**3GPP TSG-SA WG4 Meeting #130S4-241799**

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

**Source: Huawei, HiSilicon**

**Title: Solution KI #9 Guidelines for PDU Set Marking in Multiplexing Scenarios without SSRC/PT based packet filter**

**Spec: 3GPP TR 26.822 version 1.0.1**

**Agenda item: 10.6**

**Document for: Agreement**

**1. Introduction**

Multiplexed RTP traffic is common in practical applications such as WebRTC and Internet Protocol Television.

In this solution proposal we provide guidelines for using RTP HE extension for PDU Set Marking developed in TS 26.522 for such cases.

**2. Reason for Change**

For KI#9 a solution is missing that provides details on how to use the RTP Header Extension for PDU Set Marking defined in 26.522 in case when multiplexing is used.

Multiplexing of Audio, Video and RTCP is common in practical scenarios such as WebRTC (RTP multiplexing) or IPTV (stream native multiplexing).

It is important to provide guidance to use the RTP HE defined in 26.522 in such cases to enable practical adoption.

In Release 19, solutions using extended packet filter at UPF are proposed to map RTP multiplexed traffic to different QoS flows.

In this solution the simple case of carrying multiplexed traffic on a single QoS flow is considered instead, as this case is the most common case and the case often assumed by applications.

**3. Conclusions**

This solution provides guidelines for common use cases envisioned in TS 26.522 that involve multiplexing and using the RTP Header Extension of PDU Set marking.

**4. Proposal**

It is proposed to agree the following changes to 3GPP TR 26.822.

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

[ZZ] [Real-Time Transport Protocol (RTP) Parameters (iana.org)](https://www.iana.org/assignments/rtp-parameters/rtp-parameters.xhtml)

[ZZa] 3GPP TS 29.571 3rd Generation partnership project; technical specification group core network and terminals; 5G System; common data types for Service based interfaces; stage 3

[ZZb] 3GPP TS 38.415 NG-RAN; PDU Session User Plane Protocol (Release 18)

\* \* \* Next Change (All new Text) \* \* \* \*

## 6.X Solution #X: Guidelines for PDU Set Marking in Multiplexing Scenarios

### 6.X.1 Key Issue mapping

Solution to key issue #9.

### 6.X.2 Description

#### 6.X.2.1 General

The RTP Header Extension for PDU Set marking aims to support enabling PDU Set QoS for RTP media traffic in the 5G System as defined in [3].

It enables components in the 5G System to identify PDU Sets and apply PDU Set QoS, i.e. see 5.37.5 in [3].

This clause proposes guidelines for applying and using the RTP Header Extension for PDU Set Marking in additional multiplexing scenarios to enable effective PDU Set based QoS handling.

NOTE: This solution covers the case where either the 5G System cannot apply packet filter based on RTP SSRC in a QoS flow (Release 18), or it is not desirable to use different QoS Flows for the multiplexed content. In this solution multiplexed streams are handled in a single QoS flow.

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

- 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 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).

In multiplexing scenarios, multiple types of media and/or control packets are carried on a single QoS flow.

#### 6.X.2.2 Unmarked packet Handling.

It is recommended that when the RTP HE for PDU set marking is enabled, the RTP HE is applied to each RTP packet that belongs to a PDU Set. This enables effective identification of all packets belonging to a PDU Set by the 5G System. This can subsequently enable suitable PDU Set QoS based Handling for each PDU Set in the NG-RAN.

In some cases, packets may exist that do not belong a PDU Set, but are instead a single independent packet intended for transmission. Examples, of these cases are given in solutions to KI #2 such as in clause 6.2 (e.g. RTCP packet, unmarked audio packet).

The guidelines for handling unmarked packets are discussed in solutions to KI#2.

#### 6.X.2.3 RTP HE for multiplexed content

An RTP sender could also include additional RTP HE for the additional multiplexed streams. This may be useful in the case frames consist of multiple packets that can be grouped in PDU Sets or if setting the PDU Set importance is desired (sc1, sc2). In addition, cases are considered when the content is natively multiplexed and it is hard to distinguish packets based on media type by a sender or receiver, as they may contain multiple media types in an RTP Packet (sc3, sc4). Also, the case where multiple RTP streams of the same media type is multiplexed is considered (sc5, sc6).

