           RTP Control Protocol (RTCP) Extended Report (XR) Blocks
           for Concealment Metrics Reporting on Audio Applications

Abstract

   This document defines two RTP Control Protocol (RTCP) Extended Report
   (XR) blocks that allow the reporting of concealment metrics for audio
   applications of RTP.

Status of This Memo

   This is an Internet Standards Track document.

   This document is a product of the Internet Engineering Task Force
   (IETF). It represents the consensus of the IETF community. It has
   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
   Internet Standards is available in Section 2 of RFC 5741.

   Information about the current status of this document, any errata,
   and how to provide feedback on it may be obtained at
   http://www.rfc-editor.org/info/rfc7294.

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1. Introduction

1.1. Loss Concealment and Concealed Seconds Metrics Blocks

   At any instant, the audio output at a receiver may be classified as
   either 'normal' or 'concealed'. 'Normal' refers to playout of audio
   payload received from the remote end and also includes locally
   generated signals such as announcements, tones, and comfort noise.
   'Concealed' refers to playout of locally generated signals used to
   mask the impact of network impairments or to reduce the audibility of
   jitter buffer adaptations.

   This document defines two new concealment-related block types to
   augment those defined in [RFC3611] for use in a range of RTP
   applications. These two block types extend the packet loss
   concealment mechanism defined in Section 4.7.6 of [RFC3611].

The first block type, the Loss Concealment Metrics Block, provides
metrics for actions taken by the receiver to mitigate the effect of
packet loss and packet discard. Specifically, the first metric
(On-Time Playout Duration) reports the duration of normal playout of
data that the receiver obtained from the sender's stream. A second
metric (Loss Concealment Duration) reports the total time during
which the receiver played out media data that was manufactured
locally, because the sender's data for these periods was not
available due to packet loss or discard. A similar metric (Buffer
Adjustment Concealment Duration) reports the duration of playout of
locally manufactured data replacing data that is unavailable due to
adaptation of an adaptive de-jitter buffer. Further metrics (Playout
Interrupt Count and Mean Playout Interrupt Size) report the number of
times normal playout was interrupted and the mean duration of these
interruptions.

Loss Concealment Duration and Buffer Adjustment Concealment Duration
are reported separately because buffer adjustment is typically
arranged to occur in silence periods, so it may have very little
impact on user experience, whilst loss concealment may occur at any
time.

The second block type, the Concealed Seconds Metrics Block, provides
metrics for Concealed Seconds, which are measured at the receiving
end of the RTP stream. Specifically, the first metric (Unimpaired
Seconds) reports the number of whole seconds occupied only with
normal playout of data that the receiver obtained from the sender's
stream. The second metric (Concealed Seconds) reports the number of
whole seconds during which the receiver played out any locally
generated media data. A third metric, Severely Concealed Seconds
(SCSs), reports the number of whole seconds during which the receiver
played out locally generated data to conceal a lost or discarded
frame percentage in excess of the configured SCS Threshold.

These metrics belongs to the class of transport-related terminal
metrics defined in [RFC6792].

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

1.4. Applicability

   These metrics are applicable to audio applications of RTP and the
   audio component of audio/video applications in which the packet loss
   concealment machinery is contained at the receiving end to mitigate
   the impact of network impairments to user's perception of media
   quality.

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].

2.2. Notations

   The report blocks in this document make use of binary fractions. The
   following terminology is used:

   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. Loss Concealment Metrics Block

   The Loss Concealment Metrics Block is intended to be used as
   described in this section, in conjunction with information from the
   Measurement Information Block [RFC6776]. Instances of this metrics
   block refer by synchronization source (SSRC) to the separate
   auxiliary Measurement Information Block [RFC6776], which describes
   measurement periods in use (see [RFC6776], Section 4.2). This
   metrics block relies on the measurement period in the Measurement
   Information Block indicating the span of the report and SHOULD be
   sent in the same compound RTCP packet as the Measurement Information
   Block. If the measurement period is not received in the same
   compound RTCP packet as this metrics block, this metrics block MUST
   be discarded.

