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RTP Control Protocol (RTCP) Extended Report (XR) for Run Length Encoding (RLE) of Discarded Packets
draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-07

Abstract

The RTP 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 de-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 (RTCP) 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 media sender to adapt its media transmission and/or encoding dynamically to the observed path characteristics.

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

Among many other report blocks, RFC3611 specifies the Loss Run Length Encoding (RLE) block which reports 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, RFC3611 defines the notion of "discarded" packets: packets that were received but dropped from the de-jitter buffer because they were either too early (for buffering) or too late (for playout). The "discard rate" 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]. The discard metric is believed to be applicable to a large class of RTP applications which use a de-jitter buffer RFC5481 [RFC5481].

Recently proposed extensions to the Extended Reports (XR) reporting suggest enhancing this discard metric:

- Reporting the number of discarded packets in a measurement interval, i.e., 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-xrblock-rtcp-xr-discard]. If an endpoint needs to report packet discard due to other reasons than early- and late-arrival (for example, discard due to duplication, redundancy, etc.) then it should consider using the Discarded Packets Report Block [I-D.ietf-xrblock-rtcp-xr-discard].

- Reporting gaps and bursts of discarded packets during a measurement interval, i.e., the last reporting interval or the duration of the session [I-D.ietf-xrblock-rtcp-xr-burst-gap-discard].

- Reporting the sum of payload bytes discarded during a measurement interval, i.e., the last reporting interval or the duration of the session [I-D.singh-xrblock-rtcp-xr-bytes-discarded-metric].

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 [I-D.ietf-xrblock-rtcp-xr-discard] or from the gap/burst report [I-D.ietf-xrblock-rtcp-xr-burst-gap-discard], 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].

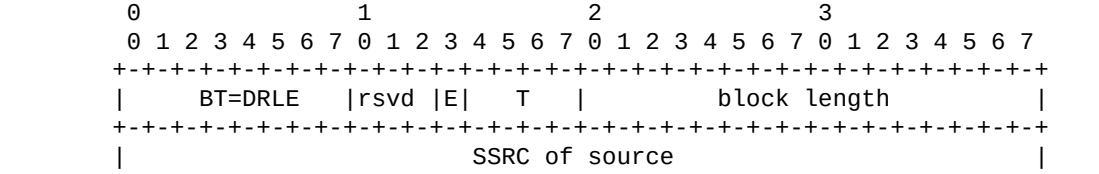
2. Terminology

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].

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]. Figure 1 describes the packet format. The fields "BT", "T", "block length", "SSRC of source", "begin_seq", and "end_seq" have the same semantics and representation as defined in [RFC3611], with the addition of the "E" flag to indicate the reason for discard. The "chunks" encoding the run length have the same representation as in RFC3611, but encode discarded packets. A definition of a discarded packet is given in [I-D.ietf-xrblock-rtcp-xr-discard].



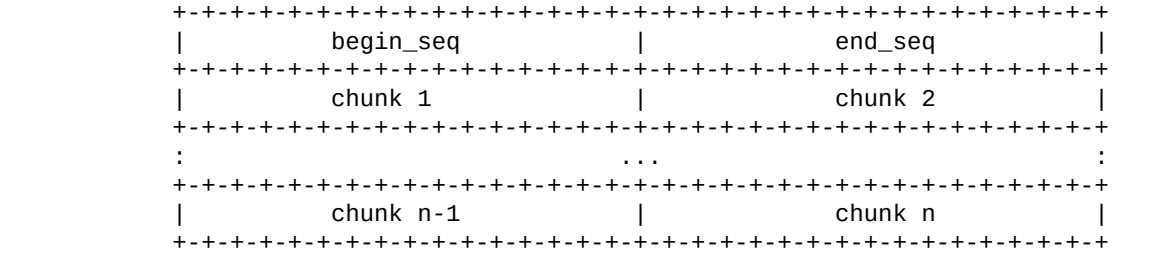


Figure 1: XR Discard RLE Report Block

Block Type (BT, 8 bits): A Run-length encoded Discarded Packets Report Block is identified by the constant DRLE.

[Note to RFC Editor: please replace DRLE with the IANA provided RTCP XR block type for this block. Please remove this note prior to publication as an RFC.]

rsvd (3 bits): This field is reserved for future definition. In the absence of such definition, the bits in this field MUST be set to zero and MUST be ignored by the receiver.

The 'E' bit is introduced to distinguish between packets discarded due to early arrival and those discarded due to late arrival. The 'E' bit is set to '1' if the chunks represent packets discarded due to too early arrival and is 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 and not appear marked in both. If packets appear in both report blocks, the conflicting packets are ignored. Packets reported in neither are considered to be properly received and not discarded.

Discard RLE Report Blocks SHOULD be sent in conjunction with an RTCP RR as a compound RTCP packet.

4. Protocol Operation

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

4.1. Reporting Node (Receiver)

Transmission of RTCP XR Discard RLE Reports is up to the discretion of the media receiver, as is the reporting granularity. However, it

is RECOMMENDED that the media receiver signals all discarded packets using the method defined in this document. If all packets over a reporting period were discarded, the media receiver MAY use the Discard Report Block [I-D.ietf-xrblock-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.

The media receiver MAY send the Discard RLE 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.

