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RTP Control Protocol (RTCP) Extended Report (XR) Block for Jitter Buffer
                        Metric Reporting
                draft-ietf-xrblock-rtcp-xr-jb-11.txt

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 de-jitter buffer [RFC5481] 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 are corresponding to terminal related factors that
   affect real-time application quality and are useful to provide better
   end-user quality of experience (QoE) when these terminal-related
   factors are used as inputs to calculate QoE metrics [QMB].

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 and before it is
   played out. Packets that arrive early are held in the jitter buffer
   longer. If packets arrive too early they may be discarded if there
   is no available jitter buffer space. If packets are delayed
   excessively by the network they may be discarded if they miss their
   playout time.

   Overall user perceived delay = network round trip delay + local
   (jitter buffer (nominal) delay + encoder serialization delay) +
   remote (jitter buffer (nominal) delay + encoder serialization delay)

   The jitter buffer can be considered as a time window with early edge
   aligned with the delay corresponding to the earliest arriving packet
   and late edge representing the maximum permissible delay before a
   late arriving packet would be discarded. The delay applied to
   packets that arrive on time or at their expected arrival time is
   known as the Nominal Delay and this is equivalent to the time
   difference/ buffer size difference between the on-time packets
   insertion point and the point at which packets are read out.

   The reference for the expected arrival time may, for example, be the
   first packet in the session or the running average delay. If all
   packets arrived at their expected arrival time, then every packet
   would be held in the jitter buffer exactly the Nominal Delay.

   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 edge of the jitter buffer time window.

3.1. Idealized Jitter Buffer

   In practice jitter buffer implementations vary considerably however
   they should behave in a manner conceptually consistent with an
   idealized jitter buffer described as follows:

      (i). Receive the first packet and delay playout by D ms. Keep
      the RTP timestamp and receive time as a reference.

      RTP TS[1]

      receive time[1]

      Assume that both are normalized in ticks.

(ii). Receive the next packet

(iii). Calculate r = RTP TS[n] - RTP TS[1] and t = receive
time[n] - receive time[1]. If r = t then the packet arrived on
time. If r < t then the packet arrived late and if r > t then the
packet arrived early.

(iv). Delay playout of packet by D + (r-t)

(v). Go back to (ii)

Note that this idealized implementation assumes that the sender's RTP
clock is synchronized to the clock in the receiver which is used to
timestamp packet arrivals. If there is no such inherent
synchronization, the system may need to use an adaptive jitter buffer
or other techniques to ensure reliable reception.

3.2. Fixed Jitter Buffer

A fixed jitter buffer lacks provision to track network condition and
has a fixed size and packets leaving the jitter buffer have a
constant delay. For fixed jitter buffer implementation, the nominal
delay is set to a constant value corresponding to the packets that
arrive at their expected arrival time while the maximum delay is set
to a constant value corresponding to the fixed size of the jitter
buffer.

3.3. Adaptive Jitter Buffer

An adaptive jitter buffer can adapt to the change in the network's
delay and has variable size or variable delay. It allows the nominal
delay to be set to a low value initially, to minimize user perceived
delay, however can automatically extend the late edge (and possibly
also retract the early edge) of buffer window if a significant
proportion of packets are arriving late (and hence being discarded).

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 MUST 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 MUST
   be discarded.