3.1. Report Block Structure

   The structure of the Loss Concealment Metrics Block is as follows.

```
    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=30      | I |plc| resv |        block length=6          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                         SSRC of Source                        |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                     On-Time Playout Duration                  |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                     Loss Concealment Duration                 |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |              Buffer Adjustment Concealment Duration           |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |     Playout Interrupt Count     |          Reserved           |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                   Mean Playout Interrupt Size                 |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
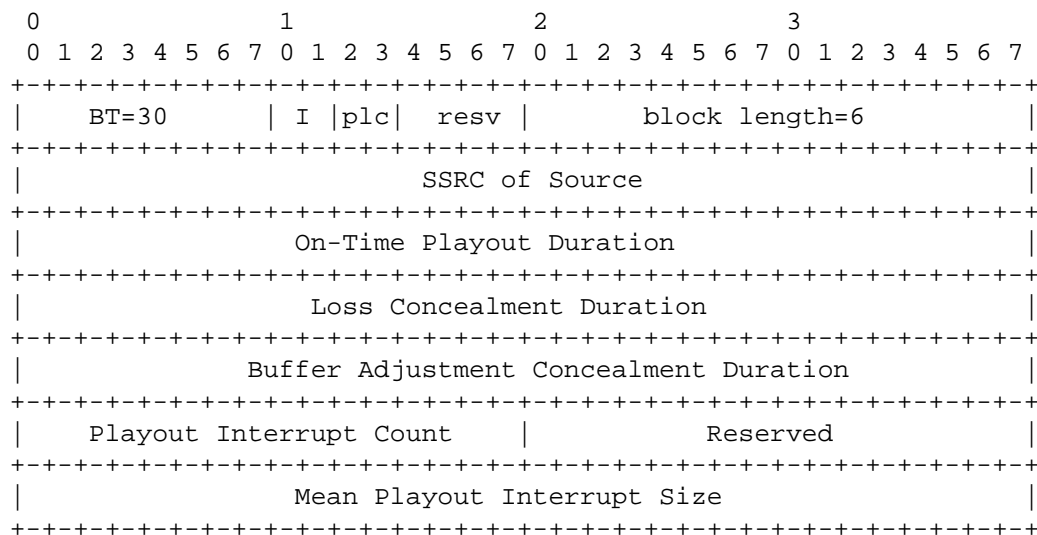
                Figure 1: Loss Concealment Metrics Block

3.2. Definition of Fields in Loss Concealment Metrics Block

   Block type (BT): 8 bits

      A Loss Concealment Metrics Block is identified by the constant 30.

   Interval Metric flag (I): 2 bits

      This field is used to indicate whether the loss concealment
      metrics are Sampled, Interval, or Cumulative metrics:

         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 - the reported value is a sampled
         instantaneous value (not allowed in this block).

         I=00: Reserved value - this value is reserved for future use.

      In this document, Loss Concealment metrics can only be measured
      over definite intervals and cannot be sampled. Senders MUST NOT
      use the values I=00 or I=01. If a block is received with I=00 or
      I=01, the receiver MUST discard the block.

   Packet Loss Concealment Method (plc): 2 bits

      This field is used to identify the packet loss concealment method
      in use at the receiver, according to the following code:

         bits 014-015

            0 = silence insertion

            1 = simple replay, no attenuation

            2 = simple replay, with attenuation

            3 = enhancement

            Other values are reserved.

      Note that the enhancement method (plc=3) for packet loss
      concealment offers an improved audio quality and better robustness
      against packet losses [G.711] and is equivalent to "enhanced" in
      Section 4.7.6 of [RFC3611].

   Reserved (resv): 4 bits

      These bits are reserved. They MUST be set to zero by senders and
      ignored by receivers (see [RFC6709], Section 4.2).

block length: 16 bits

   The length of this report block in 32-bit words, minus one. For
   the Loss Concealment Metrics Block, the block length is equal to
   6.

SSRC of Source: 32 bits

   As defined in Section 4.1 of [RFC3611].

On-Time Playout Duration: 32 bits

   'On-time playout' is the uninterrupted, in-sequence playout of
   valid decoded audio information originating from the remote
   endpoint. This includes comfort noise during periods of remote
   talker silence, if Voice Activity Detection (VAD) [VAD] is used,
   and locally generated or regenerated tones and announcements.

   An equivalent definition is that on-time playout is playout of any
   signal other than those used for concealment.

   On-time playout duration is expressed in units of RTP timestamp
   and MUST include both speech and silence intervals, whether VAD is
   used or not.

   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.

Loss Concealment Duration: 32 bits

   The duration, expressed in units of RTP timestamp, of audio
   playout corresponding to Loss-Type concealment.

   Loss-Type concealment is reactive insertion or deletion of samples
   in the audio playout stream due to effective frame loss at the
   audio decoder. Effective frame loss is the event in which a frame
   of coded audio is simply not present at the audio decoder when
   required. In this case, substitute audio samples are generally
   formed, at the decoder or elsewhere, to reduce audible impairment.

   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.

   Buffer Adjustment Concealment Duration: 32 bits

      The duration, expressed in units of RTP timestamp, of audio
      playout corresponding to Buffer Adjustment-Type concealment, if
      known.

      Buffer Adjustment-Type concealment is proactive or controlled
      insertion or deletion of samples in the audio playout stream due
      to jitter buffer adaptation, re-sizing decisions, or re-centering
      decisions within the endpoint.

      Because this insertion is controlled, rather than occurring
      randomly in response to losses, it is typically less audible than
      Loss-Type concealment. For example, jitter buffer adaptation
      events may be constrained to occur during periods of talker
      silence, in which case only silence duration is affected, or
      sophisticated time-stretching methods for insertion/deletion
      during favorable periods in active speech may be employed.

      Concealment events that cannot be classified as Buffer Adjustment-
      Type MUST be classified as Loss-Type.

      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.

   Playout Interrupt Count: 16 bits

      The number of interruptions to normal playout that occurred during
      the reporting period.

      Two values are reserved: a value of 0xFFFE indicates out of range
      (that is, a measured value exceeding 0xFFFD), and a value of
      0xFFFF indicates that the measurement is unavailable.

   Reserved: 16 bits

      These bits are reserved. They MUST be set to zero by senders and
      ignored by receivers (see [RFC6709], Section 4.2).

Mean Playout Interrupt Size: 32 bits

   The mean duration, expressed in units of RTP timestamp, of
   interruptions to normal playout that occurred during the reporting
   period.

   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.

4. Concealed Seconds Metrics Block

   The Concealed Seconds Metrics Block is intended to be used as
   described in this section, in conjunction with information from the
   Measurement Information Block [RFC6776]. It provides a description
   of potentially audible impairments due to lost and discarded packets
   at the endpoint, expressed on a time basis analogous to a traditional
   Public Switched Telephone Network (PSTN) T1/E1 errored seconds
   metric. Instances of this metrics block refer by synchronization
   source (SSRC) to the separate auxiliary Measurement Information Block
   [RFC6776] that describes measurement periods in use (see [RFC6776],
   Section 4.2). This metrics block relies on the measurement period in
   the Measurement Information Block indicating the span of the report
   and SHOULD be sent in the same compound RTCP packet as the
   Measurement Information Block. If the measurement period is not
   received in the same compound RTCP packet as this metrics block, this
   metrics block MUST be discarded.

   The following metrics are based on successive one-second intervals as
   declared by an RTP clock. This RTP clock does not need to be
   synchronized to any external time reference. The starting time of
   this clock is unspecified. Note that this implies that the same loss
   pattern could result in slightly different count values, depending on
   where the losses occur relative to the particular one-second
   demarcation points. For example, two loss events occurring 50 ms
   apart could result in either one Concealed Second or two, depending
   on the particular one-second boundaries used.

   The seconds in this sub-block are not necessarily calendar seconds.
   At the tail end of a session, periods of time of less than one second
   shall be incorporated into these counts if they exceed 500 ms and
   shall be disregarded if they are less than 500 ms.

4.1. Report Block Structure

   The structure of the Concealed Seconds Metrics Block is as follows.

