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RTCP XR Blocks for QoE Metric Reporting
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Abstract

This document defines an RTCP XR Report Block 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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This Internet-Draft will expire on August 5, 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

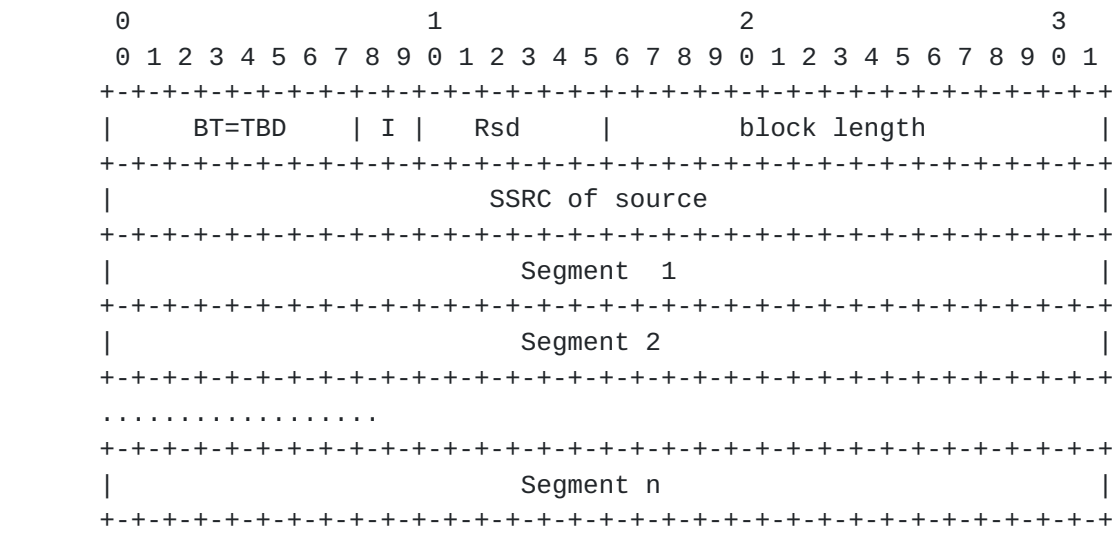
3. QoE Metrics Block

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:



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 Basic Loss/Discard 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=01) (the Interval Duration) or to the accumulation period characteristic of cumulative measurements (I=00) (the Cumulative Duration) or to the value of a continuously measured or calculated that has been sampled at end of the interval (I=10) (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.

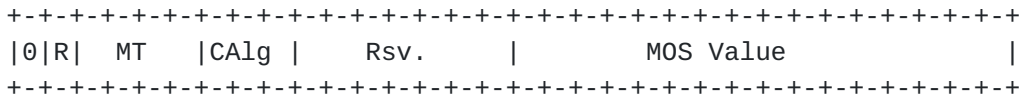
SSRC of source: 32 bits

As defined in Section 4.1 of [RFC3611].

Segment i: 32 bits

There are three segment types : single stream per SSRC segment, multi-channel audio per SSRC segment, multi-layer per SSRC segment. Multi-channel per SSRC segment and multi-layer per SSRC segment are 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, if the leftmost bit is one and the second bit is one, then it is multi- view segment. Note that in these three segment type,any 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 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.

Rsd.:7 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: 16 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 8:8 with the value in the range 0.0 to 255.996. 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-Layer per SSRC Segment

Segment Type (S): 1 bit

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

Media Type (M): 1bit

A one identifies this as a multi-layer video 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-V, the receiver using multi-layer segment should discard this invalid segment with the wrong MoS Type.

Calculation Algorithm (CALg):3 bits

000~010 - Reserved.
011 - ITU-T P.NAMS [P.NAMS] (Multimedia).
100 - ITU-T P.NBAMS [P.NBAMS] (Multimedia).
101~111 - Reserved for future extension.

Sub Stream Identifier (SSID): 5 bits

If multiple layers of video are carried in the same RTP stream, each layer will be viewed as a sub stream. Specially, If multiple views of video are carried in the same RTP stream, each view will be viewed as a sub stream. This field is used to identify each layer of video that is carried in the same media stream. NAL unit type is one example of such SSID.

(Editor's Note: It's not sufficient to simply say that a "NAL unit type is one example", the draft needs to give normative rules for the use of this field)

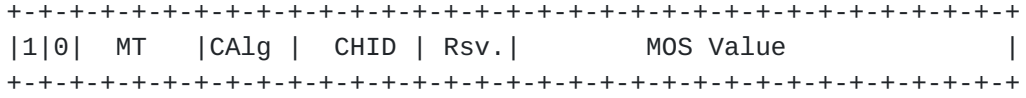
Rsd.:2 bits

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: 16 bits

As defined in Section 3.2.1 of this document.

3.2.3. Multi-Channel 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 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.

Channel Identifier (CHID): 4 bits

This field is used to identify each channel that is carried in the same media stream. 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). Channel mapping follows static ordering rule described in the section 4.1 of [RFC3551].

(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: 16 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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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:

- 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-layer per SSRC segment

This document creates a new registry for multi-layer per SSRC segment defined in the section 3.2.2 to be called "RTCP XR QoE metric block - layered application Calculation Algorithm" as a sub-registry of the "RTP Control Protocol Extended Reports (RTCP XR) Block Type Registry" if multi-layer video 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.NAMS [P.NAMS] (Multimedia)
  2. ITU-T P.NBAMS [P.NBAMS] (Multimedia)

5.6. 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:

- 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 different drafts addressing the QoE metric Reporting issue. The authors of these drafts are listed below (in alphabetical order) :

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9.1. Normative References

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Appendix A. Change Log

A.1. 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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