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RTP Control Protocol (RTCP) Extended Report (XR) Blocks for Summary Statistics Metrics Reporting

Abstract

This document defines three RTP Control Protocol (RTCP) Extended Report (XR) blocks that allow the reporting of loss, duplication, and discard summary statistics metrics in a range of RTP applications.

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/rfc7004.

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1. Introduction

1.1. Summary Statistics Metrics

This document defines three new block types to augment those defined in [RFC3611] for use in a range of RTP applications:

- Burst/Gap Loss Summary Statistics Block
- Burst/Gap Discard Summary Statistics Block
- Frame Impairment Statistics Summary Block

The first two block types support the reporting of burst/gap loss and burst/gap discard summary statistics including packet loss/discard proportion, mean, and variance and belong to the class of transport-related end-system metrics defined in [RFC6792]. These two blocks are intended to be used in conjunction with information from the Burst/Gap Loss Metrics Block [RFC6958] or Burst/Gap Discard Metrics Block [RFC7003], on which these two blocks therefore depend. The metrics in the Burst/Gap Loss Metrics Block and Burst/Gap Discard Metrics Block are consistent with the definitions of "burst", "gap", "loss", and "discard" in RTCP XR [RFC3611].

The third block supports the reporting of detailed video statistics for each frame type, including the number of frames received, lost, and discarded of each frame type in the Group of Pictures (GOP) and additional data allowing the calculation of statistical parameters (e.g., the proportion of each frame type impaired by packet loss and discard). The metrics defined in this block belong to the class of application-level metrics defined in [RFC6792].

1.2. RTCP and RTCP Extended 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 for use with [RFC3550] and [RFC3611].

1.3. Performance Metrics Framework

The RTP Monitoring Framework [RFC6792] provides guidelines for reporting block format using RTCP XR. Metrics described in this document are in accordance with the guidelines in [RFC6792].

1.4. Applicability

These metrics are applicable to a wide range of RTP applications and reflect transient IP problems that affect user experience. They can be used to form an accurate assessment of users' quality of experience and influence sender strategies to mitigate the problem.

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].

In addition, the following term is defined:

Frame Type

In many cases, a video frame is compressed using different algorithms. Frame type is used to identify different algorithms for video frames. Two frame types used in the different video algorithms are the Key frame and Derived frames. The Key frame is independently coded without prediction from other pictures and used as a reference frame for predicting other pictures. Derived frames are predicatively coded and derived from a Key frame using a prediction algorithm. If there is no video image compression, all frames are Key frames.

3. Transport-Related End-System Metrics

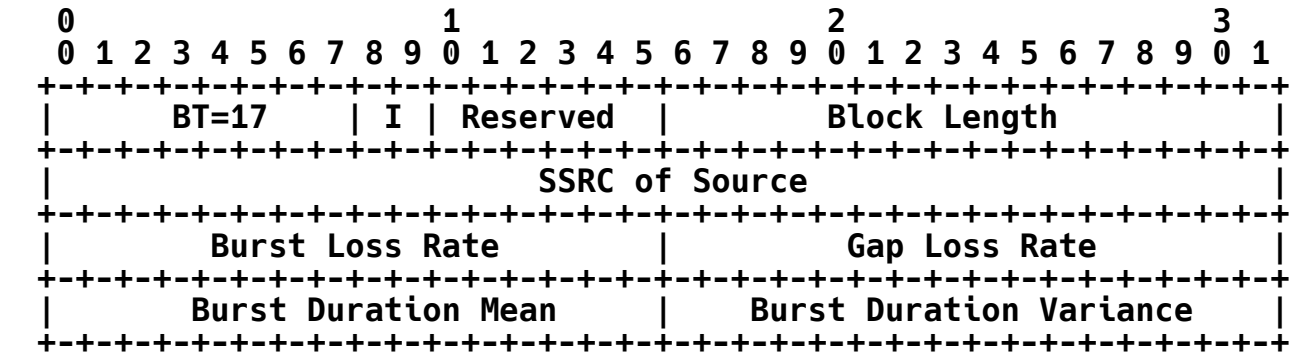
3.1. Burst/Gap Loss Summary Statistics Block

This block extends packet loss and discard metrics defined in Section 4.7.1 of [RFC3611]. The metrics described here are intended to be used as described in this section, in conjunction with information from the Measurement Information Block [RFC6776] (which MUST be present in the same RTCP packet as the Burst/Gap Loss Metrics Block [RFC6958]) and also with the metric "cumulative number of packets lost" provided in standard RTCP [RFC3550]. Instances of this metrics block use the synchronization source (SSRC) to refer 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.