4.1. Report Block Structure

   JB Metrics Block

```
     0                   1                   2                   3
     0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |     BT=NJB    | I |C|  Rsvd.  |          block length=3        |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                        SSRC of Source                          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |          JB nominal          |          JB maximum             |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |       JB high water mark      |       JB low water mark        |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
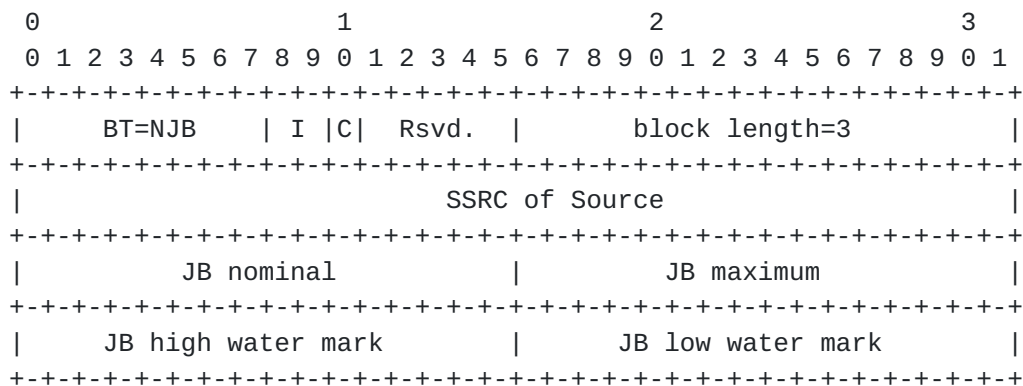
                  Figure 1: Report Block Structure

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.

In this document, Jitter Buffer Metrics can only be sampled , and
cannot be measured over definite intervals. Also, the value I=00
is reserved for future use. Senders MUST NOT use the values I=00
or I=10 or I=11. If a block is received with I=00 or I=10 or
I=11, the receiver MUST discard the block.

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.

The measured value is 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.

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.

   The measured value is 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.

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.

   The measured value is 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.

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.

   The measured value is 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.

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-buffer"

5.2. Offer/Answer Usage

   When SDP is used in offer-answer context [RFC3264], 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-buffer" 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
   Nanjing, Jiangsu 210012
   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

10. References

10.1. Normative References

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

[RFC3264]   Rosenberg, J. and H. Schulzrinne, "An Offer/Answer Model
            with the Session Description Protocol (SDP)", RFC 3264,
            June 2002.

[RFC3550]   Schulzrinne, H., "RTP: A Transport Protocol for Real-Time
            Applications", RFC 3550, July 2003.

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

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

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

10.2. Informative References

[QMB]   Clark, A., "RTP Control Protocol (RTCP) Extended Report
            (XR) Blocks for QoE Metric Reporting",
            ID draft-ietf-xrblock-rtcp-xr-qoe-06, February 2013.

[RFC5481]   Morton, A. and B. Claise, "Packet Delay Variation
            Applicability Statement", RFC 5481, March 2009.

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

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

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

Appendix A. Metrics represented using RFC6390 Template

   RFC EDITOR NOTE: please change XXXX in [RFCXXXX] by the new RFC
   number, when assigned.

   a. jitter buffer nominal delay Metric

       * Metric Name: jitter buffer nominal delay in RTP

       * Metric Description: The "expected arrival time" is the time
          that a RTP packet would arrive if there was no delay
          variation. The delay applied to packets that arrive at their
          expected time is known as the Nominal Delay.

       * Method of Measurement or Calculation: See section 4.2, jitter
          buffer nominal delay definition [RFCXXXX].

       * Units of Measurement: See section 4.2, jitter buffer nominal
          delay definition [RFCXXXX].

       * Measurement Point(s) with Potential Measurement Domain: See
          section 4, 1st paragraph [RFCXXXX].

       * Measurement Timing: See section 4, 1st paragraph [RFCXXXX] for
          measurement timing and section 4.2 paragraph [RFCXXXX] for
          Interval Metric flag.

       * Use and applications: See section 1.4 [RFCXXXX].

       * Reporting model: See RFC3611.

   b. jitter buffer maximum delay Metric

       * Metric Name: jitter buffer maximum delay in RTP

       * Metric Description: It is the current maximum jitter buffer
          delay for RTP traffic which corresponds to the earliest

arriving packet that would not be discarded.

* Method of Measurement or Calculation: See section 4.2, jitter
