Network Working Group   A. Morton
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                                                       P. Eardley
                                                               BT
                                                      K. D'Souza
                                                        AT&T Labs
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Initial Performance Metric Registry Entries
draft-ietf-ippm-initial-registry-04

Abstract

   This memo defines the Initial Entries for the Performance Metrics
   Registry. This version includes:

   * Addition of Loss Ratio metric in various sections (multiple metrics
   per section).

   * All section 4, 5, 6, 7, and 8 parameters reference YANG types for
   alternate data formats.

   * implementation of standard naming format for parameters.

   * implementation of many IANA early-review comments.

   Still need: Add MBM metric entry.

Requirements 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].

Status of This Memo

Internet-Drafts are draft documents valid for a maximum of six months
and may be updated, replaced, or obsoleted by other documents at any
time. It is inappropriate to use Internet-Drafts as reference
material or to cite them other than as "work in progress."

This Internet-Draft will expire on January 1, 2018.

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Table of Contents

1. Introduction

   Note: Efforts to synchronize structure and terminology with
   [I-D.ietf-ippm-metric-registry] will likely be incomplete until both
   drafts are stable.

   This memo proposes an initial set of entries for the Performance
   Metric Registry. It uses terms and definitions from the IPPM
   literature, primarily [RFC2330]. Proponents of Passive Performance
   Metrics are encouraged to develop a similar document.

Although there are several standard templates for organizing
specifications of performance metrics (see [RFC2679] for an example
of the traditional IPPM template, based to large extent on the
Benchmarking Methodology Working Group's traditional template in
[RFC1242], and see [RFC6390] for a similar template), none of these
templates were intended to become the basis for the columns of an
IETF-wide registry of metrics. While examinating aspects of metric
specifications which need to be registered, it became clear that none
of the existing metric templates fully satisfies the particular needs
of a registry.

Therefore, [I-D.ietf-ippm-metric-registry] defines the overall format
for a Performance Metric Registry. Section 5 of
[I-D.ietf-ippm-metric-registry] also gives guidelines for those
requesting registration of a Metric, that is the creation of entry(s)
in the Performance Metric Registry: "In essence, there needs to be
evidence that a candidate Registered Performance Metric has
significant industry interest, or has seen deployment, and there is
agreement that the candidate Registered Performance Metric serves its
intended purpose." The process in [I-D.ietf-ippm-metric-registry]
also requires that new entries are administered by IANA through
Expert Review, which will ensure that the metrics are tightly
defined.

2. Scope

This document defines the initial set of Performance Metrics Registry
entries, for which IETF approval (following development in the IP
Performance Metrics (IPPM) Working Group) will satisfy the
requirement for Expert Review. Note that all are Active Performance
Metrics, which are based on RFCs prepared in the IPPM working group
of the IETF, according to their framework [RFC2330] and its updates.

3. Registry Categories and Columns

This section provides the categories and columns of the registry, for
easy reference. An entry (row) therefore gives a complete
description of a Registered Metric.

 Registry Categories and Columns, shown as

```
                                        Category
                                        ------------------
                                        Column |  Column |

Summary
---------------------------------------------------------------------------
Identifier | Name | URIs | Desc. | Reference | Change Controller | Ver |

Metric Definition
---------------------------------------------
Reference Definition | Fixed Parameters |

Method of Measurement
---------------------------------------------------------------------
Reference | Packet     | Traffic | Sampling     | Run-time   | Role |
Method    | Stream     | Filter  | Distribution | Parameters |      |
          | Generation |
Output
---------------------------------------------
Type | Reference  | Units | Calibration |
     | Definition |       |             |

Administrative Information
-----------------------------------
Status |Request | Rev | Rev.Date |

Comments and Remarks
--------------------
```


4. UDP Round-trip Latency and Loss Registry Entries

   This section specifies an initial registry entry for the UDP Round-
   trip Latency, and another entry for UDP Round-trip Loss Ratio.

   Note: Each Registry entry only produces a "raw" output or a
   statistical summary. To describe both "raw" and one or more
   statistics efficiently, the Identifier, Name, and Output Categories
   can be split and a single section can specify two or more closely-
   related metrics. This section specifies two Registry entries with
   many common columns. See Section 7 for an example specifying
   multiple Registry entries with many common columns.

   All column entries beside the ID, Name, Description, and Output
   Reference Method categories are the same, thus this section proposes
   two closely-related registry entries. As a result, IANA is also
   asked to assign corresponding URNs and URLs to each Named Metric.

4.1. Summary

This category includes multiple indexes to the registry entry: the element ID and metric name.

4.1.1. ID (Identifier)

<insert a numeric identifier, an integer, TBD>

IANA is asked to assign different numeric identifiers to each of the two Named Metrics.

4.1.2. Name

<insert name according to metric naming convention>

RTDelay_Active_IP-UDP-Poisson_RFCXXXXsecY_Seconds_95Percentile

RTLoss_Active_IP-UDP-Poisson_RFCXXXXsecY_Percent_LossRatio

4.1.3. URIs

URN: Prefix urn:ietf:metrics:perf:<name>

URL: http://<TBD by IANA>/<name>

4.1.4. Description

RTDelay: This metric assesses the delay of a stream of packets exchanged between two hosts (which are the two measurement points), and the Output is the Round-trip delay for all successfully exchanged packets expressed as the 95th percentile of their conditional delay distribution.

RTLoss: This metric assesses the loss ratio of a stream of packets exchanged between two hosts (which are the two measurement points), and the Output is the Round-trip loss ratio for all successfully exchanged packets expressed as a percentage.

4.1.5. Change Controller

IETF

4.1.6. Version (of Registry Format)

1.0

4.2. Metric Definition

   This category includes columns to prompt the entry of all necessary
   details related to the metric definition, including the RFC reference
   and values of input factors, called fixed parameters.

4.2.1. Reference Definition

   <Full bibliographic reference to an immutable doc.>

   Almes, G., Kalidindi, S., and M. Zekauskas, "A Round-trip Delay
   Metric for IPPM", RFC 2681, September 1999.

   [RFC2681]

   <specific section reference and additional clarifications, if needed>

   Section 2.4 of [RFC2681] provides the reference definition of the
   singleton (single value) Round-trip delay metric. Section 3.4 of
   [RFC2681] provides the reference definition expanded to cover a
   multi-singleton sample. Note that terms such as singleton and sample
   are defined in Section 11 of [RFC2330].

   Note that although the [RFC2681] definition of "Round-trip-Delay
   between Src and Dst" is directionally ambiguous in the text, this
   metric tightens the definition further to recognize that the host in
   the "Src" role will send the first packet to "Dst", and ultimately
   receive the corresponding return packet from "Dst" (when neither are
   lost).

   Finally, note that the variable "dT" is used in [RFC2681] to refer to
   the value of Round-trip delay in metric definitions and methods. The
   variable "dT" has been re-used in other IPPM literature to refer to
   different quantities, and cannot be used as a global variable name.

   Morton, A., "Round-trip Packet Loss Metrics", RFC 6673, August 2012.

   [RFC6673]

   Both delay and loss metrics employ a maximum waiting time for
   received packets, so the count of lost packets to total packets sent
   is the basis for the loss ratio calculation as per Section 6.1 of
   [RFC6673].

4.2.2. Fixed Parameters

<list and specify Fixed Parameters, input factors that must be
determined and embedded in the measurement system for use when
needed>

Type-P as defined in Section 13 of [RFC2330]:

o IPv4 header values:

   * DSCP: set to 0

   * TTL: set to 255

   * Protocol: Set to 17 (UDP)

o IPv6 header values:

   * DSCP: set to 0

   * Hop Count: set to 255

   * Protocol: Set to 17 (UDP)

o UDP header values:

   * Checksum: the checksum MUST be calculated and included in the
      header

o UDP Payload

   * total of 9 bytes

Other measurement parameters:

o Tmax: a loss threshold waiting time

   * 3.0, expressed in units of seconds, as a positive value of type
      decimal64 with fraction digits = 4 (see section 9.3 of
      [RFC6020]) and with resolution of 0.0001 seconds (0.1 ms), with
      lossless conversion to/from the 32-bit NTP timestamp as per
      section 6 of [RFC5905].

