: FS\_UPEAS / Rel-18**

*Abstract of the contribution: This paper removes Editor Notes in Solution 7 related to handling of AoI in subscription for “Any UE” and to mechanism by which NWDAF obtains from SMF information of UPF to be contacted.*

# 1 Introduction

In the procedure described in TR 23700-62 in clause 6.7.3.1 Subscription to UPF for Data Collection for “Any UE”, there is one Editor Note stating the following:

Editor’s Note: It is FFS whether subscription with an AOI should be possible and how to handle (how the UPF reporting is triggered only when the UE(s) are is in the AOI).

And a corresponding Note in impact clause 6.7.4:

Editor’s Note: It is FFS whether subscription with an AOI should be possible and how to handle (how the UPF reporting is triggered only when the UE(s) are is in the AoI). All impacts of this aspect of the solution are FFS.

TS 23.288 [5] specifies in clause 6.2.2 how NWDAF handles Area of Interest filter conditions in data collection from NFs. For an Analytic that involves “Any UE” but within an Area of Interest (AoI) that requires data from UPF, NWDAF could use any of following 3 Alternatives:

#1 NWDAF could obtain the AMF instances serving the AoI, and from the discovered AMF(s) a list of UEs located within the Area of Interest (this not needed if NWDAF already knows the UEs within the AOI e.g. by data collection for another analytic). Then, for each UE in the list, the NWDAF applies the procedure in solution #7 clause 6.7.3.2 “Subscription to UPF for Data Collection for certain PDU Sessions” for the data collection from UPF instead of procedure in clause 6.7.3.1.

#2 Or, NWDAF could obtain the UPF instances serving the AOI using Nnrf\_NFDiscovery and use the procedure in solution #7 clause 6.7.3.1 “Subscription to UPF for Data Collection for “Any\_UE”. NWDAF shall consider for the analytic the notifications of PDU Sessions within AoI (NWDAF can know UEs located within the AOI as described in 1.) only.

#3 Or, NWDAF could obtain the UPF instances serving the AoI using Nnrf\_NFDiscovery and use the procedure in solution #7 clause 6.7.3.1 “Subscription to UPF for Data Collection for “Any UE” providing an AoI as input parameter.

Alternative#3 above requires that UPF is able to determine which PDU Sessions are within an AoI. In this solution, UPF performs selection of PDU Sessions within an AOI that is defined with TA granularity as follows:

- SMF supports the exchange of UE Location parameter when SMF interacts with AMF via Nsmf\_PDUSession\_Create/Update/CreateSMContext/ UpdateSMContext due to session establishment, modification, or release, service request, or handover procedures (as defined in the TS 23.502 [3] clause 5.2.8.2)

- SMF Provides to UPF over N4 the User Location information (ULI) defined as TA

- UPF maps the PDU sessions to the AoI and determines which ones meet the AoI filter condition received in the subscription. PDU sessions within AoI can change during subscription time and trigger start or stop of data collection for a PDU Session.

Mobility events that do not require communication with SMF/UPF (i.e. no UP update) may not trigger procedures in AMF where ULI is communicated to SMF. There may also be mobility events that do not trigger that RAN provides updated ULI to AMF. As a result, in theory, we may have that (a) UPF event notifications include some notifications related to users that have gone out of AoI after last N4 ULI update and (b) UPF misses to notify a few events for users that have gone into the AoI after last N4 ULI update. Their actual relevance may be very small or none in real deployments e.g. when gNB only serves one TA.

Taking the above into account, one of the other alternatives (#1 or #2) may be preferred for a given analytic, or even a combination of Alternatives #3 and #2: UPF have considered AOI but UPF event notifications are crosschecked against information of Users and/or PDU Sessions within AoI obtained by other means (e.g. via AMF/SMF events).

Note that when NWDAF subscribes to events from AMF/SMF for an AOI, AMF/SMF use existing procedures to widen the mobility events where they get ULI updates. The mobility events where UPF gets ULI updates are also going to be widen.

