**3GPP TSG-SA WG4 Meeting #131-bis-e** **S4-250573**

**Online, 11 – 17 April 2025**

**Source: Nokia**

**Title: [5G\_RTP\_Ph2] On RTP retransmission signaling**

**Agenda item: 4.6**

**Document for: Agreement**

# Background

TR 26.822 investigated aspects related to RTP retransmission for supporting 5G XR services. The following aspects were concluded as principles for the normative work:

**- Coordinate with SA2 and RAN2 on network awareness of retransmitted PDUs as well as core network and RAN handling of retransmitted PDUs based on the information provided by the application.**

**- Based on SA2 and RAN2 guidance, consider sending information related to end-to-end retransmissions from the application to the 5G Core Network.**

Based on the TR conclusions, SA4 defined a related objective for 5G\_RTP\_Ph2.

* **Conduct normative work on network awareness of retransmitted PDUs as well as core network and RAN handling of retransmitted PDUs based on the information provided by the application.**

 **NOTE: This objective requires coordination with SA2 and RAN2.**

IETF defined an RTP retransmission payload format in RFC 4588. The payload format was designed for use with the extended RTP profile for RTCP-based feedback, the RTP/AVPF defined in RFC 4585.

Retransmission packets carry copies of lost packets along with sequence numbers and timestamps to facilitate accurate reconstruction at the receiver. The timing and frequency of retransmission packets are controlled by the sender based on network conditions and feedback from the receiver. This allows a trade-off between reliability and delay; the endpoint may give up on retransmitting after a given buffering time.

RFC 4588 requires the original and retransmission packets to be sent in two separate streams. Two options are given.

1) Session-multiplexing: The streams are multiplexed by sending them in two different sessions. In this case, the original and retransmission streams are sent to different network addresses or port numbers.

2) SSRC-multiplexing: The streams are sent in the same session using different SSRC values. This allows minimizing the port usage since the same port can be used for both streams.

MTSI senders and receivers are required to support handling of RTP retransmission packets using SSRC-multiplexing. WebRTC also requires that the endpoints support handling of RTP retransmission packets using SSRC multiplexing and leaves the support of session-multiplexing optional.

More details on RTP retransmission are provided in TR 26.822, clause 6.9.

# Discussion

RTP retransmission is negotiated and configured end-to-end between a sender and a receiver. Currently, there is no mechanism to indicate to the 5G network whether an application uses retransmission for any of its RTP streams.

When PDU Set based handling is used, the 5G System may benefit from awareness of application layer retransmissions while configuring and performing the network operations like buffering, scheduling and discarding PDU Sets.

For example, in the event of temporary congestion, the RAN may prioritize discarding PDU Sets from RTP streams that use retransmission. These discarded PDU Sets are expected to be retransmitted by the application during a non-congested period, provided that the packet remains in the sender application buffer.

According to RFC 4588, retransmitted PDUs are transmitted in a separate RTP stream.

An example SDP description given below describes a session with two video streams transported in the same RTP session, a source H.264 video stream (pt=96) and its retransmission stream (pt=97). The RTP HE for PDU Set marking is negotiated for the source stream, but not for the retransmission stream.

v=0

o=mascha 2980675221 2980675778 IN IP4 host.example.net c=IN IP4 192.0.2.0

t=0 0

m=video 49170 RTP/AVPF 96

a=rtpmap:96 H264/90000

a=fmtp:96 profile-level-id=42A01E; packetization-mode=1

a=rtcp-fb:96 nack

a=extmap:6 urn:3gpp:pdu-set-marking:rel-18

m=video 49170 RTP/AVPF 97

a=rtpmap:97 rtx/90000

a=fmtp:97 apt=96;rtx-time=3000

In another case, the RTP HE for PDU Set marking may be negotiated for both the source and retransmission streams.

v=0

o=mascha 2980675221 2980675778 IN IP4 host.example.net c=IN IP4 192.0.2.0

t=0 0

m=video 49170 RTP/AVPF 96

a=rtpmap:96 H264/90000

a=fmtp:96 profile-level-id=42A01E; packetization-mode=1

a=rtcp-fb:96 nack

a=extmap:6 urn:3gpp:pdu-set-marking:rel-18

m=video 49170 RTP/AVPF 97

a=rtpmap:97 rtx/90000

a=fmtp:97 apt=96;rtx-time=3000

a=extmap:6 urn:3gpp:pdu-set-marking:rel-18

Since the original and retransmitted PDUs associated to a media flow are transmitted in different RTP streams, there are two options in terms of the QoS flow mapping in the network:

**Option 1: Source stream and retransmission stream are mapped by the 5GC into the same QoS flow.**

**Option 1a**: RTP sender enables PDU Set marking both for the source stream and retransmission stream. Then, a retransmitted PDU can be placed in the same PDU Set as its original PDU in the source stream.

