**SA WG2 Meeting #143eS2-2100259r02**

**Feb 24th – March 9th, 2021 ; Elbonia (revision of S2-210xxxx)**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **23.502** | **CR** | **2485** | **rev** | **-** | **Current version:** | **16.7.1** |  |
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| *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:***  | Correction of Inter-AMF mobility with group monitoring |
|  |  |
| ***Source to WG:*** | Nokia, Nokia Shanghai Bell |
| ***Source to TSG:*** | S2 |
|  |  |
| ***Work item code:*** | 5GS\_Ph1, TEI16 |  | ***Date:*** | 2021-02-02 |
|  |  |  |  |  |
| ***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 canbe 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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | UE mobility with group monitoring as specified in clause 4.15.4.2 has got fundamental flaws that prevent CT4 from finalising their work on this topic.  |
|  |  |
| ***Summary of change:*** | The handling of monitoring configuration at Inter-AMF mobility is corrected as follows: - Monitoring configuration is transferred only if Maximum number of reports has not been reached yet. If the Maximum number of reports quota has been used up already, then the monitoring configuration is not transferred to the new AMF irrespective of whether Group monitoring configuration for the group exists already or not. - Subscription correlation ID for Group monitoring configuration is created just once in the target AMF- Maximum number of reports is stored per UE even for single group member UE- NEF attempt to count the remaining number of reports is based on (Maximum number of reports x Number of UEs)- Monitoring event running out of Maximum duration of reporting is cancelled locally in the affected NFs and monitoring event running out of Maximum number of reports is cancelled explicitly by the NEF.  |
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| ***Consequences if not approved:*** | Inter-AMF mobility with active group monitoring event is broken.  |
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| ***Clauses affected:*** | 4.15.1, 4.15.3.2.2, 4.15.3.2.3, 4.15.4.2. |
|  |  |
|  | **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*

### 4.15.1 General

The network capability exposure comprises

- Exposure of network events externally as well as internally towards core network NFs;

- Exposure of provisioning capability towards external functions;

- Exposure of policy and charging capabilities towards external functions;

- Exposure of core network internal capabilities for analytics.

- Exposure of analytics to external party.

- Retrieval of data from external party by NWDAF.

When subscribing to event reporting the NF consumer(s) provide:

- One or multiple Event ID(s). An Event ID identifies the type of event being subscribed to (e.g. PDU Session Release, UE mobility out of an Area of Interest, etc.).

- Event Filter Information: Provides Event Parameter Types and Event Parameter Value(s) to be matched against, in order to meet the condition for notifying the subscribed Event ID e.g. the Event Parameter Type could be "Area of interest" and Event Parameter Value list could be list of TAs; The Event Filter depends on the Event ID. The Event Filter Information is provided per Event ID(s) being subscribed to: within a subscription different Event ID(s) may be associated with different Event Filter Information.

- Event Reporting Information described in the Table 4.15.1-1 below. Within a subscription all Event ID(s) are associated with a unique Event Reporting Information.

- Target of Event Reporting: this may indicate a specific UE or PDU Session, a group of UE(s) or any UE (i.e. all UEs), Within a subscription all Event ID (s) are associated with the same Target of Event Reporting (possibly corresponding to multiple UE or multiple PDU Sessions).

- A Notification Target Address (+ Notification Correlation ID) allowing the Event Receving NF to correlate notifications received from the Event provider with this subscription. A subscription is associated with an unique Notification Target Address (+ Notification Correlation ID). In the case that the NF consumer subscribes to the NF producer on behalf of other NF, the NF consumer includes the Notification Target Address(+Notification Correlation ID) of other NF for the Event ID which is to be notified to other NF directly, and the Notification Target Address(+Notification Correlation ID) of itself for the Subscription change related event notification. Each Notification Target Address(+ Notification Correlation ID) is associated with related (set of) Event ID(s).

- An Expiry time represents the time upto which the subscription is desired to be kept as active. The NF service consumer may suggest an Expiry time and provide to the NF service producer. Based on the operator's policy, the NF service producer decides whether the subscription can be expired. If the subscripton can be expired, the NF service producer determines the Expiry time and provide it in the response to the NF service consumer. If the event subscription is about to expire based on the received Expiry time and the NF service consumer wants to keep receiving notifications, the NF service consumer update the subscription with the NF service producer in order to extend the Expiry time. Once the Expiry time associated with the subscription is reached, the subscription becomes invalid at the NF service producer. If the NF service consumer wants to keep receiving notifications, it shall create a new subscription with the NF service producer.

