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RTP Control Protocol (RTCP) Extended Report (XR) for Post-Repair Loss Count Metrics

Abstract

This document defines an RTP Control Protocol (RTCP) Extended Report (XR) block that allows reporting of a post-repair loss count metric for a range of RTP applications. In addition, another metric, repaired loss count, is also introduced in this report block for calculating the pre-repair loss count when needed, so that the RTP sender or a third-party entity is able to evaluate the effectiveness of the repair methods used by the system.

Status of This Memo

This is an Internet Standards Track document.

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1. Introduction

RTCP Sender Reports (SRs) / Receiver Reports (RRs) [RFC3550] contain some rough statistics about the data received from the particular source indicated in that block. One of them is the cumulative number of packets lost, which is called the pre-repair loss metric in this document. This metric conveys information regarding the total number of RTP data packets that have been lost since the beginning of the RTP session.

However, this metric is measured on the media stream before any loss-repair mechanism, e.g., retransmission [RFC4588] or Forward Error Correction (FEC) [RFC5109], is applied. Using a repair mechanism usually results in recovering some or all of the lost packets. The recovery process does not reduce the values reported by the two loss metrics in RTCP RR [RFC3550] -- namely, the fraction lost and the cumulative loss. Hence, the sending endpoint cannot infer the performance of the repair mechanism based on the aforementioned metrics in [RFC3550].

Consequently, [RFC5725] specifies a post-repair loss Run-Length Encoding (RLE) XR report block to address this issue. The sending endpoint is able to infer which packets were repaired from the RLE report block, but the reporting overhead for the packet-by-packet report block is higher compared to other report blocks.

When applications use multiple XR blocks, the endpoints may require more concise reporting to save bandwidth. This document defines a new XR block type to augment those defined in [RFC3611] and complement the report block defined in [RFC5725] for use in a range of RTP applications. This new block type reports the post-repair loss count metric, which records the number of primary source RTP packets that are still lost after applying one or more loss-repair mechanisms. In addition, another metric, repaired loss count, is also introduced in this report block for calculating the pre-repair loss count during this range, so that the RTP sender or a third-party entity is able to evaluate the effectiveness of the repair methods used by the system. The metrics defined in this document are packet level rather than slice/picture level; this means the partial recovery of a packet will not be regarded as a repaired packet.

The metrics defined in this document belong to the class of transport-related metrics defined in [RFC6792] and are specified in accordance with the guidelines in [RFC6390] and [RFC6792]. These metrics are applicable to any RTP application, especially those that use loss-repair mechanisms.

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 [KEYWORDS].

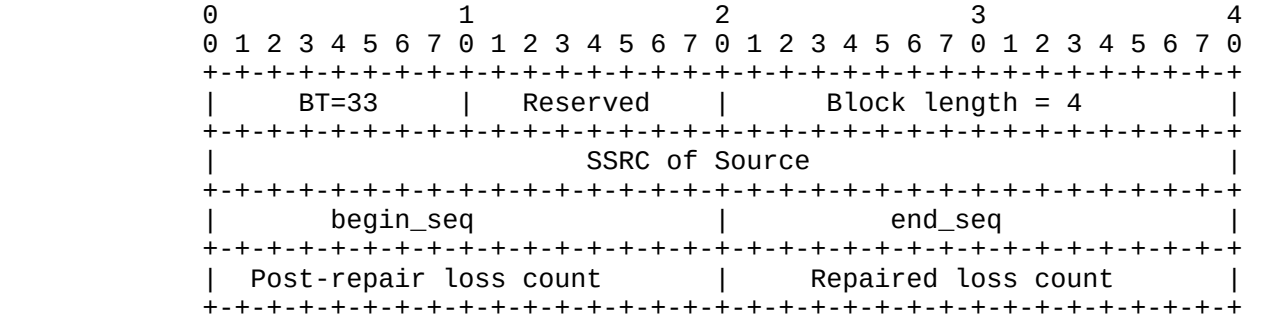
primary source RTP packet: The original RTP packet sent from the RTP sender for the first time. A lost primary source RTP packet may be repaired by some other RTP packets used in repair mechanisms like FEC or retransmission.

3. Post-Repair Loss Count Metrics Report Block

This block reports the number of packets lost after applying repair mechanisms (e.g., FEC). It complements the RTCP XR metrics defined in [RFC5725]. As noted in [RFC5725], ambiguity may occur when comparing this metric with a pre-repair loss metric reported in an RTCP SR/RR, i.e., some packets were not repaired in the current RTCP interval, but they may be repaired later. Therefore, this block uses a begin sequence number and an end sequence number to explicitly indicate the actual sequence number range reported by this RTCP XR. Accordingly, only packets that have no further chance of being repaired and that have been repaired are included in this report block.

3.1. Report Block Structure

The Post-Repair Loss Count Metrics Report Block has the following format:



Block Type (BT): 8 bits

A Post-Repair Loss Count Metrics Report Block is identified by the constant 33.

Reserved: 8 bits

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

Block length: 16 bits

This field is in accordance with the definition in [RFC3611]. In this report block, it MUST be set to 4. The block MUST be discarded if the block length is set to a different value.

SSRC of source: 32 bits

As defined in Section 4.1 of [RFC3611].

begin_seq: 16 bits

The first sequence number that this block reports on. It can remain fixed when calculating metrics over several RTCP reporting intervals.

end_seq: 16 bits

The last sequence number that this block reports on plus one.

