**3GPP TSG-SA4 meeting #129 S4-241660**

**revision of S4-241610 and merge of S4-241611 and S4-241501**

**Electronic Meeting, 19th -23rd August, 2024**

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| *CR-Form-v12.0* | | | | | | | | |
| **PSEUDO CHANGE REQUEST** | | | | | | | | |
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|  | **26.822** | **CR** | pseudo | **rev** | **-** | **Current version:** | **0.1.1** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

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| ***Title:*** | **[FS\_5G\_RTP\_Ph2] Candidate RTCP messages and RTP header extensions to support XR services in 5G** | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | InterDigital Communications, Qualcomm Incorporated, Lenovo | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | FS\_5G\_RTP\_Ph2 | | | | |  | ***Date:*** | | | 2024-08-19 |
|  |  | | | |  | |  | | |  |
| ***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 can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-10 (Release 10) Rel-11 (Release 11) Rel-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)*  *Rel-17 (Release 17)*  *Rel-18 (Release 18)* | |
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| ***Reason for change:*** | | Key issue #7: RTCP messages to better support XR services in 5G  Some of the potential RTCP messages as well as RTP header extensions to better support XR services in 5G are provided in S4aR240042. This document extends the proposal to include more RTCP feedback messages that are relevant for XR services. | | | | | | | | |
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| ***Summary of change:*** | | Adding RTCP feedback messages relevant for XR services. | | | | | | | | |
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| ***Consequences if not approved:*** | |  | | | | | | | | |
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| ***Clauses affected:*** | | 6 | | | | | | | | |
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|  | | **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:*** | |  | | | | | | | | |
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| ***This CR's revision history:*** | |  | | | | | | | | |

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# Proposed changes

\* \* \* \* 1st change \* \* \* \*

[TWCC] RTP Extensions for Transport-wide Congestion Control, draft-holmer-rmcat-transport-wide-cc-extensions-01 <https://datatracker.ietf.org/doc/html/draft-holmer-rmcat-transport-wide-cc-extensions-01>

\* \* \* \* 2nd change \* \* \* \*

## 6.x Solution #x: Candidate RTCP messages and RTP header extensions to support XR services in 5G

### 6.x.1 Key Issue mapping

This maps to Key Issue #7.

### 6.x.2 Description

The following RTCP messages and RTP header extensions are relevant for XR services.

### 6.x.2.1 RTCP messages

To understand the RTCP messages that may be used for supporting XR applications, we need to know what RTCP messages have been defined in standard specifications such as IETF RFCs and what RTCP messages have been used in commercial systems. For this purpose, we look at the WebRTC implementation [28] and IETF RFCs.

RTCP messages defined in RFCs:

* **Receiver report (RR)** (RFC 3550): The packet type (PT) is 201. It provides reception quality feedback to the other RTP endpoint on a per source SSRC basis. Among the reported information is
  1. the fraction lost: The fraction of RTP data packets from a source SSRC lost since the previous SR or RR packet was sent
  2. cumulative number of packets lost: The total number of RTP data packets from a source SSRC that have been lost since the beginning of reception.
  3. interarrival jitter: An estimate of the statistical variance of the RTP data packet interarrival time
* **Sender report (SR)** (RFC 3550): The packet type (PT) is 200. It is the same as the RR except that it carries additional 20 bytes of information about the RTP endpoint that originates this report.
* **Application-Defined Packet** (APP) (RFC 3550): The PT is 204. It is is intended for experimental use as new applications and new features are developed, without requiring packet type value registration.
* **Feedback messages**:
  1. **Transport layer FeedBack messages** (RTPFB): The PT value is 205.
     + **Generic NACK** (RFC 4585): The PT value is 205 and the format type (FMT) value is 1. The Generic NACK is used to indicate RTP packet losses, identified by the means of a packet identifier and a bit mask.
     + **TMMBR** (RFC 5104): The PT value is 205 and the FMT value is 3. The Temporary Maximum Media Stream Bit Rate Request message is used to notify the media sender about the changes in downlink bandwidth allocation with a new current maximum bitrate.
     + **TMMBN** (RFC 5104): The PT value is 205 and the FMT value is 4. The Temporary Maximum Media Stream Bit Rate Notification message is used to notify the media receiver about the adjusted new media bitrate by a media sender. This message is sent in response to a received TMMBR message.
     + **RTP-ECN-FB** (RFC 6679): The PT value is 205 and the FMT value is 8. The RTP Explicit Congestion Notification (ECN) feedback message reports reception of an ECN-CE-marked RTP packet so that the RTP sender may perform congestion control.
     + **RTP Congestion Control Feedback** (CCFB) (RFC 8888): The PT value is 205 and the FMT value is 11. The congestion control feedback message is used to transmit the status of each RTP packet received at the RTP receiver along with the RTP sequence number, packet arrival time and packet Explicit Congestion Notification (ECN) Marking. This message specifies a common RTCP feedback packet format that can be used by Network-Assisted Dynamic Adaptation (NADA) [RFC 8698], Self-Clocked Rate Adaptation for Multimedia (SCReAM) [RFC 8298], Google Congestion Control [Google-GCC], and Shared Bottleneck Detection [RFC 8382] congestion control algorithms.

The format and semantics of the RTCP CCFB packet is as shown below.