When the subscription is accepted by the Event provider NF, the consumer NF receives from the event provider NF an identifier (Subscription Correlation ID) allowing to further manage (modify, delete) this subscription.

NOTE 1: The Notification Correlation ID is allocated by the consumer NF that subscribes to event reporting and the Subscription Correlation ID is allocated by the NF that notifies when the event is met. Both correlation identifiers can be assigned the same value, although in principle they are supposed to be different, as they are optimized for finding the subscription related context within each NF.

The consumer NF may use an operation dedicated to subscription modification to add or remove Event ID(s) to this subscription or to modify Event Filter Information.

Events are subscribed by the consumer NF(s) by providing Event Filters. The contents of the Event Reporting Information along with the presence requirement of each information element is described in Table 4.15.1-1.

Table 4.15.1-1: Event Reporting Information

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| --- | --- | --- |
| Event Reporting Information Parameter | Description | Presence requirement |
| Event reporting mode | Mode of reporting - e.g reporting up to a maximum number of reports, periodic reporting along with periodicity, reporting up to a maximum duration | mandatory |
| Maximum number of reports | Maximum number of reports after which the event subscription ceases to exist | (see NOTE 2) |
| Maximum duration of reporting | Maximum duration after which the event subscription ceases to exist | (see NOTE 2) |
| Immediate reporting flag | The Event provider NF notifies the current status of the subscribed event, if available, immediately to the consumer NF. |  |
| Sampling ratio | Percentage of sampling (1%..100%) among impacted UEs. | optional(see NOTE 3) |
| Group Reporting Guard Time | Parameter for group-based monitoring configuration to indicate the time for which the Monitoring Event Reporting(s) related with the UEs in a group can be aggregated before sending them to the consumer NF. | optional |
| NOTE 2: The requester shall include 2) Maximum number of reports or 3) Maximum duration of reporting, or both, depending on 1) Event reporting mode.NOTE 3: Parameter only applicable to certain event IDs reporting metrics (e.g. Number of UEs present in a geographical area) used and used e.g. by the NWDAF for data collection. |

NOTE 4: Explicit unsubscribe by the NF consumer is still possible.

Maximum number of reports is applicable to the subscription to one UE or a group of UE(s). When the subscription is applied to a group of UE(s), the initial value of the parameter is applied to each individual member UE. The count of number of reports is per UE and per Event Type granularity also for group member UE.

Maximum duration of reporting is applicable to the subscription to one UE, a group of UE(s) or any UE. When the subscription is applied to a group of UE(s), this parameter applies to each group member UE. When the subscription is applied to any UE, this parameter applies to all the impacted UEs.

If for a given subscription Maximum duration of reporting is included then the subscription is cancelled locally in the NF as soon Maximum duration of reporting is reached. If the Maximum number of reports is reached for a given subscription, the NEF cancels the subscription in the affected NFs.

Sampling ratio is applicable to subscription targeting a group of UEs or any UE. When a sampling ratio is provided, a random subset is selected among the target UEs according to the sampling ratio and only the events related to this subset are reported. A UE remains selected until it is not managed by the event provider NF any more. A UE newly managed by the NF may become selected.

Group Reporting Guard Time is an optional parameter for group-based monitoring configuration to indicate the time for which the Monitoring Event Reporting(s) related with the UEs in a group can be aggregated before sending them to the consumer NF. The value of the Group Reporting Guard time should be set less than the Maximum duration of reporting. For the continuous monitoring reporting, unless the Maximum duration of reporting has been reached, the Group Reporting Guard timer is restarted when it expires. If the time left until the Maximum duration of reporting is less than the Group Reporting Guard Time, then the Group Reporting Guard timer shall be set to expire when the Maximum duration of reporting expires. If the Maximum duration of reporting is expired, the Group Reporting Guard Time, if running, shall be considered to expire and aggregated Monitoring Event Reporting(s) is sent to destination immediately.

Table 4.15.1-1 indicates the presence requirements for the Event Reporting Information.

Corresponding notifications contain at least the Notification Correlation ID together with the Event ID and the individual target (e.g. UE or PDU Session ID) associated with the notification.

If the NF service consumer decides to terminate the event subscription, it unsubscribes the event subscription by sending unsubscription request to the event provider NF. After receiving unsubscription request from the NF service consumer, the event provider NF terminates the event subscription.

The following clauses describe the external exposure of network capabilities and core network internal event and capability exposure.

When the immediate reporting flag is set, the first corresponding event report is included in the output message, if corresponding information is available at the reception of the subscription request of the event.

The optional parameter MTC Provider Information as used e.g. in clause 4.25.3, is a reference parameter that may be provided by AF or determined by NEF based on which AF it communicates with. The MTC Provider Information identifies the MTC Service Provider and/or MTC Application.