```
    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=31      | I |plc| resv  |        block length=4         |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                        SSRC of Source                         |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                      Unimpaired Seconds                       |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                       Concealed Seconds                       |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Severely Concealed Seconds    | Reserved      | SCS Threshold |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
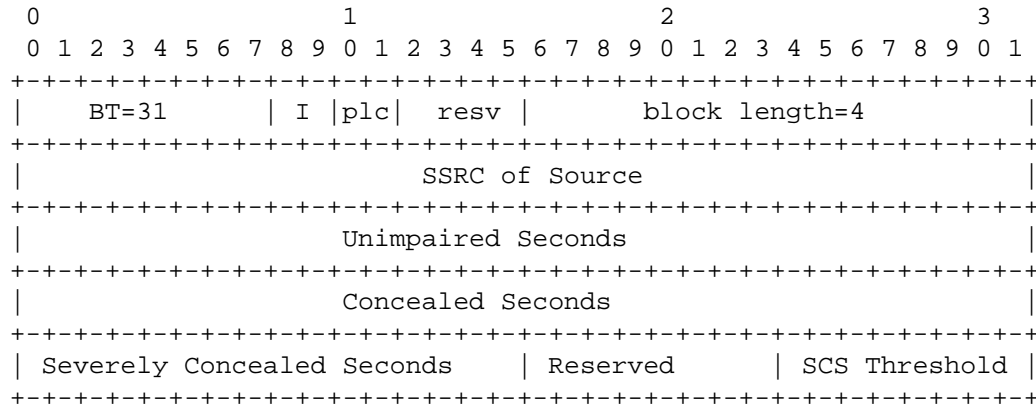
                Figure 2: Concealed Seconds Metrics Block