4.3. Method of Measurement

This category includes columns for references to relevant sections of
the RFC(s) and any supplemental information needed to ensure an
unambiguous methods for implementations.

4.3.1. Reference Method

<for metric, insert relevant section references and supplemental
info>

The methodology for this metric is defined as Type-P-Round-trip-
Delay-Poisson-Stream in section 2.6 of RFC 2681 [RFC2681] and section
3.6 of RFC 2681 [RFC2681] using the Type-P and Tmax defined under
Fixed Parameters.

The reference method distinguishes between long-delayed packets and
lost packets by implementing a maximum waiting time for packet
arrival. Tmax is the waiting time used as the threshold to declare a
packet lost. Lost packets SHALL be designated as having undefined
delay, and counted for the RTLoss metric.

The calculations on the delay (RTT) SHALL be performed on the
conditional distribution, conditioned on successful packet arrival
within Tmax. Also, when all packet delays are stored, the process
which calculates the RTT value MAY enforce the Tmax threshold on
stored values before calculations. See section 4.1 of [RFC3393] for
details on the conditional distribution to exclude undefined values
of delay, and Section 5 of [RFC6703] for background on this analysis
choice.

The reference method requires some way to distinguish between
different packets in a stream to establish correspondence between
sending times and receiving times for each successfully-arriving
packet. Sequence numbers or other send-order identification MUST be
retained at the Src or included with each packet to dis-ambiguate
packet reordering if it occurs.

If a standard measurement protocol is employed, then the measurement
process will determine the sequence numbers or timestamps applied to
test packets after the Fixed and Runtime parameters are passed to
that process. The chosen measurement protocol will dictate the
format of sequence numbers and time-stamps, if they are conveyed in
the packet payload.

Refer to Section 4.4 of [RFC6673] for expanded discussion of the
instruction to "send a Type-P packet back to the Src as quickly as
possible" in Section 2.6 of RFC 2681 [RFC2681]. Section 8 of
[RFC6673] presents additional requirements which MUST be included in
the method of measurement for this metric.

4.3.2. Packet Stream Generation

This section gives the details of the packet traffic which is the
basis for measurement. In IPPM metrics, this is called the Stream,
and can easily be described by providing the list of stream
parameters.

<section/specification references, and description of any new
generation parameters, if needed>

Section 11.1.3 of [RFC2330] provides three methods to generate
Poisson sampling intervals. the reciprocal of lambda is the average
packet spacing, thus the Run-time Parameter is Reciprocal_lambda = 1/
lambda, in seconds.

Method 3 SHALL be used, where given a start time (Run-time
Parameter), the subsequent send times are all computed prior to
measurement by computing the pseudo-random distribution of inter-
packet send times, (truncating the distribution as specified in the
Run-time Parameter, Trunc), and the Src sends each packet at the
computed times.

Note that Trunc is the upper limit on inter-packet times in the
Poisson distribution. A random value greater than Trunc is set equal
to Trunc instead.

4.3.3. Traffic Filtering (observation) Details

The measured results based on a filtered version of the packets
observed, and this section provides the filter details (when
present).

<section reference>.

NA

4.3.4. Sampling Distribution

<insert time distribution details, or how this is diff from the
filter>

NA

4.3.5. Run-time Parameters and Data Format

Run-time Parameters are input factors that must be determined,
configured into the measurement system, and reported with the results
for the context to be complete.

   Src the IP address of the host in the Src Role (format ipv4-address-
      no-zone value for IPv4, or ipv6-address-no-zone value for IPv6,
      see Section 4 of [RFC6991])

   Dst the IP address of the host in the Dst Role (format ipv4-address-
      no-zone value for IPv4, or ipv6-address-no-zone value for IPv6,
      see section 4 of [RFC6991])

   T0 a time, the start of a measurement interval, (format "date-and-
      time" as specified in Section 5.6 of [RFC3339], see also Section 3
      of [RFC6991]). The UTC Time Zone is required by Section 6.1 of
      [RFC2330]. When T0 is "all-zeros", a start time is unspecified
      and Tf is to be interpreted as the Duration of the measurement
      interval. The start time is controlled through other means.

   Tf a time, the end of a measurement interval, (format "date-and-time"
      as specified in Section 5.6 of [RFC3339], see also Section 3 of
      [RFC6991]). The UTC Time Zone is required by Section 6.1 of
      [RFC2330]. When T0 is "all-zeros", a end time date is ignored and
      Tf is interpreted as the Duration of the measurement interval.

   Reciprocal_lambda average packet interval for Poisson Streams
      expressed in units of seconds, as a positive value of type
      decimal64 with fraction digits = 4 (see section 9.3 of [RFC6020])
      with resolution of 0.0001 seconds (0.1 ms), and with lossless
      conversion to/from the 32-bit NTP timestamp as per section 6 of
      [RFC5905].

   Trunc Upper limit on Poisson distribution expressed in units of
      seconds, as a positive value of type decimal64 with fraction
      digits = 4 (see section 9.3 of [RFC6020]) with resolution of
      0.0001 seconds (0.1 ms), and with lossless conversion to/from the
      32-bit NTP timestamp as per section 6 of [RFC5905] (values above
      this limit will be clipped and set to the limit value). (if fixed,
      Trunc = 30.0000 seconds.)

   >>> should Poisson run-time params be fixed instead? probably yes if
   modeling a specific version of MBA tests.

4.3.6. Roles

   <lists the names of the different roles from the measurement method>

   Src launches each packet and waits for return transmissions from
      Dst.

Dst waits for each packet from Src and sends a return packet to Src.

4.4. Output

This category specifies all details of the Output of measurements
using the metric.

4.4.1. Type

<insert name of the output type, raw or a selected summary statistic>

Percentile -- for the conditional distribution of all packets with a
valid value of Round-trip delay (undefined delays are excluded), a
single value corresponding to the 95th percentile, as follows:

See section 4.1 of [RFC3393] for details on the conditional
distribution to exclude undefined values of delay, and Section 5 of
[RFC6703] for background on this analysis choice.

The percentile = 95, meaning that the reported delay, "95Percentile",
is the smallest value of Round-trip delay for which the Empirical
Distribution Function (EDF), F(95Percentile) >= 95% of the singleton
Round-trip delay values in the conditional distribution. See section
11.3 of [RFC2330] for the definition of the percentile statistic
using the EDF.

LossRatio -- the count of lost packets to total packets sent is the
basis for the loss ratio calculation as per Section 6.1 of [RFC6673].

4.4.2. Reference Definition

<describe the reference data format for each type of result>

For all outputs ---

T0 the start of a measurement interval, (format "date-and-time" as
   specified in Section 5.6 of [RFC3339], see also Section 3 of
   [RFC6991]). The UTC Time Zone is required by Section 6.1 of
   [RFC2330].

Tf the end of a measurement interval, (format "date-and-time" as
   specified in Section 5.6 of [RFC3339], see also Section 3 of
   [RFC6991]). The UTC Time Zone is required by Section 6.1 of
   [RFC2330].

TotalPkts the count of packets sent by the Src to Dst during the
   measurement interval.

For

RTDelay_Active_IP-UDP-Poisson_RFCXXXXsecY_Seconds_95Percentile:

95Percentile The time value of the result is expressed in units of
   seconds, as a positive value of type decimal64 with fraction
   digits = 9 (see section 9.3 of [RFC6020]) with resolution of
   0.000000001 seconds (1.0 ns), and with lossless conversion to/from
   the 64-bit NTP timestamp as

For

RTLoss_Active_IP-UDP-Poisson_RFCXXXXsecY_Percent_LossRatio:

Percentile The numeric value of the result is expressed in units of
   lost packets to total packets times 100%, as a positive value of
   type decimal64 with fraction digits = 9 (see section 9.3 of
   [RFC6020]) with resolution of 0.0000000001.

4.4.3. Metric Units

<insert units for the measured results, and the reference
specification>.

The 95th Percentile of Round-trip Delay is expressed in seconds.

The Round-trip Loss Ratio is expressed as a percentage of lost
packets to total packets sent.