The metrics carried in this metrics block provide information relevant to statistical parameters, including Burst Loss Rate, Gap Loss Rate, Burst Duration Mean, and Burst Duration Variance, and are measured at the receiving end of the RTP stream using burst/gap loss metrics defined in [RFC6958] and other information that is sent together with this report block.

3.1.1. Report Block Structure

The structure of the Burst/Gap Loss Summary Statistics Block is as follows.



3.1.2. Definition of Fields in Loss Summary Statistics Block

Block Type (BT): 8 bits

A Burst/Gap Loss Summary Statistics Block is identified by the constant 17.

Interval Metric flag (I): 2 bits

This field is used to indicate whether the burst/gap loss summary statistics 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.

In this document, the value I=00 is the reserved value and MUST NOT be used.

Reserved: 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 ignored by the receiver (see [RFC6709], Section 4.2).

Block Length: 16 bits

The constant 3, in accordance with the definition of this field in Section 3 of RFC 3611 [RFC3611].

SSRC of Source: 32 bits

As defined in Section 4.1 of RFC 3611 [RFC3611].

Burst Loss Rate: 16 bits

The fraction of packets lost during bursts since the beginning of reception, expressed as a fixed point number with the binary point immediately after the left-most bit. This value is calculated by dividing Packets Lost in Bursts by Total Packets Expected in Bursts, multiplying the result of the division by 32768 (0x8000), and keeping only the integer part. The maximum value is thus 0x8000. Representing this as a formula:

integer-part((Packets Lost in Bursts / Total Packets Expected in Bursts) * 0x8000)

If the measurement is unavailable, the value 0xFFFF MUST be reported.

Gap Loss Rate: 16 bits

The fraction of packets lost during gaps since the beginning of reception expressed as a fixed point number with the binary point immediately after the left-most bit. This value is calculated by dividing the difference between number of packets lost and Packets Lost in Bursts by the difference between Packets Expected and Total Packets Expected in Bursts, multiplying the result of the division by 32768 (0x8000), and keeping only the integer part. The maximum value is thus 0x8000. Representing this as a formula:

integer-part ((number of packets lost - Packets Lost in Bursts)/ (Packets Expected - Total Packets Expected in Bursts) * 0x8000)

where "number of packets lost" is obtained from standard RTCP [RFC3550] and Packets Expected is calculated as the difference between "extended last sequence number" and "extended first

sequence number" (Interval or Cumulative) provided in the Measurement Identity and Information Block [RFC6776].

If the measurement is unavailable, the value 0xFFFF MUST be reported.

Note that if the metric is to be calculated on an Interval basis, a difference must be taken between the current and preceding values of "cumulative number of packets lost" in RTCP to obtain the "number of packets lost" for the reporting interval.

Burst Duration Mean: 16 bits

The mean burst duration is obtained as the quotient:

mean = Sum of Burst Durations / Number of Bursts

where "Sum of Burst Durations" and "Number of Bursts" is obtained from the RTCP XR Burst/Gap Loss Metrics Block [RFC6958].

If the measurement is unavailable, the value 0xFFFF MUST be reported.

Burst Duration Variance: 16 bits

The variance of the burst duration is obtained using the standard result:

var = (Sum of Squares of Burst Durations - Number of Bursts * mean^2) / (Number of Bursts - 1)

where "Sum of Squares of Burst Durations" and "Number of Bursts" is obtained from the RTCP XR Burst/Gap Loss Metrics Block [RFC6958].

If the measurement is unavailable, the value 0xFFFF MUST be reported.

