**3GPP TSG-CT WG3 Meeting #134C3-242208**

**Changsha, China, 15 - 19 April, 2024 (revision of C3-242abc)**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **29.522** | **CR** | **1235** | **rev** | **-** | **Current version:** | **18.5.0** |  |
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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:*** | Support of data rate monitoring for the list of UEs | | | | | | | | | |
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| ***Source to WG:*** | Huawei, Qualcomm, Nokia, Ericsson | | | | | | | | | |
| ***Source to TSG:*** | CT3 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | AIMLsys | | | | |  | ***Date:*** | | | 2024-04-01 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
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| ***Reason for change:*** | | The procedure for data rate monitoring for the list of UEs is missing and needs to be added according to clause 4.15.6.13.1 of TS 23.502 and the data model definition in TS 29.122. | | | | | | | | |
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| ***Summary of change:*** | | Add the procedure for data rate monitoring for the list of UEs. | | | | | | | | |
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| ***Consequences if not approved:*** | | Incomplete and unclear specification. | | | | | | | | |
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| ***Clauses affected:*** | | 4.4.9.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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 does not impact the OpenAPI file. | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

**Additional discussion(if needed):**

**Proposed changes:**

\*\*\* 1st Change \*\*\*

#### 4.4.9.2 Procedures for AF setting up an AF session with required QoS for target UE identified by UE address or for target list of UEs identified by list of UE addresses

The provisions and procedures for setting up an AF session with required QoS in 5GS targeting a UE identified by its UE address (IP address or Mac address) or setting up a Multi-member AF session with required QoS in 5GS for target list of UEs identified by the list of UE addresses are described in clause 4.4.13 of 3GPP TS 29.122 [4] with the following differences:

- description of the SCS/AS applies to the AF;

- description of the SCEF applies to the NEF;

- description of the PCRF applies to the PCF;

- the NEF may interact with NRF to retrieve the BSF address of the serving UE IP address (es) as defined in 3GPP TS 29.510 [57];

- the NEF may interact with BSF by using Nbsf\_Management\_Discovery service as defined in 3GPP TS 29.521 [9] to retrieve the PCF address;

- the NEF shall interact with the PCF by using Npcf\_PolicyAuthorization service as defined in 3GPP TS 29.514 [7];

- when the "ListUE\_5G" feature is supported, in case the NEF receives a list of UE addresses, the NEF shall interact with the NRF/BSF/PCF with above procedures for each UE address individually.

- in the HTTP POST request, the AF may include a "dnn" attribute and/or a "snssai" attribute; and in the HTTP PUT request, the AF shall keep the same value(s) of the "dnn" attribute and/or the "snssai" attribute as set in the HTTP POST request if provided;

- description about the INDICATION\_OF\_SUCCESSFUL\_RESOURCES\_ALLOCATION event and INDICATION\_OF\_FAILED\_RESOURCES\_ALLOCATION event apply to the SUCCESSFUL\_RESOURCES\_ALLOCATION event and FAILED\_RESOURCES\_ALLOCATION event respectively; In addition, description about the INDICATION\_OF\_RELEASE\_OF\_BEARER, INDICATION\_OF\_LOSS\_OF\_BEARER and INDICATION\_OF\_RECOVERY\_OF\_BEARER events are not applicable in this specification.

- if the EthAsSessionQoS\_5G feature as defined in clause 5.14.4 of 3GPP TS 29.122 [4] is supported and the request is for Ethernet UE:

- in the HTTP POST/PUT request, the AF shall include the UE MAC address within the "macAddr" attribute instead of the UE IP address. If the AppId feature is not supported, the AF shall include the Ethernet Flow description within the "ethFlowInfo" attribute instead of the IP Flow description; otherwise, the AF shall include either the External Application Identifier within the "exterAppId" attribute or the Ethernet Flow description within the "ethFlowInfo" attribute;

- in the HTTP PATCH request, the AF may update the Ethernet Flow description within the "ethFlowInfo" attribute or the External Application Identifier within the "exterAppId" attribute;

- if the "ListUE\_5G" feature as defined in clause 5.14.4 of 3GPP TS 29.122 [4] is supported, in order to support the QoS handling and QoS monitoring for the list of UEs from AF, the AF may include:

1. the list of UE addresses within the "listUeAddrs" attribute.
2. the list of UE addresses subject for Consolidated Data Rate monitoring within the "listUeConsDtRt" attribute.

NOTE 1: If the "listUeConsDtRt" attribute is provided, it is a subset of "listUeAddrs" attribute.

