RTP Control Protocol (RTCP) Extended Report (XR) Block
for the Bytes Discarded Metric

Abstract

   The RTP Control Protocol (RTCP) is used in conjunction with the Real-
   time Transport Protocol (RTP) 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 report
   computing the bytes discarded from the de-jitter buffer after
   successful reception.

Status of This Memo

   This is an Internet Standards Track document.

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   Internet Engineering Steering Group (IESG). Further information on
   Internet Standards is available in Section 2 of RFC 5741.

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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] 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.

   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]. The
   discard metric is believed to be applicable to a large class of RTP
   applications that use a de-jitter buffer [RFC5481].

   Recently proposed extensions to the Extended Reports (XR) reporting
   suggest enhancing the 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 [RFC7002]. 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
      [RFC7002].

   o Reporting gaps and bursts of discarded packets during a
      measurement interval, i.e., the last reporting interval or the
      duration of the session [RFC7003].

   o Reporting run-length encoding of a discarded packet during a
      measurement interval, i.e., between a set of sequence numbers
      [RFC7097].

However, none of these metrics allow a receiver to report precisely
the number of RTP payload bytes that were discarded. While this
information could in theory be derived from high-frequency reporting
on the number of discarded packets [RFC7002] or from the Discard RLE
(Run Length Encoding) report [RFC7097], these two mechanisms do not
appear feasible. The former would require an unduly high amount of
reporting that still might not be sufficient due to the non-
deterministic scheduling of RTCP packets. The latter incurs
significant complexity (by storing a map of sequence numbers and
packet sizes) and reporting overhead.

An XR block is defined in this document to indicate the number of RTP
payload bytes discarded, per interval or for the duration of the
session, similar to the other XR 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, [RFC2119].