3.2. Burst/Gap Discard Summary Statistics Block

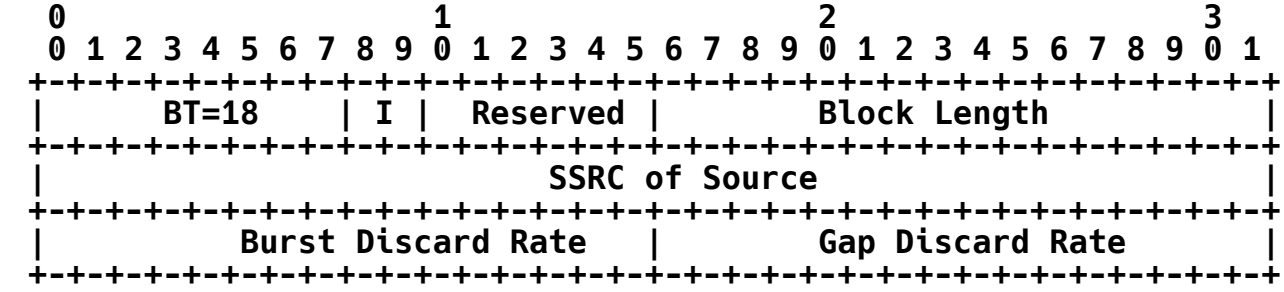
This block extends packet loss and discard metrics defined in Section 4.7.1 of [RFC3611]. The metrics described here are intended to be used as described in this section, in conjunction with information from the Measurement Identity Block [RFC6776] (which MUST be present in the same RTCP packet as the Burst/Gap Discard Summary Statistics Block).

These metrics provide information relevant to statistical parameters, including Burst Discard Rate and Gap Discard Rate, and are measured at the receiving end of the RTP stream using burst/gap discard metrics defined in [RFC7003] and other information that is sent together with this report block.

Instances of this metrics block use the synchronization source (SSRC) to refer 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.

3.2.1. Report Block Structure

The structure of the Burst/Gap Discard Summary Statistics Block is as follows.



3.2.2. Definition of Fields in Burst/Gap Discard Summary Statistics Block

Block Type (BT): 8 bits

A Burst/Gap Discard Summary Statistics Block is identified by the constant 18.

Interval Metric flag (I): 2 bits

This field is used to indicate whether the burst/gap discard summary statistics 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.

In this document, the value I=00 is the reserved value and MUST NOT be used.

Reserved: 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 ignored by the receiver (see [RFC6709], Section 4.2).

Block Length: 16 bits

The constant 2, in accordance with the definition of this field in Section 3 of RFC 3611 [RFC3611].

SSRC of Source: 32 bits

As defined in Section 4.1 of RFC3611 [RFC3611].

Burst Discard Rate: 16 bits

The fraction of packets discarded during bursts since the beginning of reception, expressed as a fixed point number with the binary point immediately after the left-most bit. This value is calculated by dividing Packets Discarded in Bursts by Total Packets Expected in Bursts, multiplying the result of the division by 32768 (0x8000), and keeping only the integer part, according to the formula:

integer-part((Packets Discarded in Bursts / Total Packets Expected in Bursts) * 0x8000)

If the measurement is unavailable, the value 0xFFFF MUST be reported.

Gap Discard Rate: 16 bits

The fraction of packets discarded during gaps since the beginning of reception expressed as a fixed point number with the binary point immediately after the left-most bit. This value is calculated by dividing the difference between number of packets discarded and Packets Discarded in Bursts by the difference between Packets Expected and Total Packets Expected in Bursts,

multiplying the result of the division by 32768 (0x8000), and keeping only the integer part. The maximum value is thus 0x8000. Representing this as a formula:

integer-part((number of packets discarded - Packets Discarded in Bursts) /(Packets Expected - Total Packets Expected in Bursts) * 0x8000)

where "number of packets discarded" is obtained from the RTCP XR Discard Count Block [RFC7002] and filled with the sum of packets discarded due to early arrival (DT=1) and packets discarded due to late arrival (DT=2) and Packets Expected is calculated as the difference between "extended last sequence number" and "extended first sequence number" (Interval or Cumulative) provided in the Measurement Information Block [RFC6776]. In order for the Burst/Gap Discard Summary Statistics Block to be meaningful, 2 instances of the Discard Count Block with DT=1 and DT=2 MUST be included in the same RTCP XR packet as the Burst/Gap Discard Summary Statistics Block.

