**3GPP TSG-WG SA2 Meeting #165 *S2-24xxxxx***

**14 - 18 October, 2024, Hyderabad, India**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **23.501** | **CR** |  | **rev** | **-** | **Current version:** | **19.1.0** |  |
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| *For* ***[HE](http://www.3gpp.org/3G_Specs/CRs.htm%22%20%5Cl%20%22_blank)******[LP](http://www.3gpp.org/3G_Specs/CRs.htm%22%20%5Cl%20%22_blank)*** *on using this form: comprehensive instructions can be found at <http://www.3gpp.org/Change-Requests>.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network | **X** |

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|  |
| ***Title:***  | Support PDU Set information identification based on MoQ for encrypted XRM traffic |
|  |  |
| ***Source to WG:*** | China Mobile |
| ***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)* |
|  |  |
| ***Reason for change:*** | The PDU Set information can be identified via Metadata based on Media over QUIC (MoQ) for end-to-end encrypted XRM traffic, which should be supported in normative work according to the conclusions for KI#2.  |
|  |  |
| ***Summary of change:*** | The PDU Set information identification based on MoQ for encrypted XRM traffic is enhanced for KI#2. |
|  |  |
| ***Consequences if not approved:*** | The PDU Set information identification for end-to-end encrypted XRM traffic is not supported. |
|  |  |
| ***Clauses affected:*** | 5.8.5.4, 5.37.5, 6.2.3, 6.3.3.3 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  |  |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

\* \* \* \* Start of changes\* \* \* \*

#### 5.8.5.4 QoS Enforcement Rule

The following table describes the QoS Enforcement Rule (QER) that defines how a packet shall be treated in terms of bit rate limitation and packet marking for QoS purposes. All Packet Detection Rules that refer to the same QER share the same QoS resources, e.g. MFBR.

Table 5.8.5.4-1: Attributes within QoS Enforcement Rule

|  |  |  |
| --- | --- | --- |
| Attribute | Description | Comment |
| N4 Session ID | Identifies the N4 session associated to this QER |  |
| Rule ID | Unique identifier to identify this information. |  |
| QoS Enforcement Rule correlation ID (NOTE 1) | An identity allowing the UP function to correlate multiple Sessions for the same UE and APN. | Is used to correlate QoS Enforcement Rules for APN-AMBR enforcement. |
| Gate status UL/DL | Instructs the UP function to let the flow pass or to block the flow. | Values are: open, close, close after measurement report (for termination action "discard"). |
| Maximum bitrate | The uplink/downlink maximum bitrate to be enforced for the packets. | This field may e.g. contain any one of:- APN-AMBR (for a QER that is referenced by all relevant Packet Detection Rules of all PDN Connections to an APN) (NOTE 1).- Session-AMBR (for a QER that is referenced by all relevant Packet Detection Rules of the PDU Session)- QoS Flow MBR (for a QER that is referenced by all Packet Detection Rules of a QoS Flow)- SDF MBR (for a QER that is referenced by the uplink/downlink Packet Detection Rule of a SDF)- Bearer MBR (for a QER that is referenced by all relevant Packet Detection Rules of a bearer) (NOTE 1). |
| Guaranteed bitrate | The uplink/downlink guaranteed bitrate authorized for the packets. | This field contains:- QoS Flow GBR (for a QER that is referenced by all Packet Detection Rules of a QoS Flow)- Bearer GBR (for a QER that is referenced by all relevant Packet Detection Rules of a bearer) (NOTE 1). |
| Averaging window | The time duration over which the Maximum and Guaranteed bitrate shall be calculated. | This is for counting the packets received during the time duration. |
| Down-link flow level marking | Flow level packet marking in the downlink. | For UPF, this is for controlling the setting of the RQI in the encapsulation header as described in clause 5.7.5.3. |
| QoS Flow ID | QoS Flow ID to be inserted by the UPF. | The UPF inserts the QFI value in the tunnel header of outgoing packets. |
| Paging Policy Indicator | Indicates the PPI value the UPF is required to insert in outgoing packets (see clause 5.4.3.2). | PPI applies only for DL traffic. The UPF inserts the PPI in the outer header of outgoing PDU. |
| Packet rate (NOTE 1) | Number of packets per time interval to be enforced. | This field contains any one of:- downlink packet rate for Serving PLMN Rate Control (the QER is referenced by all PDRs of the UE belonging to PDN connections using CIoT EPS Optimisations as described in TS 23.401 [26]).- uplink/downlink packet rate for APN Rate Control (the QER is referenced by all PDRs of the UE belonging to PDN connections to the same APN using CIoT EPS Optimisations as described in TS 23.401 [26]). |
| End of Data Burst Marking Indication | Indicates to the UPF to provide an End of Data Burst indication of the last PDU of a Data burst to the NG-RAN over GTP-U | NG-RAN can configure UE power management schemes like connected mode DRX when UPF provides an indication of the End of Data Burst, see clause 5.37.8.3. |
| PDU Set Information marking Indicator | Indicates the UPF to insert PDU Set Information related to packets belonging to a PDU Set into GTP-U header. | UPF identifies PDU Sets in DL traffic and forwards PDU Set related information of each PDU to the NG-RAN over GTP-U, as described in clause 5.37.5. |
| MoQ Relay Indication | Instructs the UPF to activate the MoQ relay functionality, as well as provides the UPF with the AS address to establish MoQ connection with AS. | UPF identifies PDU Set information from the MoQ metadata, as described in clause 5.37.5. |
| ECN marking for L4S indicator | Indicates the UPF to perform ECN marking for L4S for the corresponding QoS Flow. | UPF uses information sent by NG-RAN in GTP-U header extension to perform ECN marking for L4S for the corresponding direction. |
| NOTE 1: This parameter is only used for interworking with EPC. |

