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.

Status of This Memo

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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:

o 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].

o 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].

o 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].

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     BT=DRLE   |rsvd |E|   T   |          block length          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      SSRC of source                           |
```

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           begin_seq          |            end_seq           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           chunk 1            |            chunk 2            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
:                            ...                               :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           chunk n-1         |            chunk n            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
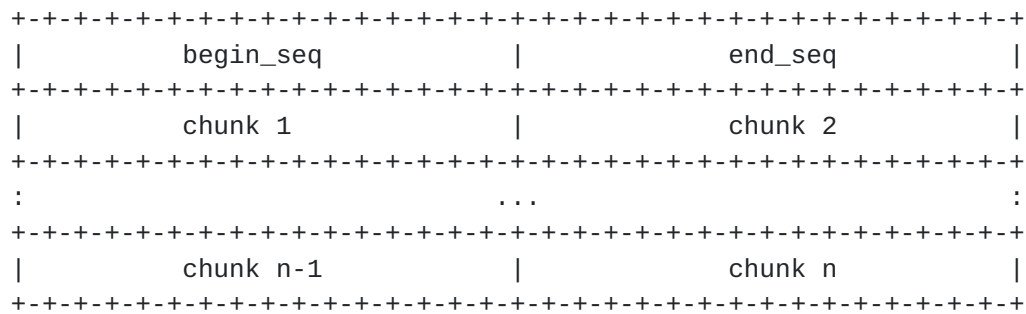
Figure 1: XR Discard RLE Report Block

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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   Colin Perkins, Dan Romascanu, Dan Wing, and Qin Wu for providing
   valuable feedback on earlier versions of this draft.

9. References

9.1. Normative References

   [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
              Requirement Levels", BCP 14, RFC 2119, March 1997.

   [RFC3550] Schulzrinne, H., Casner, S., Frederick, R., and V.
              Jacobson, "RTP: A Transport Protocol for Real-Time
              Applications", STD 64, RFC 3550, July 2003.

   [RFC3611] Friedman, T., Caceres, R., and A. Clark, "RTP Control
              Protocol Extended Reports (RTCP XR)", RFC 3611, November
              2003.

   [RFC4585] Ott, J., Wenger, S., Sato, N., Burmeister, C., and J. Rey,
              "Extended RTP Profile for Real-time Transport Control
              Protocol (RTCP)-Based Feedback (RTP/AVPF)", RFC 4585, July
              2006.

   [RFC4566] Handley, M., Jacobson, V., and C. Perkins, "SDP: Session
              Description Protocol", RFC 4566, July 2006.

   [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

   [I-D.ietf-xrblock-rtcp-xr-burst-gap-discard]
              Clark, A., Huang, R., and W. Wu, "RTP Control
              Protocol(RTCP) Extended Report (XR) Block for Burst/Gap
              Discard metric Reporting", draft-ietf-xrblock-rtcp-xr-
              burst-gap-discard-14 (work in progress), April 2013.

[RFC5481]   Morton, A. and B. Claise, "Packet Delay Variation
            Applicability Statement", RFC 5481, March 2009.

[RFC3711]   Baugher, M., McGrew, D., Naslund, M., Carrara, E., and K.
            Norrman, "The Secure Real-time Transport Protocol (SRTP)",
            RFC 3711, March 2004.

[RFC5124]   Ott, J. and E. Carrara, "Extended Secure RTP Profile for
            Real-time Transport Control Protocol (RTCP)-Based Feedback
            (RTP/SAVPF)", RFC 5124, February 2008.

[I-D.ietf-avt-srtp-not-mandatory]
            Perkins, C. and M. Westerlund, "Securing the RTP Protocol
            Framework: Why RTP Does Not Mandate a Single Media
            Security Solution", draft-ietf-avt-srtp-not-mandatory-13
            (work in progress), May 2013.

[I-D.ietf-avtcore-rtp-security-options]
            Westerlund, M. and C. Perkins, "Options for Securing RTP
            Sessions", draft-ietf-avtcore-rtp-security-options-04
            (work in progress), July 2013.

[I-D.singh-xrblock-rtcp-xr-bytes-discarded-metric]
            Singh, V., Ott, J., and I. Curcio, "RTP Control Protocol
            (RTCP) Extended Reports (XR) for Bytes Discarded Metric",
            draft-singh-xrblock-rtcp-xr-bytes-discarded-metric-00
            (work in progress), August 2013.

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

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

o Added this section.

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

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

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

o Removed the extra Tag bits from the Discarded bytes XR block.

o 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

o Added explanation for block length in bytes discarded block.

o Added an acknowledgement section.

[B.5](#). **changes in [draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-04](#)**

   o Added Block Type definition to each XRBlock.

   o Made changes requested in WGLC.

[B.6](#). **changes in [draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-05](#)**

   o Made changes requested by SDP directorate.

[B.7](#). **changes in [draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-06](#)**

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

[B.8](#). **changes in [draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-07](#)**

   o Editorial fixes based on review from IESG.

   o Editorial fixes based on Security and PM directorate.

   o Split bytes discarded from this draft to another.

   o Updated Security Considerations Section.

   o This draft now normatively cites the definition of discards in
      'packets discarded' draft.

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