In order to support the QoS Monitoring for UL and/or DL data rate for the list of UEs, the AF shall include the required data rate monitoring information within "qosMonDatRate" attribute. The subscribed event is "QOS\_MONITORING". The AF shall include within the "qosMonDatRate" attribute:

a) the requested data rate parameter(s) to be measured (i.e. DL and/or UL data rate) within the "reqQosMonParams" attribute;

b) one or more report frequency within the "repFreqs" attribute;

c) when the "repFreqs" attribute is set to the value "EVENT\_TRIGGERED":

- the data rate threshold for downlink with the "consDataRateThrDl" attribute; and/or

- the data rate threshold for uplink with the "consDataRateThrUl" attribute;

d) when the "repFreqs" attribute is set to the value "PERIODIC", the periodic time for reporting and the maximum period with no data rate measurement within the "repPeriod" attribute; and

e) when the "repFreqs" attribute is set to the value "EVENT\_DETECTION", the minimum waiting time between subsequent reports within the "waitTime" attribute and the maximum period with no packet delay variation within the "repPeriod" attribute;

- if the NEF recognizes, based on configuration, that the IP address(es) received within the "listUeAddrs" attribute are different from the IP address(es) assigned by 5GC (i.e. the UE(s) are behind a NAT in UPFs), the NEF shall invoke the UEId API as defined in clause 4.4.32 for each UE IP address with port number in order to identify the corresponding IP address (and IP domain, if necessary) that has been assigned by the 5GC. The NEF then uses the respective corresponding IP address (and IP domain, if necessary) in the following steps instead of the UE IP address provided by the AF;

If the NEF authorizes the AF request, the NEF subscribes to data rate QoS Monitoring for each UE in the list to the PCFs by invoking the Npcf\_PolicyAuthorization service as defined in 3GPP TS 29.514 [7]. The NEF shall always set its notification URI as the Target of Reporting and set "directNotifInd" to true in the request to PCFs to ensure that QoS Monitoring reports can be sent by the UPF directly to the NEF regardless of whether the "directNotifInd" attribute was set to "true" in the request from the AF.

when the NEF receives the notification about data rate for the list of UEs from the PCFs as defined in clause 4.2.5.14 of 3GPP TS 29.514 [7], the NEF shall aggregate the QoS Monitoring reports for data rate for those UEs identified by "listUeConsDtRt" or "listUeAddrs" attribute and notify the AF with the "aggrDataRateRpts" attribute, it may include:

a) the uplink data rate within the "ulAggrDataRate" attribute; and/or

b) the downlink data rate within the "dlAggrDataRate" attribute.

- if the "QoSMonitoring\_5G" feature as defined in clause 5.14.4 of 3GPP TS 29.122 [4] is supported, in order to support the QoS Monitoring for packet delay, the AF shall include "qosMonInfo" attribute. The AF shall also include the "directNotifInd" attribute set to true if the "ExposureToEAS" feature is supported and the direct notification is required. Within the QosMonitoringInformation data structure, the AF shall include:

1. one or more requested QoS Monitoring Parameter(s) (i.e., UL, DL and/or RTT delay) within the "reqQosMonParams"; and

2. one or more report frequency within the "repFreqs" attribute; and

3. when the "repFreqs" attribute includes the value "PERIODIC", the periodic time for reporting and, if the feature "PacketDelayFailureReport" is supported, the maximum period with no QoS measurement results reported within the "repPeriod" attribute; and

4. when the "repFreqs" attribute includes the value "EVENT\_TRIGGERED":

a. delay threshold(s) as follows:

- the delay threshold for downlink with the "repThreshDl" attribute;

- the delay threshold for uplink with the "repThreshUl" attribute; and/or

- the delay threshold for round trip with the "repThreshRp" attribute;

b. the minimum waiting time between subsequent reports within the "waitTime" attribute; and

c. if the feature "PacketDelayFailureReport", the maximum period with no QoS measurement results reported within the "repPeriod" attribute;

- if the "EnQoSMon" feature is supported and QoS monitoring control is for packet delay and/or congestion and/or data rate and if the "MultiMedia" feature is supported, the request is not for multiple flows (i.e., the "multiModDatFlows" attribute is not included), the AF shall include:

i. the "qosMonInfo" attribute to request QoS monitoring for packet delay as described for the "QoSMonitoring\_5G" feature, the "qosMonConReq" attribute to request QoS monitoring for congestion and/or the "qosMonDatRate" attribute to request QoS monitoring for data rate;

NOTE 2: When the feature "MultiMedia" is supported and the request is for multiple flows (i.e., the "multiModDatFlows" attribute is included) the subscription for QoS monitoring can only be indicated within the corresponding "multiModDatFlows" entry.

ii. if direct notification is required for the QoS measurement(s) provided in the "qosMonInfo", "qosMonConReq" and "qosMonDatRate" attribute(s), the "directNotifInd" attribute set to true;

iii. within each of the provided QosMonitoringInformation data structure(s):

1. one or more requested QoS Monitoring Parameter(s) for the concerned QoS monitoring parameter within the "reqQosMonParams" attribute;

2. one or more report frequency within the "repFreqs" attribute, if applicable;

NOTE 3: If the "reqQosMonParams" attribute indicates congestion measurement(s), the "repFreqs" attribute can only indicate "EVENT\_TRIGGERED".