NOTE 5: The MTC Provider Information can be used by Service Providers for, e.g. to distinguish their different customers.

*NEXT CHANGE*

##### 4.15.3.2.2 UDM service operations information flow

The procedure is used by the NEF to subscribe to notifications and to explicitly cancel a previous subscription. Cancelling is done by sending Nudm\_EventExposure\_Unsubscribe request identifying the subscription to cancel. The notification steps 4 and 5 are not applicable in cancellation case.



Figure 4.15.3.2.2-1: Nudm\_EventExposure\_Subscribe, Unsubscribe and Notify operations

1. The NEF subscribes to one or several monitoring events by sending Nudm\_EventExposure\_Subscribe request. The NEF subscribes to one or several Event(s) (identified by Event ID) and provides the associated notification endpoint of the NEF.

 Event Reporting Information defines the type of reporting requested. If the reporting event subscription is authorized by the UDM, the UDM records the association of the event trigger and the requester identity.

 The subscription may include Maximum number of reports and/or Maximum duration of reporting IE.

2a. [Conditional] Some events (e.g. loss of connectivity), require that UDM sends Namf\_EventExposure\_Subscribe request to the AMF serving that UE. As the UDM itself is not the Event Receiving NF, the UDM shall additionally provide the notification endpoint of itself besides the notification endpoint of NEF. Each notification endpoint is associated with the related (set of) Event ID(s). This is to assure the UDM can receive the notification of subscription change related event.

 The UDM sends the Namf\_EventExposure\_Subscribe request to all serving AMF(s) (if subscription applies to a UE or a group of UE(s)), or to all the AMF(s) in the same PLMN as UDM (if subscription applies to any UE).

 If the subscription applies to a group of UE(s), the UDM shall include the same notification endpoint of itself, i.e. Notification Target Address (+ Notification Correlation Id), in the subscriptions to all UE's serving AMF(s).

NOTE: The same notification endpoint of UDM is to help the AMF identify whether the subscription for the requested group event is same or not when a new group member UE is registered.

2b. [Conditional] AMF acknowledges the execution of Namf\_EventExposure\_Subscribe.

3. UDM acknowledges the execution of Nudm\_EventExposure\_Subscribe.

 If the subscription is applicable to a group of UE(s) and the Maximum number of reports is included in the Event Report information in step 1, the Number of UEs within this group is included in the acknowledgement.

4a - 4b. [Conditional - depending on the Event] The UDM detects the monitored event occurs and sends the event report, by means of Nudm\_EventExposure\_Notify message, to the associated notification endpoint of the NEF, along with the time stamp. NEF may store the information in the UDR along with the time stamp using either Nudr\_DM\_Create or Nudr\_DM\_Update service operation as appropriate.

4c - 4d. [Conditional - depending on the Event] The AMF detects the monitored event occurs and sends the event report, by means of Namf\_EventExposure\_Notify message, to the associated notification endpoint of the NEF, along with the time stamp. NEF may store the information in the UDR along with the time stamp using either Nudr\_DM\_Create or Nudr\_DM\_Update service operation as appropriate.

 If the AMF has a maximum number of reports stored for the UE, the AMF shall decrease its value by one for the reported event.

 For both step 4a and step 4c, when the maximum number of reports is reached and if the subscription is applied to a UE, The NEF unsubscribes the monitoring event(s) to the UDM and the UDM unsubscribes the monitoring event(s) to AMF serving that UE.

 For both step 4a and step 4c, when the maximum number of reports is reached for an individual group member UE, the NEF uses the Number of UEs received in step 3 and the Maximum number of reports to determine if reporting for the group is complete. If the NEF determines that reporting for the group is complete, the NEF unsubscribes the monitoring event(s) to the UDM and the UDM unsubscribes the monitoring event(s) to all AMF(s) serving the UEs belonging to that group.

 When the Maximum duration of reporting expires in the NEF, the UDM and the AMF, then each of these nodes shall locally unsubscribe the monitoring event.

5. [Conditional - depending on the Event] The AMF detects the subscription change related event occurs, e.g. Subscription Correlation ID change due to AMF reallocation or addition of new Subscription Correlation ID due to a new group UE registered, it sends the event report by means of Namf\_EventExposure\_Notify message to the associated notification endpoint of the UDM.

*NEXT CHANGE*

##### 4.15.3.2.3 NEF service operations information flow

The procedure is used by the AF to subscribe to notifications and to explicitly cancel a previous subscription. Cancelling is done by sending Nnef\_EventExposure\_Unsubscribe request identifying the subscription to cancel with Subscription Correlation ID. The notification steps 6 to 8 are not applicable in cancellation case.