If the measurement is unavailable, the value 0xFFFF MUST be reported.

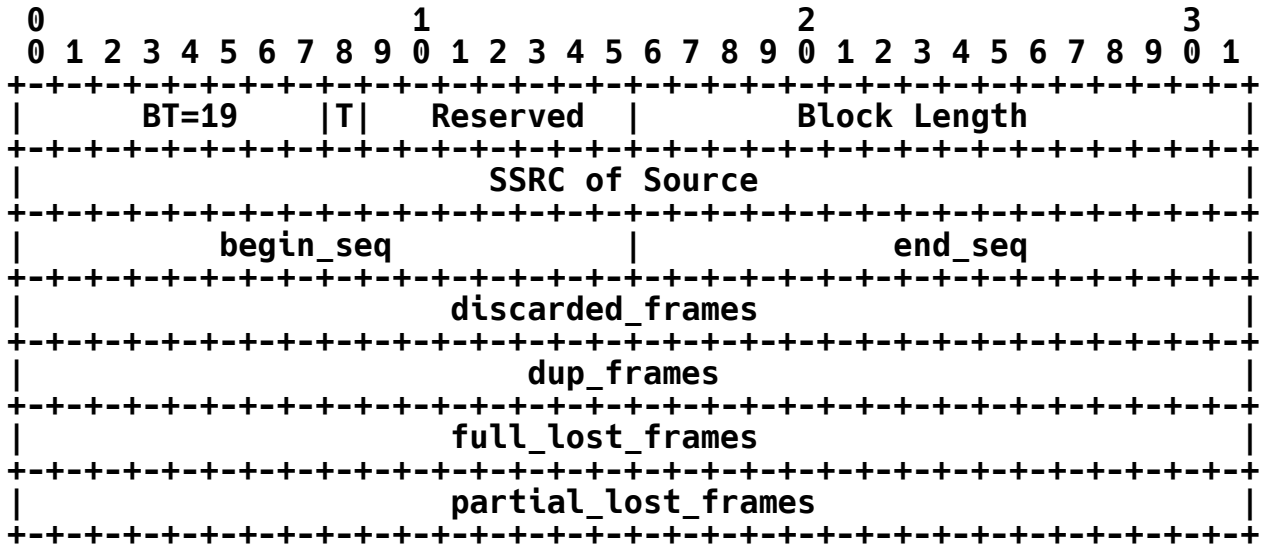
4. Application-Level Metrics

4.1. Frame Impairment Statistics Summary Block

This block extends the statistics summary report mechanism defined in Section 4.6 of [RFC3611] and reports statistics on which frame types were affected beyond the information carried in the Statistics Summary Report Block RTCP packet specified in Section 4.6 of [RFC3611]. Information is measured at the receiving end of the RTP stream and recorded about the number of frames received, lost frames, duplicated frames, and lost partial frames. Such information can be useful for network management and video quality monitoring.

4.1.1. Report Block Structure

The structure of the Frame Impairment Statistics Summary Block is as follows.



4.1.2. Definition of Fields in Frame Impairment Statistics Summary Block

Block Type (BT): 8 bits

A Frame Impairment Statistics Summary Block is identified by the constant 19.

Frame type indicator (T): 1 bit

This field is used to indicate the frame type to be reported. The bit is set to 0 if the full_lost_frames, partial_lost_frames, dup_frames, and discarded_frames fields contain Key frame (reference frame) counts or 1 if they contain Derived frame counts. Note that if both the Key frame and Derivation frame report are sent, they should be sent in the same RTCP compound packet using two Frame Impairment Statistics Summary Blocks.

Reserved: 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 ignored by the receiver (see [RFC6709], Section 4.2).

Block Length: 16 bits

The constant 6, in accordance with the definition of this field in Section 3 of RFC 3611 [RFC3611].