3. when the "repFreqs" attribute includes the value "PERIODIC", the periodic time for reporting and the maximum period with no QoS measurement results reported within the "repPeriod" attribute; and

4. when the "repFreqs" attribute includes the value "EVENT\_TRIGGERED":

a. for QoS monitoring for data rate:

- the data rate threshold for downlink within the "repThreshDatRateDl" attribute; and/or

- the data rate threshold for uplink within the "repThreshDatRateUl" attribute;

b. for QoS monitoring for congestion information

- the congestion threshold for downlink with the "conThreshDl" attribute; and/or

- the congestion threshold for uplink with the "conThreshUl" attribute; and

c. the minimum waiting time between subsequent reports within the "waitTime" attribute; and

d. the maximum period with no QoS measurement results reported within the "repPeriod" attribute.

e. when the "ListUE\_5G" feature is supported, for QoS monitoring for consolidated data rate for list of UEs:

- the consolidated data rate threshold for downlink within the "consDataRateThrDl" attribute; and/or

- the consolidated data rate threshold for uplink within the "consDataRateThrUl" attribute; and

NOTE 4: If the "consDataRateThrDl" and/or "consDataRateThrUl" attributes are provided, the QoS parameter(s) to be measured indicates the Guaranteed Bitrate shall be provided.

Editor’s note: Whether the applicable reporting frequency for the Data Rate QoS monitoring can be event triggered and/or periodic is FFS.

if the "EnQoSMon" feature is supported and QoS monitoring control is for data rate, the AF may include the averaging window within the "avrgWndw" attribute.

If the NEF authorizes the AF request, the NEF may create a QoS monitoring notification correlation identifier for the AF transaction during the creation of the AF resource and may provision it together with the received QoS monitoring parameters to the PCF by invoking the Npcf\_PolicyAuthorization service as defined in 3GPP TS 29.514 [7] or, if the "TSC\_5G" feature is supported, to the TSCTSF by invoking the Ntsctsf\_QoSandTSCAssistance service as defined in 3GPP TS 29.565 [50];

- when the NEF receives the event notification for the AF transaction as defined in clause 4.2.2 of 3GPP TS 29.508 [26] or clause 4.2.5.14 of 3GPP TS 29.514 [7] or, if the "TSC\_5G" feature is supported, clause 5.3.2.5.7 of 3GPP TS 29.565 [50], or when the AF requested direct notification, as defined in clause 5.2.2.3 of 3GPP TS 29.564 [61], the NEF shall include one or more QoS monitoring reports with the delay measurement within the "qosMonReports", the data rate measurements within the "qosMonDatRateReps" and/or the congestion measurements within "qosMonCongReps" attribute. Within the QosMonitoringReport data structure, the NEF shall include the received monitored QoS information.

- for packet delay measurements, within "qosMonReports":

a. the uplink packet delays within the "ulDelays" attribute; and/or

b. the downlink packet delays within the "dlDelays" attribute; and/or

c. the round trip packet delays within the "rtDelays" attribute;

NOTE 5: The PCF, the SMF, the UPF or the TSCTSF report one UL, DL and/or round-trip packet delay measurement for each periodic and/or event-triggered report as described in 3GPP TS 29.514 [7], 3GPP TS 29.508 [26], 3GPP TS 29.564 [61] and 3GPP TS 29.565 [50], i.e, the NEF can include only one element within the "ulDelays", "dlDelays", and/or "rtDelays" array(s), each one with the received report from the PCF, SMF, UPF or the TSCTSF for the UL, DL and/or round trip delay(s).

- when the feature "EnQoSMon" is supported, for congestion information measurements, within the "qosMonConInfoReps":

a. the uplink congestion information measurement(s) within the "ulConInfo" attribute; and/or

b. the downlink congestion information measurement(s) within the "dlConInfo" attribute;

- when the feature "EnQoSMon" is supported, for data rate measurements, within "qosMonDatRateReports":

a. one data rate measurement for the UL within the "ulDataRate" attribute; and/or

b. one data rate measurement for the DL within the "dlDataRate" attribute; or

- if the feature "PacketDelayFailureReport" is supported or the "EnQoSMon" feature is supported, the packet delay measurement failure indicator within the "pdmf" attribute;

- when the "ListUE\_5G" feature is supported, for QoS monitoring for consolidated data rate for list of UEs, within "aggrDataRateRpts":

- the consolidated data rate measurement for DL within the "dlAggrDataRate" attribute; and/or

- the consolidated data rate measurement for UL within the "ulAggrDataRate" attribute;

Editor’s Note: It is FFS whether new data type structure is needed for QoS monitoring control for multi-modal services.

- if the "MultiMedia" feature is supported, when the NEF receives the event notification for the AF transaction as defined in clause 4.2.2 of 3GPP TS 29.508 [26] or clause 4.2.5.14 of 3GPP TS 29.514 [7], or when the AF requested direct notification, as defined in clause 5.2.2.3 of 3GPP TS 29.564 [61], the NEF shall include the affected single-modal identification number and the corresponding flows within the "multiModFlows" attribute.

