Internet Engineering Task Force (IETF)
Request for Comments: 7243
Category: Standards Track
ISSN: 2070-1721

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May 2014

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.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc7243.

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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:

- 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].

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

- 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].

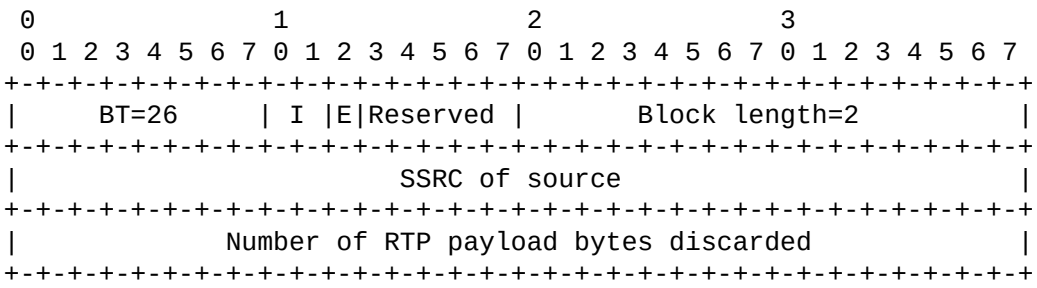

Figure 1: XR Bytes Discarded Report Block

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>

8. Acknowledgments

The authors would like to thank Benoit Claise, Alan Clark, Roni Even, Vijay Gurbani, Sam Hartman, Vinayak Hegde, Jeffrey Hutzelman, Barry Leiba, Colin Perkins, Dan Romascanu, Dan Wing, and Qin Wu for providing valuable feedback on this document during its development.

9. References

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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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