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Real-time Transport Control Protocol Extension Report for Run Length Encoding of Discarded Packets
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Status of this Memo

Abstract

The Real-time Transport Control Protocol (RTCP) is used in conjunction with the Real-time Transport Protocol (RTP) in to provide a variety of short-term and long-term reception statistics. The available reporting may include aggregate information across longer periods of time as well as individual packet reporting. This document specifies a per-packet report metric capturing individual packets discarded from the jitter buffer after successful reception.

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1. Introduction

RTP [RFC3550] provides a transport for real-time media flows such as audio and video together with the RTP control protocol which provides periodic feedback about the media streams received in a specific duration. In addition, RTCP can be used for timely feedback about individual events to report (e.g., packet loss) [RFC4585]. Both long-term and short-term feedback enable a sender to adapt its media transmission and/or encoding dynamically to the observed path characteristics.

RFC3611 [RFC3611] defines RTCP eXtension Reports as a detailed reporting framework to provide more than just the coarse RR statistics. The detailed reporting may enable a sender to react more appropriately to the observed networking conditions as these can be characterized better, albeit at the expense of extra overhead.

Among many other fields, RFC3611 specifies the Loss RLE block which define runs of packets received and lost with the granularity of individual packets. This can help both error recovery and path loss characterization. In addition to lost packets, RFC 3611 defines the notion of "discarded" packets: packets that were received but dropped from the jitter buffer because they were either too early (for buffering) or too late (for playout). This metric is part of the VoIP metrics report block even though it is not just applicable to audio: it is specified as the fraction of discarded packets since the beginning of the session. See section 4.7.1 of RFC3611 [RFC3611].

Recently proposed extensions to the XR reporting suggest enhancing this discard metric:

- Reporting the number of discarded packets during either the last reporting interval or since the beginning of the session, as indicated by a flag in the suggested XR report [I-D.ietf-avt-rtcp-xr-discard].
- Reporting gaps and bursts of discarded packets during the last reporting interval or cumulatively since the beginning of the session [I-D.ietf-avt-rtcp-xr-burst-gap-discard].

However, none of these metrics allow a receiver to report precisely which packets were discarded. While this information could in theory be derived from high-frequency reporting on the number of discarded packets or from the gap/burst report, these two mechanisms do not appear feasible: The former would require an unduly high amount of reporting which still might not be sufficient due to the non-deterministic scheduling of RTCP packets. The latter incur significant complexity and reporting overhead and might still not deliver the desired accuracy.

This document defines a discard report block following the idea of the run-length encoding applied for lost and received packets in RFC3611.

Complementary to or instead of the indication which packets were lost, an XR block is defined to indicate the number of bytes lost, per interval or for the duration of the session, similar to other XR report blocks.

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14, RFC 2119 [RFC2119] and indicate requirement levels for compliant implementations.

The terminology defined in RTP [RFC3550] and in the extensions for XR reporting [RFC3611] applies.

3. XR Discard RLE Report Block

The XR Discard RLE report block uses the same format as specified for the loss and duplicate report blocks in RFC3611 [RFC3611]. Figure Figure 1 recaps the packet format. The fields "BT", "T", "block length", "SSRC of source", "begin_seq", and "end_seq" SHALL have the same semantics and representation as defined in RFC3611. The "chunks" encoding the run length SHALL have the same representation as in RFC3611, but encode discarded packets.

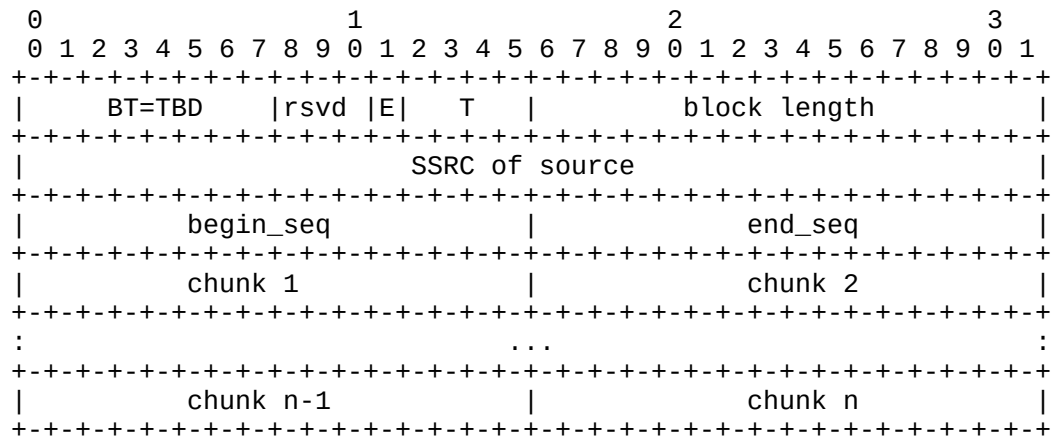

Figure 1: XR Discard Report Block

The 'E' bit is introduced to distinguish between packets discarded due to early arrival and those discarded due to late arrival. The 'E' bit MUST be set to '1' if the chunks represent packets discarded due to too early arrival and MUST be set to '0' otherwise.