- if the "AlternativeQoS\_5G" feature is supported, the AF may include an ordered list of QoS references within the "altQosReferences" attribute and, if the "DisableUENotification\_5G" feature is also supported, an indication that the UE does not need to be informed about changes related to Alternative QoS Profiles within the "disUeNotif" attribute.

- When the NEF interfaces directly with the PCF, the NEF shall transfer them to the PCF in the Npcf\_PolicyAuthorization service and subscribe to PCF event "QOS\_NOTIF" in the Npcf\_PolicyAuthorization service. When the NEF receives the notification of PCF event "QOS\_NOTIF", it shall notify the AF with "QOS\_GUARANTEED" event or with "QOS\_NOT\_GUARANTEED" event and the currently applied QoS reference if received. When the NEF receives the notification of PCF event "SUCCESSFUL\_RESOURCES\_ALLOCATION", it shall notify the AF the event together with the currently applied QoS reference if received.

- If the "TSC\_5G" feature is supported, when the NEF interfaces with the TSCTSF, the NEF shall transfer the received alternative QoS references to the TSCTSF in the Ntsctsf\_QoSandTSCAssistance service and subscribe with TSCTSF to "QOS\_GUARANTEED" and "QOS\_NOT\_GUARANTEED" events. When the NEF receives the event notification from the TSCTSF, the NEF shall notify the AF with "QOS\_GUARANTEED" event or with "QOS\_NOT\_GUARANTEED" event and the currently applied QoS reference if received. When the NEF receives the notification of TSCTSF event "SUCCESSFUL\_RESOURCES\_ALLOCATION", it shall notify the AF the event together with the currently applied QoS reference if received.

If the feature "AltQoSProfilesSupportReport" is supported, when the NEF receives the indication from the PCF or the TSCTSF about the support of alternative QoS profiles, the NEF shall notify the AF forwarding the received indication within the "altQosNotSuppInd" attribute.

NOTE 6: Based on the operator configuration, the QoS reference identifiers received from the AF can be the same or different as the QoS reference identifiers known at the PCF. The NEF can perform a mapping for the QoS reference identifier.

- if the "TSC\_5G" feature is supported, the AF may include:

- the TSC QoS requirement within the "tscQosReq" attribute. Within the TscQosRequirement data structure, the AF may include:

- the input information to construct the TSC Assistance Container within the "tscaiInputUl" attribute and/or "tscaiInputDl"attribute, and the (g)PTP domain that the AF is located in within the "tscaiTimeDom" attribute;

NOTE 7: For the adjustment of burst sending time and adjustment of periodicity within the "periodicityRange" attribute in the UL direction within the "tscaiInputUl" attribute, it is expected that the AF interacts with the application in the UE or devices behind the UE based on application layer signaling.

- the capability for BAT adaptation within the "capBatAdaptation" attribute, if the "EnTSCAC" feature is also supported. The capability for BAT adaptation and the burst arrival time window ("burstArrivalTimeWnd" attribute within the "tscaiInputUl" attribute and/or "tscaiInputDl" attribute of the "tscQosReq" attribute) are mutually exclusive; and

- if individual QoS parameters instead of QoS reference is provided, may include:

- requested GBR within the "reqGbrDl" attribute and/or "reqGbrUl" attribute;

- requested MBR within the "reqMbrDl" attribute and/or "reqMbrUl" attribute;

- the maximum burst size within the "maxTscBurstSize" attribute;

- the priority within the "priority" attribute;

- the requested 5GS delay within the "req5Gsdelay" attribute; and

- the requested packet error rate within the "reqPer" attribute, if the "ExtQoS\_5G" feature is also supported.

If the NEF authorizes the AF request, the NEF may provision the received QoS requirements to the TSCTSF by invoking the Ntsctsf\_QoSandTSCAssistance\_Create/Update request as defined in 3GPP TS 29.565 [50]. The NEF determines whether to invoke the TSCTSF or to directly contact the PCF based on operator configuration. This determination may consider the AF identifier, whether the "tscaiInputUl" and/or "tscaiInputDl" attributes within the "tscQosReq" attribute were received in the subscription request, whether the "qosReference" attribute or individual QoS parameters within the "tscQosReq" attribute were received in the subscription request, and SLA between operator and application provider. A TSCTSF address may be locally configured in the NEF or the NEF uses the DNN/S-NSSAI (which may be provided in the request or determined based on the AF identifier) to discover the TSCTSF from the NRF. If the NEF directly contacts the PCF while the NEF determined to invoke the TSCTSF when authorizing the update request, the NEF shall reject the request message by sending an HTTP response to the AF with a status code set to 403 Forbidden and may include the "INVALID\_SESSION\_UPDATE" error in the "cause" attribute of the "ProblemDetails" structure and indicate which parameters can not be served in current session in the "invalidParams" attribute of the "ProblemDetails" structure.

NOTE 7: The NEF can determine whether the TSCTSF needs to be involved based on the DNN/S-NSSAI for the AF session according to the SLA.