\* \* \* \* Next change\* \* \* \*

### 5.37.5 PDU Set based Handling

#### 5.37.5.1 General

A PDU Set is comprised of one or more PDUs carrying an application layer payload such as a video frame or video slice. The PDU Set based QoS handling by the NG-RAN is determined by PDU Set QoS Parameters in the QoS profile of the QoS Flow (specified in clause 5.7.7) and PDU Set Information provided by the PSA UPF via N3/N9 interface as described in clause 5.37.5.2. The PDU Set based Handling can be applied for GBR and non-GBR QoS Flows. The AF should provide PDU Set related assistance information for dynamic PCC control. One or more of the following PDU Set related assistance information may be provided to the NEF/PCF using the AF session with required QoS procedures in clauses 4.15.6.6 and 4.15.6.6a of TS 23.502 [3].

- PDU Set QoS Parameters as described in clause 5.7.7

- Protocol Description: Indicates the transport protocol used by the service data flow (e.g. RTP, SRTP) and information, e.g. the following:

- RTP [185] or SRTP [186];

- RTP or SRTP with RTP Header Extensions, including:

- RTP Header Extensions for PDU Set Marking as defined in TS 26.522 [179];

- Other RTP Header Extensions as defined RFC 8285 [189];

- RTP or SRTP without RTP Header Extensions, but together with RTP Payload Format (e.g. H.264 [187] or H.265 [188]);

- RTP or SRTP with RTP Header Extensions for PDU Set Marking as defined in TS 26.522 [179], and together with RTP Payload Format (e.g. H.264 [187] or H.265 [188]);

- RTP or SRTP with other RTP Header Extensions following RFC 8285 [189], and together with RTP Payload Format (e.g. H.264 [187] or H.265 [188]).

NOTE 1: With the Protocol Description options combining SRTP together with RTP Payload Format the UPF can still obtain some of the PDU Set information from the RTP Header (refer to Annex A of TS 26.522 [179]).

 When RTP Header Extensions for PDU Set Marking (as defined in TS 26.522 [179] or other RTP header extensions as defined in RFC 8285 [189] is included, the differentiation between different RTP Header Extension Types should be supported.

 When RTP Payload Format is included, the differentiation between different RTP Payload Formats should be supported.

NOTE 2: Multiplexing of different transport protocols and different media traffic for differentiated PDU Set based handling is not supported in the current Release.

- Encrypted Traffic Handling Assistance Information as described in clause 5.37.5.X.

The Protocol Description can be UL only, DL only or UL and DL. The Protocol Description for UL and DL traffic may be different.

AF provided PDU Set QoS Parameters and UL and/or DL Protocol Description may be used in determining the PCC Rule by the PCF as defined in clause 6.1.3.27.4 of TS 23.503 [45] and the DL Protocol Description may be used for identifying the PDU Set Information and PDU Set Information marking by the PSA UPF.

When the SMF receives the PCC rule, the SMF performs binding of the PCC rule to one QoS Flow as described in clause 6.1.3.2.4 of TS 23.503 [45]. At least one of the following shall be included in the PCC rule to enable PDU Set based handling: 1) a PSIHI and/or 2) both PSDB and PSER. Based on the PCC rule, the SMF adds the PDU Set QoS Parameters to the QoS Profile of the QoS Flow as described in clause 6.2.2.4 of TS 23.503 [45]. Alternatively, the SMF may be configured to support PDU Set based Handling without receiving PCC rules from a PCF.

For the downlink direction, the PSA UPF identifies PDUs that belong to PDU Sets and marks them accordingly as described in clause 5.37.5.2. If the PSA UPF receives a PDU that does not belong to a PDU Set based on Protocol Description for PDU Set identification, then the PSA UPF still maps it to a PDU Set and determines the PDU Set Information as described in clause 5.37.5.2.

