**3GPP SA WG2 Meeting #165 *S2-2409848***

**Hyderabad, IN, 14 - 18 Oct 2024 *(was S2-2408819)***

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | **23.501** | **CR** | **5407** | **rev** | **2** | **Current version:** | **19.1.0** |  |
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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:***  | Leveraging PDU Set QoS information for DSCP marking over N3/N9 in the transport network |
|  |  |
| ***Source to WG:*** | Intel, InterDigital Inc, China Telecom, Nokia, Tencent, Xiaomi |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | XRM\_Ph2 |  | ***Date:*** | 2024-10-04 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-19 |
|  | *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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
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| ***Reason for change:*** | The following conclusion was agreed in TR 23.700-70 on Key Issue 3 (“Leverage PDU Set QoS information for DSCP marking over N3/N9 in the transport network”):*- For every QoS Flow, the SMF shall determine the transport level packet marking value (e.g. the DSCP in the outer IP header) based on the 5QI, the Priority Level (if explicitly signalled) and optionally, the ARP priority level and provide the transport level packet marking value to the UPF as described in clause 5.8.2.7 of TS 23.501 [2]. For a QoS Flow configured for PDU Set QoS handling, besides the above information, the SMF may further consider PDU Set Importance values to be used by the QoS Flow, to provide a list of DSCP values, each of the DSCP values corresponding to one or several PDU Set Importance values.**NOTE 1: It is recommended that DSCP markings be used to vary the drop precedence between PDUs in the transport network nodes (e.g. IP routers) on the N3/N9 interfaces. If the Class Selector Codepoint of the DSCP markings varies within a QoS Flow, the packets of the QoS Flow can be reordered by the transport network.**NOTE 2: The transport level marking values being provided on per-QoS Flow basis, it is up to operator deployments to enforce consistency of transport level marking in the transport network.**- The SMF sends the mapping list of the transport level marking for DL packets (N3/N9 interface) and related PDU set importance value(s) in the FAR to the UPF, and the UPF performs the DSCP value marking based additionally on the PDU Set Importance per PDU Set.* |
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| ***Summary of change:*** | Introduction of functionality for Leveraging PDU Set QoS information for DSCP marking over N3/N9 in the transport network, according to the KI#3 conclusions in TR 23.700-70 clause 8.3. |
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| ***Consequences if not approved:*** | New feature not implemented in the specification.  |
|  |  |
| ***Clauses affected:*** | 5.7.1.6; 5.8.2.7; 5.8.5.6; 5.37.1; 6.3.3.3 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **x** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

\* \* \* \* First change \* \* \* \*

#### 5.7.1.6 DL traffic

The following characteristics apply for processing of DL traffic:

- UPF maps User Plane traffic to QoS Flows based on the PDRs.

- UPF performs Session-AMBR enforcement as specified in clause 5.7.1.8 and performs counting of packets for charging.

- UPF transmits the PDUs of the PDU Session in a single tunnel between 5GC and (R)AN, the UPF includes the QFI in the encapsulation header. In addition, UPF may include an indication for Reflective QoS activation in the encapsulation header.

- UPF performs transport level packet marking in DL on a per QoS Flow basis (or on a per PDU Set basis, if applicable). The UPF uses the transport level packet marking value(s) provided by the SMF (as described in clause 5.8.2.7).

- (R)AN maps PDUs from QoS Flows to access-specific resources based on the QFI and the associated 5G QoS profile, also taking into account the N3 tunnel associated with the DL packet.

NOTE: Packet Filters are not used for the mapping of QoS Flows onto access-specific resources in (R)AN.

- If Reflective QoS applies, the UE creates a new derived QoS rule as defined in clause 5.7.5.2.

\* \* \* \* Second change \* \* \* \*

#### 5.8.2.7 PDU Session and QoS Flow Policing

ARP is used for admission control (i.e. retention and pre-emption of the new QoS Flow). The value of ARP is not required to be provided to the UPF.

For every QoS Flow, the SMF shall determine the transport level packet marking value (e.g. the DSCP in the outer IP header) based on the 5QI, the Priority Level (if explicitly signalled) and optionally, the ARP priority level and provide the transport level packet marking value to the UPF.

