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                    RTCP XR Blocks for QoE Metric Reporting
                      draft-ietf-xrblock-rtcp-xr-qoe-01

Abstract

   This document defines an RTCP XR Report Block including two new
   segment types and associated SDP parameters that allow the reporting
   of QoE metrics for use in a range of RTP applications.

Status of this Memo

   This Internet-Draft is submitted in full conformance with the
   provisions of BCP 78 and BCP 79.

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   material or to cite them other than as "work in progress."

   This Internet-Draft will expire on November 15, 2012.

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1. **Introduction**

1.1. **QoE Metrics Report Block**

   This draft 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 multimedia quality using
   one of several standard metrics.

   The metrics belong to the class of application level metrics defined
   in [MONARCH] (work in progress).

1.2. **RTCP and RTCP XR Reports**

   The use of RTCP for reporting is defined in [RFC3550]. [RFC3611]
   defined an extensible structure for reporting using an RTCP Extended
   Report (XR). This draft defines a new Extended Report block that
   MUST be used as defined in RFC3550 and RFC3611.

1.3. **Performance Metrics Framework**

   The Performance Metrics Framework [PMOL] provides guidance on the
   definition and specification of performance metrics. Metrics
   described in this draft either reference external definitions or
   define metrics generally in accordance with the guidelines in [PMOL].

1.4. **Applicability**

   The QoE Metrics Report Block can be used in any application of RTP
   for which QoE measurement algorithms are defined.

   The factors that affect real-time AV application quality can be split
   into two categories. The first category consists of transport-
   dependent factors such as packet loss, delay and jitter (which also
   translates into losses in the playback buffer). The factors in the
   second category are application-specific factors that affect real
   time application (e.g., video) quality and are sensitivity to network
   errors. These factors can be but not limited to video codec and loss
   recovery technique, coding bit rate, packetization scheme, and
   content characteristics.

   Compared with application-specific factors, the transport-dependent
   factors sometimes are not sufficient to measure real time data
   quality, since the ability to analyze the real time data in the
   application layer provides quantifiable measurements for subscriber
   Quality of Experience (QoE) that may not be captured in the
   transmission layers or from the RTP layer down. In a typical

scenario, monitoring of the transmission layers can produce
statistics suggesting that quality is not an issue, such as the fact
that network jitter is not excessive. However, problems may occur in
the service layers leading to poor subscriber QoE. Therefore
monitoring using only network-level measurements may be insufficient
when application layer content quality is required.

In order to provide accurate measures of real time application
quality when transporting real time contents across a network, the
synthentical multimedia quality Metrics is highly required which can
be conveyed in the RTCP XR packets[RFC3611] and may have the
following three benefits:

o Tuning the content encoder algorithm to satisfy real time data
   quality requirements.
o Determining which system techniques to use in a given situation
   and when to switch from one technique to another as system
   parameters change.
o Verifying the continued correct operation of an existing system.

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].

The terminology used is

   Numeric formats S X:Y

      where S indicates a two's complement signed representation, X
      the number of bits prior to the decimal place and Y the number
      of bits after the decimal place.
      Hence 8:8 represents an unsigned number in the range 0.0 to
      255.996 with a granularity of 0.0039. S7:8 would represent the
      range -127.996 to +127.996. 0:16 represents a proper binary
      fraction with range
      0.0 to 1 - 1/65536 = 0.9999847
      though note that use of flag values at the top of the numeric
      range slightly reduces this upper limit. For example, if the
      16- bit values 0xfffe and 0xffff are used as flags for "over-
      range" and "unavailable" conditions, a 0:16 quantity has range
      0.0 to 1 - 3/65536 = 0.9999542

