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RTP Control Protocol (RTCP) Extended Report (XR) Block for Jitter Buffer Metric Reporting

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Abstract

This document defines an RTP Control Protocol (RTCP) Extended Report (XR) Block that allows the reporting of Jitter Buffer metrics for a range of RTP applications.

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1. Introduction

1.1. Jitter Buffer Metrics Block

This document defines a new block type to augment those defined in [RFC3611], for use in a range of RTP applications.

The new block type provides information on jitter buffer configuration and performance.

The metric belongs to the class of transport-related end system metrics defined in [RFC6792].

Instances of this Metrics Block refer by Synchronization source (SSRC) to the separate auxiliary Measurement Information block [RFC6776] which contains information such as the SSRC of the measured stream, and RTP sequence numbers and time intervals indicating the span of the report.

1.2. RTCP and RTCP XR Reports

The use of RTCP for reporting is defined in [RFC3550]. [RFC3611] defines 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 Architectures [RFC6792] provides guideline for reporting block format using RTCP XR. Metrics described in this draft are in accordance with the guidelines in [RFC6390]and [RFC6792].

1.4. Applicability

Real-time applications employ a jitter buffer to absorb jitter introduced on the path from source to destination. These metrics are used to report how the jitter buffer at the receiving end of RTP stream behaves as a result of jitter in the network and are applicable to a range of RTP applications.

These metrics reflect how terminal-related factors affect real-time application quality and are useful to provide better end-user quality of experience (QoE).

2. Terminology

2.1. Standards Language

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].

3. Jitter Buffer Operation

A jitter buffer is required to absorb delay variation in network delivery of media packets. A jitter buffer works by holding media data for a period of time after it is received but before it s played out. Packets that arrive relatively early are held in the jitter buffer relatively longer. Playout can fail if packets arrive too early and find no available jitter buffer space to be held until time for playout. Playout can also fail if packets are delayed excessively by the network and arrive too late after they are scheduled to be played.

The jitter buffer can be considered as a time window with one side (the early side) aligned with the delay corresponding to the early arriving packet and the other side (the late side) representing the maximum permissible delay before a late arriving packet would be discarded. The Jitter Buffer delay is referred to as the time spent in the jitter buffer. The Jitter Buffer Nominal delay is the delay that is applied to a packet that arrives at its expected time (i.e. 0 jitter) - and corresponds to the late window of the jitter buffer. The Jitter buffer maximum delay is the delay that is applied to an earliest arriving packet that is not discarded and corresponds to the early window of the jitter buffer.

Note that when a packet arrives at its expected time (i.e. 0 jitter), this packet will fall between left window and right window and we also call this packet as the packet that arrives exactly on time. The jitter buffer nominal delay uses this packet as the reference packet. The reference point would typically be selected as the first packet. However the reference point could also be selected based on some other common criterions, e.g., a running average of the delay.

3.1. Fixed Jitter Buffer

A receiver can use either a fixed or adaptive jitter buffer method. A fixed jitter buffer method is a simple implementation with the fixed jitter buffer size but may not do a good job of accommodating varying network performance. The fixed jitter buffer may also have extra buffer memory and therefore incur extra media latency compared to an adaptive implementation.

3.2. Adaptive Jitter Buffer

An adaptive jitter buffer method has adaptive jitter buffer size and may adjust jitter buffer delay during playback in response to changing network performance. The jitter buffer delay is typically adjusted to minimize media latency while also minimizing of lost data due to packets arriving too early or too late.

4. Jitter Buffer Metrics Block

This block describes the configuration and operating parameters of the jitter buffer in the receiver of the RTP end system or RTP mixer which sends the report. Instances of this Metrics Block refer by SSRC to the separate auxiliary Measurement Information block [RFC6776] which describes the measurement interval in use. This Metrics Block relies on the measurement interval in the Measurement Information block indicating the span of the report and should be sent in the same compound RTCP packet as the measurement information block. If the measurement interval is not received in the same compound RTCP packet as this Metrics Block, this Metrics Block should be discarded.

4.1. Report Block Structure

JB Metrics Block

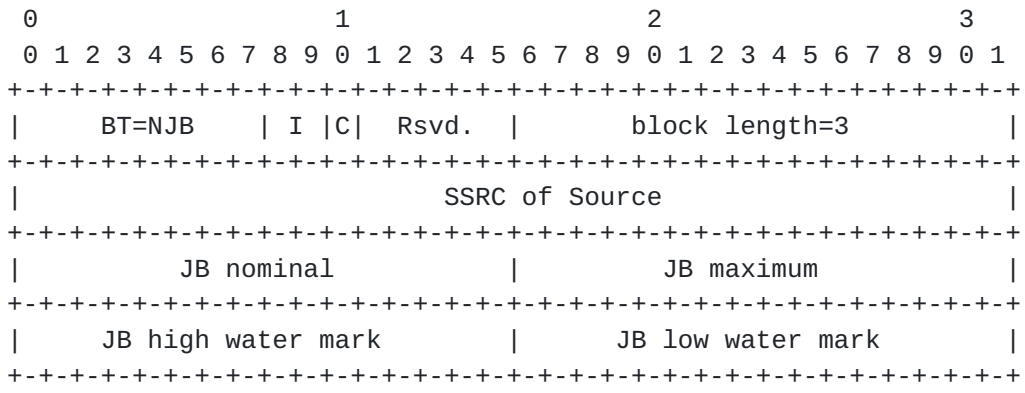


Figure 1: Report Block Structure

4.2. Definition of Fields in Jitter Buffer Metrics Block

Block type (BT): 8 bits

A Jitter Buffer Metrics Report Block is identified by the constant NJB.

