Audio/Video Transport Working Group	G. Hunt BT	
Internet-Draft	A. Clark Telchemy	
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RTCP XR Report Block for Packet Delay Variation Metric Reporting
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Abstract

This document defines an RTCP XR Report Block that allows the reporting of Packet Delay Variation metrics for a range of RTP applications.

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1. Introduction

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1.1. Packet Delay Variation Metrics Block

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This draft defines a new block type to augment those defined in [RFC3611] (Friedman, T., “RTP Control Protocol Extended Reports (RTCP XR),” November 2003.), for use in a range of RTP applications.
The new block type provides information on Packet Delay Variation using one of several standard metrics.
The metrics belong to the class of transport metrics defined in [MONARCH] (work in progress).
Instances of this Metrics Block refer by tag to the separate auxiliary Measurement Identity block [MEASIDENT] (Hunt, G., “RTCP XR Measurement Identifier Block,” May 2009.) which contains information such as the SSRC of the measured stream, and RTP sequence numbers and time intervals indicating the span of the report.

1.2. RTCP and RTCP XR Reports

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The use of RTCP for reporting is defined in [RFC3550] (Schulzrinne, H., “RTP: A Transport Protocol for Real-Time Applications,” July 2003.). [RFC3611] (Friedman, T., “RTP Control Protocol Extended Reports (RTCP XR),” November 2003.) 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] (Schulzrinne, H., “RTP: A Transport Protocol for Real-Time Applications,” July 2003.) and [RFC3611] (Friedman, T., “RTP Control Protocol Extended Reports (RTCP XR),” November 2003.).

1.3. Performance Metrics Framework

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The Performance Metrics Framework [PMOLFRAME] (Clark, A., “Framework for Performance Metric Development,” March 2009.) 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 [PMOLFRAME] (Clark, A., “Framework for Performance Metric Development,” March 2009.).

1.4. Applicability

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These metrics are applicable to a range of RTP applications.

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2. Packet Delay Variation Metrics Block

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Metrics in this block report on packet delay variation in the stream arriving at the RTP system.

2.1. Report Block Structure

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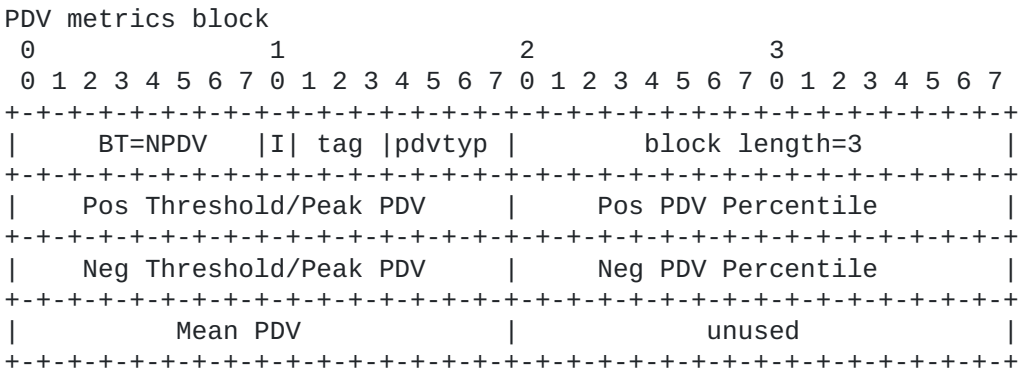

Figure 1: Report Block Structure

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2.2. Definition of Fields in PDV Metrics Block

block type (BT): 8 bits

> A Packet Delay Variation Metrics Report Block is identified by the constant NPDV.

[Note to RFC Editor: please replace NPDV with the IANA provided RTCP XR block type for this block.]
Interval Metric flag (I): 1 bit

> This field is used to indicate whether the Packet Delay Variation metrics block is an Interval or a Cumulative report, that is, whether the reported values apply to the most recent measurement interval duration between successive metrics reports (I=1) (the Interval Duration) or to the accumulation period characteristic of cumulative measurements (I=0) (the Cumulative Duration). Numerical values for both these intervals are provided in the Measurement Identifier block referenced by the tag field below.

Measurement Identifier association (tag): 3 bits

> This field is used to identify the Measurement Identifier block [MEASIDENT] (Hunt, G., "RTCP XR Measurement Identifier Block," May 2009.) which describes this measurement. The relevant Measurement Identifier block has the same tag value as the Packet Delay Variation Metrics block. Note that there may be more than one Measurement Identifier block per RTCP packet.

