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RTCP XR Blocks for QoE Metric Reporting
draft-ietf-xrblock-rtcp-xr-qoe-02

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

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This Internet-Draft will expire on January 14, 2013.

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1. Introduction

1.1. QoE Metrics Report 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 multimedia quality using one of several standard metrics.

The metrics belong to the class of application level metrics defined in [MONARCH].

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 document defines a new Extended Report block. The use of Extended Report blocks is defined by [RFC3611].

1.3. Performance Metrics Framework

The Performance Metrics Framework [RFC6390] 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 [RFC6390].

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

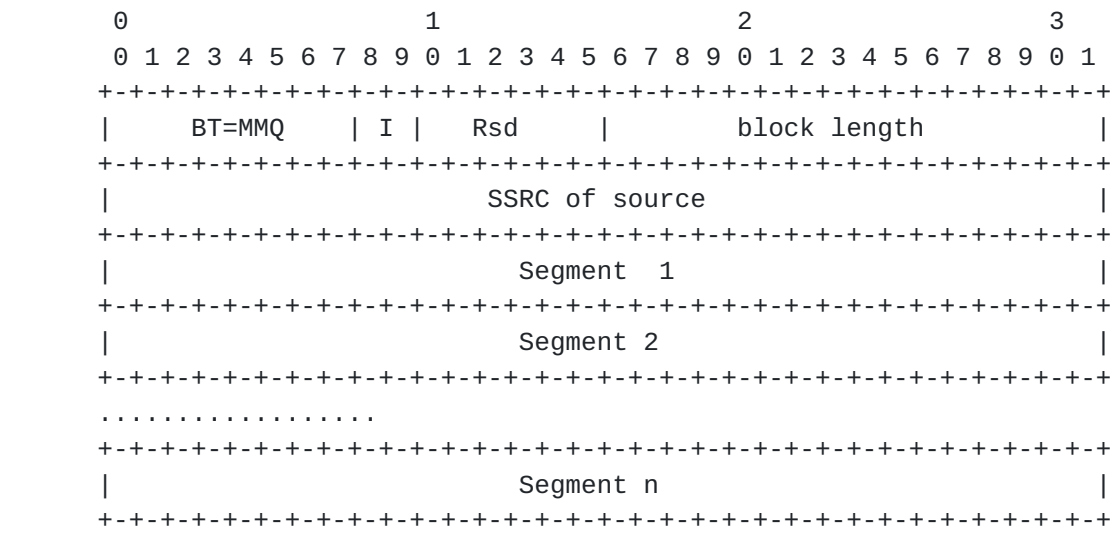
3. QoE Metrics Block

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:



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 bits

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.

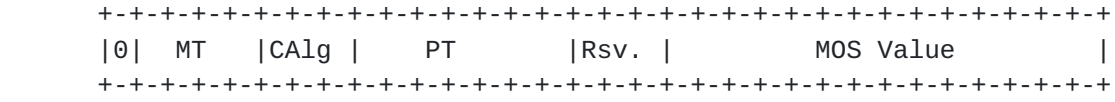
SSRC of source: 32 bits

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 audio per SSRC segment is used to deal with the case where Multi-channel audios are carried in one RTP stream while single stream per SSRC segment is used to deal with the case where each media stream is identified by SSRC and sent in separate 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, 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



Segment Type (S): 1 bit

A zero identifies this as a single stream segment. Single stream means there is only one media stream carried in one RTP stream. The single stream segment can be used to report the MoS value associated with this media stream identified by SSRC. If there are multiple media streams and they want to use the single stream per SSRC 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 media 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.

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.

G.107 and P.564 and ETSI TS101 329-5 specify three Calculation algorithms or 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.

Payload Type (PT): 7 bits

QoE metrics reporting depends 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.

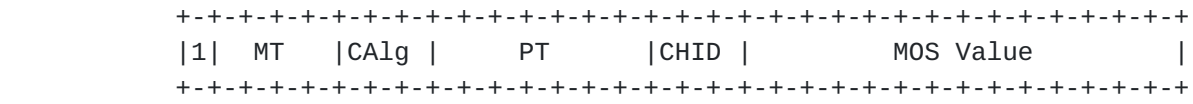
Rsd.:3 bits

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: 14 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 6:8 with the value in the range 0.0 to 63.996. 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 audio per SSRC Segment



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 corresponding to 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.

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: 14 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 MMQ in the IANA "RTCP XR Block Type Registry" to the "QoE Metrics Block".

[Note to RFC Editor: please replace MMQ 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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5.4. New registry of calculation algorithms for single stream 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:

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

- 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 audio segment

This document creates a new registry for multi-channel audio per SSRC segment defined in the section 3.2.2 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:

- 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".
- The review process for the registry is "Specification Required" as described in Section 4.1 of [RFC5226].
- 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.
- 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 drafts addressing the QoE metric Reporting issue. The authors of these drafts are listed below (in alphabetical order):

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9. References

9.1. Normative References

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[P.NBAMS] ITU-T, "non-intrusive bit-stream model for assessment of performance of multimedia streaming", ITU-T Recommendation P.NBAMS, November 2009.

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[RFC4598] Link, B., "Real-time Transport Protocol (RTP) Payload Format for Enhanced AC-3 (E-AC-3) Audio", RFC 4598, July 2006.

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

Appendix A. Change Log

A.1. draft-ietf-xrblock-rtcp-xr-qoe-02

The following are the major changes compared to previous version:

- Remove leftmost second bit since it is ueeless.
- Change 13bits MoS value field into 14 bits to increase MoS precision.
- Fix some typo and make some editorial changes.

A.2. draft-ietf-xrblock-rtcp-xr-qoe-01

The following are the major changes compared to previous version:

- Remove layered support from the QoE metric draft.
- 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.
- Clarify using Payload Type to determine the appropriate channel mapping in the definition of Channel Identifier.

A.3. draft-ietf-xrblock-rtcp-xr-qoe-00

The following are the major changes compared to previous version:

- Allocate one more bit in the single stream per SSC segment to get alignment with the other two segment type.

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