For QoS Flows that are configured for PDU Set QoS handling, the SMF may additionally take into account the PDU Set Importance when determining the transport level packet marking values. In this case, the SMF provides a list of transport level packet marking values for the downlink direction to the UPF in FAR, each of the transport level packet marking values pointing to one or more PDU Set Importance values. When an I-SMF/I-UPF is inserted in the PDU Session, the I-SMF may instruct the I-UPF to derive the transport level packet marking of the outgoing N3 downlink packet based on the transport level packet marking of the incoming N9 downlink packet.

NOTE 1: It is recommended that the used PDU Set Importance based transport level packet marking values only vary the drop precedence between PDUs in the transport network nodes (e.g. IP routers) on the N3/N9 interfaces. This is needed to avoid causing packet reordering in the transport network when different DSCP marking values are used for a single QoS Flow.

NOTE 2: The transport level packet marking values are provided on per-QoS Flow basis and it is up to operator deployments to enforce consistency of transport level marking in the transport network.

The SMF shall provide the Session-AMBR values of the PDU Session to the UPF so that the UPF can enforce the Session-AMBR of the PDU Session across all Non-GBR QoS Flows of the PDU Session.

SMF shall provide the GFBR and MFBR value for each GBR QoS Flow of the PDU Session to the UPF. SMF may also provide the Averaging window to the UPF, if Averaging window is not configured at the UPF or if it is different from the default value configured at the UPF.

SMF may decide to activate ECN marking for L4S by PSA UPF for the QoS Flow (see clause 5.37). In this case, the SMF shall send an ECN marking for L4S indicator to PSA UPF.

\* \* \* \* Third change \* \* \* \*

#### 5.8.5.6 Forwarding Action Rule

The following table describes the Forwarding Action Rule (FAR) that defines how a packet shall be buffered, dropped or forwarded, including packet encapsulation/decapsulation and forwarding destination.

