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RTCP XR Report Block for Loss Concealment Metrics Reporting on Video Applications
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Abstract

This draft defines a new video loss concealment block type to augment those defined in [RFC3611] and [RFC7294] for use in a range of RTP video applications.

Status of this Memo

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1 Introduction

Multimedia applications often suffer from packet losses in IP networks. In order to get a reasonable degree of quality in case of packet losses, it is necessary to have loss concealment mechanisms at the decoder. Video loss concealment is a range of techniques to mask the effects of packet loss in video communications.

In some applications, reporting the information of receivers applying video loss concealment could give monitors or senders useful information on application QoE. One example is no-reference video quality evaluation. Video probes located upstream from the video endpoint or terminal may not see loss occurring between the probe and the endpoint, and may also not be fully aware of the specific loss concealment methods being dynamically applied by the video endpoint. Evaluating error concealment is important in the circumstance in estimating the subjective impact of impairments.

This draft defines one new video loss concealment block type to augment those defined in [RFC3611] and [RFC7294] for use in a range of RTP video applications. The metrics defined in this draft belong to the class of transport-related terminal metrics defined in [RFC6792].

1.1 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 draft defines a new Extended Report block that MUST be used as defined in [RFC3550] and [RFC3611].

1.2 Performance Metrics Framework

The Performance Metrics Framework [RFC6390] provides guidance on the definition and specification of performance metrics. The RTP Monitoring Architectures [RFC6792] provides guidelines for reporting block format using RTCP XR. The XR block type described in this document are in accordance with the guidelines in [RFC6390] and [RFC6792].

1.3 Applicability

These metrics are applicable to video applications of RTP and the video component of Audio/Video applications in which packet loss concealment mechanisms are incorporated into the receiving endpoint to mitigate the impact of network impairments on QoE. For example, in an IPTV system Set Top Boxes could use this RTCP XR block to report loss and loss concealment metrics to an IPTV management system to

enable the service provider to monitor the quality of the IPTV service being delivered to end users.

2 Terminology

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 [KEYWORDS].

3 Video Loss Concealment Methods

Video loss concealment mechanisms can be classified into 4 types as follow:

a) Frame freeze

The impaired video frame is not displayed, instead, the previously displayed frame is frozen for the duration of the loss event.

b) Inter-frame extrapolation

If an area of the video frame is damaged by loss, the same area from the previous frame(s) can be used to estimate what the missing pixels would have been. This can work well in a scene with no motion but can be very noticeable if there is significant movement from one frame to another. Simple decoders may simply re-use the pixels that were in the missing area while more complex decoders may try to use several frames to do a more complex extrapolation.

c) Interpolation

A decoder may user the undamaged pixels in the video frame to estimate what the missing block of pixels should have.

d) Error Resilient Encoding

The sender may encode the message in a redundant way so that receiver can correct errors using the redundant information. The redundant data useful for error resiliency performed at the decoder can be embedded into the compressed image/video bitstream. For example, the encoder may select an important area of an original video frame, extract some important characteristics of this area, e.g., motion vector of each macroblock, and imperceptibly embed them into other parts of the video frame. FEC is also another error resilient method.

In this document, we differentiate between frame freeze and the other 3 concealment mechanisms described.

4. Video Loss Concealment Report Block

This block reports the video loss concealment metrics to complement the audio metrics defined in [i.d-ietf-xrblock-rtcp-xr-loss-concealment]. This block may be stacked with other RTCP packets to form compound RTCP packets and share the average reporting interval calculated by the RTCP method described in [RFC3550]. It should be noted that the metrics in this report block are based on measurements that are typically made at the time that a video frame is decoded and rendered for playout. The metrics in this block MUST be measured at a consistent point.