Figure 4.15.3.2.3-1: Nnef\_EventExposure\_Subscribe, Unsubscribe and Notify operations

1. The AF subscribes to one or several Event(s) (identified by Event ID) and provides the associated notification endpoint of the AF by sending Nnef\_EventExposure\_Subscribe request.

 Event Reporting Information defines the type of reporting requested (e.g. one-time reporting, periodic reporting or event based reporting, for Monitoring Events). If the reporting event subscription is authorized by the NEF, the NEF records the association of the event trigger and the requester identity. The subscription may also include Maximum number of reports and/or Maximum duration of reporting IE.

2. [Conditional - depending on authorization in step 1] The NEF subscribes to received Event(s) (identified by Event ID) and provides the associated notification endpoint of the NEF to UDM by sending Nudm\_EventExposure\_Subscribe request. The NEF maps the AF-Identifier into DNN and S-NSSAI combination based on local configuration, and include DNN, S-NSSAI in the request.

 If the reporting event subscription is authorized by the UDM, the UDM records the association of the event trigger and the requester identity. Otherwise, the UDM continues in step 4 indicating failure.

3a. [Conditional] If the requested event (e.g. monitoring of Loss of Connectivity) requires AMF assistance, then the UDM sends the Namf\_EventExposure\_Subscribe to the AMF serving the requested user. The UDM sends the Namf\_EventExposure\_Subscribe request to the all serving AMF(s) (if subscription applies to a UE or a group of UE(s)), or all the AMF in the same PLMN as the UDM (if subscription applies to any UE).

 As the UDM itself is not the Event Receiving NF, the UDM shall additionally provide the notification endpoint of itself besides the notification endpoint of NEF. Each notification endpoint is associated with the related (set of) Event ID(s). This is to assure the UDM can receive the notification of subscription change related event.

 If the subscription applies to a group of UE(s), the UDM shall include the same notification endpoint of itself, i.e. Notification Target Address (+ Notification Correlation Id), in the subscriptions to all UE's serving AMF(s).

NOTE 1: The same notification endpoint of UDM is to help the AMF identify whether the subscription for the requested group event is same or not when a new group member UE is registered.

3b. [Conditional] AMF acknowledges the execution of Namf\_EventExposure\_Subscribe.

3c. [Conditional] If the requested event (e.g. PDU Session Status) requires SMF assistance, then the UDM sends the Nsmf\_EventExposure\_Subscribe Request message to each SMF where at least one UE identified in step 2 has a PDU session established. The NEF notification endpoint received in step 2 is included in the message.

NOTE 2: In the home routed case, the UDM sends the subscription to the V-SMF via the H-SMF.

3d. [Conditional] The SMF acknowledges the execution of Nsmf\_EventExposure\_Subscribe.

4. [Conditional] UDM acknowledges the execution of Nudm\_EventExposure\_Subscribe.

 If the subscription is applicable to a group of UE(s) and the Maximum number of reports is included in the Event Report information in step 1, the Number of UEs is included in the acknowledgement.

5. NEF acknowledges the execution of Nnef\_EventExposure\_Subscribe to the requester that initiated the request.

6a - 6b. [Conditional - depending on the Event] The UDM (depending on the Event) detects the event occurs and sends the event report, by means of Nudm\_EventExposure\_Notify message to the associated notification endpoint of the NEF along with the time stamp. NEF may store the information in the UDR along with the time stamp using either Nudr\_DM\_Create or Nudr\_DM\_Update service operation as appropriate.

6c - 6d. [Conditional - depending on the Event] The AMF detects the event occurs and sends the event report, by means of Namf\_EventExposure\_Notify message to associated notification endpoint of the NEF along with the time stamp. NEF may store the information in the UDR along with the time stamp using either Nudr\_DM\_Create or Nudr\_DM\_Update service operation as appropriate.

 If the AMF has a maximum number of reports stored for the UE or the individual member UE, the AMF shall decrease its value by one for the reported event.

 For both step 6a and step 6b, when the maximum number of reports is reached and if the subscription is applied to a UE, The NEF unsubscribes the monitoring event(s) to the UDM and the UDM unsubscribes the monitoring event(s) to AMF serving for that UE.

 For both step 6a and step 6b, when the maximum number of reports is reached for an individual group member UE, the NEF uses the Number of UEs received in step 4 and the Maximum number of reports to determine if reporting for the group is complete. If the NEF determines that reporting for the group is complete, the NEF unsubscribes the monitoring event(s) to the UDM and the UDM unsubscribes the monitoring event(s) to all AMF(s) serving the UEs belonging to that group.