In case both early and late discarded packets shall be reported, two Discard RLE report blocks MUST be included; their sequence number range MAY overlap, but individual packets MUST only be reported as either early or late. Packets reported in both MUST be considered as discarded without further information available, packets reported in neither are considered to be properly received and not discarded.

Editor's node: is it acceptable to use one of the 'reserved' bits for this purpose or should two block types be used?

4. XR Bytes Discarded Report Block

The XR Bytes Discarded report block uses the following format:

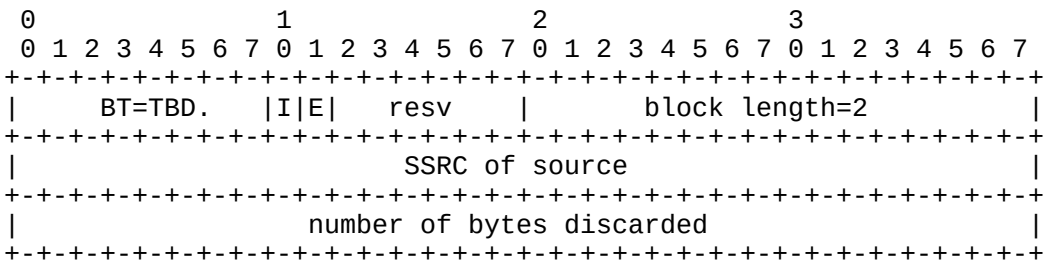

Figure 2: XR Bytes Discarded Report Block

The Interval Metric flag (I) (1 bit) is used to indicate whether the Post-Repair Loss metric is an Interval or a Cumulative metric, that is, whether the reported value applies to the most recent measurement interval duration between successive metrics reports (I=1) (the Interval Duration) or to the accumulation period characteristic of cumulative measurements (I=0) (the Cumulative Duration).

The 'E' flag (1 bit) is introduced to distinguish between bytes discarded due to early arrival and bytes discarded due to late arrival. The 'E' bit MUST be set to '1' if the 'number of bytes discarded' represents bytes discarded due to too early arrival and MUST be set to '0' otherwise. In case both early and late discarded packets shall be reported, two Bytes Discarded report blocks MUST be included.

The 'number of bytes discarded' (32 bits) is an unsigned integer value indicating the total number of bytes discarded (I=0) or the number of bytes discarded since the last RTCP XR Bytes Discarded block was sent (I=1).

Editor's note: is it acceptable to use one of the 'reserved' bits for this purpose or should two block types be used?

5. Protocol Operation

This section describes the behavior of the reporting (= receiver) RTP node and the sender RTP node.

5.1. Reporting Node (Receiver)

Any of the Discard RLE and the Bytes Discarded RLE report blocks SHOULD be sent in conjunction with an RTCP RR as a compound RTCP packet. Nevertheless, the Discard RLE Report Block MAY be sent as a non-compound packet [I-D.ietf-avt-rtcp-non-compound] to expedite reporting or to increase the reporting frequency.

Transmission of RTCP XR Discard RLE and Bytes Discarded reports is up to the discretion of the receiver, as is the reporting granularity. They MAY sent independently of each other or together in a single datagram.

However, for the Discard RLE report blocks, it is RECOMMENDED that the receiver signals all discarded packets using the method defined in this document. If all packets over a reporting period were discarded, the receiver MAY use the Discard Report Block [I-D.ietf-avt-rtcp-xr-discard] instead. In case of limited available reporting bandwidth, it is up to the receiver whether or not to include RTCP XR Discard RLE reports or not.

The receiver MAY send the Discard RLE and the Bytes Discarded reports as part of the regularly scheduled RTCP packets as per RFC3550. It MAY also include Discard RLE Reports in immediate or early feedback packets as per RFC4585.

5.2. Media Sender

The media sender MUST be prepared to operate without receiving any Discard RLE or Bytes Discarded reports. If Discard RLE reports are generated by the receiver, the sender cannot rely on all these reports being received, nor can the sender rely on a regular generation pattern from the receiver side.

However, if the sender receives any RTCP reports but no Discard RLE report blocks and is aware that the receiver supports Discard RLE or Bytes Discarded report blocks, it SHOULD assume that no packets were discarded at the receiver.

6. SDP signaling

The present report blocks define an extension to RTCP XR reporting. Whether or not this specific extended report is sent is left to the discretion of the receiver. Its presence may enable better operation of the sender since more detailed information is available. Not providing this information will make the sender rely on other RTCP report metrics. Whether there is a need to signal this optimization is left for further study at this point. If the receiver knows that the sender supports this metric, it may decide to include such reports as deemed necessary and not send them otherwise to save reporting bandwidth. Hence, there is some value.

Editor’s node: There is ample precedence for signaling such capabilities (and even required support) in SDP, so that defining the corresponding attributes is a straightforward exercise should the

need be confirmed.

7. Security Considerations

The security considerations of RFC3550, RFC3611, and RFC4585 apply. Since this document offers only a more precise reporting for an already existing metric, no further security implications are foreseen.

8. IANA Considerations

One or two IANA actions are expected, depending on the future evolution of this document: Registration of two XR report blocks and, optionally, registration of SDP attributes for indicating support for these XR Report Blocks.

9. Normative References

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