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

3. Bytes Discarded Report Block

The Bytes Discarded Report Block uses the following format, which
follows the model of the framework for performance metric development
[RFC6390].

```
 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=26     | I |E|Reserved |         Block length=2         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        SSRC of source                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            Number of RTP payload bytes discarded              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
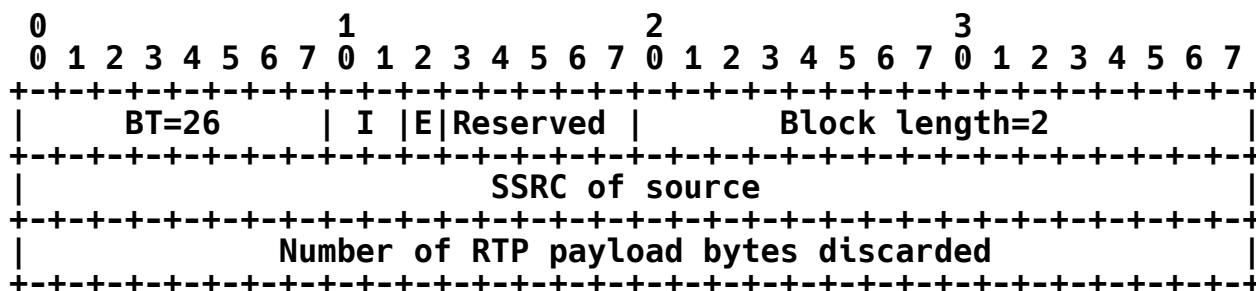
                Figure 1: XR Bytes Discarded Report Block

Block Type (BT): 8 bits. A Bytes Discarded Packets Report Block is
identified by the constant 26.

Interval Metric flag (I): 2 bits. It is used to indicate whether the
discard metric is an Interval or a Cumulative metric, that is,
whether the reported value applies to the most recent measurement

interval duration between successive reports (I=10, the Interval
Duration) or to the accumulation period characteristic of cumulative
measurements (I=11, the Cumulative Duration). Since the bytes
discarded are not measured at a particular time instance but over one
or several reporting intervals, the metric MUST NOT be reported as a
Sampled Metric (I=01). In addition, the value I=00 is reserved and
MUST NOT be sent, and it MUST be discarded when received.

Early bit (E): It 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 it reports bytes discarded due
to early arrival and is set to '0' if it reports bytes discarded due
to late arrival. If a duplicate packet is received and discarded,
these duplicate packets are ignored and not reported. In case both
early and late discarded packets shall be reported, two Bytes
Discarded report blocks MUST be included.

Reserved: 5 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.

Block length: 16 bits. It MUST be set to 2, in accordance with the
definition of this field in [RFC3611]. The block MUST be discarded
if the block length is set to a different value.

Number of RTP payload bytes discarded: It is a 32-bit unsigned
integer value indicating the total number of bytes discarded. The
'bytes discarded' corresponds to the RTP payload size of every RTP
packet that is discarded (due to early or late arrival). Hence, the
'bytes discarded' ignores the size of any RTP header extensions and
the size of the padding bits. Also the discarded packet is
associated to the interval in which it was discarded, not when it was
expected.

If the Interval Metric flag is set as I=11, the value in the field
indicates the number of RTP payload bytes discarded from the start of
the session; if the Interval Metric flag is set as I=10, it indicates
the number of bytes discarded in the most recent reporting interval.

If the XR block follows a Measurement Information Block [RFC6776] in
the same RTCP compound packet, then the cumulative (I=11) or the
interval (I=10) for this report block corresponds to the values of
the "measurement duration" in the Measurement Information Block.

If the receiver sends the Bytes Discarded Report Block without the
Measurement Information Block, then the Bytes Discarded Report Block
MUST be sent in conjunction with an RTCP Receiver Report (RR) as a
compound RTCP packet.

4. Protocol Operation

   This section describes the behavior of the reporting node (i.e., the
   media receiver) and the media sender.

4.1. Reporting Node (Receiver)

   The media receiver MAY send the Bytes Discarded Reports as part of
   the regularly scheduled RTCP packets as per RFC 3550. It MAY also
   include Bytes Discarded Reports in immediate or early feedback
   packets as per [RFC4585].

   Transmission of the RTCP XR Bytes Discarded Report is up to the
   discretion of the media receiver, as is the reporting granularity.
   However, it is RECOMMENDED that the media receiver signals the bytes
   discarded packets using the method defined in this document. When
   reporting several metrics in a single RTCP packet, the reporting
   intervals for the report blocks are synchronized, therefore the media
   receiver may choose to additionally send the Discarded Packets
   [RFC7002] or Discard RLE [RFC7097] Report Block to assist the media
   sender in correlating the bytes discarded to the packets discarded in
   that particular interval.

   If all packets over a reporting period were discarded, the media
   receiver MAY use the Discarded Packets Report Block [RFC7002]
   instead.

4.2. Media Sender

   The media sender MUST be prepared to operate without receiving any
   Bytes Discarded reports. If Bytes Discarded 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 Bytes
   Discarded report blocks and is aware that the media receiver supports
   Bytes Discarded report blocks, it MAY assume that no packets were
   discarded by the media receiver.

   The media sender SHOULD accept the Bytes Discarded Report Block only
   if it is received in a compound RTCP receiver report or if it is
   preceded by a Measurement Information Block [RFC6776]. Under all
   other circumstances, it MUST ignore the block.

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 RFC
   3611 is augmented to indicate the Bytes Discarded metric. This is
   described in the following ABNF [RFC5234]:

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

   xr-format   =/ xr-discard-bytes

   xr-discard-bytes = "discard-bytes"

   The parameter 'discard-bytes' to indicate support for the Bytes
   Discarded Report Block is defined in Section 3.

   When SDP is used in the 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 Bytes Discarded block does not provide per-packet statistics,
   hence the risk to confidentiality documented in Section 7, paragraph
   3 of [RFC3611] does not apply. 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. For example,
   assume that the attacker sends a packet with a stale timestamp (i.e.,
   time in the past) to the receiver. If the receiver now sends a
   discard report with the same number of bytes as the payload of the
   injected packet, the attacker can infer that no security processing
   was performed. If, on the other hand, the attacker does not receive
   a discard report, it can equivalently assume that the security
   procedures were performed on the packet.

   Implementers should therefore consider the guidance in [RFC7202] 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 [RFC7201]) and might be more
   suitable.

   The Bytes Discarded report is employed by the sender to perform
   congestion control, typically, for calculating goodput (i.e.,
   throughput that is useful). In these cases, an attacker MAY drive
   the endpoint to lower its sending rate and under-utilize the link;
   therefore, media senders should choose appropriate security measures
   to mitigate such attacks.

   Lastly, 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 Block Registration

   This document registers a new value in the IANA "RTP Control Protocol
   Extended Reports (RTCP XR) Block Type Registry": 26 for BDR (Bytes
   Discarded Report).

7.2. SDP Parameter Registration

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

7.3. Contact Information for IANA Registrations

   RAI Area Directors <rai-ads@tools.ietf.org>

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Appendix A. Metrics Represented Using the Template from RFC 6390

   a. RTP Payload Bytes Discarded Metric

       * Metric Name: RTP Payload Bytes Discarded Metric

       * Metric Description: Total number of RTP payload bytes
          discarded over the period covered by this report.

       * Method of Measurement or Calculation: See the definition of
          "Number of RTP payload bytes discarded" in Section 3.

       * Units of Measurement: See the definition of "Number of RTP
          payload bytes discarded" in Section 3.

       * Measurement Point(s) with Potential Measurement Domain: See
          the first paragraph of Section 3.

       * Measurement Timing: See the last three paragraphs of Section 3
          for measurement timing and for the Interval Metric flag.

       * Use and applications: See the third paragraph of Section 1.

       * Reporting model: See RFC 3611.

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