4.4.4. Calibration

Section 3.7.3 of [RFC7679] provides a means to quantify the
systematic and random errors of a time measurement. In-situ
calibration could be enabled with an internal loopback at the Source
host that includes as much of the measurement system as possible,
performs address manipulation as needed, and provides some form of
isolation (e.g., deterministic delay) to avoid send-receive interface
contention. Some portion of the random and systematic error can be
characterized this way.

When a measurement controller requests a calibration measurement, the
loopback is applied and the result is output in the same format as a
normal measurement with additional indication that it is a
calibration result.

Both internal loopback calibration and clock synchronization can be
used to estimate the *available accuracy* of the Output Metric Units.
For example, repeated loopback delay measurements will reveal the

portion of the Output result resolution which is the result of system
noise, and thus inaccurate.

4.5. Administrative items

4.5.1. Status

<current or deprecated>

4.5.2. Requestor (keep?)

name or RFC, etc.

4.5.3. Revision

1.0

4.5.4. Revision Date

YYYY-MM-DD

4.6. Comments and Remarks

Additional (Informational) details for this entry

5. Packet Delay Variation Registry Entry

This section gives an initial registry entry for a Packet Delay
Variation metric.

Note: If each Registry entry should only produce a "raw" output or a
statistical summary, then the "Output" Category can be split and this
section can become two closely-related metrics.

5.1. Summary

This category includes multiple indexes to the registry entries, the
element ID and metric name.

<skipping some Summary columns for now>

5.1.1. ID (Identifier)

<insert numeric identifier, an integer>

[5.1.2](#). **Name**

   <insert name according to metric naming convention>

   OWPDV_Active_IP-UDP-Poisson_RFCXXXXsecY_Seconds_95Percentile

[5.1.3](#). **URIs**

   URI: Prefix urn:ietf:metrics:perf:<name>

   URL: http://<TBD by IANA>/<name>

[5.1.4](#). **Description**

   An assessment of packet delay variation with respect to the minimum
   delay observed on the stream, and the Output is expressed as the 95th
   percentile of the packet delay variation distribution.

[5.1.5](#). **Change Controller**

   <org or person >

   IETF

[5.1.6](#). **Version (of Registry Format)**

   1.0

[5.2](#). **Metric Definition**

   This category includes columns to prompt the entry of all necessary
   details related to the metric definition, including the RFC reference
   and values of input factors, called fixed parameters.

[5.2.1](#). **Reference Definition**

   <Full bibliographic reference to an immutable doc.>

   Paxson, V., Almes, G., Mahdavi, J., and M. Mathis, "Framework for IP
   Performance Metrics", [RFC 2330](#), May 1998. [[RFC2330](#)]

   Demichelis, C. and P. Chimento, "IP Packet Delay Variation Metric
   for IP Performance Metrics (IPPM)", [RFC 3393](#), November 2002.
   [[RFC3393](#)]

   Morton, A. and B. Claise, "Packet Delay Variation Applicability
   Statement", [RFC 5481](#), March 2009. [[RFC5481](#)]

Mills, D., Martin, J., Burbank, J., and W. Kasch, "Network Time
Protocol Version 4: Protocol and Algorithms Specification", RFC 5905,
June 2010.[RFC5905]

<specific section reference and additional clarifications, if needed>

See sections 2.4 and 3.4 of [RFC3393]. Singleton delay differences
measured are referred to by the variable name "ddT" (applicable to
all forms of delay variation). However, this metric entry specifies
the PDV form defined in section 4.2 of [RFC5481], where the singleton
PDV for packet i is referred to by the variable name "PDV(i)".

5.2.2. Fixed Parameters

<list and specify Fixed Parameters, input factors that must be
determined and embedded in the measurement system for use when
needed>

o   IPv4 header values:

    *   DSCP: set to 0

    *   TTL: set to 255

    *   Protocol: Set to 17 (UDP)

o   IPv6 header values:

    *   DSCP: set to 0

    *   Hop Count: set to 255

    *   Protocol: Set to 17 (UDP)

o   UDP header values:

    *   Checksum: the checksum MUST be calculated and included in the
        header

o   UDP Payload

    *   total of 200 bytes

Other measurement parameters:

Tmax: a loss threshold waiting time with value 3.0, expressed in
    units of seconds, as a positive value of type decimal64 with
    fraction digits = 4 (see section 9.3 of [RFC6020]) and with

resolution of 0.0001 seconds (0.1 ms), with lossless conversion
to/from the 32-bit NTP timestamp as per section 6 of [RFC5905].

F a selection function unambiguously defining the packets from the
stream selected for the metric. See section 4.2 of [RFC5481] for
the PDV form.

See the Packet Stream generation category for two additional Fixed
Parameters.

5.3. Method of Measurement

This category includes columns for references to relevant sections of
the RFC(s) and any supplemental information needed to ensure an
unambiguous methods for implementations.

5.3.1. Reference Method

<for metric, insert relevant section references and supplemental
info>

See section 2.6 and 3.6 of [RFC3393] for general singleton element
calculations. This metric entry requires implementation of the PDV
form defined in section 4.2 of [RFC5481]. Also see measurement
considerations in section 8 of [RFC5481].

The reference method distinguishes between long-delayed packets and
lost packets by implementing a maximum waiting time for packet
arrival. Tmax is the waiting time used as the threshold to declare a
packet lost. Lost packets SHALL be designated as having undefined
delay.

The calculations on the one-way delay SHALL be performed on the
conditional distribution, conditioned on successful packet arrival
within Tmax. Also, when all packet delays are stored, the process
which calculates the one-way delay value MAY enforce the Tmax
threshold on stored values before calculations. See section 4.1 of
[RFC3393] for details on the conditional distribution to exclude
undefined values of delay, and Section 5 of [RFC6703] for background
on this analysis choice.

The reference method requires some way to distinguish between
different packets in a stream to establish correspondence between
sending times and receiving times for each successfully-arriving
packet. Sequence numbers or other send-order identification MUST be
retained at the Src or included with each packet to dis-ambiguate
packet reordering if it occurs.

If a standard measurement protocol is employed, then the measurement
process will determine the sequence numbers or timestamps applied to
test packets after the Fixed and Runtime parameters are passed to
that process. The chosen measurement protocol will dictate the
format of sequence numbers and time-stamps, if they are conveyed in
the packet payload.

5.3.2. Packet Stream Generation

<list of generation parameters and section/spec references if needed>

Section 11.1.3 of [RFC2330] provides three methods to generate
Poisson sampling intervals. the reciprocal of lambda is the average
packet spacing, thus the Run-time Parameter is Reciprocal_lambda = 1/
lambda, in seconds.

Method 3 SHALL be used, where given a start time (Run-time
Parameter), the subsequent send times are all computed prior to
measurement by computing the pseudo-random distribution of inter-
packet send times, (truncating the distribution as specified in the
Parameter Trunc), and the Src sends each packet at the computed
times.

Note that Trunc is the upper limit on inter-packet times in the
Poisson distribution. A random value greater than Trunc is set equal
to Trunc instead.

Reciprocal_lambda average packet interval for Poisson Streams
   expressed in units of seconds, as a positive value of type
   decimal64 with fraction digits = 4 (see section 9.3 of [RFC6020])
   with resolution of 0.0001 seconds (0.1 ms), and with lossless
   conversion to/from the 32-bit NTP timestamp as per section 6 of
   [RFC5905]. Reciprocal_lambda = 1 packet per second.

Trunc Upper limit on Poisson distribution expressed in units of
   seconds, as a positive value of type decimal64 with fraction
   digits = 4 (see section 9.3 of [RFC6020]) with resolution of
   0.0001 seconds (0.1 ms), and with lossless conversion to/from the
   32-bit NTP timestamp as per section 6 of [RFC5905] (values above
   this limit will be clipped and set to the limit value). Trunc =
   30.0000 seconds.

5.3.3. Traffic Filtering (observation) Details

<insert the measured results based on a filtered version of the
packets observed, and this section provides the filter details (when
present), and section reference>.