Packet Delay Variation Metric Type (pdvtyp): 4 bits

> This field is used to identify the Packet Delay Variation Metric Type used in this report block, according to the following code:

```
bits 014-017
    0: interarrival jitter, Section 6.4.1 of [RFC3550],
    1: MAPDV2, Clause 6.2.3.2 of [G.1020],
    2: 2-point PDV, Clause 6.2.4 of [Y.1540]
```

> Other values as registered by IANA in new registry "RTCP XR PDV block - PDV type", see Section 4.4 (New registry of PDV types).

block length: 16 bits

> The length of this report block in 32-bit words, minus one. For the Packet Delay Variation Metrics block, the block length is equal to 3.

Positive Threshold/Peak PDV: 16 bit, S11:4 format

> The PDV associated with the Positive PDV percentile expressed in milliseconds. The term Positive is associated with packets arriving later than the expected time.
>
> If the measured value is more negative than -2047.9375 (the value which would be coded as 0x8001), the value 0x8000 SHOULD be reported

> to indicate an over-range negative measurement. If the measured value is more positive than +2047.8125 (the value which would be coded as 0x7FFD), the value 0x7FFE SHOULD be reported to indicate an over-range positive measurement. If the measurement is unavailable, the value 0x7FFF SHOULD be reported.

Positive PDV Percentile: 16 bit, 8:8 format

> The percentage of packets on the call for which individual packet delays were less than the Positive Threshold PDV.
>
> If the measurement is unavailable, the value 0xFFFF SHOULD be reported.

Negative Threshold/Peak PDV: 16 bit, S11:4 format

> The PDV associated with the Negative PDV percentile expressed in milliseconds. The term Negative is associated with packets arriving earlier than the expected time.
>
> If the measured value is more negative than -2047.9375 (the value which would be coded as 0x8001), the value 0x8000 SHOULD be reported to indicate an over-range negative measurement. If the measured value is more positive than +2047.8125 (the value which would be coded as 0x7FFD), the value 0x7FFE SHOULD be reported to indicate an over-range positive measurement. If the measurement is unavailable, the value 0x7FFF SHOULD be reported.

Negative PDV Percentile: 16 bit, 8:8 format

> The percentage of packets on the call for which individual packet delays were more than the Negative Threshold PDV.
>
> If the measurement is unavailable, the value 0xFFFF SHOULD be reported.

If the PDV Type indicated is 2-point PDV and the Positive and Negative PDV Percentiles are set to 100.0 then the Positive and Negative Threshold/Peak PDV values are the peak values measured during the reporting interval (which may be from the start of the call for cumulative reports). In this case, the difference between the Positive and Negative Threshold/Peak values defines the range of 2-point PDV.
Mean PDV: (16 bit, S11:4 format) expressed in milliseconds

> For MAPDV2 this value is generated according to Clause 6.2.3.2 of [G.1020] (ITU-T, “ITU-T Rec. G.1020, Performance parameter definitions for quality of speech and other voiceband applications utilizing IP networks,” July 2006.). For interval reports the MAPDV2 value is reset at the start of the interval.
>
> For interarrival jitter, the value reported is the value of J(i) calculated according to [RFC3550] (Schulzrinne, H., “RTP: A Transport Protocol for Real-Time Applications,” July 2003.) at the time the report is generated.
>
> For 2-point PDV, the value reported is the mean of per-packet 2-point PDV values. This metric indicates the arrival time of the first media packet of the session with respect to the mean of the

> arrival times of every packet of the session. A single value of the metric (for a single session) may not be useful by itself, but its average over a number of sessions may be useful in diagnosing media delay at session startup. For example, this might occur if media packets are often delayed behind signalling packets due to head-of-line blocking.
>
> If the measured value is more negative than -2047.9375 (the value which would be coded as 0x8001), the value 0x8000 SHOULD be reported to indicate an over-range negative measurement. If the measured value is more positive than +2047.8125 (the value which would be coded as 0x7FFD), the value 0x7FFE SHOULD be reported to indicate an over-range positive measurement. If the measurement is unavailable, the value 0x7FFF SHOULD be reported.

unused: 16 bits

> These bits are unused. They SHOULD be set to zero by the sender and MUST be ignored by the receiver.

