**3GPP TSG-SA WG4 Meeting #130S4-241932**

**USA, Orlando, 18 – 22 November 2024**

**Source: Huawei, HiSilicon**

**Title: [FS\_5G\_RTP\_Ph2] Corrections and conclusions for the Sol#2.**

**Spec: TR 26.822**

**Agenda item: 10.6**

**Document for: Agreement**

**1. Introduction**

This document is based on the agreed version of S4aR240080 during the RTC SWG post 129-e telco.

**2. Reason for Change**

TR 26.822 clause 6.2 includes a gap analysis on the QoS requirements for lone PDUs. However, it is unclear on the way-forward for this solution. This paper intends to further clarify and provide the conclusion and way forward for this Key Issue.

**3. Proposal**

It is proposed to agree the following changes to TR 26.822.

\* \* \* First Change \* \* \* \*

## 6.2 Solution #2: Gap analysis on the QoS requirements for lone PDUs

### 6.2.1 Key Issue mapping

This solution intends to give gap analysis on the KI#2: QoS handling requirements for lone PDUs.

### 6.2.2 Description

According to TS 23.501 [3], in case a single PDU doesn't belong to a PDU Set based on the Protocol Description for PDU Set identification, the UPF still maps it to a PDU Set and determines the PDU Set Information accordingly. In this case, both the lone PDU and the PDUs belonging to a PDU Set are in the same service data flow and the lone PDU is delivered to the UE in the DL direction following the PDU Set QoS parameters.

There could be different scenarios where the application server may send the PDU Sets and lone PDUs in the same service data flow which can be detected by the 5GS. For video data, as described in Annex A.2.2.1 of TS 26.522 [2], it is generally recommended that the network function considers non-VCL NAL units as part of the PDU Set of the associated VCL NALUs, e.g. identified by the same timestamp. Once the RTP header extension for PDU Set has been negotiated between the RTP sender and receiver, the RTP sender marks each packet with RTP HE for PDU Set marking.

However, there are other scenarios where lone PDUs and PDUs belonging to a PDU Set are multiplexed in a single service data flow as following.

- **Scenario #A:** RTP streams multiplexed in a single RTP session. In this scenario, multiple RTP streams are multiplexed in a single RTP session which is carried over a single service data flow. For example, the audio and video streams are multiplexed in a single RTP session, while the PDU Set handling is needed only for the video streams. Similarly, when FEC or RTP retransmission feature is enabled, the corresponding repair packets or retransmission packets may also be multiplexed with the original video stream. As of Rel-18, the 5GS cannot distinguish different RTP streams multiplexed in a single service data flow and has to treat the PDUs in other RTP streams as lone PDUs.

- **Scenario #B**: RTP data and control packets are multiplexed on a single port. In this scenario, the RTP and RTCP flows are carried over a single service data flow. When the PDU Set handling is needed for the RTP flow(s), the 5GS has to treat the RTCP traffic as lone PDUs since it cannot distinguish between the RTP and RTCP traffic.

NOTE: A combination of scenario #A and #B is possible

As can be seen from the above, one key reasons for the lone PDU handling is that the PDUs belonging to a PDU Set and the lone PDUs are carried over a single service data flow and as of Rel-18, therefore, the 5GS cannot differentiate the multiplexed data flows in a single service data flow.

Therefore, it is clear that

- **Coexistence of lone PDUs and PDUs belonging to a PDU Set in a single service data flow can be due to the lack of the capability to differentiate multiplexed media flows in 5GS.**

NOTE: This solution mainly focuses on the scenario where the lone PDUs are resulted from the missing capability of multiplexed traffic identification.

However, the scenario where lone PDUs may exist, is still possible due to the multiplexed RTP and RTCP or RTP audio and video traffic flows. As the streams are in a single QoS Flow as requested by the application layer, e.g., the QoS requirements for them have to be the same.

However, the QoS requirements for multiplexed media streams could be different. For example, the QoS requirements for audio and video streams could be different. In Release 19 limited support for mapping multiplexed traffic flows was added and this is studied in KI #14.

For PDU Set based QoS handling, the PDU Set QoS parameters are introduced in TS 23.501 [3] as following:

- PDU Set Delay Budget, which defines an upper bound for the delay that a PDU Set may experience for the transfer between the UE and the N6 termination point at the UPF.

- PDU Set Error Rate, which defines an upper bound for the rate of PDU Sets that have been processed by the sender of a link layer protocol (e.g., RLC in RAN of a 3GPP access) but that are not successfully delivered by the corresponding receiver to the upper layer (e.g., PDCP in RAN of a 3GPP access).

- PDU Set Integrated Handling Information, which indicates whether all PDUs of the PDU Set are needed for the usage of the PDU Set by the application layer in the receiver side.

If the NG-RAN receives PDU Set QoS Parameters, it enables the PDU Set based QoS handling and applies PDU Set QoS Parameters. When the PDU Set QoS parameters are available, they will supersede the PDU QoS parameters (i.e. PSDB/PSER supersedes the PDB/PER).