NA

5.3.4. Sampling Distribution

<insert time distribution details, or how this is diff from the
filter>

NA

5.3.5. Run-time Parameters and Data Format

<list of run-time parameters, and their data formats>

Src the IP address of the host in the Src Role (format ipv4-address-
     no-zone value for IPv4, or ipv6-address-no-zone value for IPv6,
     see Section 4 of [RFC6991])

Dst the IP address of the host in the Dst Role (format ipv4-address-
     no-zone value for IPv4, or ipv6-address-no-zone value for IPv6,
     see section 4 of [RFC6991])

T0 a time, the start of a measurement interval, (format "date-and-
     time" as specified in Section 5.6 of [RFC3339], see also Section 3
     of [RFC6991]). The UTC Time Zone is required by Section 6.1 of
     [RFC2330]. When T0 is "all-zeros", a start time is unspecified
     and Tf is to be interpreted as the Duration of the measurement
     interval. The start time is controlled through other means.

Tf a time, the end of a measurement interval, (format "date-and-time"
     as specified in Section 5.6 of [RFC3339], see also Section 3 of
     [RFC6991]). The UTC Time Zone is required by Section 6.1 of
     [RFC2330]. When T0 is "all-zeros", a end time date is ignored and
     Tf is interpreted as the Duration of the measurement interval.

5.3.6. Roles

<lists the names of the different roles from the measurement method>

Src launches each packet to Dst.

Dst waits for each packet from Src.

5.4. Output

This category specifies all details of the Output of measurements
using the metric.

5.4.1. Type

   <insert name of the output type, raw or a selected summary statistic>

   Percentile -- for the conditional distribution of all packets with a
   valid value of one-way delay (undefined delays are excluded), a
   single value corresponding to the 95th percentile, as follows:

   See section 4.1 of [RFC3393] for details on the conditional
   distribution to exclude undefined values of delay, and Section 5 of
   [RFC6703] for background on this analysis choice.

   The percentile = 95, meaning that the reported delay, "95Percentile",
   is the smallest value of one-way PDV for which the Empirical
   Distribution Function (EDF), F(95Percentile) >= 95% of the singleton
   one-way PDV values in the conditional distribution. See section 11.3
   of [RFC2330] for the definition of the percentile statistic using the
   EDF.

5.4.2. Reference Definition

   <the output type and data format for each type of result>

   T0 the start of a measurement interval, (format "date-and-time" as
      specified in Section 5.6 of [RFC3339], see also Section 3 of
      [RFC6991]). The UTC Time Zone is required by Section 6.1 of
      [RFC2330].

   Tf the end of a measurement interval, (format "date-and-time" as
      specified in Section 5.6 of [RFC3339], see also Section 3 of
      [RFC6991]). The UTC Time Zone is required by Section 6.1 of
      [RFC2330].

   95Percentile The time value of the result is expressed in units of
      seconds, as a positive value of type decimal64 with fraction
      digits = 9 (see section 9.3 of [RFC6020]) with resolution of
      0.000000001 seconds (1.0 ns), and with lossless conversion to/from
      the 64-bit NTP timestamp as per section 6 of RFC [RFC5905]

5.4.3. Metric Units

   <insert units for the measured results, and the reference
   specification>.

   The 95th Percentile of one-way PDV is expressed in seconds.

5.4.4. Calibration

Section 3.7.3 of [RFC7679] provides a means to quantify the
systematic and random errors of a time measurement. In-situ
calibration could be enabled with an internal loopback that includes
as much of the measurement system as possible, performs address
manipulation as needed, and provides some form of isolation (e.g.,
deterministic delay) to avoid send-receive interface contention.
Some portion of the random and systematic error can be characterized
this way.

For one-way delay measurements, the error calibration must include an
assessment of the internal clock synchronization with its external
reference (this internal clock is supplying timestamps for
measurement). In practice, the time offsets of clocks at both the
source and destination are needed to estimate the systematic error
due to imperfect clock synchronization (the time offsets are
smoothed, thus the random variation is not usually represented in the
results).

time_offset The time value of the result is expressed in units of
   seconds, as a signed value of type decimal64 with fraction digits
   = 9 (see section 9.3 of [RFC6020]) with resolution of 0.000000001
   seconds (1.0 ns), and with lossless conversion to/from the 64-bit
   NTP timestamp as per section 6 of RFC [RFC5905]

When a measurement controller requests a calibration measurement, the
loopback is applied and the result is output in the same format as a
normal measurement with additional indication that it is a
calibration result. In any measurement, the measurement function
SHOULD report its current estimate of time offset as an indicator of
the degree of synchronization.

Both internal loopback calibration and clock synchronization can be
used to estimate the *available accuracy* of the Output Metric Units.
For example, repeated loopback delay measurements will reveal the
portion of the Output result resolution which is the result of system
noise, and thus inaccurate.

5.5. Administrative items

5.5.1. Status

5.5.2. Requestor (keep?)

<name of individual or RFC, etc.>

5.5.3. Revision

1.0

5.5.4. Revision Date

YYYY-MM-DD

5.6. Comments and Remarks

<Additional (Informational) details for this entry>

Lost packets represent a challenge for delay variation metrics. See
section 4.1 of [RFC3393] and the delay variation applicability
statement[RFC5481] for extensive analysis and comparison of PDV and
an alternate metric, IPDV.

6. DNS Response Latency and Loss Registry Entries

This section gives initial registry entries for DNS Response Latency
and Loss. RFC 2681 [RFC2681] defines a Round-trip delay metric. We
build on that metric by specifying several of the input parameters to
precisely define two metrics for measuring DNS latency and loss.

Note to IANA: Each Registry "Name" below specifies a single registry
entry, whose output format varies in accordance with the name.

All column entries beside the ID, Name, Description, and Output
Reference Method categories are the same, thus this section proposes
two closely-related registry entries. As a result, IANA is also
asked to assign corresponding URNs and URLs to each Named Metric.

6.1. Summary

This category includes multiple indexes to the registry entries, the
element ID and metric name.

<skipping some admin columns for now>

6.1.1. ID (Identifier)

<insert numeric identifier, an integer>

IANA is asked to assign different numeric identifiers to each of the two Named Metrics.

6.1.2. Name

<insert name according to metric naming convention>

RTDNS_Active_IP-UDP-Poisson_RFCXXXXsecY_Seconds_Raw

RLDNS_Active_IP-UDP-Poisson_RFCXXXXsecY_Logical_Raw

6.1.3. URI

URI: Prefix urn:ietf:metrics:perf:<name>

URL: http://<TBD by IANA>/<name>

6.1.4. Description

RTDNS: This metric assesses the response time, the interval from the query transmission to the response.

RLDNS: This metric indicates that the respnse was deemed lost. In other words, the response time exceeded the maximum waiting time.

6.1.5. Change Controller

IETF

6.1.6. Version (of Registry Format)

1.0

6.2. Metric Definition

This category includes columns to prompt the entry of all necessary details related to the metric definition, including the RFC reference and values of input factors, called fixed parameters.

6.2.1. Reference Definition

<Full bibliographic reference to an immutable doc.>

Mockapetris, P., "Domain names - implementation and specification", STD 13, RFC 1035, November 1987. (and updates)

[RFC1035]

Almes, G., Kalidindi, S., and M. Zekauskas, "A Round-trip Delay
Metric for IPPM", RFC 2681, September 1999.

[RFC2681]

<specific section reference and additional clarifications, if needed>

Section 2.4 of [RFC2681] provides the reference definition of the
singleton (single value) Round-trip delay metric. Section 3.4 of
[RFC2681] provides the reference definition expanded to cover a
multi-singleton sample. Note that terms such as singleton and sample
are defined in Section 11 of [RFC2330].

For DNS Response Latency, the entities in [RFC1035] must be mapped to
[RFC2681]. The Local Host with its User Program and Resolver take
the role of "Src", and the Foreign Name Server takes the role of
"Dst".

Note that although the [RFC2681] definition of "Round-trip-Delay
between Src and Dst at T" is directionally ambiguous in the text,
this metric tightens the definition further to recognize that the
host in the "Src" role will send the first packet to "Dst", and
ultimately receive the corresponding return packet from "Dst" (when
neither are lost).