3. **QoE Metrics Block**

   This block reports the multimedia application performance or quality
   beyond the information carried in the standard RTCP packet format.
   Information is recorded about multimedia application QoE metric which
   provides a measure that is indicative of the user's view of a
   service. Multimedia application QoE metric is commonly expressed as
   a MOS ("Mean Opinion Score"), MOS is on a scale from 1 to 5, in which
   5 represents excellent and 1 represents unacceptable. MOS scores are
   usually obtained using subjective testing or using objective
   algorithm. However Subjective testing to estimate the multimedia
   quality may be not suitable for measuring the multimedia quality
   since the results may vary from test to test. Therefore using
   objective algorithm to calculate MOS scores is recommended. ITU-T
   recommendations define the methodologies for assessment of the
   performance of multimedia stream
   [G.107][P.564][G.1082][P.NAMS][P.NBAMS] and provides a method to
   evaluate QoE estimation algorithms and objective model for video and
   audio. Hence this document recommends vendors and implementers to
   use these International Telecommunication Union (ITU)-specified
   methodologies to measure parameters when possible.

3.1. **Metric Block Structure**

   The report block contents are dependent upon a series of flag bits
   carried in the first part of the header. Not all parameters need to
   be reported in each block. Flags indicate which are and which are
   not reported. The fields corresponding to unreported parameters MUST
   be present, but are set to zero. The receiver MUST ignore any QoE
   Metrics Block with a non-zero value in any field flagged as
   unreported. The encoding of QoE metrics block payload consists of a
   series of 32 bit units called segments that describe MOS Type, MoS
   algorithm and MoS value.

   The QoE Metrics Block has the following format:

```
     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=TBD    | I |   Rsd     |          block length         |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                       SSRC of source                         |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                       Segment  1                             |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                       Segment 2                              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    .................
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                       Segment n                              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
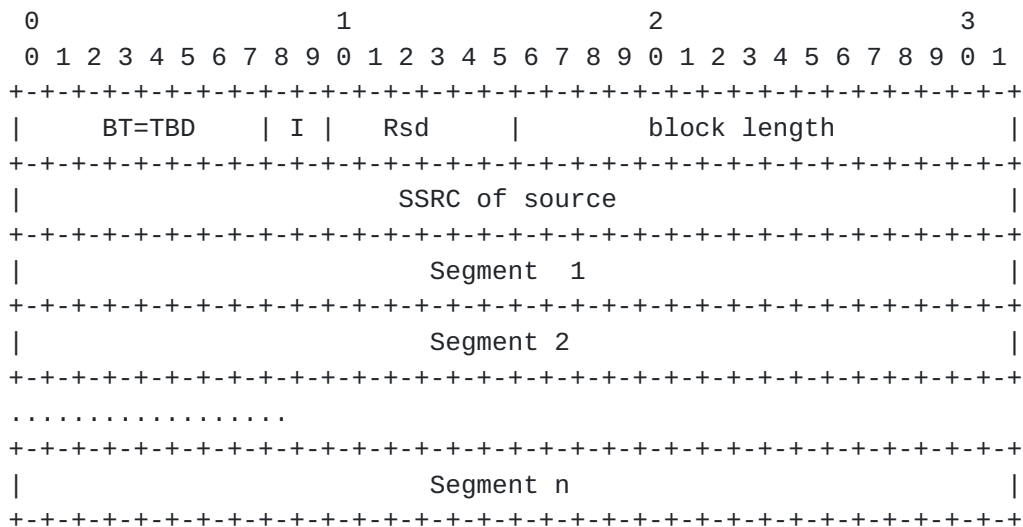
3.2. Definition of Fields in QoE Metrics Block

   Block type (BT): 8 bits

      The QoE Metrics Block is identified by the constant <SMQ>.

   Interval Metric flag (I): 2 bit

      This field is used to indicate whether the QoE metrics are
      Interval or Cumulative metrics, that is, whether the reported
      values applies to the most recent measurement interval duration
      between successive metrics reports (I=10) (the Interval Duration)
      or to the accumulation period characteristic of cumulative
      measurements (I=11) (the Cumulative Duration) or is a sampled
      instantaneous value (I=01) (Sampled Value).

   Rsd.:6 bits

      This field is reserved for future definition. In the absence of
      such a definition, the bits in this field MUST be set to zero and
      MUST be ignored by the receiver.

   Block Length: 16 bits

      The length of this report block in 32-bit words, minus one. For
      the QoE Metrics Block, the block length is variable length.

   SSRC of source: 32 bits

      As defined in Section 4.1 of [RFC3611].

Segment i: 32 bits

> There are two segment types defined in this document: single
> stream per SSRC segment, multi-channel audio per SSRC segment.
> Multi-channel per SSRC segment is used to deal with the case where
> multiple elementary streams or components are carried in one RTP
> stream while single stream per SSRC segment is used to deal with
> the case where there is no more than one elementary stream or
> component in one RTP stream. The left two bits of the section
> determine its type. If the leftmost bit of the segment is zero,
> then it is single stream segment. If the leftmost bit is one and
> the second bit is zero, then it is multi-channel audio segment.
> Note that two segment types can not be present in the same metric
> block.

3.2.1. Single Stream per SSRC Segment

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|0|R|  MT   |CAlg |     PT      |Rsv. |        MOS Value         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Segment Type (S): 1 bit

> A zero identifies this as a single stream segment. Single stream
> means there is only one elementary stream carried in one RTP
> stream. The single stream segment can be used to report the MoS
> value associated with this elementary stream. If there are
> multiple streams and they want to use the single stream segment to
> report the MOS value, they should be carried in the separate RTP
> streams with different SSRC. In this case, multiple QoE Metrics
> Blocks are required to report the MOS value corresponding to each
> stream using single stream segment.

Reserved (R): 1bit

> The bit in this field is reserved. It MUST be set to zero and
> MUST be ignored by the receiver if the leftmost bit of Single
> Stream Per SSRC Segment is set to 0.

MoS Type (MT): 4 bits

> This field is used to indicate the MOS type to be reported. The
> MOS type is defined as follows:

```
0000 MOS-LQ - Listening Quality MoS.
0001 MOS-CQ - Conversation Quality MoS.
0010 MOS-A - Audio Quality MOS.
0010 MOS-V - Video Quality MOS.
0011 MOS-AV - Audio-Video Quality MOS.
0100~1111 - Reserved for future definitions.
```

MoS-LQ measures the quality of audio for listening purposes only
while MoS-CQ measures the quality of audio for conversation
purpose only. MoS-A,MoS-V and MoS-AV measures the quality of
audio application, the quality of video application and Audio-
Video application respectively. Both MoS-LQ and MoS-CQ are
commonly used in VoIP applications. MOS-LQ uses either wideband
audio codec or narrowband audio codec, or both and does not take
into account any of bidirectional effects, such as delay and echo.
MOS-CQ uses narrowband codec and takes into account listening
quality in each direction, as well as the bidirectional effects.
G.107 and P.564 and ETSI TS101 329-5 specify three MoS algorithms
that are used to estimate speech quality or conversation quality.
P.NAMS and P.NBAMS specify two MoS algorithms that are used to
estimate multimedia quality including video quality, audio quality
and audio-video quality. If MoS type is MoS-LQ and MoS-CQ, the
MoS value can be calculated based on ITU-T G.107[G.107], ITU-T
P.564 [P.564]or ETSI TS 101 329-5 [ETSI], if the Mos type is MoS-V
or MoS-AV, the Mos value can be calculated based on ITU-T P.NAMS
[P.NAMS]or ITU-T P.NBAMS [P.NBAMS]. If new MOS types are defined,
they can be added by an update to this document. If the receiver
does not understand the MOS type defined in this document it
should discard this report. If MoS Type does not match the MoS
algorithm in the report (e.g., specify a voice MOS algorithm for a
video quality MOS), the receiver should also discard this report.

Calculation Algorithm (CALg):3 bits