**Proposal:** update solution 7 so all these alternatives are available.

In the procedure described in TR 23700-62 in clause 6.7.3.1 Subscription to UPF for Data Collection for certain PDU Sessions, there is one more Editor Note step 3 in 6.7.3.1-2:

*“3. NWDAF sends a request to SMF including the target and any conditions that need be considered for filtering or sampling the PDU Sessions. Those may include S-NSSAI, DNN, or SSID/BSSID for WLAN PDU Sessions. The SMF response/notification identifies the User PDU Sessions matching the request and the information of the UPF to be contacted.*

*Editor's note: It is FFS whether this step can be performed leveraging existing SMF services, maybe combined with other data collection from SMF, or if a new service may be required.”*

And a corresponding Note in impact clause 6.7.4:

Editor's note: It is FFS whether selecting the User PDU Session and getting UPF Id can be part of data collection from SMF or if a new service will be required. All impacts of this aspect of the solution are FFS.

Nsmf Event Exposure service provides events related to PDU Sessions towards consumer NF and can be used to collect data for analytics. TS 23.502 clause 5.2.8.3 lists the SMF events that can be subscribed by a NF consumer. Several events could be used in 6.7.3.1-2 for the purpose of collecting, for matching PDU Sessions, UPF PDU Session identifiers and corresponding UPF service contact information. The SMF UPF Info event notification if enhanced could be used for this purpose, but other examples include enhanced notifications of event PDU Session Establishment or Information on PDU Session for WLAN (SSID and BSSID is part of WLAN PDU Session notification). They would need be extended to include UPF Information (the UPF event exposure service address or a UPF Id to obtain the address) and identifier of PDU Session info in UPF. Subscription indication for immediate report, can be used to require SMF immediate reporting of the current status of the subscribed event if known

**Proposal:** based on the above, in step 3, reuse existing SMF event exposure service and remove Editor’s Note in step 3.

# 2 Proposal

Update TR 23700-62 as follows:

\*\*\*\*\*\*\*\*\*\* Start Changes\*\*\*\*\*\*\*\*\*\*\*\*\*

## 6.7 Solution #7: Support to existing (Rel‑16-Rel‑17) data analytics with PDU Session Data Usage Events

### 6.7.1 Key Issue mapping

This Solution addresses KI#2.

### 6.7.2 Description

This solution extends the Rel-17 UPF Event Exposure service with two new events for the collection of information of user data usage of the User PDU Session:

- One event provides measurements, and it will be referred to as UserDataUsageMeasures along the solution and can include following information:

- Volume Measurement: measures of data volume exchanged (UL, DL and/or overall) and/or number of packets exchanged (UL, DL and/or overall) with or without application granularity. This measurement can also include number of packets transmitted and retransmitted for applications where that is possible to differentiate.

- Throughput Measurement: measures of data throughput (UL and DL) measures aggregated for the PDU Session or per application.

- The other event provides statistical measurements, and it will be referred to as UserDataUsageTrends along the solution and can include following information:

- Throughput Statistic Measurement (average and/or peak throughput) over the measurement period for the PDU Session or per application.

Both events provide measurement context (for example, time stamps for the packets and the measures) and information of the PDU Session. When the information refers to an application, the Application Id or Packet Filter Set is included.

This solution defines a UPF Event Exposure Subscription operation that consumers can use to subscribe to UPF Event Exposure service for the two new events, UserDataUsageMeasures and UserDataUsageTrends. Subscription can be for a UE, "Any\_UE", or a specific PDU Session. The Event Subscription includes filters for the data collection, and measurement, event reporting and notification control information like which data that is requested and with which granularity (for the PDU Session or for an Application within the PDU Session).

In this solution, the subscription to UPF does not have any impact on UPF packet matching procedure. The UPF traffic differentiation in the User PDU Session is according to the packet detection rules that have been installed for each PFCP session by SMF. This means that when measurements are requested for an/per application, UPF considers for the measurements of a User PDU Session and App Id only the traffic that is matching a PDR which has that App Id.