2.3. Guidance on use of PDV metrics

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This subsection provides informative guidance on when it might be appropriate to use each of the PDV metric types.
Interarrival jitter (Section 6.4.1 of [RFC3550] (Schulzrinne, H., “RTP: A Transport Protocol for Real-Time Applications,” July 2003.)) allows comparison of results with those from RTP end systems which support only RTCP as defined in [RFC3550] (Schulzrinne, H., “RTP: A Transport Protocol for Real-Time Applications,” July 2003.).
MAPDV2 (Clause 6.2.3.2 of [G.1020] (ITU-T, “ITU-T Rec. G.1020, Performance parameter definitions for quality of speech and other voiceband applications utilizing IP networks,” July 2006.)) compares instantaneous (per-packet) delay variation against a moving average delay variation. This metric could be useful in determining residual impairment when an RTP end system uses an adaptive de-jitter buffer which tracks the average delay variation, provided the MAPDV2 algorithm and the adaptive de-jitter buffer have similar averaging behaviour.
2-point PDV (Clause 6.2.4 of [Y.1540] (ITU-T, “ITU-T Rec. Y.1540, IP packet transfer and availability performance parameters,” November 2007.)) reports absolute packet delay variation with respect to the time of arrival of the first packet of the connection. In an RTP context, the two "points" are at the sender (the synchronization source which applies RTP timestamps) and at the receiver. The value of this metric for the packet with index j is identical to the quantity D(i,j) defined in Section 6.4.1 of [RFC3550] (Schulzrinne, H., “RTP: A Transport Protocol for Real-Time Applications,” July 2003.) if the packet index i is set equal to 1, that is, the reference packet for the metric is the first packet of the connection. The metric includes the effect of the frequency offsets of clocks in both the sender and receiver end systems, so it is useful mainly in network where synchronisation is distributed. As well as measuring packet delay variation in such networks, it may be used to ensure that synchronisation is effective, for example where the network carries ISDN data traffic over RTP [RFC4040] (Kreuter, R., “RTP Payload Format

for a 64 kbit/s Transparent Call," April 2005.). The metric is likely to be useful in networks which use fixed de-jitter buffering, because it may be used to determine the length of the required de-jitter buffer, or to determine if network performance has deteriorated such that existing de-jitter buffers are too small to accommodate the observed delay variation.

2.4. Examples of use

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(a) To report interarrival jitter [RFC3550] (Schulzrinne, H., "RTP: A Transport Protocol for Real-Time Applications," July 2003.):
Threshold PDV = FFFF (Undefined); PDV Percentile = FFFF (Undefined); PDV type = 0 (interarrival jitter)
causes interarrival jitter to be reported in the Mean PDV field.
(b) To report MAPDV2 [G.1020] (ITU-T, "ITU-T Rec. G.1020, Performance parameter definitions for quality of speech and other voiceband applications utilizing IP networks," July 2006.):
Pos Threshold PDV = 50.0; Pos PDV Percentile = 95.3; Neg Threshold PDV = 50.0 (note this implies -50ms); Neg PDV Percentile = 98.4; PDV type = 1 (MAPDV2)
causes average MAPDV2 to be reported in the Mean PDV field.
Note that implementations may either fix the reported percentile and calculate the associated PDV level OR may fix a threshold PDV level and calculate the associated percentile. From a practical implementation perspective it is simpler to use the second of these approaches (except of course in the extreme case of a 100% percentile).
2-point PDV, according to [Y.1540] (ITU-T, "ITU-T Rec. Y.1540, IP packet transfer and availability performance parameters," November 2007.) is the difference in delay between the current packet and the first packet of the stream. If the sending and receiving clocks are not synchronized, this metric includes the effect of relative timing drift.

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3. SDP Signaling

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[RFC3611] (Friedman, T., "RTP Control Protocol Extended Reports (RTCP XR)," November 2003.) defines the use of SDP (Session Description Protocol) [RFC4566] (Handley, M., "SDP: Session Description Protocol," July 2006.) for signaling the use of XR blocks. XR blocks MAY be used without prior signaling.
This section augments the SDP [RFC4566] (Handley, M., "SDP: Session Description Protocol," July 2006.) attribute "rtcp-xr" defined in [RFC3611] (Friedman, T., "RTP Control Protocol Extended Reports (RTCP XR)," November 2003.) by providing an additional value of "xr-format" to signal the use of the report block defined in this document.
rtcp-xr-attrib = "a=" "rtcp-xr" ":" [xr-format *(SP xr-format)] CRLF
(defined in [RFC3611] (Friedman, T., "RTP Control Protocol Extended Reports (RTCP XR)," November 2003.))
xr-format =/ xr-pdv-block

xr-pdv-block = "pkt-dly-var" ["," pdvtype] ["," nspec "," pspec]

```
pdvtype     = "pdv="    0      ; interarrival jitter  RFC 3550
                      / 1      ; MAPDV2 ITU-T G.1020
                      / 2      ; 2-point PDV ITU-T Y.1540
nspec       = "nthr=" fixpoint     ; negative threshold PDV (ms)
            / "npc=" fixpoint    ; negative PDV percentile
pspec       = "pthr=" fixpoint     ; positive threshold PDV (ms)
            / "ppc=" fixpoint    ; positive PDV percentile


fixpoint       = 1*DIGIT "." 1*DIGIT  ; fixed point decimal
DIGIT          = %x30-39
```

When SDP is used in offer-answer, a system sending SDP may request a specific type of PDV measurement. In addition, they may state a specific percentile or threshold value, and expect to receive the corresponding threshold or percentile metric, respectively. The system receiving the SDP SHOULD send the PDV metrics requested, but if the metric is not available, the system receiving the SDP SHOULD send the flag value indicating that the metric is unavailable.

