XR Block Working Group
Internet-Draft
Intended status: Standards Track
Expires: January 6, 2013

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July 5, 2012

# RTP Control Protocol (RTCP) Extended Reports (XR) for Run Length Encoding (RLE) of Discarded Packets
## draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-04.txt

Abstract

The RTP Control Protocol (RTCP) is used in conjunction with the Real-time Transport Protocol (RTP) in 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 per-packet report metric capturing individual packets discarded from the jitter buffer after successful reception.

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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 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 (e.g., packet loss) [RFC4585]. Both long-term and short-term feedback enable a sender to adapt its media transmission and/or encoding dynamically to the observed path characteristics.

RFC3611 [RFC3611] defines RTCP Extended Reports as a detailed reporting framework to provide more than just the coarse RR statistics. The detailed reporting may enable a sender to react more appropriately to the observed networking conditions as these can be characterized better, although at the expense of extra overhead.

Among many other report blocks, RFC3611 specifies the Loss RLE block which reports runs of packets received and lost with the granularity of individual packets. This can help both error recovery and path loss characterization. In addition to lost packets, RFC3611 defines the notion of "discarded" packets: packets that were received but dropped from the 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 [RFC3611].

Recently proposed extensions to the XR reporting suggest enhancing this 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 [I-D.ietf-xrblock-rtcp-xr-discard]. 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 [I-D.ietf-xrblock-rtcp-xr-discard].
- Reporting gaps and bursts of discarded packets during a measurement interval, i.e., the last reporting interval or the duration of the session [I-D.ietf-xrblock-rtcp-xr-burst-gap-discard].

However, none of these metrics allow a receiver to report precisely which packets were discarded. While this information could in theory be derived from high-frequency reporting on the number of discarded packets [I-D.ietf-xrblock-rtcp-xr-discard] or from the gap/burst report [I-D.ietf-xrblock-rtcp-xr-burst-gap-discard], these two

mechanisms do not appear feasible: The former would require an unduly high amount of reporting which still might not be sufficient due to the non-deterministic scheduling of RTCP packets. The latter incur significant complexity and reporting overhead and might still not deliver the desired accuracy.

This document defines a discard report block following the idea of the run-length encoding applied for lost and received packets in [RFC3611].

Complementary to or instead of the indication which packets were discarded, an XR block is defined to indicate the number of bytes discarded, per interval or for the duration of the session, similar to other XR report 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, RFC 2119 [RFC2119] and indicate requirement levels for compliant implementations.

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

## 3. XR Discard RLE Report Block

The XR Discard RLE report block uses the same format as specified for the loss and duplicate report blocks in [RFC3611]. Figure 1 recaps the packet format. The fields "BT", "T", "block length", "SSRC of source", "begin_seq", and "end_seq" SHALL have the same semantics and representation as defined in [RFC3611]. The "chunks" encoding the run length SHALL have the same representation as in RFC3611, but encode discarded packets.

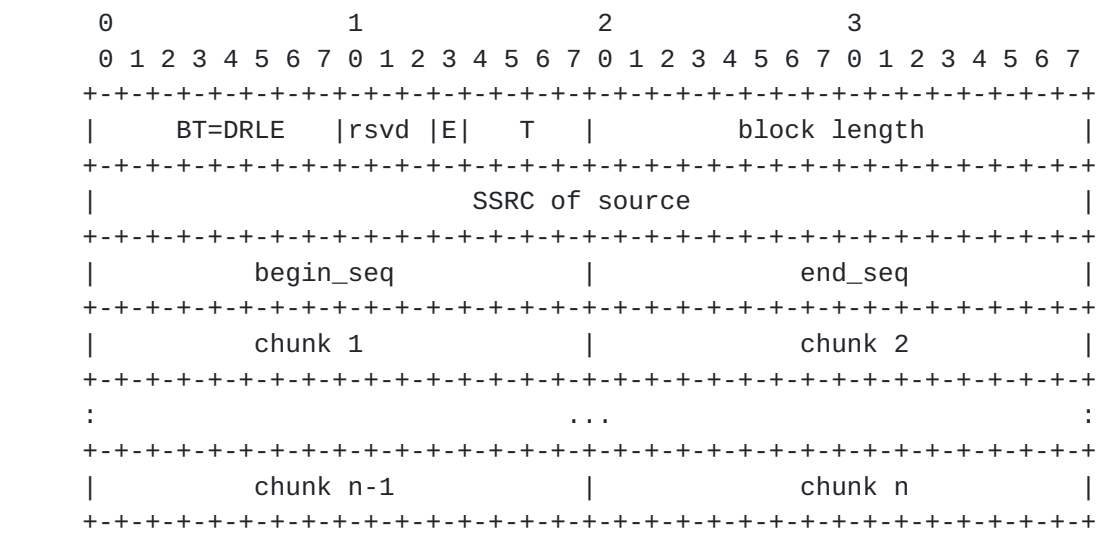


Figure 1: XR Discard Report Block

Block Type (BT, 8 bits): A Run-length encoded Discarded Packets Report Block is identified by the constant DRLE.

