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**RTP Control Protocol (RTCP) Extended Report (XR) Block for Effective
Loss Index Reporting
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Abstract

This document defines a new metric for RTP monitors to estimate the effectiveness of stream repair means, and an RTP Control Protocol (RTCP) Extended Report (XR) Block to report the metric.

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[1.](#) Introduction

RTP applications often use stream repair means, e.g. FEC (Forward Error Correction) [[RFC5109](#)] and/or retransmission [[RFC4588](#)] to improve the robustness of media streams. With the presence of those stream repair means, a degree of packet loss can be recovered for a media stream. In the past, some RTCP Extend Reports (XRs) were defined to reflect the situation of post-repair loss. For example, [[RFC5725](#)] defines an XR block using Run Length Encoding (RLE) to report post-repair loss; [[RFC7509](#)] defines count metrics for post-repair loss.

This document proposes a new metric Effective Loss Index (ELI) to estimate the effectiveness of stream repair means by calculating the probability of the post-repair losses. The new metric provides a simpler view on the post-repair loss than the mechanisms documented in [[RFC5725](#)] and [[RFC7509](#)]. ELI is an index, so the values reported from the monitors deployed in the different places in the network can

be compared directly, which makes it easier to diagnose the network problem when delivering the RTP streams. A use case is to compare the ELI value reported by a monitor in the network with a certain reasonable threshold to see if there are any problems in the IPTV services. For those endpoints, more informative XR reports such as those in [\[RFC5725\]](#) and [\[RFC7509\]](#) can then be used to discover more details about the loss situations.

This document also defines in [section 3](#), an XR block to report the metric.

[1.1](#). Effective Loss Index

Effective Loss Index (ELI) uses a simple model to measure the loss impact after applying loss repair. It is useful especially in the middleboxes which usually are passive observer and do not have the ability to recover the loss data.

The model assumes that repair means are applied onto packets by batches of equal size. Lower ELI means that loss impact is minimal. Specifically, a batch is identified by a range of RTP sequence numbers. The size of a batch is number of packets. An application can agree upon a default batch size, or use the SDP signaling defined in [Section 4.1](#) to communicate one if the middlebox can see the SDP, or just configure it.

An RTP endpoint is assumed to process received packets and apply repair means batch by batch. For each batch, if there is still some unrecoverable loss after having applied the repair means, then the repair means are deemed as ineffective. The ineffectiveness is denoted by Effective Loss Factor (ELF), along with a parameter Loss Repair Threshold, showing below:

```
if Loss Packets Number > Loss Repair Threshold
    Effective Loss Factor = 1
else
    Effective Loss Factor = 0
endif
```

Figure 1: Calculation of Effective Loss Factor

The parameters in Figure 1 are explained below:

- o Loss Packets Number is the number of packet lost in the batch.
- o Loss Repair Threshold indicates the maximum loss packets number that can be recovered.

The minimum value of Loss Repair Threshold is zero, which means there is no loss repair. This document does not mandate any value for Loss Repair Threshold. Applications can prescribe a value for themselves without signaling. For example, it can be calculated by the batch size multiplied by the fixed redundancy ratio of the FEC algorithm; And when used in the retransmission case, it can be set to the maximum number of lost packets to be retransmitted in a batch. On the other hand, SDP signaling defined in [Section 4.1](#) can be used to communicate the value.

Effective Loss Index is an integer derived by calculating the average Effective Loss Factor across a sequence of consecutive batches of RTP packets. Let ELF(i) be the Effective Loss Factor calculated for i-th batch, and N as number of batches in the sequence, then Effective Loss Index is calculated as:

$$\text{Effective Loss Index} = \frac{\text{ELF}(1) + \text{ELF}(2) + \dots + \text{ELF}(N)}{N}$$

Figure 2: Calculation of Effective Loss Index

The following is an example of how to calculate Effective Loss Index. For simplicity and demonstration purpose, the size of a batch is assumed to be 3, and the Loss Repair Threshold is assumed to be 1. The example processes a sequence of 9 RTP packets (x means lost) in 7 batches.

1xx4x6x89

Batch	Loss	Effective Loss Factor
1 2 3	2, 3	1
2 3 4	2, 3	1
3 4 5	3	0
4 5 6	5	0
5 6 7	5, 7	1
6 7 8	7	0
7 8 9	7	0

$$\text{Effective Loss Index} = \frac{1+1+0+0+1+0+0}{7} = 0.4285$$

This example provides fine grained estimation for loss recovery. It can detect the loss burst happening over batches. Implementations can also do coarse grained estimation by simply dividing total packets into several batches.

1.2. Applicability

The metric defined by this document is applicable to a range of RTP applications that send packets with stream repair means (e.g., Forward Error Correction (FEC) [[RFC5109](#)] and/or retransmission [[RFC4588](#)]) applied on them. Note that this metric is only valuable for FECs where the redundant data are sent in a different RTP stream from the original media stream.

This document does not mandate any value for the batch size. Applications can prescribe a value for themselves without signaling. For example, the batch size can be set to the number of packets containing source symbols in a source block in the case of FEC, and can be prescribed arbitrarily, e.g. 100, in the case of retransmission.