Table 5.8.5.6-1: Attributes within Forwarding Action Rule

|  |  |  |
| --- | --- | --- |
| Attribute | Description | Comment |
| N4 Session ID | Identifies the N4 session associated to this FAR. | NOTE 9. |
| Rule ID | Unique identifier to identify this information. |  |
| Action | Identifies the action to apply to the packet | Indicates whether the packet is to be forwarded, duplicated, dropped or buffered.When action indicates forwarding or duplicating, a number of additional attributes are included in the FAR.For buffering action, a Buffer Action Rule is also included and the action can also indicate that a notification of the first buffered and/or a notification of first discarded packet is requested (see clause 5.8.3.2).For drop action, a notification of the discarded packet may be requested (see clause 5.8.3.2). |
| Network instance(NOTE 2) | Identifies the Network instance associated with the outgoing packet (NOTE 1). | NOTE 8. |
| Destination interface(NOTE 3)(NOTE 7) | Contains the values "access side", "core side", "SMF", "N6-LAN", "5G VN internal". | Identifies the interface for outgoing packets towards the access side (i.e. down-link), the core side (i.e. up-link), the SMF, the N6-LAN (i.e. the DN), or to 5G VN internal (i.e. local switch). |
| Outer header creation(NOTE 3) | Instructs the UP function to add an outer header (e.g. IP+UDP+GTP, VLAN tag), IP + possibly UDP to the outgoing packet. | Contains the CN tunnel info, N6 tunnel info or AN tunnel info of peer entity (e.g. NG-RAN, another UPF, SMF, local access to a DN represented by a DNAI) (NOTE 8).Any extension header stored for this packet shall be added.The time stamps should be added in the GTP-U header if QoS Monitoring for packet delay is enabled for the traffic corresponding to the PDR(s). |
| Send end marker packet(s)(NOTE 2) | Instructs the UPF to construct end marker packet(s) and send them out as described in clause 5.8.1. | This parameter should be sent together with the "outer header creation" parameter of the new CN tunnel info. |
| Transport level marking(NOTE 3) | Transport level packet marking in the uplink and downlink, e.g. setting the DiffServ Code Point. For the downlink direction, when the network is configured to take the PDU Set Importance into account for transport level marking, contains a list of Transport level marking values, each associated with one or more PDU Set Importance values. | NOTE 8. |
| Forwarding policy(NOTE 3) | Reference to a preconfigured traffic steering policy or http redirection (NOTE 4). | The Forwarding policy refers to a preconfigured forwarding behaviour in UPF, which may be related to:- N6-LAN steering to steer the subscriber's traffic to the appropriate N6 Service Functions deployed by the operator;- local N6 steering to enable traffic steering in the local access to the DN according to the routing information provided by an AF as described in clause 5.6.7;- a Redirect Destination and values for the forwarding behaviour (always, after measurement report (for termination action "redirect")). |
| Metadata(NOTE 10) | Metadata the UPF needs to add to traffic sent over a SFC. | The metadata information is associated with a TSP ID related to N6-LAN steering. |
| Request for Proxying in UPF | Indicates that the UPF shall perform ARP proxying and / or IPv6 Neighbour Solicitation Proxying as specified in clause 5.6.10.2. | Applies to the Ethernet PDU Session type. |
| Container for header enrichment(NOTE 2) | Contains information to be used by the UPF for header enrichment. | Only relevant for the uplink direction. |
| Buffering Action Rule(NOTE 5) | Reference to a Buffering Action Rule ID defining the buffering instructions to be applied by the UPF(NOTE 6) |  |
| NOTE 1: Needed e.g. if: - UPF supports multiple DNN with overlapping IP addresses; - UPF is connected to other UPF or NG-RAN node in different IP domains; - UPF "local switch" and N19 forwarding is used for different 5G LAN groups.NOTE 2: These attributes are required for FAR action set to forwarding.NOTE 3: These attributes are required for FAR action set to forwarding or duplicating.NOTE 4: The TSP ID is preconfigured in the SMF and used to determine the Forwarding Policy included in the FAR according to the description in clause 5.6.7 and clause 6.1.3.14 of TS 23.503 [45] for local N6 steering and in clause 5.6.16 and clause 6.1.3.14 of TS 23.503 [45] for N6-LAN steering. The Forwarding Policy action is enforced before the Outer header creation actions.NOTE 5: This attribute is present for FAR action set to buffering.NOTE 6: The buffering action rule is created by the SMF and associated with the FAR in order to apply a specific buffering behaviour for UL/DL packets requested to be buffered, as described in clause 5.8.3 and clause 5.2.4 of TS 29.244 [65].NOTE 7: The use of "5G VN internal" instructs the UPF to send the packet back for another round of ingress processing using the active PDRs pertaining to another N4 session of the same 5G VN group.NOTE 8: When in architectures defined in clause 5.34, a FAR is sent over N16a from SMF to I-SMF, the FAR sent by the SMF may indicate that the I-SMF is to locally determine the value of this attribute in order to build the N4 FAR rule sent to the actual UPF controlled by the I-SMF. This is further defined in clause 5.34.6.NOTE 9: In the architecture defined in clause 5.34, the rules exchanged between I-SMF and SMF are not associated with a N4 Session ID but are associated with a N16a association.NOTE 10: The use of Metadata is described in clause 5.6.16. How the UPF transforms the Metadata into actual information sent with the traffic (e.g. in the encapsulation header) is based on local policies related with the Forwarding Policy and not specified. |

\* \* \* \* Fourth change \* \* \* \* \*

### 5.37.1 General

This clause provides an overview of 5GS functionalities for support of XR services (AR/VR applications) and interactive media services that require high data rate and low latency communication, e.g. cloud gaming and tactile/multi-modal communication services according to service requirements documented in TS 22.261 [2]. The standardized 5QI characteristics for such interactive services are provided in Table 5.7.4-1 and TSCAI is used to describe the related traffic characteristics as defined in clause 5.27.2. Further enhancements for these interactive media services are as follows:

- The 5GS may support QoS policy control for multi-modal traffic, see clause 5.37.2.

- The 5GS may support network information exposure which can be based on ECN markings for L4S, see clause 5.37.3 or 5GS exposure API, see clause 5.37.4.

- The 5GS may support PDU Set based QoS handling including PDU Set identification and marking, see clause 5.37.5.

- The 5GS may ensure that the UL and DL packets together meet the requested round trip delay and also update the delay for UL and DL considering QoS monitoring results, see clause 5.37.6.

- The 5GS may perform per-flow Packet Delay Variation (PDV) monitoring and policy control according to AF provided requirements, see clause 5.37.7.

- The 5GC may provide traffic assistance information to the NG-RAN to enable Connected mode DRX power saving, see clause 5.37.8.

- The 5GC may perform PDU Set Importance based DSCP transport level packet marking, see clause 5.8.2.7.

\* \* \* \* Fifth change \* \* \* \* \*

#### 6.3.3.3 Selection of an UPF for a particular PDU Session

The following parameter(s) and information may be considered by the SMF for UPF selection and re-selection:

- UPF's dynamic load.