Morton, A., "Round-trip Packet Loss Metrics", RFC 6673, August 2012.

[RFC6673]

Both response time and loss metrics employ a maximum waiting time for
received responses, so the count of lost packets to total packets
sent is the basis for the loss determination as per Section 4.3 of
[RFC6673].

6.2.2. Fixed Parameters

<list and specify Fixed Parameters, input factors that must be
determined and embedded in the measurement system for use when
needed>

Type-P as defined in Section 13 of [RFC2330]:

o   IPv4 header values:

   *   DSCP: set to 0

   *   TTL set to 255

   * Protocol: Set to 17 (UDP)

o IPv6 header values:

   * DSCP: set to 0

   * Hop Count: set to 255

   * Protocol: Set to 17 (UDP)

o UDP header values:

   * Source port: 53

   * Destination port: 53

   * Checksum: the checksum must be calculated and included in the
      header

o Payload: The payload contains a DNS message as defined in RFC 1035
   [RFC1035] with the following values:

   * The DNS header section contains:

      + Identification (see the Run-time column)

      + QR: set to 0 (Query)

      + OPCODE: set to 0 (standard query)

      + AA: not set

      + TC: not set

      + RD: set to one (recursion desired)

      + RA: not set

      + RCODE: not set

      + QDCOUNT: set to one (only one entry)

      + ANCOUNT: not set

      + NSCOUNT: not set

      + ARCOUNT: not set

* The Question section contains:

  + QNAME: the Fully Qualified Domain Name (FQDN) provided as
    input for the test, see the Run-time column

  + QTYPE: the query type provided as input for the test, see
    the Run-time column

  + QCLASS: set to 1 for IN

* The other sections do not contain any Resource Records.

Other measurement parameters:

o Tmax: a loss threshold waiting time (and to help disambiguate
  queries)

  * 5.0, expressed in units of seconds, as a positive value of type
    decimal64 with fraction digits = 4 (see section 9.3 of
    [RFC6020]) and with resolution of 0.0001 seconds (0.1 ms), with
    lossless conversion to/from the 32-bit NTP timestamp as per
    section 6 of [RFC5905].

Observation: reply packets will contain a DNS response and may
contain RRs.

6.3. Method of Measurement

This category includes columns for references to relevant sections of
the RFC(s) and any supplemental information needed to ensure an
unambiguous methods for implementations.

6.3.1. Reference Method

<for metric, insert relevant section references and supplemental
info>

The methodology for this metric is defined as Type-P-Round-trip-
Delay-Poisson-Stream in section 2.6 of RFC 2681 [RFC2681] and section
3.6 of RFC 2681 [RFC2681] using the Type-P and Timeout defined under
Fixed Parameters.

The reference method distinguishes between long-delayed packets and
lost packets by implementing a maximum waiting time for packet
arrival. Tmax is the waiting time used as the threshold to declare a
packet lost. Lost packets SHALL be designated as having undefined
delay, and counted for the RLDNS metric.

The calculations on the delay (RTT) SHALL be performed on the
conditional distribution, conditioned on successful packet arrival
within Tmax. Also, when all packet delays are stored, the process
which calculates the RTT value MAY enforce the Tmax threshold on
stored values before calculations. See section 4.1 of [RFC3393] for
details on the conditional distribution to exclude undefined values
of delay, and Section 5 of [RFC6703] for background on this analysis
choice.

The reference method requires some way to distinguish between
different packets in a stream to establish correspondence between
sending times and receiving times for each successfully-arriving
reply. Therefore, sequence numbers or other send-order
identification MUST be retained at the Src or included with each
packet to dis-ambiguate packet reordering if it occurs. Sequence
number is part of the payload described under Fixed Parameters.

DNS Messages bearing Queries provide for random ID Numbers in the
Identification header field, so more than one query may be launched
while a previous request is outstanding when the ID Number is used.

IF a DNS response does not arrive within Tmax, the response time is
undefined, and RTDNS = 1. The Message ID SHALL be used to
disambiguate the successive queries.

@@@@ This would require support of ID generation and population in
the Message. An alternative would be to use a random Source port on
the Query Message, but we would choose ONE before proceding.

Refer to Section 4.4 of [RFC6673] for expanded discussion of the
instruction to "send a Type-P packet back to the Src as quickly as
possible" in Section 2.6 of RFC 2681 [RFC2681]. Section 8 of
[RFC6673] presents additional requirements which shall be included in
the method of measurement for this metric.

In addition to operations described in [RFC2681], the Src MUST parse
the DNS headers of the reply and prepare the information for
subsequent reporting as a measured result, along with the Round-Trip
Delay.

6.3.2. Packet Stream Generation

This section gives the details of the packet traffic which is the
basis for measurement. In IPPM metrics, this is called the Stream,
and can easily be dscribed by providing the list of stream
parameters.

Section 11.1.3 of RFC 2681 [RFC2330] provides three methods to
generate Poisson sampling intervals. The reciprocal of lambda is the
average packet rate, thus the Run-time Parameter is Reciprocal_lambda
= 1/lambda, in seconds.

Method 3 is used, where given a start time (Run-time Parameter), the
subsequent send times are all computed prior to measurement by
computing the pseudo-random distribution of inter-packet send times,
(truncating the distribution as specified in the Run-time
Parameters), and the Src sends each packet at the computed times.

Note that Trunc is the upper limit on inter-packet times in the
Poisson distribution. A random value greater than Trunc is set equal
to Trunc instead.

6.3.3. Traffic Filtering (observation) Details

The measured results based on a filtered version of the packets
observed, and this section provides the filter details (when
present).

<section reference>.

NA

6.3.4. Sampling Distribution

<insert time distribution details, or how this is diff from the
filter>

NA

6.3.5. Run-time Parameters and Data Format

Run-time Parameters are input factors that must be determined,
configured into the measurement system, and reported with the results
for the context to be complete.

<list of run-time parameters, and their data formats>

Src the IP address of the host in the Src Role (format ipv4-address-
   no-zone value for IPv4, or ipv6-address-no-zone value for IPv6,
   see Section 4 of [RFC6991])

Dst the IP address of the host in the Dst Role (format ipv4-address-
   no-zone value for IPv4, or ipv6-address-no-zone value for IPv6,
   see section 4 of [RFC6991])

   T0 a time, the start of a measurement interval, (format "date-and-
      time" as specified in Section 5.6 of [RFC3339], see also Section 3
      of [RFC6991]). The UTC Time Zone is required by Section 6.1 of
      [RFC2330]. When T0 is "all-zeros", a start time is unspecified
      and Tf is to be interpreted as the Duration of the measurement
      interval. The start time is controlled through other means.

   Tf a time, the end of a measurement interval, (format "date-and-time"
      as specified in Section 5.6 of [RFC3339], see also Section 3 of
      [RFC6991]). The UTC Time Zone is required by Section 6.1 of
      [RFC2330]. When T0 is "all-zeros", a end time date is ignored and
      Tf is interpreted as the Duration of the measurement interval.

   Reciprocal_lambda average packet interval for Poisson Streams
      expressed in units of seconds, as a positive value of type
      decimal64 with fraction digits = 4 (see section 9.3 of [RFC6020])
      with resolution of 0.0001 seconds (0.1 ms), and with lossless
      conversion to/from the 32-bit NTP timestamp as per section 6 of
      [RFC5905].

   Trunc Upper limit on Poisson distribution expressed in units of
      seconds, as a positive value of type decimal64 with fraction
      digits = 4 (see section 9.3 of [RFC6020]) with resolution of
      0.0001 seconds (0.1 ms), and with lossless conversion to/from the
      32-bit NTP timestamp as per section 6 of [RFC5905] (values above
      this limit will be clipped and set to the limit value). (if fixed,
      Trunc = 30.0000 seconds.)

   ID The 16-bit identifier assigned by the program that generates the
      query, and which must vary in successive queries, see
      Section 4.1.1 of [RFC1035]. This identifier is copied into the
      corresponding reply and can be used by the requester (Src) to
      match-up replies to outstanding queries.