The number of batches among which ELI is calculated should not be too few, otherwise the result may be biased. It is suggested to calculate it based on the total number of RTP packets during the measurement interval, as in the [section 1.1](#) example:

The number of batches = (The total number of RTP packets - the size of a batch) + 1.

1.3. RTCP and RTCP XR Reports

The use of RTCP for reporting is defined in [[RFC3550](#)]. [[RFC3611](#)] defines an extensible structure for reporting by using an RTCP Extended Report (XR). This document defines a new Extended Report block for use with [[RFC3550](#)] and [[RFC3611](#)].

1.4. Performance Metrics Framework

The Performance Metrics Framework [[RFC6390](#)] provides guidance on the definition and specification of performance metrics. The "Guidelines for Use of the RTP Monitoring Framework" [[RFC6792](#)] provides guidelines for reporting block format using RTCP XR. The Metrics Block described in this document is in accordance with the guidelines in [[RFC6390](#)] and [[RFC6792](#)].

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 [RFC 2119](#) [[RFC2119](#)].

3. Effective Loss Index Report Block

The Effective Loss Index Report Block has the following format:

```

0          1          2          3          4
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 0
+-+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|      BT=TBD      |  Reserved  |      Block length = 3      |
+-+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                     SSRC of Source          |
+-+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|      Effective Loss Index      |      Padding              |
+-+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+

```

Block Type (BT): 8 bits: An Effect Loss Index Report Block is identified by the constant 'TBD'.

[[Editor Note: should replace 'TBD' with assigned value]]

Reserved: 8 bits: These bits are reserved for future use. They MUST be set to zero by senders and ignored by receivers (see [Section 4.2 of \[RFC6709\]](#)).

Block length: 16 bits: This field is in accordance with the definition in [\[RFC3611\]](#). In this report block, it MUST be set to

3. The block MUST be discarded if the block length is set to a different value.

SSRC of source: 32 bits: The SSRC of the RTP data packet source being reported upon by this report block, as defined in [Section 4.1 of \[RFC3611\]](#).

Effective Loss Index: 16 bits: The value of Effective Loss Index, equivalent to taking the integer part after multiplying the the calculated result of Effective Loss Index (as in Figure 2) by 65535.

Padding: 16 bits: These bits MUST be set to zero by senders and ignored by receivers.

4. 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 \[RFC3611\]](#)).

4.1. SDP rtcp-xr-attr 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. The ABNF [\[RFC5234\]](#) syntax is as follows.

```
xr-format =/ xr-eli-block
```

```
xr-eli-block = "effective-loss-index"  
              [ ":" effective-loss-batch-size]  
              [ ">" effective-loss-threshold]
```

```
effective-loss-batch-size = 1*DIGIT  
                           ; the batch size is in number of packets
```

```
effective-loss-threshold  = 1*DIGIT  
                           ; the threshold is in number of packets
```

```
DIGIT = %x30-39
```

The SDP attribute "xr-eli-block" is designed to contain two optional values, one for signaling the batch size, another for the Effective Loss Threshold. Here are some examples:

1. signaling both batch size (100) and Effective Loss Threshold (2)

xr-eli-block = "effective-loss-index" : "100" > "2"

2. signaling only batch size (100)

xr-eli-block = "effective-loss-index" : "100"

3. signaling only Effective Loss Threshold (2)

xr-eli-block = "effective-loss-index" > "2"

4.2. Offer/Answer Usage

When SDP is used in offer/answer context, the SDP Offer/Answer usage defined in [\[RFC3611\]](#) for the unilateral "rtcp-xr" attribute parameters applies. For detailed usage of Offer/Answer for unilateral parameters, refer to [Section 5.2 of \[RFC3611\]](#).

5. Security Considerations

This proposed 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 confidentiality documented in [Section 7](#), paragraph 3 of [\[RFC3611\]](#) does not apply.

An attacker may put incorrect information in the Effective Loss Index reports. 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.

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 'TBD' in the IANA "RTP Control Protocol Extended Reports (RTCP XR) Block Type Registry" to the "Post-Repair Loss Count Metrics Report Block".

[[Editor Note: should replace 'TBD' with assigned value]]

6.2. New RTCP XR SDP Parameter

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

6.3. Contact Information for Registrations

The contact information for the registrations is:

RAI Area Directors <rai-ads@ietf.org>

7. Acknowledgements

This document has benefited greatly from the comments of various people. The following individuals have contributed to this document: Colin Perkins, Yanfang Zhang.

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Appendix A. Metric Represented Using the Template from [RFC 6390](#)

A.1. Effective Loss Index

- o Metric Name: RTP Effective Loss Index.
- o Metric Description: The effectiveness of stream repair means applied on a sequence of RTP packets.
- o Method of Measurement or Calculation: See the "Effective Loss Index" definition in [Section 1.1](#). It is directly measured and must be measured for the primary source RTP packets with no further chance of repair.
- o Units of Measurement: This metric is expressed as a 16-bit unsigned integer value representing the effectiveness of stream repair means.
- o Measurement Point(s) with Potential Measurement Domain: It is measured at the receiving end of the RTP stream.
- o Measurement Timing: This metric relies on the sequence number interval to determine measurement timing.
- o Use and Applications: These metrics are applicable to any RTP applications, especially those that use loss-repair mechanisms. See [Section 1](#) for details.
- o Reporting Model: See [RFC 3611](#).

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