If the "EnTSCAC" feature is supported and the NEF receives the BAT offset information from the TSCTSF about the BAT offset and the optionally adjusted periodicity, the NEF shall send an Event Notification to the AF with the "event" attribute set to BAT\_OFFSET\_INFO and including the "ranBatOffsetNotif" attribute and optionally the "adjPeriod" attribute within the "batOffsetInfo" attribute.

- if the "AltQosWithIndParams\_5G" feature is supported, the AF may include:

- an ordered list of alternative service requirements that include individual QoS parameter sets within the "altQosReqs" attribute and, if the "DisableUENotification\_5G" feature is also supported, an indication that the UE does not need to be informed about changes related to Alternative QoS Profiles within the "disUeNotif" attribute. Within the AlternativeServiceRequirementsData data structure, the AF shall include:

- a reference to the alternative individual QoS related parameter(s) included in this set within the "altQosParamSetRef" attribute; and

- at least one of the following:

- The guaranteed bandwidth in uplink within the "gbrUl" attribute and the guaranteed bandwidth in downlink within the "gbrDl" attribute;

- The requested packet delay budget within the "pdb" attribute;

- The requested packet error rate within the "per" attribute if the "ExtQoS\_5G" feature is supported;

If the NEF authorizes the AF request, and if the "TSC\_5G" feature is supported, the NEF may provision the received QoS requirements and subscribe with the TSCTSF to "QOS\_GUARANTEED" and "QOS\_NOT\_GUARANTEED" events by invoking the Ntsctsf\_QoSandTSCAssistance\_Create request as defined in 3GPP TS 29.565 [50]. The NEF determines whether to invoke the TSCTSF or to directly contact the PCF based on operator configuration. This determination may consider the AF identifier, whether the "tscaiInputUl" and/or "tscaiInputDl" attributes within the "tscQosReq" attribute were received in the subscription request, whether the "qosReference" attribute or individual QoS parameters within the "altQosReqs" attribute were received in the subscription request, and SLA between operator and application provider. A TSCTSF address may be locally configured in the NEF or the NEF uses the DNN/S-NSSAI (which may be provided in the request or determined based on the AF identifier) to discover the TSCTSF from the NRF. When the NEF receives the notification of TSCTSF "QOS\_GUARANTEED" event or "QOS\_NOT\_GUARANTEED" event, it shall notify the AF with "QOS\_GUARANTEED" event or "QOS\_NOT\_GUARANTEED" event with the currently applied individual QoS parameter set within the "appliedQosRef" attribute if received. When the NEF receives the notification of the TSCTSF event "SUCCESSFUL\_RESOURCES\_ALLOCATION", it shall notify the AF the event together with the currently applied individual QoS parameter set within the "appliedQosRef" attribute if received. If the NEF directly contacts the PCF while the NEF determined to invoke the TSCTSF when authorizing the update request, the NEF shall reject the request message by sending an HTTP response to the AF with a status code set to 403 Forbidden and may include the "INVALID\_SESSION\_UPDATE" error in the "cause" attribute of the "ProblemDetails" structure and indicate which parameters can not be served in current session in the "invalidParams" attribute of the "ProblemDetails" structure.

NOTE 9: The NEF can determine whether the TSCTSF needs to be involved based on the DNN/S-NSSAI for the AF session according to the SLA.

When the NEF interfaces directly with the PCF, the NEF shall transfer the received QoS requirements to the PCF in the Npcf\_PolicyAuthorization service and subscribe to PCF event "QOS\_NOTIF" in the Npcf\_PolicyAuthorization service. When the NEF receives the notification of PCF event "QOS\_NOTIF", it shall notify the AF with "QOS\_GUARANTEED" event or with the "QOS\_NOT\_GUARANTEED" event and the currently applied QoS reference if received. When the NEF receives the notification of PCF event "SUCCESSFUL\_RESOURCES\_ALLOCATION", it shall notify the AF the event together with the currently applied QoS reference if received.

If the feature "AltQoSProfilesSupportReport" is supported, when the NEF receives the indication from the PCF or the TSCTSF about the support of alternative QoS profiles, the NEF shall notify the AF forwarding the received indication within the "altQosNotSuppInd" attribute.

- If the "enNB\_5G" feature is supported, the AF may additionally subscribe the event(s) "ACCESS\_TYPE\_CHANGE" and/or "PLMN\_CHG". If the NEF authorizes the AF request, the NEF shall subscribe the event(s) at the PCF by invoking the Npcf\_PolicyAuthorization service operation.

