**Source: Huawei (Rapporteur)**

**Title: KI#4 and KI#5, key questions for company view collection**

This document is to collect company views on key questions of KI#4 and #5 to facilitate the following conclusion discussion. Please kindly provide your company views on the following questions before EoB of Sep 16th. The rapporteur will collect the views and propose summary/way forwards/SoH for further discussion afterwards.

### Q1: How does UPF identify DL PDU Set info?

* Option 1: use existing IETF RTP/SRTP RFC and draft
* Option 2: Define/extend N6 protocols to carry related info
	+ Option 2.1: extend GTP-U protocol
	+ Option 2.2: extend HTTP header (S2-2205830)
	+ Option 2.3: extend RTP header
* Option 3: UPF implementation based on e.g. traffic characteristics.
* Option 4: UPF interacts with NWDAF(S2-2205838)

**[Futurewei view]**

**Position:**Support option 1.

Methods in option 2 need to be considered only beyond Rel18 as HTTP/3 matures.
(For completeness, option 2.4 (extend UDP options, QUIC media header) should also be evaluated.)

Do not support options 3, 4.

**Justification**:

Option 1 with RTP and SRTP where header/header extensions are visible are well defined and should be specified in the normative phase.

Option 2 is for use cases with encrypted media payloads/ no visible meta-data. Since XRM focuses on low latency, our view is that option 2 applies in practice to HTTP/3 (QUIC transport). TCP based transports for WebRTC, DASH suffer from HOL blocking and do not offer unreliable delivery.

QUIC media header - MoQ (<https://datatracker.ietf.org/group/moq/about/>) has just started standardization work in IETF. While this method will likely not be ready for Release 18, other methods will compete with a general solution in MoQ. The best approach for now would be to engage IETF, provide input such that 3GPP requirements and concerns are considered during the MoQ standardization.

If MoQ cannot meet XRM needs, 3GPP specific options such as MASQUE (Option 2.2), GTP-U (Option 2.1), or UDP options (Option 2.4) should be evaluated. A short evaluation of each below:

* MASQUE will require 3GPP specific adaptation by the application domain (AF – 5GC), incurs per packet overhead of L7 encapsulation and TLS encryption overhead and negotiation overhead per application flow.
In addition, L7 load balancer/reverse proxy at application domain would need to encode MASQUE meta-data for media streams on path from AS to UE (both meta-data and reverse proxy behavior need new stds)
* GTP-U requires CP support for tunnel termination, and AS to support GTP-U.
* UDP options while standardized in IETF would require new standards for XRM meta-data.

(Figures below show comparison of the different options)

Option 3 (traffic characteristics) is not practical to implement at UPF as transport segments between AS and UPF introduce distortions to the expected traffic patterns due to variability in forwarding and out-of-order packet arrivals. In addition, the AS may adjust sending rates (codec rates) dynamically to respond to network congestion.

Option 4 (S2-2205838 has been noted), but similar comments as for option 3.

Figures:



### Q2. How to deliver PDU Set importance information to RAN:

* Option 1: use different QoS Flows with different priority level. PDU Set importance is mapped to existing QoS flow priority.
* Option 2: use one QoS flow for different PDU Set with different priority level
	+ Option 2.1: use different sub-QoS Flow within one QoS Flow, and using sub-QoS flow Identifier in GTP-U header
	+ Option 2.2: use PDU Set importance information in GTP-U header

**[Futurewei view]**

**Position:**

Support Option 2.
Option 1 is complex.

**Justification**:

Importance information (PDU set priority) along with PDU set sequence number (PSSN), PDU set GBR (PS-GBR) and PDU set MBR (PS-MBR) are necessary for gNB in our view.
Prefer option 2.2 - importance plus PSSN, PS-GBR, PS-MBR, but option 2.1 where sub-QoS flow indicates importance/priority for the PDU set plus PSSN, PS-GBR, PS-MBR is quite close (the concept of a sub-QoS “flow” is a bit confusing though).

Option 1 is complex.
The limiting factor regardless of the number of QoS flows is eventually DRB queues (so whether there are 10 queues or 1 queue, it will be mapped to the same limited set of DRBs.) And handling more (virtual) queues is relatively more complicated.

### Q3: Support to PDU Set dependency-based scheduling

* Option 1: Identify accurate dependency relationship between PDU Sets for scheduling.
* Option 2: In some scenario (e.g. closed GOP), the decoding of the non-I frames between two successive I frames always directly or indirectly relies on the 1st I frame of the two successive I frames. If the 1st I frame is in error, the non-I frames can be dropped until the next I frame. (proposed in S2-2205839)
* Option 3: If a PDU Set is depended by others, it can be considered as more important during scheduling. But the scheduling will not further consider the accurate dependency relationship.

**[Futurewei view]**

**Position:**

Support Option 3.
Options 1, 2 are more complex and may be too rigid to easily adapt to different/future encoding schemes.

**Justification**:

The extensions to QoS for XR should reflect the handling and optimizations needed for general patterns of media such as treating a set of packets and their associated characteristics as a group. Additions to QoS consisting of importance and related PDU set parameters that RAN can use to optimize XR handling are needed.

Since XR and media applications are continuously evolving, specific mechanisms for a particular encoding may be better to avoid as the application space, codecs and packetization techniques are likely to change at a faster rate than lower layer network enhancements (such as for gNB). As applications change, richer meta-data should be provided and the UPF should “map” the meta-data in N6 to N3 accordingly. But the QoS enhancements over N3 should only have to evolve as the gNB/RAN capabilities evolve.

### Q4. Support to hierarchical PDU Set:

* Option 1: introduces PDU Set group. (S2-2205938)
* Option 2: not support.

**[Futurewei view]**

**Position:**

Support Option 2.
Options 1 is more complex and may be too rigid to easily adapt to future encoding schemes.

**Justification**: (similar to Q3)

The extensions to QoS for XR should reflect the handling and optimizations needed for general patterns of media such as treating a set of packets and their associated characteristics as a group. Additions to QoS consisting of importance and related PDU set parameters that RAN can use to optimize XR handling are needed.

Since XR and media applications are continuously evolving, specific mechanisms for a particular encoding may be better to avoid as the application space, codecs and packetization techniques are likely to change at a faster rate than lower layer network enhancements (such as for gNB). As applications change, richer meta-data should be provided and the UPF should “map” the meta-data in N6 to N3 accordingly. But the QoS enhancements over N3 should only have to evolve as the gNB/RAN capabilities evolve.

### Q5. On “*Whether to drop a PDU Set in case PSDB is exceeded*”, do we need further define “*PDU Set Discard Time*” (A PDU Set shall be dropped in case this time is exceeded (sol 25 etc):

* Option 1: Support
* Option 2: not support.

**[Futurewei view]**

**Position:**

Support Option 2 (but qualified, please see description).

**Justification**:

In our view, both PDB and PDU set delay budget are not necessary as it resolves to the same (since each packet of the PDU set is from media that has the same timestamp.) PDB is therefore sufficient.

Regarding the discarding of packets after the expiry of a discard timer, we agree that RAN should continue to forward packets in some cases even beyond the delay budget. This can be related to the importance of the packet and perhaps a delta value by which to extend the discard time.

Note: PDU set size (or burst size) may be useful in addition to MDBV (Maximum Data Burst Volume) for RAN to reserve resources accurately. However, PDU set size/burst size information is not available in RTP/SRTP headers and statically configured values are not useful as the PDU set size can vary based on network congestion, codec level changes and content. RAN should have accurate values for it to be useful.