SSRC of Source: 32 bits

As defined in Section 4.1 of RFC 3611 [RFC3611].

begin_seq: 16 bits

As defined in Section 4.1 of RFC 3611 [RFC3611].

end_seq: 16 bits

As defined in Section 4.1 of RFC 3611 [RFC3611].

Number of discarded frames (discarded_frames): 32 bits

Number of frames discarded in the above sequence number interval.

Number of duplicate frames (dup_frames): 32 bits

Number of duplicate frames received in the above sequence number interval.

Number of full lost frames (full_lost_frames): 32 bits

A frame is either split across multiple packets or carried in only one packet. If the whole frame or all the packets of the frame are lost, this frame is regarded as one full_lost_frame. The full_lost_frames can be inferred from packet(s) that comprise the frame. The full_lost_frames is equivalent to the number of full lost frames in the above sequence number interval.

Number of partial lost frames (partial_lost_frames): 32 bits

When a frame is split across multiple packets and some packets of the frame are lost, this frame is regarded as one partial_lost_frame. The partial_lost_frames can be inferred from packets that comprise the frame. The value of the partial_lost_frames field is equivalent to the number of partial lost frames in the above sequence number interval.

5. SDP Signaling

RFC 3611 defines the use of SDP (Session Description Protocol) [RFC4566] for signaling the use of XR blocks. However, XR blocks MAY be used without prior signaling (see Section 5 of [RFC3611]).

5.1. SDP rtcp-xr Attribute Extension

This section augments the SDP [RFC4566] attribute "rtcp-xr" defined in Section 5.1 of [RFC3611] by providing three additional values 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-bglss-block
           / xr-bgdss-block
           / xr-fiss-block
xr-bglss-block = "burst-gap-loss-stat"
xr-bgdss-block = "burst-gap-discard-stat"
xr-fiss-block  = "frame-impairment-stat"
```

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. IANA Considerations

New block types for RTCP XR are subject to IANA registration. For general guidelines on IANA considerations for RTCP XR, refer to RFC 3611.

6.1. New RTCP XR Block Type Values

This document assigns three new block type values in the "RTP Control Protocol Extended Reports (RTCP XR) Block Type Registry":

```
Name:       BGLSS
Long Name:  Burst/Gap Loss Summary Statistics Block
Value       17
Reference:  Section 3.1