- if the ToSTC\_5G feature as defined in clause 5.14.4 of 3GPP TS 29.122 [4] is supported:

- in the HTTP POST request, the AF may include the "tosTC" attribute within the "flowInfo" attribute of the AsSessionWithQoSSubscription data type; and

- in the HTTP PATCH request, the AF may include the "tosTC" attribute within the "flowInfo" attribute of the AsSessionWithQoSSubscriptionPatch data type;

- if the "PowerSaving" feature is supported, the AF may include:

- the Uplink and/or Downlink Periodicity information which indicates the time period between the start of the two data bursts in Uplink and/or Downlink direction within the "periodUl" and "periodDl" attributes respectively;

- if the "EnQoSMon" feature is supported, the AF may include:

- in order to support the QoS Monitoring for packet delay variation, the AF shall include the required Packet Delay Variation monitoring information within "pdvMon" attribute. The subscribed event is "PACK\_DELAY\_VAR". The AF shall include within the "pdvMon" attribute:

a) the requested Packet Delay Variation parameter(s) to be measured (i.e. DL, UL and/or round trip packet delay variation) within the "reqQosMonParams" attribute;

b) one or more report frequency within the "repFreqs" attribute;

c) when the "repFreqs" attribute is set to the value "EVENT\_TRIGGERED":

- the Packet Delay Variation threshold for downlink with the "repThreshDl" attribute;

- the Packet Delay Variation threshold for uplink with the "repThreshUl" attribute; and/or

- the Packet Delay Variation threshold for round trip with the "repThreshRp" attribute;

d) when the "repFreqs" attribute is set to the value "PERIODIC", the periodic time for reporting and the maximum period with no packet delay variance measurement within the "repPeriod" attribute; and

e) when the "repFreqs" attribute is set to the value "EVENT\_DETECTION", the minimum waiting time between subsequent reports within the "waitTime" attribute and the maximum period with no packet delay variation within the "repPeriod" attribute;

NOTE 10: The direct notification "directNotifInd" attribute is not applicable for "pdvMon" attribute because the PDV monitoring calculation and notification is performed by the PCF. In case "directNotifInd" attribute is provided for packet delay, data rate, and/or congestion information along with PDV monitoring, the PDV monitoring follows the specified PCF notification mechanism and other QoS monitorings request follows the direct notification mechanism, if feasible.

- when the NEF receives the notification about Packet Delay Variation event notification from the PCF as defined in clause 4.2.5.26 of 3GPP TS 29.514 [7], the NEF shall notify the AF with "PACK\_DELAY\_VAR" event and include the received monitored Packet Delay Variation information within the "pdvMonReports" attribute, it may include:

a) the uplink packet delay variation measurement(s) within the "ulPdv" attribute;

b) the downlink packet delay variation measurement(s) within the "dlPdv" attribute;

c) the round trip packet delay variation measurement(s) within the "rtPdv" attribute;

- in order to support the QoS Monitoring for the required round-trip delay over two QoS flows (i.e. the UL traffic and DL traffic of the service data flow are separated into two QoS flows respectively), the AF shall provide the event "RT\_DELAY\_TWO\_QOS\_FLOWS" and shall include within the "rttMon" attribute:

a) the round trip packet delay value within the "reqQosMonParams" attribute;

b) one or more report frequency within the "repFreqs" attribute;

c) the requested threshold of round-trip delay measurements over two QoS flows within the "repThreshRp" attribute;

d) when the "repFreqs" attribute is set to the value "PERIODIC", the periodic time for reporting and the maximum period with no round-trip delay over two QoS flows within the "repPeriod" attribute; and

e) when the "repFreqs" attribute is set to the value "EVENT\_DETECTION", the minimum waiting time between subsequent reports within the "waitTime" attribute and the maximum period with no round-trip delay over two QoS flows within the "repPeriod" attribute;

- when the NEF receives the notification about round-trip delay over two QoS flows (i.e., the UL traffic and DL traffic of the service data flow are separated into two QoS flows respectively) event notification from the PCF as defined in clause 4.2.5.28 of 3GPP TS 29.514 [7], the NEF shall notify the AF with "RT\_DELAY\_TWO\_QOS\_FLOWS" event and include the received round-trip delay over two QoS flows information with:

a) the round-trip delay over two QoS flows within the "rtDelays" attribute;

Editor’s note: It is FFS how to correlate the uplink and downlink service data flows for the measurement of round-trip delay over two QoS flows.

- if the "MultiMedia" feature is supported, the AF may include:

- the multi-modal Service ID within the "multiModalId" attribute; and/or

- the multi-modal data flow(s) information of the multi-modal service in the "multiModDatFlows" attribute. The AF shall include for each single-modal data flow(s) of the multi-modal service:

1. the single-modal data identification number within the "medCompN" attribute;

2. the IP data flow(s) description for the single-modal data flow within the "flowInfos" attribute; and

3. the parameters that describe the requested QoS for the single-modal data flow, as follows:

a. the single-modal data flow type within the "medType" attribute, if applicable;

b. either a reference to a pre-defined QoS information for the single-modal data flow within the "qosReference" attribute, or individual QoS parameters within the "tsnQos" attribute;

c. if individual QoS parameters are provided, an ordered list of alternative service requirements for the single-modal data flow within the "altSerReqsData" attribute, if applicable;

d. if a reference to pre-defined QoS information is provided, an ordered list of QoS references for the single-modal data flow within the "altSerReqs" attribute, if applicable;

e. QoS assistance information for the UL and/or DL for the single-modal data flow within the "tscaiInputUl" and/or "tscaiInputDl" attribute, if applicable;

f. an indication of whether UL-DL transmission adjustments to meet the RT Latency applies to the single-modal data flow within the "rTLatencyReq" attribute, if applicable;

g. if the "PDUSetHandling" feature is supported, PDU Set QoS related information for the single-modal data flow within the "pduSetQosDl" and/or "pduSetQosUl" attribute(s), if applicable, and the Protocol Description related information within the "protoDescDl" and/or "protoDescUl" attribute(s), if applicable;