[Note to RFC Editor: please replace DRLE with the IANA provided RTCP XR block type for this block. Please remove this note prior to publication as an RFC.]

rsvd (3 bits): These reserved bits SHOULD be set to zero by receivers and MUST be ignored by senders.

The 'E' bit is introduced to distinguish between packets discarded due to early arrival and those discarded due to late arrival. The 'E' bit MUST be set to '1' if the chunks represent packets discarded due to too early arrival and MUST be set to '0' otherwise.

In case both early and late discarded packets shall be reported, two Discard RLE report blocks MUST be included; their sequence number range MAY overlap, but individual packets MUST only be reported as either early or late and not appear marked in both. Packets reported in neither are considered to be properly received and not discarded.

Discard RLE Report Blocks SHOULD be sent in conjunction with an RTCP RR as a compound RTCP packet.

## 4. XR Bytes Discarded Report Block

The XR Bytes Discarded report block uses the following format which follows the model of the framework for performance metric development [RFC6390].

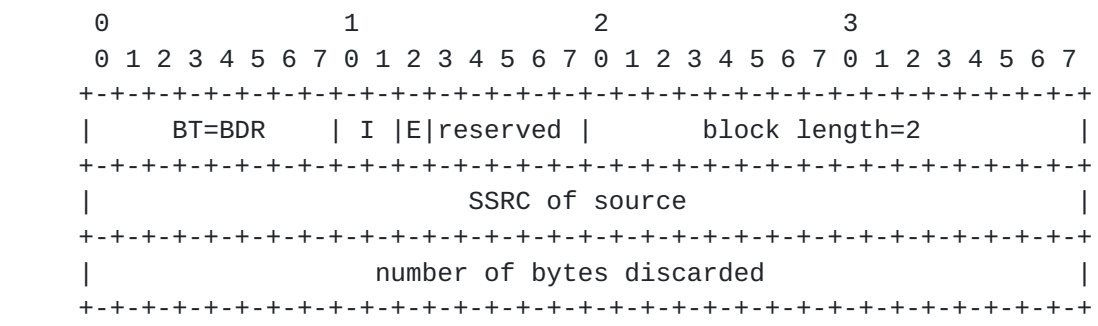


Figure 2: XR Bytes Discarded Report Block

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

[Note to RFC Editor: please replace BDR with the IANA provided RTCP XR block type for this block. Please remove this note prior to publication as an RFC.]

The Interval Metric flag (I) (2 bits) is used to indicate whether the discard metric is 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).

The 'E' bit is introduced to distinguish between packets discarded due to early arrival and those discarded due to late arrival. The 'E' bit MUST be set to '1' if it reports bytes discarded due to early arrival and MUST be set to '0' if it reports bytes discarded due to late arrival. In case both early and late discarded packets shall be reported, two Bytes Discarded report blocks MUST be included.

These reserved bits (5 bits) SHOULD be set to zero by receivers and MUST be ignored by senders.

block length (16 bits) 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.

The 'number of bytes discarded' is a 32-bit unsigned integer value indicating the total number of bytes discarded.

If Interval Metric flag (I=11) is set, the value in the field indicates the number of bytes discarded from the start of the

session, if Interval Metric flag (I=01) is set, it indicates the number of bytes discarded since the last RTCP XR Byte Discarded Block was received.

If the XR block follows a measurement identity block [I-D.ietf-xrblock-rtcp-xr-meas-identity] 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 identity block then the discard block MUST be sent in conjunction with an RTCP RR as a compound RTCP packet.

## 5. Protocol Operation

This section describes the behavior of the reporting (= receiver) node and the media sender.

### 5.1. Reporting Node (Receiver)

Transmission of RTCP XR Discard RLE Reports is up to the discretion of the receiver, as is the reporting granularity. However, it is RECOMMENDED that the receiver signals all discarded packets using the method defined in this document. If all packets over a reporting period were lost, the receiver MAY use the Discard Report Block [I-D.ietf-xrblock-rtcp-xr-discard] instead. In case of limited available reporting bandwidth, it is up to the receiver whether or not to include RTCP XR Discard RLE reports.

The receiver MAY send the Discard RLE Reports as part of the regularly scheduled RTCP packets as per RFC3550. It MAY also include Discard RLE Reports in immediate or early feedback packets as per RFC4585.

### 5.2. Media Sender

The media sender MUST be prepared to operate without receiving any Discard RLE reports. If Discard RLE reports are generated by the receiver, the sender cannot rely on all these reports being received, nor can the sender rely on a regular generation pattern from the receiver side.

However, if the sender receives any RTCP reports but no Discard RLE report blocks and is aware that the receiver supports Discard RLE report blocks, it MAY assume that no packets were discarded at the receiver.

The 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 identity block [I-D.ietf-xrblock-rtcp-xr-meas-identity]. Under all other circumstances it MUST ignore the block.