For the corresponding PDU QoS parameters, they are at a per packet granularity including the per-packet latency requirement (i.e. packet delay budget), the per-packet loss rate requirement (i.e. packet loss rate), etc. From the application perspective, the PDU Set QoS parameters and the PDU QoS parameters should reflect the same network requirements while at different granularities.

- When an RTP video stream and an RTP audio stream are multiplexed in a single RTP session and the PDU Set based QoS handling is enabled for the RTP video stream, the PDU Set QoS parameters can indicate the delay and reliability requirements for the video PDU Set (e.g. a video frame/slice), which are also applied to the audio PDU Set (typically an audio frame carried in a single audio packet). In this case, applying the PDU Set QoS parameters to the lone audio PDUs is totally fine.

- When RTCP traffic and RTP video stream are multiplexed using a single UDP port, the same PDU Set QoS parameters could then be applied to the RTCP packets and the video PDU Sets (e.g. video frame/slice), assuming they are mapped into the same QoS flow. This is expected to be the case when RTCP traffic is used to measure the network characteristics (e.g. round-trip time).

Therefore, **QoS requirements for lone PDUs and marked PDU Sets could be the same and** **applying the PDU Set QoS parameters to a single PDU could be no problem. However, QoS requirements for lone PDUs and marked PDU Sets may be different and an issue. This depends whether the lone PDUs requires (or can sustain) the same QoS requirements as the PDU Sets.**

The solution to KI#4 in TR 23.700-70 [6] enables the network to differentiate multiplexed streams sent in the same media transport such that they can be mapped into distinct QoS flows. However, in some cases this may result in unintended behavior, e.g. RTCP packets mapped to a different QoS flow would no longer measure the RTP media QoS flow characteristics which may result in errors e.g. in measuring the media flow characteristics. On the other hand, it could be problematic to apply the PDU Set QoS to lone PDUs, as described above.

NOTE: Other measurement methods may be used instead in this case and it is up to the application whether to request differentiated QoS handling for the RTP and RTCP traffic.

In addition, as discussed in draft TR 23.700-70 [6], how to support the traffic detection and QoS mapping for multiplexed data flows is ongoing in SA2 Rel-19 FS\_XRM\_Ph2 as shown below:

*This key issue proposes study traffic detection and QoS Flow mapping in 5GS for different media streams multiplexed within a single end-to-end transport connection.*

*- How to identify multiplexed traffic flows with different QoS requirements within a single transport connection.*

*- How to do QoS Flow mapping for traffic flows with different QoS requirements.*

*- Whether and what information needs to be provided from AF for traffic detection.*

*- Whether and how AF provides QoS requirements of different traffic flows to the 5GS.*

Via the potential R19 enhancements in 5GS, it is possible to differentiate the multiplexed RTP streams or RTP/RTCP flows, which may avoid the co-existence of lone PDUs and PDUs belonging to a PDU Set in a QoS flow.

As concluded in clause 8.4 in TR 23.700-70 [6], the application layer may ask the 5G system to differentiate the different RTP/RTCP streams in one RTP session with the extended packet filter set. The extended packet filter includes the legacy IP packet filter set as defined in clause 5.7.6 of TS 23.501 [3] and also the additional packet filter to detect the multiplexed traffic and map them into different QoS requirements as requested by the AF. This additional packet filter may contain the RTP-SSRC, etc.

In case that the RTP/RTCP streams are multiplexed in an RTP session and one RTP stream needs the PDU Set based QoS handling, the legacy packet filter set together with the corresponding SSRC(s) can be used to detect the target RTP stream(s) and map to the QoS Flow with PDU Set QoS requirements. Therefore, the lone PDU issue resulted from the multiplexing could be avoided considering the additional support in 5GS in SA2 FS\_XRM\_Ph2 if the application requests different QoS handling for different multiplexed media flows.

Hence, it’s proposed that the RTC AF further provides the RTP-SSRC(s) to the 5GS if the media streams with RTP HE for PDU Set marking enabled requires the PDU Set based QoS handling. Then the 5GS can differentiate the RTP streams with RTP HE for PDU Set marking and other traffic in order to avoid the lone PDUs that would arise due to multiplexing.

NOTE: Impact to the RTC architecture in TS 26.506 needs to be considered during the normative work phase for Key Issue 14.

### 6.2.3 Conclusion

Based on the gap analysis in the above, it is proposed to make the following conclusions.

**- QoS requirements for lone PDUs and marked PDU Sets could be the same** **and** **applying the PDU Set QoS parameters to a single PDU could be no problem.**

**- In case the QoS requirements for the lone PDUs and the marked PDU Sets are different, this could be an issue. Such use cases still need further study. NOTE: Further coordination with SA2 may be necessary regarding potential normative solution in this case.**

- **Communicate with SA2 if needed to reply the question raised by SA2.**