The event notifications are sent to the consumer according to the notification control information received in the subscription to the event.

This solution satisfies following Rel-16-Rel-17 NWDAF Analytics UPD Data Collection needs as follows:

- NF Load: UserDataUsageMeasures event with Volume Measurement (see NOTE 1) accumulated for the PDU Session.

- User data Congestion: UserDataUsageTrends event with Throughput Statistic Measurement with per application or IP Packet Filter Set measures over a measurement period.

- UE Communications: UserDataUsageMeasures event with Volume Measurement and Throughput Measurement with per Application or IP Packet Filter Set measures or with PDU Session aggregated measures for a UE\_communication (see NOTE 2).

- WLAN Performance analytics: UserDataUsageMeasures event with Volume Measurement and Throughput Measurement measured for a PDU Session.

- Dispersion: UserDataUsageMeasures event with Volume measurement and per application or IP Packet Filter Set measures (they are exclusive) or with PDU Session aggregated measures.

NOTE 1: The solution defines the Volume Measurements with similar definition as in the Traffic Usage Report.

NOTE 2: UE Communication definition may imply measuring periods are defined, for example, in relation to application activity/inactivity.

### 6.7.3 Procedures

#### 6.7.3.1 Subscription to UPF for Data Collection for "Any UE"

Figure 6.7.3.1-1 below shows the procedure for UPF Event Exposure subscription and notification for the UserDataUsageMeasures and UserDataUsageTrends events that can be used in scenarios targeting data collection from UPF for "Any UE".

Example UCs are NWDAF data collection for NF Load NWDAF analytic (clause 6.5 of TS 23.288 [5]), or for User Data Congestion Analytic (clause 6.8 of TS 23.288 [5]).



Figure 6.7.3.1-1, Data Collection from UPF for Any\_UE

A description of the procedure in Figure 6.7.3.1-1follows:

1. In a first step, UPF registers its profile in NRF.

2. NWDAF receives a request from a consumer.

If type of Analytic is for example "NF Load" and NFs type=UPF, it may be for UPFs only within an Area of Interest (AoI) and specific S-NSSAI, or it may be for a given UPF Id. If for example Type of Analytic is "User Data Congestion", if "Any UE", it always includes AoI, and if the request includes a SUPI, the user location determines the AoI but UPF data collection is still for "Any UE" within AOI. In this case, the consumer may also request N top consuming Applications.

3. NWDAF identifies the Data required for this analytic and starts data collection as in TS 23.288 [5]. In this case, data from UPF is required.

4. NWDAF selects the relevant UPFs with assistance from NRF. It can take into account information received in the request (for example, S-NSSAI and/or AoI).

NOTE 1: When a PDU Session user plane consists of more than one UPF, only some of them may have service area overlapping the AoI and be selected. Their role may be ULCL/BP and/or PSA. Depending on the deployment, NWDAF may be configured to use procedure 6.7.3.1-2 instead for a given Analytic.

5. NWDAF sends Nupf\_EventExposure Subscribe for Event= UserDataUsageMeasures / UserDataUsageTrends to relevant UPF(s) for "Any UE" and it may include filters like S-NSSAI or AoI (list of TAs). NWDAF provides Event Reporting Info including the DataSubset requested.

6. UPF Selects the PDU Sessions that match the filters and for that, it may perform sampling according to input received or local configuration. It starts to produce measurements for those sessions as requested.

NOTE 2: SMF needs to have installed packet detection rules in the PFCP sessions in UCL/BP and/or PSA (see NOTE 1) with rules for the applications for which it may need differentiated measurements.

The selection of PDU Sessions may change during the lifetime of the subscription e.g. at termination or establishment of PDU Sessions that meet the criteria, or UEs entering/leaving the AoI according to user location information (ULI) received over N4.

NOTE 3: NWDAF subscription to AMF/SMF events for the AoI widens the mobility events where UPF gets ULI updates, improving accuracy of UPF PDU Session selection for the AoI.