[Note to RFC Editor: please replace NJB with the IANA provided RTCP XR block type for this block.]

Interval Metric flag (I): 2 bits

This field is used to indicate whether the Jitter Buffer metrics are Sampled, Interval or Cumulative metrics:

I=01: Sampled Value - the reported value is a sampled instantaneous value.

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.

Jitter Buffer Configuration (C): 1 bit

This field is used to identify the jitter buffer method in use at the receiver, according to the following code:

0 = Fixed jitter buffer

1 = Adaptive jitter buffer

Reserved (Rsvd.): 5 bits

These bits are reserved. They MUST be set to zero by senders ignored by receivers (See [RFC6709] section 4.2).

Block Length: 16 bits

The length of this report block in 32-bit words, minus one, in accordance with the definition in [RFC3611]. This field MUST be set to 3 to match the fixed length of the report block.

jitter buffer nominal delay (JB nominal): 16 bits

This is the current nominal jitter buffer delay in milliseconds, which corresponds to the nominal jitter buffer delay for packets that arrive exactly on time. It is calculated based on the time spend in the jitter buffer for the packet that arrives exactly on time. This parameter MUST be provided for both fixed and adaptive jitter buffer implementations.

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.

jitter buffer maximum delay (JB maximum): 16 bits

This is the current maximum jitter buffer delay in milliseconds which corresponds to the earliest arriving packet that would not be discarded. It is calculated based on the time spent in the jitter buffer for the earliest arriving packet In simple queue implementations this may correspond to the size of the jitter buffer. In adaptive jitter buffer implementations, this value may vary dynamically. This parameter MUST be provided for both fixed and adaptive jitter buffer implementations.

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.

jitter buffer high water mark (JB high water mark): 16 bits

This is the highest value of the jitter buffer nominal delay in milliseconds which occurred at any time during the reporting interval. This parameter MUST be provided for adaptive jitter buffer implementations and its value MUST be set to JB maximum for fixed jitter buffer implementations.

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.

jitter buffer low water mark (JB low water mark): 16 bits

This is the lowest value of the jitter buffer nominal delay in milliseconds which occurred at any time during the reporting interval. This parameter MUST be provided for adaptive jitter buffer implementations and its value MUST be set to JB maximum for fixed jitter buffer implementations.

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.

5. SDP Signaling

[RFC3611] defines the use of SDP (Session Description Protocol) [RFC4566] for signaling the use of XR blocks. However XR blocks MAY be used without prior signaling (see section 5 of RFC3611).

5.1. SDP rtcp-xr-attrib 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.

```
xr-format =/ xr-jb-block

xr-jb-block = "jitter-bfr"
```

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 of Offer/Answer for unilateral parameter, 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 NJB in the IANA "RTCP XR Block Type Registry" to the "JB Metrics Block".

[Note to RFC Editor: please replace NJB with the IANA provided RTCP XR block type for this block.]

6.2. New RTCP XR SDP Parameter

This document also registers a new parameter "jitter-bfr" in the "RTCP XR SDP Parameters Registry".

6.3. Contact information for registrations

The contact information for the registrations is:

Qin Wu (sunseawq@huawei.com)
101 Software Avenue, Yuhua District
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China

7. Security Considerations

It is believed that this proposed RTCP XR report 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.

8. Contributors

Geoff Hunt wrote the initial draft of this document.

9. Acknowledgments

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10. References

10.1. Normative References

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[RFC6709] Carpenter, B., Aboba, B., and S. Cheshire, "Design Considerations for Protocol Extensions", RFC 6709, September 2012.

[RFC6776] Wu, Q., "Measurement Identity and information Reporting using SDES item and XR Block", RFC 6776, August 2012.

10.2. Informative References

[RFC6390] Clark, A. and B. Claise, "Framework for Performance Metric Development", RFC 6390, October 2011.

[RFC6792] Hunt, G., Wu, Q., and P. Arden, "Monitoring Architectures for RTP", RFC 6792, November 2012.

Appendix A. Change Log

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

A.1. draft-ietf-xrblock-rtcp-xr-jb-07

The following are the major changes to previous version :

- Add one new section to discuss jitter buffer operation.

A.2. draft-ietf-xrblock-rtcp-xr-jb-05

The following are the major changes to previous version :

- Some editorial change changes based on the discussion with Glen and Kevin on the list.

A.3. draft-ietf-xrblock-rtcp-xr-jb-03

The following are the major changes to previous version :

- Reduce the "jb cfg" to 1-bit based on discussion in the WGLC.

- Other editorial change changes aligning with PDV,Delay draft.

A.4. draft-ietf-xrblock-rtcp-xr-jb-02

The following are the major changes to previous version :

- Add some explanation text in the SDP offer/answer section.

- Add some text in applicability section to explain the use to report jitter buffer metrics.

- Other editorial change changes aligning with PDV,Delay draft.

A.5. draft-ietf-xrblock-rtcp-xr-jb-01

The following are the major changes to previous version :

- Outdated reference update

- Add one Editor notes to ask clarification on the use of reporting jitter buffer metrics.

- Other Editorial changes.

A.6. draft-ietf-xrblock-rtcp-xr-jb-00

The following are the major changes to previous version :

- Boilerplate updates.
- references updates
- allocate 32 bit field in report block for SSRC
- Other editorial changes to get alignment with MONARCH draft.

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