4.2. Definition of Fields in Concealed Seconds Metrics Block

   Block type (BT): 8 bits

      A Concealed Seconds Metrics Block is identified by the constant
      31.

   Interval Metric flag (I): 2 bits

      This field is used to indicate whether the Concealed Seconds
      metrics are Sampled, Interval, or Cumulative metrics:

         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 - the reported value is a sampled
         instantaneous value (Not allowed in this block).

         I=00: Reserved value - this value is reserved for future use.

      In this document, Concealed Seconds metrics can only be measured
      over definite intervals and cannot be sampled. Senders MUST NOT
      use the values I=00 or I=01. If a block is received with I=00 or
      I=01, the receiver MUST discard the block.

Packet Loss Concealment Method (plc): 2 bits

   This field is used to identify the packet loss concealment method
   in use at the receiver, according to the following code:

      bits 014-015

         0 = silence insertion

         1 = simple replay, no attenuation

         2 = simple replay, with attenuation

         3 = enhancement

         Other values are reserved.

   Note that the enhancement method (plc=3) for packet loss
   concealment offers an improved audio quality and a better
   robustness against packet losses [G.711] and is equivalent to
   "enhanced" in Section 4.7.6 of [RFC3611].

Reserved (resv): 4 bits

   These bits are reserved. They MUST be set to zero by senders and
   ignored by receivers (see [RFC6709], Section 4.2).

Block Length: 16 bits

   The length of this report block in 32-bit words, minus one. For
   the Concealed Seconds Metrics Block, the block length is equal to
   4.

SSRC of Source: 32 bits

   As defined in Section 4.1 of [RFC3611].

Unimpaired Seconds: 32 bits

   A count of the number of Unimpaired Seconds that have occurred.

   An Unimpaired Second is defined as a continuous period of one
   second during which no frame loss or discard due to late arrival
   has occurred. Every second in a session must be classified as
   either OK or Concealed.

Normal playout of comfort noise or other silence-concealment
signals during periods of talker silence, if VAD is used, shall be
counted as Unimpaired Seconds.

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 Seconds: 32 bits

A count of the number of Concealed Seconds that have occurred.

A Concealed Second is defined as a continuous period of one second
during which any frame loss or discard due to late arrival has
occurred.

Equivalently, a Concealed Second is one in which some Loss-Type
concealment has occurred. Buffer Adjustment-Type concealment
SHOULD NOT cause Concealed Seconds to be incremented, with the
following exception. An implementation MAY cause Concealed
Seconds to be incremented for 'emergency' buffer adjustments made
during talkspurts.

Loss-Type concealment is reactive insertion or deletion of samples
in the audio playout stream due to effective frame loss at the
audio decoder. "Effective frame loss" is the event in which a
frame of coded audio is simply not present at the audio decoder
when required. In this case, substitute audio samples are
generally formed, at the decoder or elsewhere, to reduce audible
impairment.