4.2. Media Sender

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

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

5. SDP signaling

A participant of a media session MAY use SDP to signal its support for the report block specified in this document or use them without any prior signaling (see section 5 of [RFC3611]).

For signaling in SDP, the RTCP XR attribute as defined in [RFC3611] MUST be used. The SDP [RFC4566] attribute 'xr-format' defined in RFC3611 is augmented as described in the following to indicate the the discard RLE metric.

```
rtcp-xr-attrib = "a=" "rtcp-xr" ":" [xr-format *(SP xr-format)]
                 CRLF   ; defined in [RFC3611]

xr-format       =/ xr-discard-rle

xr-discard-rle   = "discard-rle"
```

The parameter 'discard-rle' is used to indicate support for the Discard RLE Report Block defined in Section 3.

When SDP is used in Offer/Answer context, the mechanism defined in [RFC3611] for unilateral "rtcp-xr" attribute parameters applies (see section 5.2 of [RFC3611]).

6. Security Considerations

The Discard RLE block provides per-packet statistics so the risk to confidentiality documented in Section 7, paragraph 3 of [RFC3611] applies. In some situations, returning very detailed error information (e.g., over-range measurement or measurement unavailable) using this report block can provide an attacker with insight into the security processing. Implementers should consider the guidance in [I-D.ietf-avt-srtp-not-mandatory] for using appropriate security mechanisms, i.e., where security is a concern, the implementation should apply encryption and authentication to the report block. For example this can be achieved by using the AVPF profile together with the Secure RTP profile as defined in [RFC3711]; an appropriate combination of the two profiles (an "SAVPF") is specified in [RFC5124]. However, other mechanisms also exist (documented in [I-D.ietf-avtcore-rtp-security-options]) and might be more suitable.

Additionally, The security considerations of [RFC3550], [RFC3611], and [RFC4585] apply.

7. IANA Considerations

New block types for RTCP XR are subject to IANA registration. For general guidelines on IANA considerations for RTCP XR, refer to [RFC3611].

7.1. XR Report Block Registration

This document extends the IANA "RTP Control Protocol Extended Reports (RTCP XR) Block Type Registry" by a new value: DRLE (Discard RLE Report).

[Note to RFC Editor: please replace DRLE with the IANA provided RTCP XR block type for this block here and in the diagrams above. Please remove this note prior to publication as an RFC.]

7.2. SDP Parameter Registration

This document registers a new parameters for the Session Description Protocol (SDP), "discard-rle" in the "RTP Control Protocol Extended Reports (RTCP XR) Session Description Protocol (SDP) Parameters Registry".

7.3. Contact information for IANA registrations

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8. Acknowledgments

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9. References

9.1. Normative References

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[I-D.ietf-xrblock-rtcp-xr-discard] Clark, A., Zorn, G., and W. Wu, "RTP Control Protocol (RTCP) Extended Report (XR) Block for Discard Count metric Reporting", draft-ietf-xrblock-rtcp-xr-discard-15 (work in progress), June 2013.

9.2. Informative References

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Appendix A. Metrics represented using RFC6390 Template

RFC EDITOR NOTE: please change XXXX in [RFCXXXX] by the new RFC number, when assigned.

a. Run-length encoding (RLE) of Discarded Packets Metric

* Metric Name: Discard Run-length encoding Metric

* Metric Description: Instances of packets discarded over the period covered by this report.

* Method of Measurement or Calculation: See section 3, for the definition of Discard RLE [RFCXXXX] and section 4.1 of RFC3611 for Run-length encoding.

* Units of Measurement: Every packet in the interval is reported as discarded or not. See section 3 for the definition of Discard RLE [RFCXXXX].

* Measurement Point(s) with Potential Measurement Domain: The measurement of these metrics is made at the receiving end of the RTP stream.

* Measurement Timing: Each packet between a beginning sequence number (begin_seq) and ending sequence number (end_seq) are reported as discarded or not. See section 3 for the definition of Discard RLE [RFCXXXX].

* Use and applications: See section 1, paragraph 1 of [RFCXXXX].

* Reporting model: See RFC3611.

Appendix B. Change Log

Note to the RFC-Editor: please remove this section prior to publication as an RFC.

B.1. changes in draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-00

- Changed the interval flag from 1 to 2 bits in the discarded bytes report. Also added the measurement identification tag to the block.
- Added this section.

B.2. changes in draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-01

- Removed the measurement identification tag in the bytes discarded block.

B.3. changes in draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-02

- Removed the extra Tag bits from the Discarded bytes XR block.
- Clarified use of measurement identity block in Section 4 and 5.2

B.4. changes in draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-03

- Added explanation for block length in bytes discarded block.
- Added an acknowledgement section.

B.5. changes in draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-04

- Added Block Type definition to each XRBlock.
- Made changes requested in WGLC.

B.6. changes in draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-05

- Made changes requested by SDP directorate.

B.7. changes in draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-06

- Editorial fixes based on review from Gen-art and IESG review.

B.8. changes in draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-07

- Editorial fixes based on review from IESG.
- Editorial fixes based on Security and PM directorate.
- Split bytes discarded from this draft to another.
- Updated Security Considerations Section.
- This draft now normatively cites the definition of discards in 'packets discarded' draft.

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