NOTE 11: For multi-modal communication services related to multiple UEs, multiple UE-specific AF requests are used, and the AF provided information to NEF is the same as single UE case. Multiple UE-specific AF requests can include the same multimodal Service ID within the "multiModalId" attribute. For the single UE case, the AF can provide the multiple single-modal data flows of the multi-modal communication service via single or multiple AF requests.

h. if the "EnQoSMon" feature is supported, the subscription information which is applicable to the QoS monitoring events within the "evSubsc" attribute;

i. if the "L4S" feature is supported, the Low Latency, Low Loss and Scalable Throughput (L4S) Support indication within the "l4sInd" attribute. In this case, the AF shall also subscribe to notifications of ECN marking for L4S support information not available in 5GS within the"evSubsc" attribute as specified in 3GPP TS 29.514 [7]; and

j. if the "PowerSaving" feature is supported, the time period between the start of the two data bursts in Uplink and/or Downlink direction within "periodUl" and "periodDl" attributes respectively;

NOTE 12: When both, "EnQoSMon" and "L4S" features are supported, for each data flow of the multi-modal service, the AF can include either the indication of L4S support within the "l4sInd" attribute or the request for congestion measurements within the "evSubsc" attribute as specified in 3GPP TS 29.514 [7], but the request cannot include both attributes simultaneously. The Individual AS Session with Required QoS Subscription resource cannot contain for a single-modal data flow(s) simultaneously both, the indication of L4S support and the subscription to congestion monitoring.

- if the NEF authorizes the AF request, the NEF shall provision the received multi-modal service information to the PCF by invoking the Npcf\_PolicyAuthorization service as defined in 3GPP TS 29.514 [7]. If the multi-modal service information contains per flow subscription to events, the NEF, per flow, shall provide a notification URI and may provide a notification correlation identifer together with the received event(s) parameters by invoking the Npcf\_PolicyAuthorization service as defined in 3GPP TS 29.514 [7]; and

- when the NEF receives the QoS monitoring event notification for the AF transaction as defined in clause 4.2.5.14 of 3GPP TS 29.514 [7] the NEF shall identify the affected AF flow identifiers based on the flow identifiers received from the PCF. When the NEF receives the QoS monitoring event notification for the AF transaction as defined in clause 4.2.2 of 3GPP TS 29.508 [26] or when the AF requested direct notification, as defined in clause 5.2.2.3 of 3GPP TS 29.564 [61], the NEF may identify the affected AF flow identifiers based on the notification correlation identifier and/or target notification URI of the received notification;

NOTE 13: When the NEF receives QoS monitoring reports from the SMF or UPF, the NEF could determine the affected flows of a QoS monitoring report based on the per flow combination of notification URI and notification correlation ID value(s) provided to the PCF during per flow subscription with the PCF.

- if the "RTLatency" feature is supported, the AF may include:

- the indication that the service data flow needs to meet the Round-Trip (RT) latency requirement within the "rTLatencyInd" attribute;

NOTE 14: The single direction latency requirement between the UE and the PSA UPF can be either explicitly included within the "req5Gsdelay" attribute or can be derived from the "qosReference" attribute. The twice of the single direction latency is used as the Uplink-Downlink Round Trip latency of the indicated service.

If the NEF authorizes the AF request, the NEF shall transfer the received multi-modal service ID and, if applicable, the single-modal data flow(s) information of the multi-modal communication service to the PCF via the Npcf\_PolicyAuthorization service.

- if the "L4S" feature is supported, the AF may include:

- the Low Latency, Low Loss and Scalable Throughput (L4S) Support within the "l4sInd" attribute. In this case, the AF shall also subscribe to notifications of ECN marking for L4S support information not available in 5GS and available again by including the "L4S\_NOT\_AVAILABLE" and "L4S\_AVAILABLE" events in the "events" attribute. When the NEF receives the ECN marking for L4S availability event notification from the PCF as specified in 3GPP TS 29.514 [7], the NEF shall notify the AF with the corresponding "L4S\_NOT\_AVAILABLE" or "L4S\_AVAILABLE" event;

NOTE 15: When both, the "L4S" and "EnQoSMon" features are supported, the AF request can include either the indication of L4S support within the "l4sInd" attribute or the request for congestion measurements within the "qosMonConReq" attribute, but the request cannot include both attributes simultaneously. The Individual AS Session with Required QoS Subscription resource cannot contain simultaneously both, the indication of L4S support and the subscription to congestion monitoring.