To illustrate this, Table 6.X.2.3-1 provides some examples on different multiplexing scenarios and the corresponding guidelines for setting RTP HE are further given in Table 6.X.2.3-2

**Table 6.X.2.3-1: Example of Multiplexing scenarios**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Scenario | Multiplex Type | Description | | Implications for RTP Header Extension for PDU Set Marking for sender | |
| sc1 | audio + video RTP multiplex [4] | | Native Audio and Video streams are carried in separate RTP streams with different SSRC and different PT Packets contain either audio or video. | | Typically, RTP HE is used for the video stream, audio packets can be unmarked or in some cases they can also use the RTP HE (if frames comprise multiple packets). If both audio and video RTP packets are marked into PDU Sets, the RTP HE for PDU Set is applied to video and audio RTP streams separately. RTP video packets and audio packets are marked as separate PDU Sets, not as part of the same PDU Set. |
| sc2 | audio + video [4], RTCP[5] | | Same as above, but in this case also RTCP packets exist. Packets contain audio, video or RTCP. | | Same as above for audio and video. RTP HE cannot be used for RTCP packets and these will be handled as unmarked/lone PDU’s.  End of Data Burst signal cannot be used in case RTCP packet is the last one in a data burst. |
| sc3 | audio, video native multiplex [36] | | Stream packets can contain both audio and video. In this case an RTP packet can contain both audio and video content. In addition, packets can also contain other metadata related to the streams. | | In this case, single PDU Sets will contain different media types; additional guidance is provided to handle this case | |
| sc4 | audio, video native multiplex [36] + RTCP [4] | | same as above adding RTCP | same as above including RTCP packets [4] that cannot carry RTP Header Extension | | |
| sc5 | video + video or audio + audio [4] | | Similar to sc1, but multiple native audio or multiple native video streams are carried in separate RTP streams with different SSRC, either with different PT or sharing same PT. Packets contain content from a single SSRC. | Different RTP streams are marked as separate PDU Sets, not mixing separate RTP streams (SSRC) in a single PDU Set. | | |
| sc6 | video + video or audio + audio [4] + RTCP [4] | | Same as above adding RTCP | Same as above including RTCP packets [4] that cannot carry RTP Header Extension | | |

**Table 6.X.2.3-2: Guidelines for applying RTP HE in different example multiplexing scenarios**

|  |  |  |  |
| --- | --- | --- | --- |
| Scenario | Guideline | Additional Comments | |
| sc1 | Video PDU Sets may be assigned for example for video frames or slices and PDU Set importance can be set using guidelines from 4.6.2 of TS 26.522.  Audio Packets can be unmarked or in case audio frames consist of multiple packets they may be marked using RTP HE.  PDU Set importance of the unmarked packet is determined by the 5G System based on a configuration, and this can also be based on the payload type. | | Typically RTP HE is used for the video stream, audio packets can be unmarked (see the lone PDU case) or the RTP HE can also be used for the audio stream. | |
| sc2 | same as above.  RTCP packets cannot be marked using RTP HE and are treated as unmarked packet in the 5G System, PDU Set importance can be determined by the 5G system. | | Same as above for audio and video.  End of Data burst signal may not be valid if RTCP is the last packet in a burst. | |
| sc3 | PDU Sets can be identified by the RTP sender based on the presentation time and the RTP HE can be used to support the PDU Set based QoS handling.  The PDU Set importance can be set to a configured value or the value corresponding to the importance of the most important part of the multiplexed stream using guidelines from 4.6.2 in [2] | | In this case in the grouping of PDU sets will contain different media types, and therefore the guidance cannot only be based on one specific media type, which may not be appropriate. Therefore, PDU Sets could be identified and marked by the RTP sender based on other aspects such as the presentation time.  The PSI can be set based on a configuration. | | |
| sc4 | same as sc3  RTCP packets cannot be marked and are treated as unmarked packet in the 5G System. | Same as above including RTCP packets [4] that cannot carry the RTP Header Extension.  Data burst signal cannot be used if RTCP is the last packet in a burst. | | | |
| sc5 | Video PDU Sets may be assigned for video frames or slices and PDU Set importance can be set using guidelines from 4.6.2 of TS 26.522, separating RTP streams with different SSRC into separate PDU Sets.  Audio Packets can be unmarked or in case audio frames consist of multiple packets they may be marked using RTP HE, separating RTP streams with different SSRC into separate PDU Sets. | Multiple PDU Sets can be "open" at the same time, i.e., some PDUs are received from multiple different SSRC and thus different PDU Sets, which requires the marking to keep track of multiple simultaneous PDU Set contexts. | | | |
| sc6 | Same as sc5.  RTCP packets cannot be marked and are treated as unmarked packet in the 5G System. PDU Set importance can be determined by the 5G system. | Same as above including RTCP packets [4] that cannot carry the RTP Header Extension.  Data burst signal cannot be used if RTCP is the last packet in a burst. | | | |