NOTE 3: If the PSA UPF receives a PDU that does not belong to a PDU Set, then it is assumed that the UPF determines the PDU Set Importance value based on pre-configuration.

For the uplink direction, the UE may identify PDU Sets, and how this is done is left up to UE implementation. The SMF may send the UL Protocol Description associated with the QoS rule to UE.

NOTE 4: Using the Protocol Description or not is left to UE implementation. The use of Protocol Description does not impact QoS Flow Mapping in the UE.

In this Release, the PDU Set based handling is supported in 5GS for UE registered in 3GPP access for single access PDU Session with IP PDU Session Type.

#### 5.37.5.2 PDU Set Information and Identification

To support PDU Set based QoS handling, the PSA UPF identifies PDUs that belong to a PDU Set and determines the below PDU Set Information and sends it to the NG-RAN in the GTP-U header. The PDU Set information is used by the NG-RAN for PDU Set based QoS handling as described above.

The PDU Set Information comprises:

- PDU Set Sequence Number.

- Indication of End PDU of the PDU Set.

- PDU Sequence Number within a PDU Set.

- PDU Set Size in bytes.

- PDU Set Importance, which identifies the relative importance of a PDU Set compared to other PDU Sets within a QoS Flow.

The NG-RAN may use the Priority Level (see clause 5.7.3.3) across QoS Flows and PDU Set Importance within a QoS Flow for PDU Set level packet discarding in presence of congestion.

NOTE 1: In addition to considering the PDU Set Importance within a QoS Flow, NG-RAN could also consider the relative PDU Set Importance across QoS Flows of the same Priority Level when determining which PDU Set needs to be discarded, which is up to implementation and configuration of operator.

NOTE 2: The PDU Set Information can be different for different PDU Sets within a QoS Flow.

If the NG-RAN has provided a PDU Set based handling support Indication indicating that PDU Set handling is supported and a Protocol Description together with 1) a PSIHI and/or 2) PSDB and PSER is included in the PCC rule, the SMF instructs PSA UPF to perform PDU Set marking and may provide the PSA UPF the DL Protocol Description used by the service data flow. The DL Protocol Description may be received in the PCC rule, based on information provided by the AF or by PCF local policies as described in clause 5.37.5.1. For encrypted service data flow, the SMF may provide PSA UPF the MoQ Relay Indication as described in clause 5.37.5.X.

PSA UPF can identify the PDU Set Information using the DL Protocol Description and the received transport protocol headers and payload or using implementation specific means. The details of the RTP/SRTP headers, header extensions and/or payloads used to identify PDU Set Information are defined in TS 26.522 [179]. For encrypted service data flow, PSA UPF can identify the PDU Set Information based on MoQ, as described in clause 5.37.5.X.

For each DL PDU received on N6 for which PDU Set based QoS handling is indicated from the SMF, the PSA UPF applies the rules for PDU Set identification and provides the available PDU Set Information to the RAN in the GTP-U header.

NOTE 3: The PSA UPF is expected to assign a unique PDU Set Sequence Number in the GTP-U header to each PDU Set of the QoS Flow.

#### 5.37.5.3 Non-homogenous support of PDU set based handling in NG-RAN

The SMF, by sending PDU Set QoS parameters to the NG-RAN as described in clause 5.7.7.1, requests the NG-RAN to activate PDU Set QoS handling for a given QoS Flow and the NG-RAN provides the SMF with a PDU Set Based Handling Support Indication if the PDU Set based handling is supported. Based on this indication, SMF may activate the PDU Set identification and marking in the PSA UPF.

During mobility procedures that result in the change of NG-RAN, the target NG-RAN provides to the SMF a PDU Set Based Handling Support Indication if it supports PDU Set based handling, as specified in TS 38.413 [34]. Based on the target NG-RAN indication, the SMF may, upon completion of the mobility procedure, initiate the PDU Session modification procedure to provide PDU Set QoS parameters to NG-RAN and may configure the PSA UPF to activate the PDU Set identification and marking. If the PDU Set Based Handling Support Indication is not received from the target NG-RAN and PDU Set identification and marking is active in the PSA UPF, the SMF may deactivate it.

In the case where the PSA UPF identifies and marks PDUs with PDU Set information in GTP-U header, it shall start doing so from a complete PDU Set.

#### 5.37.5.X Support of PDU Set Information identification for encrypted traffic

The usage of end-to-end encryption is broadly deployed in networks to provide security, and the XR and interactive media services related metadata shall be encrypted and integrity protected between the UPF and the AS. For Media over QUIC (MoQ), the PDU set information is accommodated via MoQ Metadata.

In addition to the Protocol Description, the AF may provide Encrypted Traffic Handling Assistance Information for end-to-end encrypted traffic to the NEF/PCF using the AF session with required QoS procedures in clauses 4.15.6.6 and 4.15.6.6a of TS 23.502 [3], including the following assistance information:

- Media over QUIC (MoQ) supporting indication: Indicates the encrypted service data flow to be identified via MoQ Metadata;

- AS address (e.g. URI).