If Subscription has included AoI, and the PDU Session selection in UPF does not support this filter condition, UPF rejects the request from NWDAF.

NOTE 4: Upon reject, NWDAF identifies that it needs to create the mapping of PDU sessions per TA. NWDAF can subscribe to UE mobility event notifications of AMF to retrieve the list of SUPIs in the AoI (not needed if this information is already known). It can then apply instead the procedure in 6.7.3.2 on the retrieved list of SUPIs or subscribe to UPF without AoI filter condition using the retrieved list of SUPIs to filter the UPF events (step 8).

7. UPF sends Nupf\_EventExposure Notify for Event= UserDataUsageMeasures / UserDataUsageTrends for the selected PDU Sessions. The notifications include SUPI, DNN and S-NSSAI as available and conveys measurements and context according to the subscription.

8. NWDAF derives the Requested Analytic.

NOTE 5: NWDAF may at this stage use AMF/SMF information to filter the UPF events for the AoI.

9. NWDAF provides the Analytic requested.

#### 6.7.3.2 Subscription to UPF for Data Collection for certain PDU Sessions

Figure 6.7.3.1-2 below shows the procedure for UPF Event Exposure subscription and notification for the UserDataUsageMeasures and UserDataUsageTrends events that can be used in scenarios targeting data collection from UPF for certain UEs or PDU Sessions.

If Analytic is targeting "Any UE", this procedure can still be preferred or even needed for a preselection of the PDU Sessions (for example, when UPF lacks information to evaluate some filters), or as a way to perform the PDU Session sampling in SMF only when SMF also contributes to the analytic.

Example for UCs are NWDAF data collection for WLAN Performance analytics (clause 6.11 of TS 23.288 [5]), Dispersion analytics (clause 6.10 of TS 23.288 [5]), and for UE Communication analytics (clause 6.7 of TS 23.288 [5]).



Figure 6.7.3.1-2: Data Collection from UPF for certain PDU Sessions

A description of the procedure in Figure 6.7.3.1-2 follows:

Prerequisite: SMF has installed packet detection rules in the PFCP sessions with rules for the applications for which differentiated measurements may be needed.

1. NWDAF receives a request from a consumer.

As an example, type of Analytic may be "UE Dispersion" requesting a Data Volume Dispersion Analytic (DVDA) for "Any UE", a UE or a UE\_Group including filters like S-NSSAI, AoI and/or App Ids for applications of interest. Another example would be a request with type of Analytic "WLAN performance" for "Any UE", a UE or a UE\_Group in an AoI and for certain SSID/BSSID. In another example, Analytic type could be "UE Communication" targeting a UE or UE Group and specific Applications.

2. NWDAF identifies the Data required for this analytic and starts data collection as in TS 23.288 [5]. This analytic requires Data Collection from UPF and for that, the UPF PDU Session identifiers and UPF service contact information needs to be collected from SMF. SMF may contribute to this analytic with other data.

Clause 6.2.2 of TS 23.288 [5] specifies some options for how to select SMF:

- If Target is a UE or a UE Group, NWDAF can select the SMF(s) with UDM assistance as specified in clause 6.2.2 of TS 23.288 [5].

- If Target is "Any UE", NWDAF selects SMF with assistance of NRF taking into account filter conditions if any received in the request. If AoI is also provided, NWDAF can first determine the users within AoI with AMF assistance and proceed as when Target is a UE.

3. NWDAF sends Nsmf\_EventExposure Subscribe to SMF including the target and any conditions that need be considered for filtering or sampling the PDU Sessions. The SMF response/notification includes UPF identifiers of the User PDU Sessions matching the request and the information of the UPFs to be contacted. If needed, information of whether UPF is acting as PSA and DNAI could also be provided. This information may have been retrieved already during SMF data collection for the analytic in step 2.

NOTE 1: SMF event notifications of already specified exposure events can be enhanced for this purpose, for example UPF Info, PDU session establishment or Information on PDU Session for WLAN (see clause 5.2.8.3 in TS 23.502 [3]).