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4. IANA Considerations

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New block types for RTCP XR are subject to IANA registration. For general guidelines on IANA considerations for RTCP XR, refer to [RFC3611].

4.1. New RTCP XR Block Type value

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This document assigns the block type value NPDV in the IANA "RTCP XR Block Type Registry" to the "Packet Delay Variation Metrics Block". [Note to RFC Editor: please replace NPDV with the IANA provided RTCP XR block type for this block.]

4.2. New RTCP XR SDP Parameter

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This document also registers a new parameter "pkt-dly-var" in the "RTCP XR SDP Parameters Registry".

4.3. Contact information for registrations

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The contact information for the registrations is:
Geoff Hunt (geoff.hunt@bt.com)
Orion 2 PP3, Adastral Park, Martlesham Heath, Ipswich IP5 3RE, United Kingdom

4.4. New registry of PDV types

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This document creates a new registry to be called "RTCP XR PDV block - PDV type" as a sub-registry of the "RTP Control Protocol Extended Reports (RTCP XR) Block Type Registry". Policies for this new registry are as follows:

*The information required to support an 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 three 16-bit fields "Pos Threshold/Peak PDV", "Neg Threshold/Peak PDV" and "Mean PDV" within the report block, and how the metric uses the two 16-bit fields "Pos PDV Percentile" and "Neg PDV Percentile".

*The review process for the registry is "Specification Required" as described in Section 4.1 of [RFC5226] (Narten, T., “Guidelines for Writing an IANA Considerations Section in RFCs,” May 2008.).

*Entries in the registry are integers. The valid range is 0 to 15 corresponding to the 4-bit field "pdvtyp" in the block. Values are to be recorded in decimal.

*Initial assignments are as follows:

0: interarrival jitter, Section 6.4.1 of [RFC3550],
1: MAPDV2, Clause 6.2.3.2 of [G.1020],
2: 2-point PDV, Clause 6.2.4 of [Y.1540]

5. Security Considerations

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It is believed that this proposed RTCP XR report block introduces no new security considerations beyond those described in [RFC3611] (Friedman, T., “RTP Control Protocol Extended Reports (RTCP XR),” November 2003.). This block does not provide per-packet statistics so the risk to confidentiality documented in Section 7, paragraph 3 of [RFC3611] (Friedman, T., “RTP Control Protocol Extended Reports (RTCP XR),” November 2003.) does not apply.

6. Changes from previous version

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Changed BNF for SDP following Christian Groves' and Tom Taylor's comments (4th and 5th May 2009), now aligned with RFC 5234 section 3.3 "Incremental Alternatives".
Updated references.

7. References

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7.1. Normative References

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[G.1020]	ITU-T, “ITU-T Rec. G.1020, Performance parameter definitions for quality of speech and other voiceband applications utilizing IP networks,” July 2006.
[MEASIDENT]	Hunt, G., “RTCP XR Measurement Identifier Block,” ID draft-ietf-avt-rtcp-xr-meas-identity-02, May 2009.
[RFC2119]	Bradner, S., “Key words for use in RFCs to Indicate Requirement Levels,” RFC 2119, BCP 14, March 1997.
[RFC3550]	Schulzrinne, H., “RTP: A Transport Protocol for Real-Time Applications,” RFC 3550, July 2003.
[RFC3611]	Friedman, T., “RTP Control Protocol Extended Reports (RTCP XR),” RFC 3611, November 2003.
[RFC4040]	Kreuter, R., “RTP Payload Format for a 64 kbit/s Transparent Call,” RFC 4040, April 2005.
[RFC4566]	Handley, M., “SDP: Session Description Protocol,” RFC 4566, July 2006.
[RFC5226]	Narten, T., “Guidelines for Writing an IANA Considerations Section in RFCs,” RFC 5226, BCP 26, May 2008.
[Y.1540]	ITU-T, “ITU-T Rec. Y.1540, IP packet transfer and availability performance parameters,” November 2007.

7.2. Informative References

TOC

[MONARCH]	Hunt, G., “Monitoring Architectures for RTP,” ID draft-hunt-avt-monarch-01, August 2008.
[PMOLFRAME]	Clark, A., “Framework for Performance Metric Development,” ID draft-ietf-pmol-metrics-framework-02, March 2009.

Authors' Addresses

TOC

	Geoff Hunt
	BT
	Orion 2 PP3
	Adastral Park
	Martlesham Heath
	Ipswich, Suffolk IP5 3RE
	United Kingdom
Phone:	+44 1473 651704
Email:	geoff.hunt@bt.com
	Alan Clark
	Telchemy Incorporated
	2905 Premiere Parkway, Suite 280

	Duluth, GA 30097
	USA
Email:	alan.d.clark@telchemy.com