   QNAME The domain name of the Query, formatted as specified in
      section 4 of [RFC6991].

   QTYPE The Query Type, which will correspond to the IP address family
      of the query (decimal 1 for IPv4 or 28 for IPv6, formatted as a
      uint16, as per section 9.2 of [RFC6020].

6.3.6. Roles

   <lists the names of the different roles from the measurement method>

   Src launches each packet and waits for return transmissions from
      Dst.

Dst waits for each packet from Src and sends a return packet to Src.

6.4. Output

This category specifies all details of the Output of measurements using the metric.

6.4.1. Type

<insert name of the output type, raw or a selected summary statistic>

Raw -- for each DNS Query packet sent, sets of values as defined in the next column, including the status of the response, only assigning delay values to successful query-response pairs.

6.4.2. Reference Definition

<describe the data format for each type of result>

For all outputs:

T the time the DNS Query was sent during the measurement interval, (format "date-and-time" as specified in Section 5.6 of [RFC3339], see also Section 3 of [RFC6991]). The UTC Time Zone is required by Section 6.1 of [RFC2330].

dT The time value of the round-trip delay to receive the DNS response, expressed in units of seconds, as a positive value of type decimal64 with fraction digits = 9 (see section 9.3 of [RFC6020]) with resolution of 0.000000001 seconds (1.0 ns), and with lossless conversion to/from the 64-bit NTP timestamp as per section 6 of RFC [RFC5905]. This value is undefined when the response packet is not received at Src within waiting time Tmxax seconds.

Rcode The value of the Rcode field in the DNS response header, expressed as a uint64 as specified in section 9.2 of [RFC6020]. Non-zero values convey errors in the response, and such replies must be analyzed separately from successful requests.

6.4.3. Metric Units

<insert units for the measured results, and the reference specification>.

RTDNS: Round-trip Delay, dT, is expressed in seconds.

RTLDNS: the Logical value, where 1 = Lost and 0 = Received.

6.4.4. Calibration

Section 3.7.3 of [RFC7679] provides a means to quantify the
systematic and random errors of a time measurement. In-situ
calibration could be enabled with an internal loopback at the Source
host that includes as much of the measurement system as possible,
performs address and payload manipulation as needed, and provides
some form of isolation (e.g., deterministic delay) to avoid send-
receive interface contention. Some portion of the random and
systematic error can be characterized this way.

When a measurement controller requests a calibration measurement, the
loopback is applied and the result is output in the same format as a
normal measurement with additional indication that it is a
calibration result.

Both internal loopback calibration and clock synchronization can be
used to estimate the *available accuracy* of the Output Metric Units.
For example, repeated loopback delay measurements will reveal the
portion of the Output result resolution which is the result of system
noise, and thus inaccurate.

6.5. Administrative items

6.5.1. Status

<current or depricated>

6.5.2. Requestor

name or RFC, etc.

6.5.3. Revision

1.0

6.5.4. Revision Date

YYYY-MM-DD

6.6. Comments and Remarks

Additional (Informational) details for this entry

7. UDP Poisson One-way Delay and Loss Registry Entries

   This section specifies five initial registry entries for the UDP
   Poisson One-way Delay, and one for UDP Poisson One-way Loss.

   IANA Note: Registry "Name" below specifies a single registry entry,
   whose output format varies according to the <statistic> element of
   the name that specifies one form of statistical summary. There is an
   additional metric name for the Loss metric.

   All column entries beside the ID, Name, Description, and Output
   Reference Method categories are the same, thus this section proposes
   six closely-related registry entries. As a result, IANA is also
   asked to assign corresponding URNs and URLs to each Named Metric.

7.1. Summary

   This category includes multiple indexes to the registry entries, the
   element ID and metric name.

7.1.1. ID (Identifier)

   <insert numeric identifier, an integer, one corresponding to each
   name below>

   IANA is asked to assign different numeric identifiers to each of the
   six Metrics.

7.1.2. Name

   <insert name according to metric naming convention>

   OWDelay_Active_IP-UDP-Poisson-
   Payload250B_RFCXXXXsecY_Seconds_<statistic>

   where <statistic> is one of:

   o 95Percentile

   o Mean

   o Min

   o Max

   o StdDev

OWLoss_Active_IP-UDP-Poisson-
Payload250B_RFCXXXXsecY_Percent_LossRatio

7.1.3. URI and URL

URI: Prefix urn:ietf:metrics:perf:<name>

URL: http:\\www.iana.org\ ... <name>

7.1.4. Description

OWDelay: This metric assesses the delay of a stream of packets
exchanged between two hosts (or measurement points), and reports the
<statistic> One-way delay for all successfully exchanged packets
based on their conditional delay distribution.

where <statistic> is one of:

o 95Percentile

o Mean

o Min

o Max

o StdDev

OWLoss: This metric assesses the loss ratio of a stream of packets
exchanged between two hosts (which are the two measurement points),
and the Output is the One-way loss ratio for all successfully
received packets expressed as a percentage.

7.2. Metric Definition

This category includes columns to prompt the entry of all necessary
details related to the metric definition, including the RFC reference
and values of input factors, called fixed parameters.

7.2.1. Reference Definition

<Full bibliographic reference to an immutable doc.>

For Delay:

Almes, G., Kalidindi, S., Zekauskas, M., and A. Morton, Ed., "A One-
Way Delay Metric for IP Performance Metrics (IPPM)", STD 81, RFC

7679, DOI 10.17487/RFC7679, January 2016, <http://www.rfc-editor.org/info/rfc7679>.

[RFC7679]

Morton, A., and Stephan, E., "Spatial Composition of Metrics", RFC 6049, January 2011.

[RFC6049]

<specific section reference and additional clarifications, if needed>

Section 3.4 of [RFC7679] provides the reference definition of the singleton (single value) One-way delay metric. Section 4.4 of [RFC7679] provides the reference definition expanded to cover a multi-value sample. Note that terms such as singleton and sample are defined in Section 11 of [RFC2330].

Only successful packet transfers with finite delay are included in the sample, as prescribed in section 4.1.2 of [RFC6049].

For loss:

Almes, G., Kalidini, S., Zekauskas, M., and A. Morton, Ed., "A One-Way Loss Metric for IP Performance Metrics (IPPM)", RFC 7680, DOI 10.17487/RFC7680, January 2016, <http://www.rfc-editor.org/info/rfc7680>.

Section 2.4 of [RFC7680] provides the reference definition of the singleton (single value) one-way loss metric. Section 3.4 of [RFC7680] provides the reference definition expanded to cover a multi-singleton sample. Note that terms such as singleton and sample are defined in Section 11 of [RFC2330].

7.2.2. Fixed Parameters

<list and specify Fixed Parameters, input factors that must be determined and embedded in the measurement system for use when needed>

Type-P:

o   IPv4 header values:

    *   DSCP: set to 0

    *   TTL: set to 255

       * Protocol: Set to 17 (UDP)

   o IPv6 header values:

       * DSCP: set to 0

       * Hop Count: set to 255

       * Protocol: Set to 17 (UDP)

   o UDP header values:

       * Checksum: the checksum MUST be calculated and included in the
          header

   o UDP Payload: TWAMP Test Packet Formats, Section 4.1.2 of [RFC5357]

       * Security features in use influence the number of Padding
          octets.

       * 250 octets total, including the TWAMP format

   Other measurement parameters:

   Tmax: a loss threshold waiting time with value 3.0, expressed in
      units of seconds, as a positive value of type decimal64 with
      fraction digits = 4 (see section 9.3 of [RFC6020]) and with
      resolution of 0.0001 seconds (0.1 ms), with lossless conversion
      to/from the 32-bit NTP timestamp as per section 6 of [RFC5905].

   See the Packet Stream generation category for two additional Fixed
   Parameters.

7.3. Method of Measurement

   This category includes columns for references to relevant sections of
   the RFC(s) and any supplemental information needed to ensure an
   unambiguous methods for implementations.

7.3.1. Reference Method

   <for metric, insert relevant section references and supplemental
   info>

   The methodology for this metric is defined as Type-P-One-way-Delay-
   Poisson-Stream in section 3.6 of [RFC7679] and section 4.6 of
   [RFC7679] using the Type-P and Tmax defined under Fixed Parameters.