Post-repair loss count: 16 bits

Total number of packets finally lost after applying one or more loss-repair methods, e.g., FEC and/or retransmission, during the actual sequence number range indicated by begin_seq and end_seq. This metric MUST NOT count the lost packets for which repair might still be possible. Note that this metric MUST measure only primary source RTP packets.

Repaired loss count: 16 bits

Total number of packets fully repaired after applying one or more loss-repair methods, e.g., FEC and/or retransmission, during the actual sequence number range indicated by begin_seq and end_seq. Note that this metric MUST measure only primary source RTP packets.

3.2 Example Usage

The metrics defined in this report block are all measured at the RTP receiver. However, the receiving endpoint can report the metrics in two different ways:

1) Cumulative report

In this case, implementations may set begin_seq to the first packet in the RTP session, and it will remain fixed across all reports. Hence, the "Post-repair loss count" and "Repaired loss count", respectively, will correspond to "Cumulative post-repair loss count" and "Cumulative repaired loss count" in this case. These cumulative metrics when combined with the cumulative loss metrics reported in an RTCP RR (pre-repair) assist in calculating the "Still-to-be-repaired lost packets":

```
Still-to-be-repaired lost packets =
      Cumulative number of packets lost -
      Cumulative post-repair loss count -
      Cumulative repaired loss count
```

2) Interval report

Some implementations may align the begin_seq and end_seq number with the highest sequence numbers of consecutive RTCP RRs (RTCP interval). This is NOT RECOMMENDED as packets that are not yet repaired in this current RTCP interval and may be repaired in the subsequent intervals will not be reported. An interval report is illustrated in the following example:

Interval A: The extended highest sequence number received in RTCP RR is 20. Begin_seq is 10 and end_seq is 20.

Interval B: The extended highest sequence number received in RTCP RR is 30. Begin_seq is 20 and end_seq is 30.

If packets 17 and 19 are lost and not yet repaired in interval A and subsequently repaired in interval B, they will not be reported because their sequence numbers do not belong in interval B. Therefore, if implementations want these packets to be reported as repaired, they MUST NOT align the begin_seq and end_seq to the RTCP intervals.

Alternatively, implementations may choose the begin_seq and end_seq numbers that cover several RTCP intervals. Additionally, the reported range of sequence numbers may overlap with the previous report blocks, so that the packets that were not yet repaired in one interval, but were subsequently repaired or deemed unrepairable, were reported in subsequent intervals.

In this case, the "Cumulative number of packets lost" cannot be easily compared with the post-repair metrics. However, the sending endpoint can calculate the efficiency of the error resilience algorithm using the post-repair and repaired loss count, respectively.

4. SDP Signaling

[RFC3611] defines the use of SDP (Session Description Protocol) for signaling the use of RTCP XR blocks. However, XR blocks MAY be used without prior signaling (see Section 5 of [RFC3611]).

4.1. SDP rtcp-xr-attrib Attribute Extension

This session augments the SDP attribute "rtcp-xr" defined in Section 5.1 of [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-prlr-block

xr-prlr-block = "post-repair-loss-count"
```

4.2. Offer/Answer Usage

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

5. Security Considerations

This proposed RTCP XR block introduces no new security considerations beyond those described in [RFC3611]. This block does not provide per-packet statistics, so the risk to confidentiality documented in Section 7, paragraph 3 of [RFC3611] does not apply.

An attacker may put incorrect information in the Post-Repair Loss Count reports, which will affect the performance of loss-repair mechanisms. Implementers should 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.

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 33 in the IANA "RTP Control Protocol Extended Reports (RTCP XR) Block Type Registry" to the "Post-Repair Loss Count Metrics Report Block".

6.2. New RTCP XR SDP Parameter

This document also registers a new parameter "post-repair-loss-count" 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:
RAI Area Directors <rai-ads@ietf.org>

7. References

7.1. Normative References

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Appendix A. Metrics Represented Using the Template from RFC 6390

a. Post-Repair RTP Packet Loss Count Metric

* Metric Name: Post-Repair RTP Packet Loss Count Metric.

* Metric Description: Total number of RTP packets still lost after loss-repair methods are applied.

* Method of Measurement or Calculation: See the "Post-repair loss count" definition in Section 3.1. It is directly measured and must be measured for the primary source RTP packets with no further chance of repair.

* Units of Measurement: This metric is expressed as a 16-bit unsigned integer value giving the number of RTP packets.

* Measurement Point(s) with Potential Measurement Domain: It is measured at the receiving end of the RTP stream.

* Measurement Timing: This metric relies on the sequence number interval to determine measurement timing. See the Cumulative and Interval reports defined in Section 3.2.

* Use and Applications: These metrics are applicable to any RTP application, especially those that use loss-repair mechanisms. See Section 1 for details.

* Reporting Model: See RFC 3611.

b. Repaired RTP Packet Loss Count Metric

* Metric Name: Repaired RTP Packet Count Metric.

* Metric Description: The number of RTP packets lost but repaired after applying loss-repair methods.

* Method of Measurement or Calculation: See the "Repaired loss count" in Section 3.1. It is directly measured and must be measured for the primary source RTP packets with no further chance of repair.

* Units of Measurement: This metric is expressed as a 16-bit unsigned integer value giving the number of RTP packets.

* Measurement Point(s) with Potential Measurement Domain: It is measured at the receiving end of the RTP stream.

* Measurement Timing: This metric relies on the sequence number interval to determine measurement timing. See the Cumulative and Interval reports defined in Section 3.2.

* Use and Applications: These metrics are applicable to any RTP application, especially those that use loss-repair mechanisms. See Section 1 for details.

* Reporting Model: See RFC 3611.

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