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RTP Control Protocol (RTCP) Extended Report (XR) Block for Independent Reporting of Burst/Gap Discard Metrics

Abstract

This document defines an RTP Control Protocol (RTCP) Extended Report (XR) block that allows the reporting of burst/gap discard metrics independently of the burst/gap loss metrics for use in a range of RTP applications.

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 7841.

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/rfc8015.

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1. Introduction

1.1. Independent Burst/Gap Discard Metrics Block

This document defines a new block type that extends the metrics defined in [RFC7003]. The new block type reports the proportion of packets discarded in a burst by the de-jitter buffer at the receiver. The number of packets discarded depends on the de-jitter buffer algorithm implemented by the endpoint.

The new report block defined in this document is different from the one defined in [RFC7003]. The metrics in [RFC7003] depend on the metrics in the burst/gap loss metric defined in [RFC6958]. Consequently, an endpoint that sends a Burst/Gap Discard Metrics Block [RFC7003] also needs to send a Burst/Gap Loss Metrics Block [RFC6958]. The combined usage is useful when an endpoint observes correlated packet losses and discard. However, when the burst of packet losses and discards do not occur simultaneously, the application could prefer to send a concise report block that just reports the burst/gap of discarded packets. The report block in this document provides the complete information and does not require additional report blocks. That is, this block reports the total number of packets discarded, the total burst duration, and the total number of bursts. All of these metrics are missing in [RFC7003].

This block provides information on transient network issues. Burst/gap metrics are typically used in cumulative reports; however, they can also be used in interval reports (see the Interval Metric flag in Section 3.2). The variation in the number of packet discards in a burst affects the user experience. Based on the metrics reported in the block, the sending endpoint can change the packetization interval, vary the bitrate, etc. The report can additionally be used for diagnostics [RFC6792]. The metric belongs to the class of transport-related end-system metrics defined in [RFC6792].

The definitions of "burst", "gap", "loss", and "discard" are consistent with the definitions in [RFC3611]. To accommodate a range of de-jitter buffer algorithms and packet discard logic that can be used by implementers, the method used to distinguish between bursts and gaps uses an equivalent method to that defined in Section 4.7.2 of [RFC3611]. Note that reporting the specific de-jitter buffer algorithm and/or the packet discard logic is out of the scope of this document.

1.2. RTCP and RTCP Extended Reports

The use of RTCP for reporting is defined in [RFC3550]. [RFC3611] defined an extensible structure for reporting using an RTCP Extended Report (XR). This document defines a new Extended Report block for use with [RFC3550] and [RFC3611].

1.3. Performance Metrics Framework

The Performance Metrics Framework [RFC6390] provides guidance on the definition and specification of performance metrics. The RTP Monitoring Framework [RFC6792] provides guidelines for reporting the block format using RTCP XR. The metrics block described in this document is in accordance with the guidelines in [RFC6390] and [RFC6792].

1.4. Applicability

These metrics are applicable to a range of RTP applications that contain de-jitter buffers at the receiver to smooth variation in packet-arrival time and don't use stream repair means, e.g., Forward Error Correction (FEC) [FLEX_FEC] and/or retransmission [RFC4588].

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 RFC 2119 [RFC2119].

In addition, the following terms are defined:

Received, Lost, and Discarded

A packet is regarded as "lost" if it fails to arrive within an implementation-specific time window. A packet that arrives within this time window but is too early to be played out, too late to be played out, or thrown away before playout due to packet duplication or redundancy is be recorded as "discarded". A packet SHALL NOT be regarded as "discarded" if it arrives within this time window but is dropped during decoding by some higher-layer decoder, e.g., due to a decoding error. Each packet is classified as one of "received" (or "OK"), "discarded", or "lost". The metric "cumulative number of packets lost" defined in [RFC3550] reports a count of packets lost from the media stream (single synchronization source (SSRC) within a single RTP session). Similarly, the metric "number of packets discarded" defined in [RFC7002] reports a count of packets discarded from the media stream (single SSRC within a single RTP session) arriving at the

receiver. Another metric, defined in [RFC5725], is available to report on packets that are not recovered by any repair techniques that are in use. Note that the term "discard" defined here builds on the "discard" definition in [RFC3611] but extends the concept to take into account packet duplication and reports different types of discard counts [RFC7002].

Bursts and Gaps

The terms "burst" and "gap" are used in a manner consistent with that of RTCP XR [RFC3611]. RTCP XR views an RTP stream as being divided into bursts, which are periods during which the discard rate is high enough to cause noticeable quality degradation (generally a discard rate over 5 percent), and gaps, which are periods during which discarded packets are infrequent, and hence quality is generally acceptable.

3. Independent Burst/Gap Discard Metrics Block

Metrics in this block report on burst/gap discard in the stream arriving at the RTP system. Measurements of these metrics are made at the receiving end of the RTP stream. Instances of this metrics block use the synchronization source (SSRC) to refer to the separate auxiliary Measurement Information Block [RFC6776], which describes measurement periods in use (see [RFC6776], Section 4.2).