Name:       BGDSS
Long Name:  Burst/Gap Discard Summary Statistics Block
Value       18
Reference:  Section 3.2
```

Name: FISS
Long Name: Frame Impairment Statistics Summary Block
Value 19
Reference: Section 4.1

6.2. New RTCP XR SDP Parameters

This document also registers three new SDP [RFC4566] parameters for the "rtcp-xr" attribute in the "RTP Control Protocol Extended Reports (RTCP XR) Session Description Protocol (SDP) Parameters Registry":

* "burst-gap-loss-stat"
* "burst-gap-discard-stat"
* "frame-impairment-stat"

6.3. Contact Information for Registrations

The contact information for the registrations is:

Qin Wu (sunseawq@huawei.com)
101 Software Avenue, Yuhua District
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7. Security Considerations

The new RTCP XR blocks in this document do not introduce any new security considerations beyond those described in [RFC3611].

8. Acknowledgements

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9. References

9.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC3550] Schulzrinne, H., Casner, S., Frederick, R., and V. Jacobson, "RTP: A Transport Protocol for Real-Time Applications", STD 64, RFC 3550, July 2003.

[RFC3611] Friedman, T., Caceres, R., and A. Clark, "RTP Control Protocol Extended Reports (RTCP XR)", RFC 3611, November 2003.

[RFC4566] Handley, M., Jacobson, V., and C. Perkins, "SDP: Session Description Protocol", RFC 4566, July 2006.

[RFC5234] Crocker, D. and P. Overell, "Augmented BNF for Syntax Specifications: ABNF", STD 68, RFC 5234, January 2008.

[RFC6776] Clark, A. and Q. Wu, "Measurement Identity and Information Reporting Using a Source Description (SDES) Item and an RTCP Extended Report (XR) Block", RFC 6776, October 2012.

[RFC6958] Clark, A., Zhang, S., Zhao, J., and Q. Wu, "RTP Control Protocol (RTCP) Extended Report (XR) Block for Burst/Gap Loss Metric Reporting", RFC 6958, May 2013.

[RFC7002] Clark, A., Zorn, G., and Q. Wu, "RTP Control Protocol (RTCP) Extended Report (XR) Block for Discard Count Metric Reporting", RFC 7002, September 2013.

[RFC7003] Clark, A., Huang, R., and Q. Wu, Ed., "RTP Control Protocol (RTCP) Extended Report (XR) Block for Burst/Gap Discard Metric Reporting", RFC 7003, September 2013.

9.2. Informative References

[RFC6390] Clark, A. and B. Claise, "Guidelines for Considering New Performance Metric Development", BCP 170, RFC 6390, October 2011.

[RFC6709] Carpenter, B., Aboba, B., and S. Cheshire, "Design Considerations for Protocol Extensions", RFC 6709, September 2012.

[RFC6792] Wu, Q., Hunt, G., and P. Arden, "Guidelines for Use of the RTP Monitoring Framework", RFC 6792, November 2012.

Appendix A. Metrics Represented Using the Template from RFC 6390

a. Burst Loss Rate Metric

   * Metric Name: RTP Burst Loss Rate

   * Metric Description: The fraction of packets lost during bursts since the beginning of reception for RTP traffic.

   * Method of Measurement or Calculation: See Section 3.1.2, Burst Loss Rate definition.

   * Units of Measurement: See Section 3.1.2, Burst Loss Rate definition.

   * Measurement Point(s) with Potential Measurement Domain: See Section 3.1, 2nd paragraph.

   * Measurement Timing: See Section 3.1, 1st paragraph for measurement timing and Section 3.1.2 for Interval Metric flag.

   * Use and Applications: See Section 1.4.

   * Reporting Model: See RFC 3611.

b. Gap Loss Rate Metric

   * Metric Name: RTP Gap Loss Rate

   * Metric Description: The fraction of packets lost during gaps since the beginning of reception for RTP traffic.

   * Method of Measurement or Calculation: See Section 3.1.2, Gap Loss Rate definition.

   * Units of Measurement: See Section 3.1.2, Gap Loss Rate definition.

   * Measurement Point(s) with Potential Measurement Domain: See Section 3.1, 2nd paragraph.

   * Measurement Timing: See Section 3.1, 1st paragraph for measurement timing and Section 3.1.2 for Interval Metric flag.

   * Use and Applications: See Section 1.4.

   * Reporting Model: See RFC 3611.

c. Burst Duration Mean Metric

* Metric Name: RTP Burst Duration Mean

* Metric Description: The mean duration of the burst periods that have occurred since the beginning of reception for RTP traffic.

* Method of Measurement or Calculation: See Section 3.1.2, Burst Loss Rate definition.

* Units of Measurement: This metric is expressed in milliseconds.

* Measurement Point(s) with Potential Measurement Domain: See Section 3.1, 2nd paragraph.

* Measurement Timing: See Section 3.1, 1st paragraph for measurement timing and Section 3.1.2 for Interval Metric flag.

* Use and Applications: See Section 1.4.

* Reporting Model: See RFC 3611.

d. Burst Duration Variance Metric

* Metric Name: RTP Burst Duration Variance

* Metric Description: The variance duration of the burst periods that have occurred since the beginning of reception for RTP traffic.

* Method of Measurement or Calculation: See Section 3.1.2, Burst Duration Variance definition.