Buffer Adjustment-Type concealment is proactive or controlled
insertion or deletion of samples in the audio playout stream due
to jitter buffer adaptation, re-sizing decisions, or re-centering
decisions within the endpoint.

Because this insertion is controlled, rather than occurring
randomly in response to losses, it is typically less audible than
Loss-Type concealment. For example, jitter buffer adaptation
events may be constrained to occur during periods of talker
silence, in which case only silence duration is affected, or
sophisticated time-stretching methods for insertion/deletion
during favorable periods in active speech may be employed. For
these reasons, Buffer Adjustment-Type concealment MAY be exempted
from inclusion in calculations of Concealed Seconds and Severely
Concealed Seconds.

However, an implementation SHOULD include Buffer Adjustment-Type
concealment in counts of Concealed Seconds and Severely Concealed
Seconds if the event occurs at an 'inopportune' moment, such as an
emergency or large, immediate adaptation during active speech or
an unsophisticated adaptation during speech without regard for the
underlying signal. In these cases, the assumption of low
audibility cannot hold. In other words, jitter buffer adaptation
events that may be presumed to be audible SHOULD be included in
Concealed Seconds and Severely Concealed Seconds counts.

Concealment events that cannot be classified as Buffer Adjustment-
Type MUST be classified as Loss-Type.

For clarification, the count of Concealed Seconds MUST include the
count of Severely Concealed Seconds.

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.

Severely Concealed Seconds: 16 bits

A count of the number of Severely Concealed Seconds.

A Severely Concealed Second is defined as a non-overlapping period
of one second during which the cumulative amount of time that has
been subject to frame loss or discard due to late arrival exceeds
the SCS Threshold.

Two values are reserved: a value of 0xFFFE indicates out of range
(that is, a measured value exceeding 0xFFFD), and a value of
0xFFFF indicates that the measurement is unavailable.

Reserved: 8 bits

These bits are reserved. They MUST be set to zero by senders and
ignored by receivers (see [RFC6709], Section 4.2).

SCS Threshold: 8 bits

The SCS Threshold is defined as the percentage of packets
corresponding to lost or discarded frames that must occur within a
one second period in order for the second to be classified as a
Severely Concealed Second. This is expressed in numeric format
0:8 and hence can represent a range of 0 to 99.6 percent loss or
discard.

      A default threshold of 5 percent effective frame loss (50 ms
      effective frame loss) per second is suggested. This corresponds
      to an SCS Threshold in hexadecimal of 0x0D.

5. SDP Signaling

   [RFC3611] defines the use of SDP (Session Description Protocol)
   [RFC4566] for signaling the use of XR blocks. XR blocks MAY be used
   without prior signaling.

5.1. SDP rtcp-xr-attrib Attribute Extension

   This section augments the SDP attribute "rtcp-xr" [RFC3611] by
   providing two additional values of "xr-format" to signal the use of
   the two report blocks defined in this document.

   xr-format =/ xr-conceal-block
             / xr-conc-sec-block

   xr-conceal-block = "loss-conceal"
   xr-conc-sec-block = "conc-sec" ["=" thresh]

   thresh   = 1*DIGIT   ; threshold for SCS (ms)
   DIGIT =   <as defined in Section 3 of [RFC5234]>

5.2. Offer/Answer Usage

   When SDP is used in Offer/Answer context, the SDP Offer/Answer usage
   defined in [RFC3611] applies. Note that "thresh" is declared by the
   offer.

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 Values

   This document assigns two block type values in the IANA "RTP Control
   Protocol Extended Reports (RTCP XR) Block Type Registry" under the
   subregistry "RTCP XR Block Type":

   Name: LCB
   Long Name: Loss Concealment Metrics Block
   Value   30
   Reference: Section 3.1

      Name: CSB
      Long Name: Concealed Seconds Metrics Block
      Value   31
      Reference: Section 4.1

6.2. New RTCP XR SDP Parameters

   This document also registers two new parameters in the "RTP Control
   Protocol Extended Reports (RTCP XR) Session Description Protocol
   (SDP) Parameters Registry":

   o "loss-conceal"

   o "conc-sec"

6.3. Contact Information for Registrations

   The contact information for the registrations is:

   RAI Area Directors

   rai-ads@tools.ietf.org

7. Security Considerations

   It is believed that the RTCP XR blocks defined in this document
   introduce no new security considerations beyond those described in
   [RFC3611]. These blocks do not provide per-packet statistics, so the
   risk to confidentiality documented in Section 7, Paragraph 3 of
   [RFC3611] does not apply.