 When the Maximum duration of reporting expires in the NEF, the UDM and the AMF, then each of these nodes shall locally unsubscribe the monitoring event.

6e - 6f. [Conditional - depending on the Event] When the SMF detects a subscribed event, the SMF sends the event report, by means of Nsmf\_EventExposure\_Notify message, to the associated notification endpoint of the NEF provided in step 3c. NEF may store the information in the UDR along with the time stamp using either Nudr\_DM\_Create or Nudr\_DM\_Update service operation as appropriate.

7. [Conditional - depending on the Event in steps 6a-6f] The NEF forwards to the AF the reporting event received by either Nudm\_EventExposure\_Notify and/or Namf\_EventExposure\_Notify. In the case of the PDU Session Status event, the NEF maps it to an PDN Connectivity Status notification when reporting to the AF.

8. [Conditional - depending on the Event] The AMF detects the subscription change related event occurs, e.g. Subscription Correlation ID change due to AMF reallocation or addition of new Subscription Correlation ID due to a new group UE registered, it sends the event report, by means of Namf\_EventExposure\_Notify message to the associated notification endpoint of the UDM.

*NEXT CHANGE*

#### 4.15.4.2 Exposure of Mobility Events from AMF

The AMF invokes the Namf\_EventExposure\_Notify to provide mobility related events to NF consumers that have subscribed for the events by invoking Namf\_EventExposure\_Subscribe, in the following scenarios listed below and after Namf\_EventExposure\_Subscribe service operation.

- During Registration procedure, Inter NG-RAN node N2 based handover procedure, when there is a change of AMF (within the same AMF Set or across the AMF Set), the new AMF receives all event subscriptions from old AMF or UDSF. For each event subscription whose Maximum number of reports has not been reached yet:

 if the event subscription only applies to the UE, the new AMF allocates a new Subscription Correlation ID and notify the NF consumer of the new Subscription Correlation ID associated with the change of Subscription Correlation ID event.

 if the event subscription applies to a group of UE(s) and there is no corresponding subscription for this group (identified by the internal group Id and notification endpoint) at the new AMF, the new AMF shall create corresponding event subscription, allocate a new Subscription Correlation Id and send it to the received notification endpoint, i.e. Notification Target Address (+Notification Correlation Id), associated with the addition of Subscription Correlation ID event. The remaining number of reports within the Maximum number of reports quota for the UE is transferred from the old AMF.

- During Registration procedure, when there is a change of AMF, the new AMF notifies each NF that has subscribed for UE reachability event about the UE reachability status.

- During Registration, Handover, UE Triggered Service Request procedure in CM-IDLE state, Location Reporting, N2 Notification and AN Release procedures, the AMF determines the UE presence in Area Of Interest (i.e. IN, OUT or UNKNOWN status ) as described in Annex D.1 and notifies the NF Consumers of the UE presence in an Area Of Interest if the NF consumers (e.g. SMF) had subscribed for this Area Of Interest, and if the UE presence in Area Of Interest is different from the one reported earlier.

- During Registration and Handover procedure or during Service Area Restriction update by UDM or PCF, if the UE is moving from an Allowed Area to a Non-Allowed Area, then the AMF informs all the NF consumers (e.g. SMF), that have subscribed for UE reachability event, that the UE is reachable only for regulatory prioritized service. The SMF shall explicitly subscribe UE reachability unless the established PDU Session is related to regulatory prioritized service.

- If the AMF had notified an SMF of the UE being reachable only for regulatory prioritized service earlier, the AMF informs the NF consumers (e.g. SMF), that have subscribed for UE reachability event, that the UE is reachable if the UE enters into Allowed Area.

- During Registration procedure and Service Request procedure, if the AMF had notified an SMF earlier of the UE being unreachable and that SMF need not invoke Namf\_Communication\_N1N2MessageTransfer to the AMF due to DL data notifications, the AMF informs the SMF when the UE becomes reachable.

- During Registration procedure, Handover without Registration procedure, and Service Request procedure, if the NF consumers had subscribed for UE reachability status, the AMF notifies the UE reachability status changes.

- During Network Triggered Service Request procedure, if the UE does not respond to paging, when the AMF considers the UE as unreachable the AMF notifies the NF consumers that have subscribed for UE reachability event, that the UE is not reachable.

- If the UDM had subscribed for UE reachability event notification either to be reported to the UDM or to an NF consumer directly, then the AMF notifies the UE reachability event to the UDM or to the NF consumer as specified in clause 4.2.5.2.