0 1 2 3

0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1

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|V=2|P| FMT=11 | PT = 205 | length |

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| SSRC of RTCP packet sender |

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| SSRC of 1st RTP Stream |

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

| begin\_seq | num\_reports |

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|R|ECN| Arrival time offset | ... .

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| SSRC of nth RTP Stream |

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| begin\_seq | num\_reports |

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|R|ECN| Arrival time offset | ... |

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| Report Timestamp (32 bits) |

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* + - * begin\_seq [16 bits]: The first sequence number that this feedback message reports on.
      * Received (R) [1 bit]: A boolean that indicates whether the packet was received. 0 indicates that the packet was not yet received and the subsequent 15 bits (ECN and ATO) in this 16-bit packet metric block are also set to 0 and MUST be ignored. 1 indicates that the packet was received and the subsequent bits in the block need to be parsed.
      * num\_reports [16 bits]: The number of RTP packets reported in this feedback message. The report block contains a 16-bit packet metric block for each RTP packet that has a sequence number in the range begin\_seq to begin\_seq+num\_reports inclusive.
      * ECN [2 bits]: The echoed ECN mark of the packet. These bits are set to 00 if not received or if ECN is not used.
      * Arrival time offset (ATO) [13 bits]: The arrival time of the RTP packet at the receiver, as an offset before the time represented by the Report Timestamp (RTS) field of this RTCP congestion control feedback report. The ATO field is in units of 1/1024 seconds (this unit is chosen to give exact offsets from the RTS field) so, for example, an ATO value of 512 indicates that the corresponding RTP packet arrived exactly half a second before the time instant represented by the RTS field.
      * Report Timestamp (RTS) [32 bits]: This value denotes the time instant on which this packet is reporting and is the instant from which the arrival time offset values are calculated. The value of the RTS field is derived from the same clock used to generate the NTP timestamp field in RTCP Sender Report (SR) packets.
    - **Transport-wide feedback** [TWCC]: The PT value is 205 and the FMT value is 15. This feeds back information about each packet received with a transport-wide packet sequence number.

     0                   1                   2                   3

     0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1

    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

    |V=2|P|  FMT=15 |    PT=205     |           length              |

    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

  0 |                     SSRC of packet sender                     |

    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

  4 |                      SSRC of media source                     |

    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

  8 |      base sequence number     |      packet status count      |

    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

12 |                 reference time                | fb pkt. count |

    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

16 |          packet chunk         |         packet chunk          |

    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

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    |         packet chunk          |  recv delta   |  recv delta   |

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    |           recv delta          |  recv delta   | zero padding  |

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* + - * base sequence number: The transport-wide sequence number of the first packet in this feedback.
      * reference time: it indicates an absolute reference time in some (unknown) time base chosen by the sender of the feedback packets. The first recv delta in this packet is relative to the reference time.
      * packet chunk: A list of packet status chunks, indicating the status of one or more packets starting with the one identified by base sequence number.
      * recv delta: it represents a time interval in units of 0.25ms for a packet indicated in the packet chunk relative to the reference time.
  1. **Payload-specific FeedBack Messages** (PSFB): The PT value is 206.
     + **Picture Loss Indication** (PLI) (RFC 4585): The PT is 206 and the FMT is 1. It indicates the loss of an undefined amount of coded video data belonging to one or more pictures.
     + **Full Intra Request** (FIR) (RFC 5104): The PT value is 206 and the FMT value is 4. The FIR indicates the request of a full intra or Instantaneous Decoder Refresh picture from the media sender.
     + **Region of Interest** (ROI) (TS 26.114): The PT value is 206 and the FMT value is 9. The ROI message indicates the request by the media receiver for an interested region of the media.
     + **Viewport** (VP)(TS 26.114): The PT value is 206 and the FMT value is 11. The ROI message indicates the request by the media receiver for a region of the media in an interested viewport.
* **RTCP XR Reports** (RFC 3611): The RTCP XR report is identified by PT equal to 207, which refers to an extended report block message. The block type (BT) field defined in RFC 3611 is used to identify the block format.

### 6.x.2.2 RTP header extensions

For applicaiton bitrate adaptation and congestion control, it is important for the network to understand the state of the network, i.e., whether the network is in congestion or not. Many congestion control algorithms, e.g., Google congestion control algorithms [28], NADA [29] and SCReAMv2 [30], use the queueing delay as a signal of network congestion. Therefore, it is important to measure the delays and make the measurements available to the RTP sender in an efficient manner.

TS26.522 [2] defined two RTP header extensions for in-band end-to-end delay measurement. The first RTP header extension that carries only one timestamp, also known as the “Absolute Sender Time" RTP header extension, is already implemented in WebRTC [28]. The second RTP header extension that carries three timestamps returns the measured one-way delay in the direction from the sender to the receiver back to the sender. The current implementation in WebRTC uses RTCP messages to carry the one-way delay back to the sender and that may introduce large delay due to the RTCP bandwidth limitation or large overhead due to the additional IP/UDP packet headers for a separate packet.

TS 26.522 [2] defines an RTP header extension for XR Pose which can be used for signaling either a 6DoF or 3DoF XR pose. The HE can be used either by an RTP receiver to indicate the XR pose used for rendering the media (rendered pose) or by an RTP sender to indicate to an RTP receiver the XR pose to be rendered.

NOTE: Other RTCP messages and RTCP header extensions in 3GPP TS26.522 and IETF RFCs may be also considered.

\* \* \* \* End of changes \* \* \* \*