To support multiplexed content in combination with PDU Set QoS based Handling in the 5G System, groups of packets of different media types (audio, video) but same payload type (native multiplex) may also be grouped as a PDU Set (sc3). This enables frames/groups of packets to benefit from transfer using PDU Set QoS parameters in NG-RAN (delay budget, PSIHI). In this case, each of the RTP packets can set the RTP Header Extension for PDU Set Marking to enable 5G System to identify corresponding PDU Sets.

Different options exist when applying RTP HE for multiplexed content, for which some guidelines are as follows:

* When RTP multiplexing (sc1, sc2, sc5 and sc6) is used, it is possible to separately mark the PDU Sets in different streams. In this case, the PDU Sets may also be indicated with different PDU Set importance as already discussed in [2]. As concluded in TR 23.700-70, the UPF packet filter can be extended to include SSRC, payload type, etc. in order to detect and map the each marked media stream to the specific QoS Flow with PDU Set QoS handling enabled. In this guideline, it is assumed that this is not used.
* When packets may combine different media types in a payload type such as in sc3 and sc4 PDU sets can be created around a common media presentation time grouping packets based on timestamps. Additional sender behaviour can be detailed in case such as solution is selected for normative work. In this case the PDU set importance can be set to a derived or default value.
* In case only packets of single stream are marked (e.g. the video stream), the situation as described in the previous sub-clause applies.
* In case Packets cannot carry the RTP header extension (e.g. RTCP packet), packets can be handled as lone/unmarked PDU.

The protocol description can be used to indicate to the 5G System that PDU Sets contain multiplexed content. For example by indicating a payloadType with a number that corresponds to a multiplexed data type (e.g. payloadType 33 for MPEG-2 TS). In this case the transport protocol would still be RTP, but the payload type could be 33 MPEG-2 TS (native multiplex) and/or a combination of format types e.g. (H.264, AAC) (in case of RTP multiplex). In such a case it is optional to provide additional format parameters.

The guidelines for PDU Set Marking for H.264 and/or H.265 can still apply but in this case, but when the PDU Set importance of MPEG-TS RTP packets cannot be identified, it can be set to a PSI value determined by the sender.

**Table 6.X.2.3-3: Example protocol description for different multiplexing scenarios**

|  |  |  |  |
| --- | --- | --- | --- |
| Scenario | protocol | rtpPayloadFormat (example) | Rtppayloadtypelist (example) |
| sc1 | RTP/SRTP | H265, PCMA | 97,8 |
| sc2 | RTP/SRTP | H265, PCMA | 97,8 |
| sc3 | RTP/SRTP | MP2T | 33 |
| sc4 | RTP/SRTP | MP2T | 33 |
| sc5 | RTP/SRTP | H264, H265 or just H265 | 97,98 or just 98 |
| sc6 | RTP/SRTP | H264, H265 or just H265 | 97,98 or just 98 |

Note that any of the encoding types or payload types as registered by IANA [ZZ] and beyond can be used, but this table is not fully up to date in [ZZa].

There is no way to explicitly indicate the presence of RTCP packets in the protocol description.

### 6.X.3 Proposal

a) Develop these guidelines for multiplexed content and add them to TS 26.522 to support both the PDU Set identification by RTP senders and enable PDU Set information derivation by the UPF if needed.

b) Check the TS 26.510 that it is not a requirement that all packets are marked to enable flexible cases with RTP/RTCP multiplexing or audio multiplexing with unmarked packets. The pduSetMarking property in the M1QoSSpecification in clause 7.3.3.4 of 26.510: ”Indicates that packets at reference point M4 are requiredto include PDU Set marking if the media transport protocol supports this. Default value false if omitted. “This requirement may need to be relaxed or updated.

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