4. NWDAF takes SMF information as input for the data collection from UPF. It sends Nupf\_EventExposure Subscribe for Event= UserDataUsageMeasures / UserDataUsageTrends to the UPF handling the PDU Session. The subscription targets a PDU Session. The request includes Event Reporting Info, including the DataSubset requested.

If Subscription has included AoI and UPF supports this condition, UPF takes into account whether UE is entering/leaving the AoI according to user location information (ULI) received over N4. If UPF does not support this filter condition UPF rejects the request from NWDAF.

NOTE 2: Upon reject, NWDAF identifies that it needs to create the mapping of PDU session and TA itself. When there are many UE(s) in an AoI and many mobility in and out of the AoI, it may be convenient for the NWDAF to filter the events rather than performing many subscription/unsubscription to UPF to avoid high signaling load.

5. UPF starts the measurement for the PDU Session as requested.6. UPF sends Nupf\_EventExposure Notify for Event= UserDataUsageMeasures / UserDataUsageTrends for the PDU Session. The notification includes SUPI, DNN and S-NSSAI as available and conveys measurement information according to the subscription.

7. NWDAF derives the Requested Analytic.

8. NWDAF provides the Analytic requested.

### 6.7.4 Impacts on services, entities and interfaces

This solution impacts the System as follows:

- Nupf Event Exposure Service is enhanced with two new events and a subscription operation for those events:

- The target of the subscription to these events may be "any UE", a SUPI, or a given User PDU Session (identified by UE IP address and DNN or N4 Session ID). DNN and S-NSSAI and AoI can be included as filter conditions.

- The subscription request also includes Event Reporting Information (including required DataSubset (Volume Measurement and/or Throughput Measurements or Throughput Statistic Measurement), Control Information for the measurements (like granularity) and Reporting and Notification Control Information for the event.

- Nupf Event Exposure service Notification provides information for a user PDU Session identified by UE IP address and DNN (and/or N4 Session ID) and includes SUPI and S-NSSAI when available.

- Nsmf Event Exposure service subscription notification includes UPF PDU Session identifier and UPF Event Exposure service contact information. If needed, information of whether UPF is acting as PSA and DNAI could also be provided.

NOTE: Decision is left for stage 3 for whether enhancing notifications of already specified events or defining a new SMF event.

For new UserDataUsageMeasures event, it includes:

- Volume Measurement: measures of data volume exchanged (UL, DL and/or overall) and/or number of packets exchanged (UL, DL and/or overall) with or without application granularity. This measurement can also include number of packets transmitted and retransmitted for applications where that is possible to differentiate.

- Throughput Measurement: measures of data throughput (UL and DL) aggregated for the PDU Session or per application.

For new UserDataUsageTrend event, it includes:

- Throughput Statistic Measurement (average and/or peak throughput) over the measurement period for the PDU Session or per application.

And for both events, it includes measurement context (for example, time stamps for the packets and the measures) and when the information refers to an application, the corresponding Application Id or Packet Filter Set.

- UPF is enhanced to produce measurements according to UserDataUsageMeasures event and UserDataUsageTrends event and to send notifications as instructed in the subscription.

In this solution, the subscription to UPF does not have any impact on UPF packet matching procedure. The UPF traffic differentiation in the User PDU Session is according to the packet detection rules that have been installed for each PFCP session by SMF. This means that when measurements are requested for an/per application, UPF considers for the measurements of a User PDU Session and App Id only the traffic that is matching a PDR which has that App Id.

- SMF is enhanced to provide ULI (TA) to UPF over N4. UPF is enhanced to map PDU sessions to an AoI with TA granularity based on N4 ULI and to determine which PDU Sessions are for users with an AoI.

- NWDAF is enhanced to collect Data Usage measurements from UPF with UPF Event Exposure Service Subscription using UserDataUsageMeasures / UserDataUsageTrends event. It receives Nupf Event Exposure notifications for UserDataUsageMeasures / UserDataUsageTrends event with information as requested, and correlates information from different sources to produce Analytics.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* End Changes \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*