- if "PDUSetHandling" feature as defined in clause 5.14.4 of 3GPP TS 29.122 [4] is supported, the AF may include:

- the protocol description within the "protoDescDl" and/or "protoDescUl" attribute(s) for the UPF to identify the PDU Set Information and or identify the last PDU of a data burst in the DL traffic and/or for the UE to identify PDU Set information. The protocol description indicates transport protocol (e.g. RTP, SRTP), transport protocol header extensions (e.g. RTP Header Extension for PDU Set Marking in the DL as defined in 3GPP TS 26.522 [74]), payload type and format (e.g. H.264, H.265), and format parameters (e.g. H.264 profile level and packetization mode) used by the service data flow for the DL and/or the UL. In case of the multi-modal data flow(s), each flow may have the respective "protoDescDl" and/or "protoDescUl" attribute(s);

Editor’s Note: the list of IEs of a multimodal data flow to complete the QoS parameters developed for the media component in TS 29.514 and applicable to external AFs is FFS.

- the PDU Set QoS parameters, "pduSetQosDl" and/or "pduSetQosUl" attribute(s);

- if the NEF receives the AF request with PDU Set QoS parameters within the "pduSetQosDl" and/or "pduSetQosUl" attribute(s) and protocol description information within the "protoDescDl" and/or "protoDescUl" attribute(s), the NEF shall forward the attributes to PCF to support the PDU Set QoS configuration by invoking the Npcf\_PolicyAuthorization\_Create/Update service operation(s);

- if the NEF receives from the PCF the indication that direct notification is not possible for the requested QoS monitoring parameters as specified in 3GPP TS 29.514 [7], the NEF shall include in the response to the AF request the "servAuthInfo" attribute with the value "DIRECT\_NOTIF\_NOT\_POSSIBLE";

- if the "PowerSaving" feature as defined in clause 5.14.4 of 3GPP TS 29.122 [4] is supported, the AF may include:

- the protocol description within the "protoDescDl" attribute, to assist the UPF to identify the End of Burst. In case of the multi-modal data flow(s), each flow may have the respective "protoDescDl" attribute;

- if the NEF receives the AF request with the "protoDescDl" attribute, the NEF shall forward the attribute to the PCF to support End of Burst detection;

- if the "QoSTiming\_5G" feature as defined in clause 5.14.4 of 3GPP TS 29.122 [4] is supported, NEF shall forward the following attributes to support the QoS Timing information:

- "qosDuration" attribute to indicate the QoS duration to transfer data traffic (e.g., AI/ML traffic).

- "qosInactInt" attribute for data traffic (e.g., AI/ML traffic) QoS inactivity interval.

If the NEF authorizes the AF request, the NEF shall provision with the received QoS timing parameters to the PCF by invoking the Npcf\_PolicyAuthorization service as defined in 3GPP TS 29.514 [7].

- If the "ExtErrors" feature is supported, the NEF may send the following error responses based on failed request responses received from the 5GC (TSCTSF, as specified in 3GPP TS 29.565 [50], or PCF, as specified in 3GPP TS 29.514 [7]):

a. If the NEF receives the indication that the 5GC failed in executing session binding, the NEF shall reject the HTTP POST request with an HTTP "500 Internal Server Error" response including the "cause" attribute set to "PDU\_SESSION\_NOT\_AVAILABLE".

b. If the service information provided in the body of the HTTP POST/PUT/PATCH request is rejected by the 5GC (e.g. the subscribed guaranteed bandwidth for a particular user is exceeded or the authorized data rate in that slice for a UE is exceeded), the NEF shall indicate in an HTTP "403 Forbidden" response message the cause for the rejection including the "cause" attribute set to "REQUESTED\_SERVICE\_NOT\_AUTHORIZED".

c. If the service information provided in the body of the HTTP POST/PUT/PATCH request is rejected due to a temporary condition in the network, the NEF may include in the "403 Forbidden" response the "cause" attribute set to "REQUESTED\_SERVICE\_TEMPORARILY\_NOT\_AUTHORIZED", as received. The NEF may also provide a received retry interval within the "Retry-After" HTTP header field. When the NF service consumer receives the retry interval within the "Retry-After" HTTP header field, the NF service consumer shall not send the same service information to the NEF again (for the same application session context) until the retry interval has elapsed. The "Retry-After" HTTP header is described in 3GPP TS 29.122 [4].

The NEF may additionally provide the acceptable bandwidth within the attribute "acceptableServInfo" included in the "ProblemDetailsAsSessionQos" data structure returned in the rejection response message.

d. When the request to provision sponsored data connectivity information provided in the body of the HTTP POST/PUT/PATCH request is rejected, the NEF shall reject the request with the received status and error cause, as follows:

1. HTTP "403 Forbidden" response message with the "cause" attribute set to "UNAUTHORIZED\_SPONSORED\_DATA\_CONNECTIVITY".

2. HTTP "403 Forbidden" response message with the "cause" attribute set to "REQUESTED\_SERVICE\_NOT\_AUTHORIZED".

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