```
000 - ITU-T P.564 Compliant Algorithm [P.564] (Voice)
001 - G.107 [G.107] (Voice)
010 - ETSI TS 101 329-5 Annex E [ ETSI] (Voice)
011 - ITU-T P.NAMS [P.NAMS] (Multimedia)
100 - ITU-T P.NBAMS [P.NBAMS] (Multimedia)
101~111 - Reserved for future extension.
```

Payload Type (PT): 7 bits

QoE meric reporting for a single stream will depend on the payload
format in use. This field identifies the format of the RTP
payload. For RTP sessions where multiple payload formats can be
negotiated or the payload format changes during the mid-session),
the value of this field will be used to indicate what payload

format was in use for the reporting interval.

Rsd.:3 bits

   This field is reserved for future definition. In the absence of
   such a definition, the bits in this field MUST be set to zero and
   MUST be ignored by the receiver.

MOS Value: 13 bits

   The estimated mean opinion score for multimedia application
   quality is defined as including the effects of delay,loss,
   discard,jitter and other effects that would affect multimedia
   quality . It is expressed in numeric format 6:7 with the value in
   the range 0.0 to 63.992. The valid the measured value ranges from
   0.0 to 50.0, corresponding to MoS x 10 as for MoS. If the
   measured value is over ranged, the value 0xFFFE SHOULD be reported
   to indicate an over-range measurement. If the measurement is
   unavailable, the value 0xFFFF SHOULD be reported. Values other
   than 0xFFFE,0xFFFF and the valid range defined above MUST NOT be
   sent and MUST be ignored by the receiving system.

3.2.2. Multi-Channel per SSRC Segment

```
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |1|0|  MT   |CAlg |     PT      |CHID |        MOS Value        |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Segement Type (S): 1 bit

   A one identifies this as either a multi-channel segment or multi-
   layer segment.

Media Type (M): 1bit

   A zero identifies this as a multi-channel per SSRC segment.

MoS Type (MT): 4 bits

   As defined in Section 3.2.1 of this document. If the value of
   this field is not for MoS-CQ or MoS-LQ, the receiver using multi-
   channel segment should discard this invalid segment with the wrong
   MoS Type.

   Calculation Algorithm (CALg):3 bits

        000 - ITU-T P.564 Compliant Algorithm [P.564] (Voice)
        001 - G.107 [G.107] (Voice)
        010 - ETSI TS 101 329-5 Annex E, [ETSI] (Voice)
        011~100 - Reserved.
        101~111 - Reserved for future extension.

   Payload Type (PT): 7 bits

      As defined in Section 3.2.1 of this document.

   Channel Identifier (CHID): 3 bits

      If multiple channels of audio are carried in one RTP stream, each
      channel of audio will be viewed as a independent channel(e.g.,
      left channel audio, right channel audio). This field is used to
      identify each channel carried in the same media stream. The
      default Channel mapping follows static ordering rule described in
      the section 4.1 of [RFC3551]. However there are some payload
      formats that use different channel mappings, e.g., AC-3 audio over
      RTP [RFC4184] only follow AC-3 channel order scheme defined in
      [ATSC]. Enhanced AC-3 Audio over RTP [RFC4598] uses dynamic
      channel transform mechanism. In order that the appropriate
      channel mapping can be determined, QoE reports need to be tied to
      an RTP payload format, i.e., including the payload type of the
      reported media according to [MONARCH] and using Payload Type to
      determine the appropriate channel mapping.

      (Editor's Note: It is not clear that the channel mapping in RFC
      3551 Section 4.1 is the only one in use)

   Rsd.:3 bits

      This field is reserved for future definition. In the absence of
      such a definition, the bits in this field MUST be set to zero and
      MUST be ignored by the receiver.

   MOS Value: 13 bits

      As defined in Section 3.2.1 of this document.

4. SDP Signaling

   One new parameter is defined for the report block defined in this
   document 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]:

```
rtcp-xr-attrib =  "a=rtcp-xr:"
                  [xr-format *(SP xr-format)] CRLF
      xr-format = qoe-metrics
          qoe-metrics = "multimedia-quality-metrics"
```

Refer to Section 5.1 of RFC 3611 [RFC3611] for a detailed description
and the full syntax of the "rtcp-xr" attribute.

