Internet Engineering Task Force (IETF)
Request for Comments: 5725
Category: Standards Track
ISSN: 2070-1721

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February 2010

# Post-Repair Loss RLE Report Block Type for RTP Control Protocol (RTCP) Extended Reports (XRs)

## Abstract

This document defines a new report block type within the framework of RTP Control Protocol (RTCP) Extended Reports (XRs). One of the initial XR report block types is the Loss Run Length Encoding (RLE) Report Block. This report conveys information regarding the individual Real-time Transport Protocol (RTP) packet receipt and loss events experienced during the RTCP interval preceding the transmission of the report. The new report, which is referred to as the Post-repair Loss RLE report, carries information regarding the packets that remain lost after all loss-repair methods are applied. By comparing the RTP packet receipts/losses before and after the loss repair is completed, one can determine the effectiveness of the loss-repair methods in an aggregated fashion. This document also defines the signaling of the Post-repair Loss RLE report in the Session Description Protocol (SDP).

## 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/rfc5725.

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## 1. Introduction

The RTP Control Protocol (RTCP) is the out-of-band control protocol for applications that are using the Real-time Transport Protocol (RTP) for media delivery and communications [RFC3550]. RTCP allows RTP entities to monitor data delivery and provides them minimal control functionality via sender and receiver reports as well as other control packets. [RFC3611] expands the RTCP functionality further by introducing the RTCP Extended Reports (XRs).

One of the initial XR report block types defined in [RFC3611] is the Loss Run Length Encoding (RLE) Report Block. This report conveys information regarding the individual RTP packet receipt and loss events experienced during the RTCP interval preceding the transmission of the report. However, the Loss RLE in an RTCP XR report is usually collected only on the primary source stream before any loss-repair method is applied. Once one or more loss-repair methods, e.g., Forward Error Correction (FEC) [RFC5109] and/or retransmission [RFC4588], are applied, some or all of the lost packets on the primary source stream may be recovered. However, the pre-repair Loss RLE cannot indicate which source packets were recovered and which are still missing. Thus, the pre-repair Loss RLE cannot specify how well the loss repair performed.

This issue can be addressed by generating an additional report block (within the same or a different RTCP XR report), which reflects the packet receipt/loss events after all loss-repair methods are applied. This report block, which we refer to as the post-repair Loss RLE, indicates the remaining missing, i.e., unrepairable, source packets. When the pre-repair and post-repair Loss RLEs are compared, the RTP sender or another third-party entity can evaluate the effectiveness of the loss-repair methods in an aggregated fashion. To avoid any ambiguity in the evaluation, it is RECOMMENDED that the post-repair Loss RLE be generated for the source packets that have no further chance of being repaired. If the loss-repair method(s) may still recover one or more missing source packets, the post-repair Loss RLE SHOULD NOT be sent until the loss-recovery process has been completed. However, a potential ambiguity may result from sequence-number wrapping in the primary source stream. Thus, the Post-repair Loss RLE reports may not be delayed arbitrarily. In case of an ambiguity in the incoming reports, it is the sender’s or the monitoring entity’s responsibility to understand which packets the Post-repair Loss RLE report is related to.

Similar to the pre-repair Loss RLE, the post-repair Loss RLE conveys the receipt/loss events at the packet level and considers partially repaired packets as unrepaired. Thus, the methods that can partially recover the missing data SHOULD NOT be evaluated based on the

information provided by the Post-repair Loss RLE reports since such information may underestimate the effectiveness of such methods.

Note that the idea of using pre-repair and post-repair Loss RLEs can be further extended when multiple sequential loss-repair methods are applied to the primary source stream. Reporting the Loss RLEs before and after each loss-repair method can provide specific information about the individual performances of these methods. However, it can be a difficult task to quantify the specific contribution made by each loss-repair method in hybrid systems, where different methods collectively work together to repair the lost source packets. Thus, in this specification we only consider reporting the Loss RLE after all loss-repair methods have been applied.

This document registers a new report block type to cover the post-repair Loss RLE within the framework of RTCP XR. Applications that are employing one or more loss-repair methods MAY use Post-repair Loss RLE reports for every packet they receive or for a set of specific packets they have received. In other words, the coverage of the post-repair Loss RLEs may or may not be contiguous.

## 2. Requirements Notation

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 [RFC2119].

## 3. Post-Repair Loss RLE Report Block

The Post-repair Loss RLE Report Block is similar to the existing Loss RLE Report Block defined in [RFC3611]. The report format is shown in Figure 1. Using the same structure for reporting both pre-repair and post-repair Loss RLEs allows the implementations to compare the Loss RLEs very efficiently.