This metrics block relies on the measurement period in the Measurement Information Block indicating the span of the report. Senders MUST send this block in the same compound RTCP packet as the Measurement Information Block. Receivers MUST verify that the measurement period is received in the same compound RTCP packet as this metrics block. If not, this metrics block MUST be discarded.

3.1. Report Block Structure

The structure of the Independent Burst/Gap Discard Metrics Block is as follows.

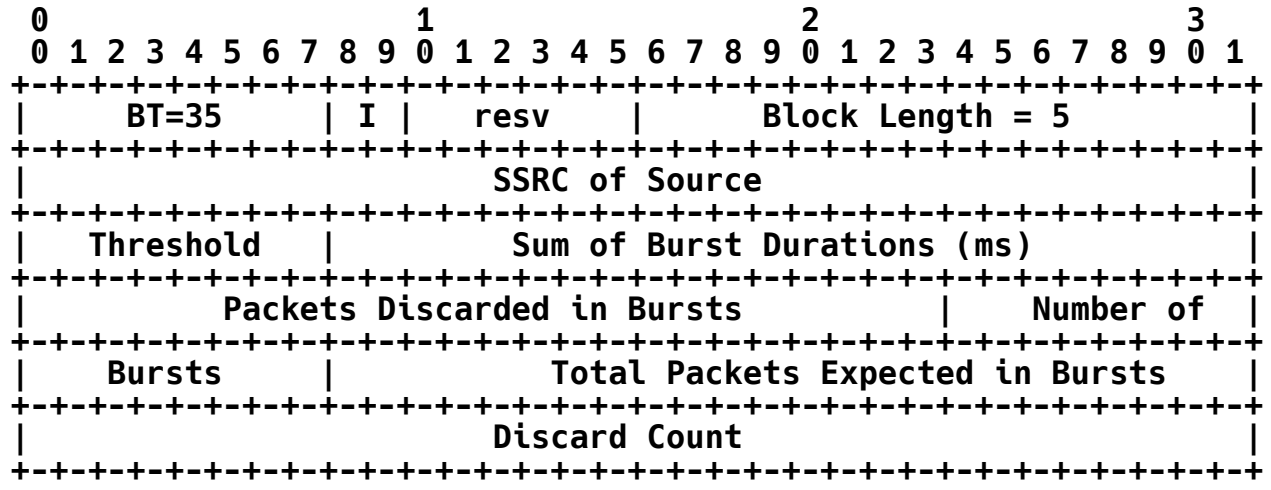

Figure 1: Report Block Structure

3.2. Definition of Fields in the Independent Burst/Gap Discard Metrics Block

Block Type (BT): 8 bits

An Independent Burst/Gap Discard Metrics Block is identified by the constant 35.

Interval Metric flag (I): 2 bits

This field is used to indicate whether the burst/gap discard metrics are Sampled, Interval, or Cumulative metrics [RFC6792]:

I=10: Interval Duration - the reported value applies to the most recent measurement interval duration between successive metrics reports.

I=11: Cumulative Duration - the reported value applies to the accumulation period characteristic of cumulative measurements.

In this document, burst/gap discard metrics can only be measured over definite intervals and cannot be sampled. Also, the value I=00 is reserved for future use. Senders MUST NOT use the values I=00 or I=01. If a block is received with I=00 or I=01, the receiver MUST discard the block.

Reserved (resv): 6 bits

These bits are reserved. They MUST be set to zero by senders and ignored by receivers (see [RFC6709], Section 4.2).

Block Length: 16 bits

The length of this report block in 32-bit words, minus one. For the Independent Burst/Gap Discard Metrics Block, the block length is equal to 5. The block MUST be discarded if the block length is set to a different value.

SSRC of Source: 32 bits

As defined in Section 4 of [RFC3611].

Threshold: 8 bits

The Threshold is equivalent to Gmin in [RFC3611], i.e., the number of successive packets that have to be received prior to, and following, a discarded packet in order for that discarded packet to be regarded as part of a gap. Note that the Threshold is set in accordance with the Gmin calculation defined in Section 4.7.2 of [RFC3611].

Sum of Burst Durations (ms): 24 bits

The total duration of bursts of discarded packets in the period of the report (Interval or Cumulative).

The measured value is an unsigned value. If the measured value exceeds 0xFFFFFD, the value 0xFFFFFE MUST be reported to indicate an over-range measurement. If the measurement is unavailable, the value 0xFFFFFF MUST be reported.

Packets Discarded in Bursts: 24 bits

The total number of packets discarded during discard bursts, as defined in Section 3.2 of [RFC7002].

Number of Bursts: 16 bits

The number of discard bursts in the period of the report (Interval or Cumulative).

The measured value is an unsigned value. If the measured value exceeds 0xFFFD, the value 0xFFFE MUST be reported to indicate an over-range measurement. If the measurement is unavailable, the value 0xFFFF MUST be reported.

Total Packets Expected in Bursts: 24 bits

The total number of packets expected during the discard bursts (that is, the sum of received packets and lost packets). The metric is defined in [RFC7003].

Discard Count: 32 bits

Number of packets discarded over the period (Interval or Cumulative) covered by this report, as defined in Section 3.2 of [RFC7002].