  buffer maximum delay definition and section 3, the last
  paragraph [RFCXXXX].

* Units of Measurement: See section 4.2, jitter buffer maximum
  delay definition [RFCXXXX].

* Measurement Point(s) with Potential Measurement Domain: See
  section 4, 1st paragraph [RFCXXXX].

* Measurement Timing: See section 4, 1st paragraph [RFCXXXX] for
  measurement timing and section 4.2 paragraph [RFCXXXX] for
  Interval Metric flag.

* Use and applications: See section 1.4 [RFCXXXX].

* Reporting model: See RFC3611.

c. jitter buffer high water mark Metric

* Metric Name: jitter buffer high water mark in RTP

* Metric Description: It is the highest value of the jitter
  buffer nominal delay for RTP traffic which occurred at any
  time during the reporting interval.

* Method of Measurement or Calculation: See section 4.2, jitter
  buffer high water mark definition [RFCXXXX].

* Units of Measurement: See section 4.2, jitter buffer nominal
  delay definition [RFCXXXX].

* Measurement Point(s) with Potential Measurement Domain: See
  section 4, 1st paragraph [RFCXXXX].

   * Measurement Timing: See section 4, 1st paragraph [RFCXXXX] for
      measurement timing and section 4.2 paragraph [RFCXXXX] for
      Interval Metric flag.

   * Use and applications: See section 1.4 [RFCXXXX].

   * Reporting model: See RFC3611.

   d. jitter buffer low water mark Metric

      * Metric Name: jitter buffer low water mark in RTP

      * Metric Description: It is the lowest value of the jitter
         buffer nominal delay for RTP traffic which occurred at any
         time during the reporting interval.

      * Method of Measurement or Calculation: See section 4.2, jitter
         buffer low water mark definition [RFCXXXX].

      * Units of Measurement: See section 4.2, jitter buffer low water
         mark definition [RFCXXXX].

      * Measurement Point(s) with Potential Measurement Domain: See
         section 4, 1st paragraph [RFCXXXX].

      * Measurement Timing: See section 4, 1st paragraph [RFCXXXX] for
         measurement timing and section 4.2 paragraph [RFCXXXX] for
         Interval Metric flag.

      * Use and applications: See section 1.4 [RFCXXXX].

      * Reporting model: See RFC3611.

Appendix B.   **Change Log**

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

B.1.   **draft-ietf-xrblock-rtcp-xr-jb-11**

   The following are the major changes to previous version :

   o Comments in WGLC and from PM-DIR review are addressed in this
      version.

B.2.   **draft-ietf-xrblock-rtcp-xr-jb-10**

   The following are the major changes to previous version :

   o Add some text to section 3.2 to clarify how fixed jitter buffer is
      used.

   o Other Editorial changes.

B.3.   **draft-ietf-xrblock-rtcp-xr-jb-09**

   The following are the major changes to previous version :

   o Incorporate proposed changes by Kevin and proposed text by Alan to
      address interoperability report issue.

   o Add new appendix to format metrics using RFC6390 template.

B.4.   **draft-ietf-xrblock-rtcp-xr-jb-08**

   The following are the major changes to previous version :

   o Rewrote descriptive text and definitions for clarification.

B.5.   **draft-ietf-xrblock-rtcp-xr-jb-07**

   The following are the major changes to previous version :

   o Add one new section to discuss jitter buffer operation.

B.6.   **draft-ietf-xrblock-rtcp-xr-jb-05**

   The following are the major changes to previous version :

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

B.7. **draft-ietf-xrblock-rtcp-xr-jb-03**

The following are the major changes to previous version :

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

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

B.8. **draft-ietf-xrblock-rtcp-xr-jb-02**

The following are the major changes to previous version :

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

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

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

B.9. **draft-ietf-xrblock-rtcp-xr-jb-01**

The following are the major changes to previous version :

o Outdated reference update

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

o Other Editorial changes.

B.10. **draft-ietf-xrblock-rtcp-xr-jb-00**

The following are the major changes to previous version :

o Boilerplate updates.

o references updates

o allocate 32 bit field in report block for SSRC

o Other editorial changes to get alignment with MONARCH draft.

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