8. Contributors

   Geoff Hunt wrote the initial version of this document.

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10. References

10.1. Normative References

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10.2. Informative References

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              Performance Metric Development", BCP 170, RFC 6390,
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              Considerations for Protocol Extensions", RFC 6709,
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   [RFC6792] Wu, Q., Hunt, G., and P. Arden, "Guidelines for Use of the
              RTP Monitoring Framework", RFC 6792, November 2012.

   [VAD]   Wikipedia, "Voice activity detection", January 2014,
              <http://en.wikipedia.org/w/
              index.php?title=Voice_activity_detection&oldid=593287643>.

Appendix A. Metrics Represented Using the Template from RFC 6390

   a. On-Time Playout Duration Metric

       * Metric Name: On-Time Playout Duration

       * Metric Description: 'On-time playout' is the uninterrupted,
          in-sequence playout of valid decoded audio information
          originating from the remote endpoint. On-time playout
          duration is playout duration of any signal other than those
          used for concealment.

       * Method of Measurement or Calculation: See Section 3.2, On-Time
          Playout Duration definition.

       * Units of Measurement: See Section 3.2, On-Time Playout
          Duration definition.

       * Measurement Point(s) with Potential Measurement Domain: See
          Section 1.1, 3rd paragraph.

       * Measurement Timing: See Section 3, 1st paragraph for
          measurement timing and Section 3.2 for Interval Metric flag.

       * Use and Applications: See Section 1.4.

       * Reporting Model: See RFC 3611.

   b. Loss Concealment Duration Metric

       * Metric Name: Loss Concealment Duration

       * Metric Description: The duration of audio playout
          corresponding to Loss-Type concealment.

       * Method of Measurement or Calculation: See Section 3.2, Loss
          Concealment Duration definition.

       * Units of Measurement: See Section 3.2, Loss Concealment
          Duration definition.

       * Measurement Point(s) with Potential Measurement Domain: See
          Section 1.1, 3rd paragraph.

       * Measurement Timing: See Section 3, 1st paragraph for
          measurement timing and Section 3.2 for Interval Metric flag.

       * Use and Applications: See Section 1.4.

   * Reporting Model: See RFC 3611.

   c. Buffer Adjustment Concealment Duration Metric

      * Metric Name: Buffer Adjustment Concealment Duration

      * Metric Description: The duration of audio playout
         corresponding to Buffer Adjustment-Type concealment.

      * Method of Measurement or Calculation: See Section 3.2, Buffer
         Adjustment Concealment Duration definition.

      * Units of Measurement: See Section 3.2, Buffer Adjustment
         Concealment Duration definition.

      * Measurement Point(s) with Potential Measurement Domain: See
         Section 1.1, 3rd paragraph.

      * Measurement Timing: See Section 3, 1st paragraph for
         measurement timing and Section 3.2 for Interval Metric flag.

      * Use and Applications: See Section 1.4.

      * Reporting Model: See RFC 3611.

   d. Playout Interrupt Count Metric

      * Metric Name: Playout Interrupt Count

      * Metric Description: The number of interruptions to normal
         playout that occurred during the reporting period.

      * Method of Measurement or Calculation: See Section 3.2, Playout
         Interrupt Count definition.

      * Units of Measurement: See Section 3.2, Playout Interrupt Count
         definition.

      * Measurement Point(s) with Potential Measurement Domain: See
         Section 1.1, 3rd paragraph.

      * Measurement Timing: See Section 3, 1st paragraph for
         measurement timing and Section 3.2 for Interval Metric flag.

      * Use and Applications: See Section 1.4.

      * Reporting Model: See RFC 3611.

   e. Mean Playout Interrupt Size Metric

       * Metric Name: Mean Playout Interrupt Size

       * Metric Description: The mean duration of interruptions to
          normal playout that occurred during the reporting period.