The reference method distinguishes between long-delayed packets and
lost packets by implementing a maximum waiting time for packet
arrival. Tmax is the waiting time used as the threshold to declare a
packet lost. Lost packets SHALL be designated as having undefined
delay, and counted for the OWLoss metric.

The calculations on the one-way delay SHALL be performed on the
conditional distribution, conditioned on successful packet arrival
within Tmax. Also, when all packet delays are stored, the process
which calculates the one-way delay value MAY enforce the Tmax
threshold on stored values before calculations. See section 4.1 of
[RFC3393] for details on the conditional distribution to exclude
undefined values of delay, and Section 5 of [RFC6703] for background
on this analysis choice.

The reference method requires some way to distinguish between
different packets in a stream to establish correspondence between
sending times and receiving times for each successfully-arriving
packet. Sequence numbers or other send-order identification MUST be
retained at the Src or included with each packet to dis-ambiguate
packet reordering if it occurs.

Since a standard measurement protocol is employed [RFC5357], then the
measurement process will determine the sequence numbers or timestamps
applied to test packets after the Fixed and Runtime parameters are
passed to that process. The measurement protocol dictates the format
of sequence numbers and time-stamps conveyed in the TWAMP-Test packet
payload.

7.3.2. Packet Stream Generation

This section gives the details of the packet traffic which is the
basis for measurement. In IPPM metrics, this is called the Stream,
and can easily be dscribed by providing the list of stream
parameters.

<list of generation parameters and section/spec references if needed>

Section 11.1.3 of RFC 2681 [RFC2330] provides three methods to
generate Poisson sampling intervals. the reciprocal of lambda is the
average packet spacing, thus the Run-time Parameter is
Reciprocal_lambda = 1/lambda, in seconds.

Method 3 SHALL be used, where given a start time (Run-time
Parameter), the subsequent send times are all computed prior to
measurement by computing the pseudo-random distribution of inter-
packet send times, (truncating the distribution as specified in the

   Parameter Trunc), and the Src sends each packet at the computed
   times.

   Note that Trunc is the upper limit on inter-packet times in the
   Poisson distribution. A random value greater than Trunc is set equal
   to Trunc instead.

   Reciprocal_lambda average packet interval for Poisson Streams
      expressed in units of seconds, as a positive value of type
      decimal64 with fraction digits = 4 (see section 9.3 of [RFC6020])
      with resolution of 0.0001 seconds (0.1 ms), and with lossless
      conversion to/from the 32-bit NTP timestamp as per section 6 of
      [RFC5905]. Reciprocal_lambda = 1 packet per second.

   Trunc Upper limit on Poisson distribution expressed in units of
      seconds, as a positive value of type decimal64 with fraction
      digits = 4 (see section 9.3 of [RFC6020]) with resolution of
      0.0001 seconds (0.1 ms), and with lossless conversion to/from the
      32-bit NTP timestamp as per section 6 of [RFC5905] (values above
      this limit will be clipped and set to the limit value). Trunc =
      30.0000 seconds.

7.3.3. Traffic Filtering (observation) Details

   NA

7.3.4. Sampling Distribution

   NA

7.3.5. Run-time Parameters and Data Format

   Run-time Parameters are input factors that must be determined,
   configured into the measurement system, and reported with the results
   for the context to be complete.

   <list of run-time parameters, and their data formats>

   Src the IP address of the host in the Src Role (format ipv4-address-
      no-zone value for IPv4, or ipv6-address-no-zone value for IPv6,
      see Section 4 of [RFC6991])

   Dst the IP address of the host in the Dst Role (format ipv4-address-
      no-zone value for IPv4, or ipv6-address-no-zone value for IPv6,
      see section 4 of [RFC6991])

   T0 a time, the start of a measurement interval, (format "date-and-
      time" as specified in Section 5.6 of [RFC3339], see also Section 3

of [RFC6991]). The UTC Time Zone is required by Section 6.1 of
        [RFC2330]. When T0 is "all-zeros", a start time is unspecified
        and Tf is to be interpreted as the Duration of the measurement
        interval. The start time is controlled through other means.

   Tf a time, the end of a measurement interval, (format "date-and-time"
        as specified in Section 5.6 of [RFC3339], see also Section 3 of
        [RFC6991]). The UTC Time Zone is required by Section 6.1 of
        [RFC2330]. When T0 is "all-zeros", a end time date is ignored and
        Tf is interpreted as the Duration of the measurement interval.

7.3.6. Roles

   <lists the names of the different roles from the measurement method>

   Src launches each packet and waits for return transmissions from
        Dst. This is the TWAMP Session-Sender.

   Dst waits for each packet from Src and sends a return packet to Src.
        This is the TWAMP Session-Reflector.

7.4. Output

   This category specifies all details of the Output of measurements
   using the metric.

7.4.1. Type

   <insert name of the output type, raw or a selected summary statistic>

   See subsection titles below for Types.

7.4.2. Reference Definition

   <describe the data format for each type of result>

   For all output types ---

   T0 the start of a measurement interval, (format "date-and-time" as
        specified in Section 5.6 of [RFC3339], see also Section 3 of
        [RFC6991]). The UTC Time Zone is required by Section 6.1 of
        [RFC2330].

   Tf the end of a measurement interval, (format "date-and-time" as
        specified in Section 5.6 of [RFC3339], see also Section 3 of
        [RFC6991]). The UTC Time Zone is required by Section 6.1 of
        [RFC2330].

For LossRatio -- the count of lost packets to total packets sent is the basis for the loss ratio calculation as per Section 4.1 of [RFC7680].

For each <statistic>, one of the following sub-sections apply:

7.4.2.1. Percentile95

The 95th percentile SHALL be calculated using the conditional distribution of all packets with a finite value of One-way delay (undefined delays are excluded), a single value as follows:

See section 4.1 of [RFC3393] for details on the conditional distribution to exclude undefined values of delay, and Section 5 of [RFC6703] for background on this analysis choice.

See section 4.3 of [RFC3393] for details on the percentile statistic (where Round-trip delay should be substituted for "ipdv").

The percentile = 95, meaning that the reported delay, "95Percentile", is the smallest value of one-way delay for which the Empirical Distribution Function (EDF), F(95Percentile) >= 95% of the singleton one-way delay values in the conditional distribution. See section 11.3 of [RFC2330] for the definition of the percentile statistic using the EDF.

95Percentile The time value of the result is expressed in units of seconds, as a positive value of type decimal64 with fraction digits = 9 (see section 9.3 of [RFC6020]) with resolution of 0.000000001 seconds (1.0 ns), and with lossless conversion to/from the 64-bit NTP timestamp as per section 6 of RFC [RFC5905]

7.4.2.2. Mean

The mean SHALL be calculated using the conditional distribution of all packets with a finite value of One-way delay (undefined delays are excluded), a single value as follows:

See section 4.1 of [RFC3393] for details on the conditional distribution to exclude undefined values of delay, and Section 5 of [RFC6703] for background on this analysis choice.

See section 4.2.2 of [RFC6049] for details on calculating this statistic, and 4.2.3 of [RFC6049].

Mean The time value of the result is expressed in units of seconds, as a positive value of type decimal64 with fraction digits = 9 (see section 9.3 of [RFC6020]) with resolution of 0.000000001

seconds (1.0 ns), and with lossless conversion to/from the 64-bit
NTP timestamp as per section 6 of RFC [RFC5905]

7.4.2.3. Min

The minimum SHALL be calculated using the conditional distribution of
all packets with a finite value of One-way delay (undefined delays
are excluded), a single value as follows:

See section 4.1 of [RFC3393] for details on the conditional
distribution to exclude undefined values of delay, and Section 5 of
[RFC6703] for background on this analysis choice.

See section 4.3.2 of [RFC6049] for details on calculating this
statistic, and 4.3.3 of [RFC6049].