In this case, PSSN, PSI and PSSize are required to be the same in the RTP HE added to the retransmitted PDU. PSN would need to be incremented for each retransmitted PDU.

However, PSSize would no longer provide correct information since the size of the PDU Set increases with each retransmitted PDU. Also, the utility of PSSize after this point is questionable since most PDUs of the PDU Set may have already been delivered by the RAN.

This option only makes sense if the source PDU and retransmitted PDU need to be treated as part of the same PDU Set. However, if all or most of the other PDUs in the PDU Set have already been transmitted, such treatment may be of little or no benefit to the RAN. Also, the RAN may need to associate retransmitted PDUs with PDU Sets of their source PDUs, which would require stateful processing in the RAN.

**Option 1b**: RTP sender enables PDU Set marking only for the source stream and not for the retransmission stream. Then, a retransmitted PDU (in this case an N6-unmarked PDU) is marked by the 5GC into a new PDU Set that contains a single PDU, since the retransmitted PDU is mapped into the same QoS flow as its source PDU where PDU Set handling is applied.

In this case, it may be beneficial for the 5GC to assign a higher importance to the PDU Set containing the retransmitted PDU, increasing its chance of timely delivery to the receiver. This PSI value can be indicated by the sender (cf. CR0005, S4-250438).

**Option 2: Source stream and retransmission stream are mapped by the 5GC into different QoS flows.**

**Option 2a**: RTP sender enables PDU Set marking both for the source stream and retransmission stream. However, they may be configured with different PDU Set QoS parameters (e.g. PSDB), i.e., the retransmission stream and source stream may receive differentiated PDU Set handling.

**Option 2b**: RTP sender enables PDU Set marking only for the source stream and not for the retransmission stream. Then, PDU Set handling is applied only to the source stream, and the retransmission stream receives ordinary QoS handling.

NOTE: For all options above, it should not be allowed that PDU Set marking is negotiated for a retransmission stream while it is not negotiated for the corresponding source stream.

**Summary and conclusions:**

Although it is technically possible that different QoS flows are used for source and retransmission (RTX) streams (as in Option 2a and 2b), based on the QoS specification indicated by the application, it is expected source and RTX streams have similar QoS requirements since they are associated to the same media flow (i.e., same ADU is reconstructed from a set of source and corresponding RTX PDUs).Therefore, it seems more preferable that the same QoS flow is used for source and RTX streams, as described in the Options 1a and 1b.

If the same QoS flow is used for both the source and RTX stream, Option 1a would require keeping state in RAN, which may not be desirable since the network operation becomes more complex. Therefore, **Option 1b** where only source PDUs are marked into PDU Sets by the RTP sender, and RTX PDUs are treated as N6-unmarked PDUs (i.e. marked into their own PDU Sets in the 5GC), seems more favorable. If further QoS differentiation is needed, e.g. to prioritize RTX PDUs to ensure their timely delivery, a higher importance can be indicated for RTX PDUs by means of signaling a common PSI via control plane, as decribed in Option 1b above.

Another approach could be to use PDU Set marking both for source and RTX PDUs and mark them into different PDU Sets. If desired, this allows RTX PDUs to be assigned to different QoS flows with better QoS requirements (Option 2b), unlike Option 1b where the same PDU Set QoS parameters are applied to both source and RTX PDUs (since they are mapped to the same QoS flow). Receivers can still easily identify RTX PDUs by means of the original sequence number, which is inserted into the first two octets of the RTP payload as the payload header when RTP retransmission is used.

Potential signaling to the 5G network**:** It is important to assess whether providing the network with any information about application-layer retransmissions would be beneficial for PDU Set based QoS handling in the network. This is the main reason SA4 needs to liaise with SA2 and RAN2.

One possible signaling approach could involve using a reserved bit in the RTP HE for PDU Set marking to indicate whether a particular PDU is a retransmission. Another option could be to indicate in the description of an Application Flow that it contains an RTX stream.

# Proposal

**Work on an LS to SA2 and RAN2:**

* **include the SA4 preferred options for handling of retransmitted PDUs by applications and network, summarized in the conclusions above**
* **request feedback from SA2 and RAN2 on what, if any, RTP retransmission related information provided by the application would be beneficial for the operation of the 5G System (5GC and/or RAN) when PDU Set based handling is enabled.**