       * Method of Measurement or Calculation: See Section 3.2, Playout
          Interrupt Count definition.

       * Units of Measurement: See Section 3.2, Playout Interrupt Count
          definition.

       * Measurement Point(s) with Potential Measurement Domain: See
          Section 1.1, 3rd paragraph.

       * Measurement Timing: See Section 3, 1st paragraph for
          measurement timing and Section 3.2 for Interval Metric flag.

       * Use and Applications: See Section 1.4.

       * Reporting Model: See RFC 3611.

   f. Unimpaired Seconds Metric

       * Metric Name: Unimpaired Seconds

       * Metric Description: A count of the number of Unimpaired
          Seconds that have occurred.

       * Method of Measurement or Calculation: See Section 4.2,
          Unimpaired Seconds definition.

       * Units of Measurement: See Section 4.2, Unimpaired Seconds
          definition.

       * Measurement Point(s) with Potential Measurement Domain: See
          Section 1.1, 5th paragraph.

       * Measurement Timing: See Section 4, 1st paragraph for
          measurement timing and Section 4.2 paragraph for Interval
          Metric flag.

       * Use and Applications: See Section 1.4.

       * Reporting Model: See RFC 3611.

   g. Concealed Seconds Metric

       * Metric Name: Concealed Seconds

       * Metric Description: A count of the number of Concealed Seconds
          that have occurred.

       * Method of Measurement or Calculation: See Section 4.2,
          Concealed Seconds definition.

       * Units of Measurement: See Section 4.2, Concealed Seconds
          definition.

       * Measurement Point(s) with Potential Measurement Domain: See
          Section 1.1, 5th paragraph.

       * Measurement Timing: See Section 4, 1st paragraph for
          measurement timing and Section 4.2 for Interval Metric flag.

       * Use and Applications: See Section 1.4.

       * Reporting Model: See RFC 3611.

   h. Severely Concealed Seconds Metric

       * Metric Name: Severely Concealed Seconds

       * Metric Description: A count of the number of Severely
          Concealed Seconds that have occurred.

       * Method of Measurement or Calculation: See Section 4.2,
          Severely Concealed Seconds definition.

       * Units of Measurement: See Section 4.2, Severely Concealed
          Seconds definition.

       * Measurement Point(s) with Potential Measurement Domain: See
          Section 1.1, 5th paragraph.

       * Measurement Timing: See Section 4, 1st paragraph for
          measurement timing and Section 4.2 for Interval Metric flag.

       * Use and Applications: See Section 1.4.

       * Reporting Model: See RFC 3611.

   i. SCS Threshold Metric

       * Metric Name: SCS Threshold

       * Metric Description: The amount of time corresponding to lost
          or discarded frames that must occur within a one-second period
          in order for the second to be classified as a Severely
          Concealed Second.

       * Method of Measurement or Calculation: See Section 4.2, SCS
          Threshold definition.

       * Units of Measurement: See Section 4.2, SCS Threshold
          definition.

       * Measurement Point(s) with Potential Measurement Domain: See
          Section 1.1, 5th paragraph.

       * Measurement Timing: See Section 4, 1st paragraph for
          measurement timing and Section 4.2 for Interval Metric flag.

       * Use and Applications: See Section 1.4.

       * Reporting Model: See RFC 3611.

Authors' Addresses

   Alan Clark
   Telchemy Incorporated
   2905 Premiere Parkway, Suite 280
   Duluth, GA 30097
   USA

   EMail: alan.d.clark@telchemy.com

   Glen Zorn
   Network Zen
   77/440 Soi Phoomjit, Rama IV Road
   Phra Khanong, Khlong Toie
   Bangkok 10110
   Thailand

   Phone: +66 (0) 87 502 4274
   EMail: gwz@net-zen.net

   Claire Bi
   Shanghai Research Institute of China Telecom Corporation Limited
   No. 1835, South Pudong Road
   Shanghai 200122
   China

   EMail: bijy@sttri.com.cn

   Qin Wu
   Huawei
   101 Software Avenue, Yuhua District
   Nanjing, Jiangsu 210012
   China

   EMail: sunseawq@huawei.com