The video loss concealment report block has the following format:

```
 0               1               2               3
 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    BT=VLC     | I | V |  RSV  |       block length=6          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         SSRC of Source                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Impaired Duration                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      Concealed Duration                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    MIFP       |    MCFP       |     FFSC      |      MFFD     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: Format for the Video Loss Concealment Report Block

Block Type (BT): 8 bits

A Video Loss Concealment Report Block is identified by the constant VLC.

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

Interval Metric Flag (I): 2 bits

This field indicates whether the reported metric is an interval, cumulative, or sampled metric [RFC6792]:

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.

I=01: Sampled Value - this value MUST NOT be used for this block type.

I=00: Reserved.

Video Loss Concealment Method Type (V): 2 bits

This field is used to identify the video loss concealment method type used at the receiver. Each bit indicates one method type, as follow:

V=10 - Frame freeze
V=11 - Other Loss Concealment Method
V=01&00 - Reserved

block length: 16 bits

This field is in accordance with the definition in [RFC3611]. In this report block, it MUST be set to 6. The block MUST be discarded if the block length is set to a different value.

SSRC of source: 32 bits

As defined in Section 4.1 of [RFC3611].

Impaired Duration: 32 bits

The total time length, expressed in units of RTP timestamp, of video impaired by transmission loss before applying any loss concealment methods.

Two values are reserved: A value of 0xFFFFFFFE indicates out of range (that is, a measured value exceeding 0xFFFFFFFD) and a value of 0xFFFFFFFF indicates that the measurement is unavailable.

Concealed Duration: 32 bits

The total time length, expressed in units of RTP timestamp, of concealed damaged video pictures on which loss concealment method corresponding to V is applied.

Two values are reserved: A value of 0xFFFFFFFE indicates out of range (that is, a measured value exceeding 0xFFFFFFFD) and a value of 0xFFFFFFFF indicates that the measurement is unavailable.

Mean Impaired Frame Proportion (MIFP): 8 bits

Mean Impaired Frame Proportion is the mean proportion of each video frame impaired by loss before applying any loss concealment method during the interval, expressed as a fixed point number with the binary point at the left edge of the field. It is equivalent to taking the integer part after multiplying the loss fraction by 256. If a video frame is totally lost, a value of 0xFF shall be used for the frame when calculating the mean value.

Mean Concealed Frame Proportion (MCFP): 8 bits

Mean Concealed Frame Proportion is the mean proportion of each video frame to which loss concealment (using V) was applied during the interval, expressed as a fixed point number with the binary point at the left edge of the field. It is equivalent to taking the integer part after multiplying the loss fraction by 256. If a lost video frame is totally concealed, a value of 0xFF and if there are no concealed macroblocks, a value of 0, shall be used for the frame when calculating the mean value.

Fraction of Frames Subject to Concealment (FFSC): 8 bits

Fraction of Frames Subject to Concealment is calculated by dividing the number of frames to which loss concealment (using V) was applied by the total number of frames and expressing this value as a fixed point number with the binary point at the left edge of the field. It is equivalent to taking the integer part after multiplying the loss fraction by 256. A value of 0 indicates that there were no concealed frame and a value of 0xFF indicates that the frames in the entire measurement interval are all concealed.

Mean Frame Freeze Duration (MFFD): 8 bits

Mean Frame Freeze Duration is the mean duration of the frame freeze events. The value of MFFD shall be calculated by summing the total duration of all frame freeze events and dividing by the number of events. A value of 0xFF shall be used to indicate a value in excess of 12700 milliseconds. A value of 0 MUST be set when V=11.

5 SDP Signaling

[RFC3611] defines the use of SDP (Session Description Protocol) for signaling the use of RTCP 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 session augments the SDP attribute "rtcp-xr" defined in Section 5.1 of [RFC3611] by providing an additional value of "xr-format" to signal the use of the report block defined in this document.

xr-format =/ xr-vlc-block

xr-vlc-block = "video-loss-concealment"

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 Security Considerations

It is believed that this RTCP XR block introduces no new security considerations beyond those described in [RFC3611]. This block does not provide per-packet statistics, so the risk to confidentially documented in Section 7, paragraph 3 of [RFC3611] does not apply.

An attacker may put incorrect information in the Video Loss Concealment reports, which will be affect the estimation of video loss concealment mechanisms performance and QoE of users. Implementers should consider the guidance in [RFC7202] for using appropriate security mechanisms, i.e., where security is a concern, the implementation should apply encryption and authentication to the report block. For example, this can be achieved by using the AVPF profile together with the Secure RTP profile as defined in [RFC3711]; an appropriate combination of the two profiles (an "SAVPF") is specified in [RFC5124]. However, other mechanisms also exist (documented in [RFC7201]) and might be more suitable.

7 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].

7.1 New RTCP XR Block Type Value

This document assigns the block type value VLC in the IANA "RTP Control Protocol Extended Reports (RTCP XR) Block Type Registry" to the "Video Loss Concealment Metrics Report Block".

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

7.2 New RTCP XR SDP Parameter

This document also registers a new parameter "video-loss-concealment" in the "RTP Control Protocol Extended Reports (RTCP XR) Session Description Protocol (SDP) Parameters Registry".

7.3 Contact Information for registrations

The following contact information is provided for all registrations in this document:

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8 Acknowledgements

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9.1 Normative References

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Appendix A. Metrics Represented Using the Template from RFC 6390

TBD.

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