5. 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].

5.1. New RTCP XR Block Type value

This document assigns the block type value NDEL in the IANA "RTCP XR
Block Type Registry" to the "QoE Metrics Block".

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

5.2. New RTCP XR SDP Parameter

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

5.3. Contact information for registrations

The contact information for the registrations is:

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                    Nanjing, JiangSu 210012 China

5.4. New registry of calculation algorithms for single stream per SSRC
         segment

This document creates a new registry for single stream per SSRC
segment defined in the section 3.2.1 to be called "RTCP XR QoE metric
block - multimedia application Calculation Algorithm" as a sub-
registry of the "RTP Control Protocol Extended Reports (RTCP XR)
Block Type Registry". This registry applies to the multimedia

session where each type of media are sent in a separate RTP stream.
Specially this registry also applies to the layered video session
where each layer video are sent in a separate RTP stream. Policies
for this new registry are as follows:

o The information required to support this assignment is an
   unambiguous definition of the new metric, covering the base
   measurements and how they are processed to generate the reported
   metric. This should include the units of measurement, how values
   of the metric are reported in the one 16-bit fields "MoS Value".

o The review process for the registry is "Specification Required" as
   described in Section 4.1 of [RFC5226].

o Entries in the registry are integers. The valid range is 0 to 7
   corresponding to the 3-bit field "CAlg" in the block. Values are
   to be recorded in decimal.

o Initial assignments are as follows:

   1. ITU-T P.564 Compliant Algorithm [P.564] (Voice)
   2. G.107 [G.107] (Voice)
   3. ETSI TS 101 329-5 Annex E [ETSI] (Voice)
   4. ITU-T P.NAMS [P.NAMS] (Multimedia)
   5. ITU-T P.NBAMS [P.NBAMS] (Multimedia)

5.5. New registry of calculation algorithms for multi-channel per SSRC
      segment

This document creates a new registry for multi-channel per SSRC
segment defined in the section 3.2.3 to be called "RTCP XR QoE metric
block - multi-channel application Calculation Algorithm" as a sub-
registry of the "RTP Control Protocol Extended Reports (RTCP XR)
Block Type Registry" if multi-channel voice data are carried in the
same RTP stream. Policies for this new registry are as follows:

o The information required to support this assignment is an
   unambiguous definition of the new metric, covering the base
   measurements and how they are processed to generate the reported
   metric. This should include the units of measurement, how values
   of the metric are reported in the one 16-bit fields "MoS Value".

o The review process for the registry is "Specification Required" as
   described in Section 4.1 of [RFC5226].

o Entries in the registry are integers. The valid range is 0 to 7
   corresponding to the 3-bit field "CAlg" in the block. Values are
   to be recorded in decimal.

o Initial assignments are as follows:

   1. ITU-T P.564 Compliant Algorithm [P.564] (Voice)
   2. G.107 [G.107] (Voice)
   3. ETSI TS 101 329-5 Annex E [ETSI] (Voice)

6. Security Considerations

   The new RTCP XR report blocks proposed in this document introduces no
   new security considerations beyond those described in [RFC3611].

7. Authors

   This draft merges ideas from two different drafts addressing the QoE
   metric Reporting issue. The authors of these drafts are listed below
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   document.

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              July 2006.

Appendix A. Change Log

A.1. draft-ietf-xrblock-rtcp-xr-qoe-01

   The following are the major changes compared to previous version:
   o Remove layered support from the QoE metric draft.
   o Allocate 7 bits in the block header for payload type to indicate
      what type of payload format is in use and add associated
      definition of payload type.
   o Clarify using Payload Type to determine the appropriate channel
      mapping in the definition of Channel Identifier.

A.2. draft-ietf-xrblock-rtcp-xr-qoe-00

   The following are the major changes compared to previous version:
   o Allocate one more bit in the single stream per SSC segment to get
      alignment with the other two segment type.

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