* Units of Measurement: See Section 3.1.2, Burst Duration Variance definition.

* Measurement Point(s) with Potential Measurement Domain: See Section 3.1, 2nd paragraph.

* Measurement Timing: See Section 3.1, 1st paragraph for measurement timing and Section 3.1.2 for Interval Metric flag.

* Use and Applications: See Section 1.4.

* Reporting Model: See RFC 3611.

e. Burst Discard Rate Metric

* Metric Name: RTP Burst Discard Rate

* Metric Description: The fraction of packets discarded during bursts since the beginning of reception for RTP traffic.

* Method of Measurement or Calculation: See Section 3.2.2, Burst Discard Rate definition.

* Units of Measurement: See Section 3.2.2, Burst Discard Rate definition.

* Measurement Point(s) with Potential Measurement Domain: See Section 3.2, 2nd paragraph.

* Measurement Timing: See Section 3.2, 3rd paragraph for measurement timing and Section 3.1.2 for Interval Metric flag.

* Use and Applications: See Section 1.4.

* Reporting Model: See RFC 3611.

f. Gap Discard Rate Metric

* Metric Name: RTP Gap Discard Rate

* Metric Description: The fraction of packets discarded during gaps since the beginning of reception for RTP traffic.

* Method of Measurement or Calculation: See Section 3.2.2, Gap Discard Rate definition.

* Units of Measurement: See Section 3.2.2, Gap Discard Rate definition.

* Measurement Point(s) with Potential Measurement Domain: See Section 3.2, 2nd paragraph.

* Measurement Timing: See Section 3.2, 3rd paragraph for measurement timing and Section 3.1.2 for Interval Metric flag.

* Use and Applications: See Section 1.4.

* Reporting Model: See RFC 3611.

g. Number of Discarded Frames Metric

* Metric Name: Number of discarded frames in RTP

* Metric Description: Number of frames discarded in a certain sequence number interval for RTP traffic.

* Method of Measurement or Calculation: See Section 4.1.2, Number of discarded frames definition. This metric is directly measured and can be inferred from packet(s) that comprise the frame.

* Units of Measurement: This metric is expressed as a 32-bit unsigned integer value.

* Measurement Point(s) with Potential Measurement Domain: See Section 4.1, 1st paragraph.

* Measurement Timing: See Section 4.1, Number of discarded frames definition. This metric relies on the sequence number interval and RTCP RR packet of [RFC3550] to determine measurement timing.

* Use and Applications: See Section 1.4.

* Reporting Model: See RFC 3611.

h. Number of Duplicate Frames Metric

* Metric Name: Number of duplicate frames in RTP

* Metric Description: Number of frames duplicated in a certain sequence number interval for RTP traffic.

* Method of Measurement or Calculation: See Section 4.1.2, Number of duplicate frames definition. This metric is directly measured and can be inferred from packet(s) that comprise the frame.

* Units of Measurement: This metric is expressed as a 32-bit unsigned integer value.

* Measurement Point(s) with Potential Measurement Domain: See Section 4.1, 1st paragraph.

* Measurement Timing: See Section 4.1, Number of duplicate frames definition. This metric relies on the sequence number interval to determine measurement timing.

* Use and Applications: See Section 1.4.

* Reporting Model: See RFC 3611.

i. Number of Full Lost Frames Metric

* Metric Name: Number of full lost frames in RTP

* Metric Description: A frame is either split across multiple RTP packets or carried in only one RTP packet. If the whole frame or all the packets of the frame is lost, this frame is regarded as one full_lost_frame.

* Method of Measurement or Calculation: See Section 4.1.2, Number of full lost frames definition.

* Units of Measurement: This metric is expressed as a 32-bit unsigned integer value.

* Measurement Point(s) with Potential Measurement Domain: See Section 4.1, 1st paragraph.

* Measurement Timing: See Section 4.1, Number of full lost frames definition. This metric relies on the sequence number interval to determine measurement timing.

* Use and Applications: See Section 1.4.

* Reporting Model: See RFC 3611.

j. Number of Partial Lost Frames Metric

* Metric Name: Number of partial lost frames in RTP

* Metric Description: When a frame is split across multiple RTP packets and some RTP packets of the frame are lost, this frame is regarded as one partial_lost_frame.

* Method of Measurement or Calculation: See Section 4.1.2, Number of partial lost frames definition.

* Units of Measurement: This metric is expressed as a 32-bit unsigned integer value.

* Measurement Point(s) with Potential Measurement Domain: See Section 4.1, 1st paragraph.

* Measurement Timing: See Section 4.1, Number of partial lost frames definition. This metric relies on the sequence number interval to determine measurement timing.

* Use and Applications: See Section 1.4.

* Reporting Model: See RFC 3611.

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