3.3. Derived Metrics Based on the Reported Metrics

The metrics described here are intended to be used in conjunction with information from the Measurement Information Block [RFC6776].

These metrics provide the following information relevant to statistical parameters (depending on cumulative of interval measures), for example:

- The average discarded burst size, which can be calculated by dividing the metric "Packets Discarded in Bursts" by the "Number of Bursts".

- The average burst duration, which can be calculated by dividing the metric "Sum of Burst Durations (ms)" by the "Number of Bursts".

4. Considerations for Voice-over-IP Applications

This metrics block is applicable to a broad range of RTP applications. Where the metric is used with a Voice-over-IP (VoIP) application and the stream repair means is not available, the following considerations apply.

RTCP XR views a call as being divided into bursts, which are periods during which the discard rate is high enough to cause noticeable call quality degradation (generally a discard rate over 5 percent) and gaps, which are periods during which discarded packets are infrequent, and hence call quality is generally acceptable.

If voice activity detection is used, the burst/gap duration is determined as if silence packets had been sent, i.e., a period of silence in excess of Gmin packets will terminate a burst condition.

The RECOMMENDED value for the threshold Gmin in [RFC3611] results in a burst being a period of time during which the call quality is degraded to a similar extent to a typical pulse code modulation (PCM) severely errored second.

5. SDP Signaling

[RFC3611] defines the use of SDP (Session Description Protocol) [RFC4566] for signaling the use of XR blocks. XR blocks can be used without prior signaling.

5.1. SDP rtcp-xr Attribute Extension

This section augments the SDP [RFC4566] attribute "rtcp-xr" defined in [RFC3611] by providing an additional value of "xr-format" to signal the use of the report block defined in this document. The ABNF [RFC5234] syntax is as follows.

```
xr-format =/ xr-ind-bgd-block

xr-ind-bgd-block = "ind-burst-gap-discard"
```

5.2. Offer/Answer Usage

When SDP is used in Offer/Answer context, the SDP Offer/Answer usage defined in [RFC3611] for unilateral "rtcp-xr" attribute parameters applies. For detailed usage in Offer/Answer for unilateral parameters, refer to Section 5.2 of [RFC3611].

6. 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].

6.1. New RTCP XR Block Type Value

This document assigns the block type value 35 in the IANA "RTP Control Protocol Extended Reports (RTCP XR) Block Type Registry" to the "Independent Burst/Gap Discard Metrics Block".

6.2. New RTCP XR SDP Parameter

This document also registers a new parameter "ind-burst-gap-discard" in the "RTP Control Protocol Extended Reports (RTCP XR) Session Description Protocol (SDP) Parameters Registry".

6.3. Contact Information for Registrations

The contact information for the registrations is:

ART Area Directors <art-ads@ietf.org>

7. Security Considerations

This block does not provide per-packet statistics, so the risk to confidentiality documented in Section 7, paragraph 3 of [RFC3611] does not apply. However, the gap indicated within this block could be used to detect the timing of other events on the path between the sender and receiver. For example, a competing multimedia stream might cause a discard burst for the duration of the stream, allowing the receiver of this block to know when the competing stream was active. This risk is not a significant threat since the only information leaked is the timing of the discard, not the cause.

Where this is a concern, the implementation SHOULD apply encryption and authentication to this report block. For example, this can be achieved by using the Audio-Visual Profile with Feedback (AVPF) profile together with the Secure RTP profile, as defined in [RFC3711]; an appropriate combination of those two profiles ("SAVPF") is specified in [RFC5124]. Besides this, it is believed that this RTCP XR block introduces no new security considerations beyond those described in [RFC3611].

8. References

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Appendix A. Metrics Represented Using the Template from RFC 6390

a. Threshold Metric

   * Defined in item a of Appendix A of [RFC7003].

b. Sum of Burst Durations (ms)

   * Metric Name: Sum of Burst Durations with Discarded RTP Packets.

   * Metric Description: The total duration of bursts of discarded RTP packets in the period of the report.

   * Method of Measurement or Calculation: See Section 3.2, Sum of Burst Durations definition.

   * Units of Measurement: See Section 3.2, Sum of Burst Durations definition.

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

   * Measurement Timing: See Section 3, second paragraph for measurement timing and Section 3.2 for Interval Metric flag.

   * Use and Applications: See Section 1.4.

   * Reporting Model: See [RFC3611].

c. Packets Discarded in Bursts Metric

   * Defined in item b of Appendix A of [RFC7003].

d. Number of Bursts

   * Metric Name: Number of discard bursts in RTP.

   * Metric Description: The total number of bursts with discarded RTP packets in the period of the report.

   * Method of Measurement or Calculation: See Section 3.2, Number of Bursts definition.

   * Units of Measurement: See Section 3.2 for the Number of Bursts definition.

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

* Measurement Timing: See Section 3, second paragraph for measurement timing and Section 3.2 for Interval Metric flag.

* Use and Applications: See Section 1.4.

* Reporting Model: See [RFC3611].

e. Total Packets Expected in Bursts Metric

* Defined in item c of Appendix A of [RFC7003].

f. Discard Count

* Defined in Appendix A of [RFC7002].

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