AF provided Protocol Description and Encrypted Traffic Handling Assistance Information may be used in determining the PCC Rule by the PCF as defined in clause 6.1.3.27.4 of TS 23.503 [45]. Based on the PCC rule, the SMF instructs the UPF to perform PDU Set Information identification as the MoQ relay, and provides the AS address to indicate UPF to establish QUIC connection with AS.

PSA UPF triggers the QUIC connection with the AS using the AS address and acts as MoQ relay. For the downlink direction, the PSA UPF can identify the PDU Set Information from the MoQ Metadata, and provides the available PDU Set Information to the RAN in the GTP-U header.

The PDU Set Information can be extracted from the MoQ Metadata as following:

- The PDU Set Sequence Number could be extracted from Object Sequence.

- Indication of End PDU of the PDU Set could be identified based on the Payload Length.

NOTE: UPF may need to store the Payload length received in a PDU at the start of the reception of an object and to use this stored information to determine the end of the PDU set when handling further PDUs related with the Object.

- PDU Set Size in bytes could be identified based on Object Payload Length.

- PDU Set Importance could be identified based on Object Send Order.

\* \* \* \* Next change\* \* \* \*

### 6.2.3 UPF

The User plane function (UPF) includes the following functionality. Some or all of the UPF functionalities may be supported in a single instance of a UPF:

- Anchor point for Intra-/Inter-RAT mobility (when applicable).

- Allocation of UE IP address/prefix (if supported) in response to SMF request.

- External PDU Session point of interconnect to Data Network.

- Packet routing & forwarding (e.g. support of Uplink classifier to route traffic flows to an instance of a data network, support of Branching point to support multi-homed PDU Session, support of traffic forwarding within a 5G VN group (UPF local switching, via N6, via N19)).

- Packet inspection (e.g. Application detection based on service data flow template and the optional PFDs received from the SMF in addition, IP or MAC filter-based packet detection functionality).

- User Plane part of policy rule enforcement, e.g. Gating, Redirection, Traffic steering).

- Lawful intercept (UP collection).

- Traffic usage reporting.

- QoS handling for user plane, e.g. UL/DL rate enforcement, Reflective QoS marking in DL.

- Uplink Traffic verification (SDF to QoS Flow mapping).

- Transport level packet marking in the uplink and downlink.

- Downlink packet buffering and downlink data notification triggering.

- Sending and forwarding of one or more "end marker" to the source NG-RAN node.

- Functionality to respond to Address Resolution Protocol (ARP) requests and / or IPv6 Neighbour Solicitation requests based on local cache information for the Ethernet PDUs. The UPF responds to the ARP and / or the IPv6 Neighbour Solicitation Request by providing the MAC address corresponding to the IP address sent in the request.

- Packet duplication in downlink direction and elimination in uplink direction in GTP-U layer.

- NW-TT functionality.

- High latency communication, see clause 5.31.8.

- ATSSS Steering functionality to steer the MA PDU Session traffic, refer to clause 5.32.6.

NOTE: Not all of the UPF functionalities are required to be supported in an instance of user plane function of a Network Slice.

- Inter PLMN UP Security (IPUPS) functionality, specified in clause 5.8.2.14.

- Event exposure, including exposure of network information, i.e. the QoS monitoring information, as specified in clause 5.8.2.18, events as specified in clause 5.2.26.2 of TS 23.502 [3], exposure of data collected for analytics, as specified in clause 5.2.26.2 of TS 23.502 [3] and exposure of the TSC management information as specified in clause 5.8.5.14.

- Exposure of the UE information, e.g. UE IP address translation information as specified in clause 5.2.26.3 of TS 23.502 [3] and clause 4.15.10 of TS 23.502 [3] if Network address translation (i.e. NAT) functionality of the UE IP address is deployed within UPF.

- Support PDU Set Handling as defined in clause 5.37.5.

- Support MoQ relay functionality and PDU Set Information identification from the MoQ metadata as defined in clause 5.37.5.X.

- NAT information exposure functionality (if NAT is deployed within UPF).

- Handling of operator configurable UPF capability as described in clause 5.8.2.21.

\* \* \* \* Next 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).

- Support for the MoQ relay functionality associated with encrypted service data flow for high data rate low latency services, eXtended Reality (XR) and interactive media services, specified in clause 5.37.5.X.

- 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]).

- Information regarding required and/or preferred UPF functionalities. If received from UDM, the SMF selects a PSA UPF supporting the required UPF functionalities and the best set of preferred functionalities based on their priorities.

- Support for operator configurable UPF capability as described in clause 5.8.2.21.

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 \* \* \* \*