- Analytics (i.e. statistics or predictions) for UPF load, Service Experience analytics and/or DN Performance analytics per UP path (including UPF and/or DNAI and/or AS instance) and UE related analytics (UE mobility, UE communication, and expected UE behavioural parameters) as received from NWDAF (see TS 23.288 [86]), if NWDAF is deployed.

- UPF's relative static capacity among UPFs supporting the same DNN.

- UPF location available at the SMF.

- UE location information.

- Capability of the UPF and the functionality required for the particular UE session: An appropriate UPF can be selected by matching the functionality and features required for an UE.

- Data Network Name (DNN).

- PDU Session Type (i.e. IPv4, IPv6, IPv4v6, Ethernet Type or Unstructured Type) and if applicable, the static IP address/prefix.

- SSC mode selected for the PDU Session.

- UE subscription profile in UDM.

- DNAI as included in the PCC Rules and described in clause 5.6.7.

- Local operator policies.

- S-NSSAI.

- Access technology being used by the UE.

- Information related to user plane topology and user plane terminations, that may be deduced from:

- 5G-AN-provided identities (e.g. CellID, TAI), available UPF(s) and DNAI(s);

- Identifiers (i.e. a FQDN and/or IP address(es)) of N3 terminations provided by a W-AGF or a TNGF or a TWIF;

NOTE 1: A W-AGF or a TNGF may provide Identifiers of its N3 terminations when forwarding over N2 uplink NAS signalling to the 5GC. The AMF may relay this information to the SMF, as part of session management signalling for a new PDU Session.

- Information regarding the user plane interfaces of UPF(s). This information may be acquired by the SMF using N4;

- Information regarding the N3 User Plane termination(s) of the AN serving the UE. This may be deduced from 5G-AN-provided identities (e.g. CellID, TAI);

- Information regarding the N9 User Plane termination(s) of UPF(s) if needed;

- Information regarding the User plane termination(s) corresponding to DNAI(s).

- RSN, support for redundant GTP-U path or support for redundant transport path in the transport layer (as in clause 5.33.2) when redundant UP handling is applicable.

- Information regarding the ATSSS Steering Capability of the UE session (e.g. any combination of ATSSS-LL capability, MPTCP capability, MPQUIC capability) and information on the UPF support of RTT measurements without PMF.

- Support for UPF allocation of IP address/prefix.

- Support of the IPUPS functionality, specified in clause 5.8.2.14.

- Support for High latency communication (see clause 5.31.8).

- Support for functionality associated with high data rate low latency services, eXtended Reality (XR) and interactive media services, specified in clause 5.37 (for example, ECN marking for L4S, specified in clause 5.37.3, PDU Set Marking, specified in clause 5.37.5, UE power saving management, specified in clause 5.37.8), or PDU Set Importance based transport level packet marking specified in clause 5.8.2.7.

- User Plane Latency Requirements within AF request (see clause 5.6.7.1 and clause 6.3.6 of TS 23.548 [130]).

- List of supported Event ID(s) for exposure of UPF-related information via service based interface (see clause 7.2.29 and clause 5.2.26.2 of TS 23.502 [3]).

NOTE 2: How the SMF determines information about the user plane network topology from information listed above, and what information is considered by the SMF, is based on operator configuration.

NOTE 3: In this release the SMF uses no additional parameters for UPF selection for a PDU Session serving TSC or Deterministic Networking. If a PDU Session needs to connect to a specific UPF hosting a specific TSN 5GS bridge or 5GS router, this can be achieved e.g. by using a dedicated DNN/S-NSSAI combination.

If there is an existing PDU Session, and the SMF receives another PDU Session request to the same DNN and S-NSSAI, and if the SMF determines that interworking with EPC is supported for this PDU Session (as specified in clause 4.11.5 of TS 23.502 [3]), the SMF should select the same UPF if it supports all capabilities required for the new PDU Session. Otherwise, if the SMF determines that interworking with EPC is not supported for the new PDU Session or the UPF of the existing PDU Session does not support all capabilities required for the new PDU Session, a different UPF may be selected according to operator policy.

For the same DNN and S-NSSAI if different UPFs are selected at 5GC, when the UE is moved to EPC network, there is no requirement to enforce APN-AMBR. Whether and how to apply APN-AMBR for the PDN Connection associated with this DNN/APN is implementation dependent, e.g. possibly only AMBR enforcement per PDU Session applies.

\* \* \* End of changes \* \* \* \*