## 6. SDP signaling

The report blocks specified in this document define extensions to RTCP XR reporting. Whether or not this specific extended report is sent is left to the discretion of the receiver. Its presence may enable better operation of the sender since more detailed information is available. Not providing this information will make the sender rely on other RTCP reports.

A participant of a media session MAY use SDP to signal its support for this attribute. In this case, the RTCP XR attribute as defined in RFC3611 [RFC3611] MUST be used. The SDP RFC4566 [RFC4566] attribute 'xr-format' defined in RFC3611 is augmented as described in the following to indicate the RLE discard metric and bytes discarded metric.

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

xr-format       =/ xr-discard-rle
                 / xr-discard-bytes

xr-discard-rle   = "discard-rle"
xr-discard-bytes = "discard-bytes"
```

The parameter 'discard-rle' MUST be used to indicate support for the Discard RLE Report Block defined in Section 3, the parameter 'discard-bytes' to indicate support for the Bytes Discarded Report Block defined in Section 4

For signaling support of the RLE discard metric and bytes discarded metric, the rules defined in RFC3611 apply. Generally, senders and receivers SHOULD indicate this capability if they support these metrics and would like to use it in the specific media session being signaled. The receiver MAY decide not to send discard information unless it knows about the sender's support to save on RTCP reporting bandwidth.

A participant in a media session MAY use the two report blocks specified in this document without any explicit (SDP) signaling.

## 7. Security Considerations

The security considerations of RFC3550 [RFC3550], RFC3611 [RFC3611], and RFC4585 [RFC4585] apply. Since this document offers only a more precise reporting for an already existing metric, no further security implications are foreseen.

## 8. 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 [RFC3611].

### 8.1. XR Report Block Registration

This document extends the IANA "RTCP XR Block Type Registry" by two new values: DRLE and BDR.

[Note to RFC Editor: please replace DRLE and BDR with the IANA provided RTCP XR block type for this block here and in the diagrams above. Please remove this note prior to publication as an RFC.]

### 8.2. SDP Parameter Registration

This document registers two new parameters for the Session Description Protocol (SDP), "discard-rle" and "discard-bytes", in the "RTCP XR SDP Parameters Registry".

### 8.3. Contact information for IANA registrations

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## 9. Acknowledgements

Thanks to Qin Wu, Colin Perkins, Dan Romascanu, and Roni Even for providing valuable feedback on earlier versions of this draft

## 10. References

### 10.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC3550] Schulzrinne, H., Casner, S., Frederick, R., and V. Jacobson, "RTP: A Transport Protocol for Real-Time Applications", STD 64, RFC 3550, July 2003.

[RFC4585] Ott, J., Wenger, S., Sato, N., Burmeister, C., and J. Rey, "Extended RTP Profile for Real-time Transport Control Protocol (RTCP)-Based Feedback (RTP/AVPF)", RFC 4585, July 2006.

[RFC4566] Handley, M., Jacobson, V., and C. Perkins, "SDP: Session Description Protocol", RFC 4566, July 2006.

[RFC3611] Friedman, T., Caceres, R., and A. Clark, "RTP Control Protocol Extended Reports (RTCP XR)", RFC 3611, November 2003.

[I-D.ietf-xrblock-rtcp-xr-meas-identity] Hunt, G., Clark, A., and W. Wu, "Measurement Identity and information Reporting using SDES item and XR Block", draft-ietf-xrblock-rtcp-xr-meas-identity-07 (work in progress), January 2012.

[RFC6390] Clark, A. and B. Claise, "Guidelines for Considering New Performance Metric Development", BCP 170, RFC 6390, October 2011.

## 10.2. Informative References

[I-D.ietf-xrblock-rtcp-xr-discard] Hunt, G., Clark, A., Zorn, G., and W. Wu, "RTCP XR Report Block for Discard metric Reporting", draft-ietf-xrblock-rtcp-xr-discard-04 (work in progress), December 2011.

[I-D.ietf-xrblock-rtcp-xr-burst-gap-discard] Hunt, G., Clark, A., Huang, R., and W. Wu, "RTCP XR Report Block for Burst/Gap Discard metric Reporting", draft-ietf-xrblock-rtcp-xr-burst-gap-discard-03 (work in progress), October 2011.

## Appendix A. Change Log

Note to the RFC-Editor: please remove this section prior to publication as an RFC.

### A.1. changes in draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-00

- Changed the interval flag from 1 to 2 bits in the discarded bytes report. Also added the measurement identification tag to the block.
- Added this section.

### A.2. changes in draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-01

- Removed the measurement identification tag in the bytes discarded block.

### A.3. changes in draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-02

- Removed the extra Tag bits from the Discarded bytes XR block.
- Clarified use of measurement identity block in Section 4 and 5.2

### A.4. changes in draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-03

- Added explanation for block length in bytes discarded block
- Added an acknowledgement section

### A.5. changes in draft-ietf-xrblock-rtcp-xr-discard-rle-metrics-04

- Added Block Type definition to each XRBlock
- Made changes requested in WGLC

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