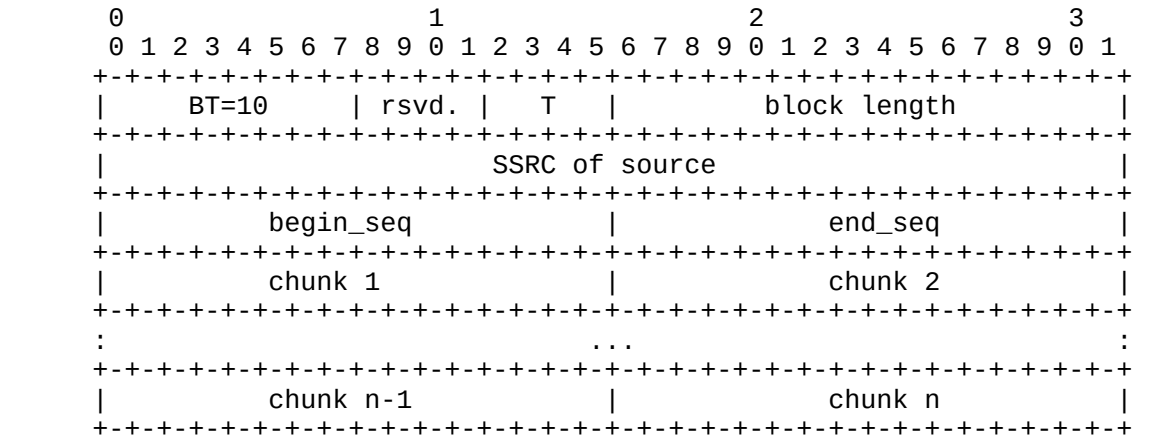


Figure 1: Format for the Post-repair Loss RLE Report Block

- block type (BT): 8 bits
  A Post-repair Loss RLE Report Block is identified by the constant 10.

- rsvd.: 4 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.

- thinning (T): 4 bits
  The amount of thinning performed on the sequence-number space. Only those packets with sequence numbers 0 mod 2^T are reported by this block. A value of 0 indicates that there is no thinning and all packets are reported. The maximum thinning is one packet in every 32,768 (amounting to two packets within each 16-bit sequence space).

  If thinning is desired, it is RECOMMENDED to use the same thinning value in the Pre-repair and Post-repair Loss RLE reports. This will allow easier report processing and correlation. However, based on the specific needs of the application or the monitoring entity, different values of thinning MAY be used for Pre-repair and Post-repair Loss RLE reports.

- block length: 16 bits
  The length of this report block, including the header, in 32-bit words minus one.

- SSRC of source: 32 bits
  The SSRC of the RTP data packet source being reported upon by this report block.

- begin_seq: 16 bits
  The first sequence number that this block reports on.

- end_seq: 16 bits
  The last sequence number that this block reports on plus one.

- chunk i: 16 bits
  There are three chunk types: run length, bit vector, and terminating null. These are defined in Section 4 of [RFC3611]. If the chunk is all zeroes, then it is a terminating null chunk. Otherwise, the left-most bit of the chunk determines its type: 0 for run length and 1 for bit vector.

Note that the sequence numbers that are included in the report refer to the primary source stream.

When using Post-repair Loss RLE reports, the amount of bandwidth consumed by the detailed reports should be considered carefully. The bandwidth usage rules, as they are described in [RFC3611], apply to Post-repair Loss RLE reports as well.

## 4. Session Description Protocol Signaling

A new parameter is defined for the Post-repair Loss RLE Report Block to be used with Session Description Protocol (SDP) [RFC4566] using the Augmented Backus-Naur Form (ABNF) [RFC5234]. It has the following syntax within the "rtcp-xr" attribute [RFC3611]:

```
pkt-loss-rle-post = "post-repair-loss-rle" ["=" max-size]

max-size = 1*DIGIT ; maximum block size in octets
```

Refer to Section 5.1 of [RFC3611] for a detailed description and the full syntax of the "rtcp-xr" attribute. The "pkt-loss-rle-post" parameter is compatible with the definition of "format-ext" in the "rtcp-xr" attribute.

## 5. Security Considerations

The security considerations of [RFC3611] apply in this document as well. Additional security considerations are briefly mentioned below.

An attacker who monitors the regular Pre-repair Loss RLE reports sent by a group of receivers in the same multicast distribution network may infer the network characteristics (Multicast Inference of Network Characteristics). However, monitoring the Post-repair Loss RLE reports will not reveal any further information about the network. Without the regular Pre-repair Loss RLE reports, the Post-repair ones will not be any use to attackers. Even when used with the regular Pre-repair Loss RLE reports, the Post-repair Loss RLE reports only reveal the effectiveness of the repair process. However, this does not enable any new attacks, nor does it provide information to an attacker that could not be similarly obtained by watching the RTP packets fly by himself, performing the repair algorithms and computing the desired output.

An attacker may interfere with the repair process for an RTP stream. In that case, if the attacker is able to see the post-repair Loss RLEs, the attacker may infer whether or not the attack is effective. If not, the attacker may continue attacking or alter the attack. In practice, however, this does not pose a security risk.

An attacker may put incorrect information in the regular Pre-repair and Post-repair Loss RLE reports such that it impacts the proactive decisions made by the sender in the repair process or the reactive decisions when responding to the feedback messages coming from the receiver. A sender application should be aware of such risks and should take the necessary precautions to minimize the chances for (or, better, eliminate) such attacks.

Similar to other RTCP XR reports, the Post-repair Loss RLE reports MAY be protected by using the Secure RTP (SRTP) and Secure RTP Control Protocol (SRTCP) [RFC3711].

## 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].

This document assigns the block type value 10 in the RTCP XR Block Type Registry to "Post-repair Loss RLE Report Block". This document also registers the SDP [RFC4566] parameter "post-repair-loss-rle" for the "rtcp-xr" attribute in the RTCP XR SDP Parameters Registry.

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## 7. Acknowledgments

The authors would like to thank the members of the VQE Team at Cisco and Colin Perkins for their inputs and suggestions.

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### 8.1. Normative References

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