Min The time value of the result is expressed in units of seconds,
   as a positive value of type decimal64 with fraction digits = 9
   (see section 9.3 of [RFC6020]) with resolution of 0.000000001
   seconds (1.0 ns), and with lossless conversion to/from the 64-bit
   NTP timestamp as per section 6 of RFC [RFC5905]

7.4.2.4. Max

The maximum SHALL be calculated using the conditional distribution of
all packets with a finite value of One-way delay (undefined delays
are excluded), a single value as follows:

See section 4.1 of [RFC3393] for details on the conditional
distribution to exclude undefined values of delay, and Section 5 of
[RFC6703] for background on this analysis choice.

See section 4.3.2 of [RFC6049] for a closely related method for
calculating this statistic, and 4.3.3 of [RFC6049]. The formula is
as follows:

```
        Max = (FiniteDelay [j])

                such that for some index, j, where 1 <= j <= N
                FiniteDelay[j] >= FiniteDelay[n] for all n
```

Max The time value of the result is expressed in units of seconds,
   as a positive value of type decimal64 with fraction digits = 9
   (see section 9.3 of [RFC6020]) with resolution of 0.000000001
   seconds (1.0 ns), and with lossless conversion to/from the 64-bit
   NTP timestamp as per section 6 of RFC [RFC5905]

7.4.2.5. **Std_Dev**

   The Std_Dev SHALL be calculated using the conditional distribution of
   all packets with a finite value of One-way delay (undefined delays
   are excluded), a single value as follows:

   See section 4.1 of [RFC3393] for details on the conditional
   distribution to exclude undefined values of delay, and Section 5 of
   [RFC6703] for background on this analysis choice.

   See section 4.3.2 of [RFC6049] for a closely related method for
   calculating this statistic, and 4.3.3 of [RFC6049]. The formula is
   the classic calculation for standard deviation of a population.

   Std_Dev The time value of the result is expressed in units of
      seconds, as a positive value of type decimal64 with fraction
      digits = 9 (see section 9.3 of [RFC6020]) with resolution of
      0.000000001 seconds (1.0 ns), and with lossless conversion to/from
      the 64-bit NTP timestamp as per section 6 of RFC [RFC5905]

7.4.3. **Metric Units**

   <insert units for the measured results, and the reference
   specification>.

   The <statistic> of One-way Delay is expressed in seconds.

   The One-way Loss Ratio is expressed as a percentage of lost packets
   to total packets sent.

7.4.4. **Calibration**

   Section 3.7.3 of [RFC7679] provides a means to quantify the
   systematic and random errors of a time measurement. In-situ
   calibration could be enabled with an internal loopback that includes
   as much of the measurement system as possible, performs address
   manipulation as needed, and provides some form of isolation (e.g.,
   deterministic delay) to avoid send-receive interface contention.
   Some portion of the random and systematic error can be characterized
   this way.

   For one-way delay measurements, the error calibration must include an
   assessment of the internal clock synchronization with its external
   reference (this internal clock is supplying timestamps for
   measurement). In practice, the time offsets of clocks at both the
   source and destination are needed to estimate the systematic error
   due to imperfect clock synchronization (the time offsets are

smoothed, thus the random variation is not usually represented in the results).

time_offset   The time value of the result is expressed in units of seconds, as a signed value of type decimal64 with fraction digits = 9 (see section 9.3 of [RFC6020]) with resolution of 0.000000001 seconds (1.0 ns), and with lossless conversion to/from the 64-bit NTP timestamp as per section 6 of RFC [RFC5905]

When a measurement controller requests a calibration measurement, the loopback is applied and the result is output in the same format as a normal measurement with additional indication that it is a calibration result. In any measurement, the measurement function SHOULD report its current estimate of time offset as an indicator of the degree of synchronization.

Both internal loopback calibration and clock synchronization can be used to estimate the *available accuracy* of the Output Metric Units. For example, repeated loopback delay measurements will reveal the portion of the Output result resolution which is the result of system noise, and thus inaccurate.

7.5. Administrative items

7.5.1. Status

<current or depricated>

7.5.2. Requestor (keep?)

name or RFC, etc.

7.5.3. Revision

1.0

7.5.4. Revision Date

YYYY-MM-DD

7.6. Comments and Remarks

Additional (Informational) details for this entry

8. UDP Periodic One-way Delay and Loss Registry Entries

   This section specifies five initial registry entries for the UDP
   Periodic One-way Delay, and one for UDP Periodic One-way Loss.

   IANA Note: Registry "Name" below specifies a single registry entry,
   whose output format varies according to the <statistic> element of
   the name that specifies one form of statistical summary. There is an
   additional metric name for the Loss metric.

   All column entries beside the ID, Name, Description, and Output
   Reference Method categories are the same, thus this section proposes
   six closely-related registry entries. As a result, IANA is also
   asked to assign corresponding URNs and URLs to each Named Metric.

8.1. Summary

   This category includes multiple indexes to the registry entries, the
   element ID and metric name.

8.1.1. ID (Identifier)

   <insert numeric identifier, an integer, one corresponding to each
   name below>

   IANA is asked to assign a different numeric identifiers to each of
   the six Metrics.

8.1.2. Name

   <insert name according to metric naming convention>

   OWDelay_Active_IP-UDP-Periodic-
   Payload142B_RFCXXXXsecY_Seconds_<statistic>

   where <statistic> is one of:

   o 95Percentile

   o Mean

   o Min

   o Max

   o StdDev

    OWLoss_Active_IP-UDP-Periodic-
    Payload142B_RFCXXXXsecY_Percent_LossRatio

8.1.3. URIs

    URI: Prefix urn:ietf:metrics:perf:<name>

    URL: http:\\www.iana.org\ ... <name>

8.1.4. Description

    OWDelay: This metric assesses the delay of a stream of packets
    exchanged between two hosts (or measurement points), and reports the
    <statistic> One-way delay for all successfully exchanged packets
    based on their conditional delay distribution.

    where <statistic> is one of:

    o 95Percentile

    o Mean

    o Min

    o Max

    o StdDev

    OWLoss: This metric assesses the loss ratio of a stream of packets
    exchanged between two hosts (which are the two measurement points),
    and the Output is the One-way loss ratio for all successfully
    received packets expressed as a percentage.

8.2. Metric Definition

    This category includes columns to prompt the entry of all necessary
    details related to the metric definition, including the RFC reference
    and values of input factors, called fixed parameters.

8.2.1. Reference Definition

    <Full bibliographic reference to an immutable doc.>

    For Delay:

    Almes, G., Kalidindi, S., Zekauskas, M., and A. Morton, Ed., "A One-
    Way Delay Metric for IP Performance Metrics (IPPM)", STD 81, RFC

7679, DOI 10.17487/RFC7679, January 2016, <http://www.rfc-editor.org/info/rfc7679>.

[RFC7679]

Morton, A., and Stephan, E., "Spatial Composition of Metrics", RFC 6049, January 2011.

[RFC6049]

<specific section reference and additional clarifications, if needed>

Section 3.4 of [RFC7679] provides the reference definition of the singleton (single value) One-way delay metric. Section 4.4 of [RFC7679] provides the reference definition expanded to cover a multi-value sample. Note that terms such as singleton and sample are defined in Section 11 of [RFC2330].

Only successful packet transfers with finite delay are included in the sample, as prescribed in section 4.1.2 of [RFC6049].

For loss:

Almes, G., Kalidini, S., Zekauskas, M., and A. Morton, Ed., "A One-Way Loss Metric for IP Performance Metrics (IPPM)", RFC 7680, DOI 10.17487/RFC7680, January 2016, <http://www.rfc-editor.org/info/rfc7680>.

Section 2.4 of [RFC7680] provides the reference definition of the singleton (single value) one-way loss metric. Section 3.4 of [RFC7680] provides the reference definition expanded to cover a multi-singleton sample. Note that terms such as singleton and sample are defined in Section 11 of [RFC2330].

8.2.2. **Fixed Parameters**

<list and specify Fixed Parameters, input factors that must be determined and embedded in the measurement system for use when needed>

Type-P:

o   IPv4 header values:

    *   DSCP: set to 0

    *   TTL: set to 255

* Protocol: Set to 17 (UDP)

o IPv6 header values:

* DSCP: set to 0

* Hop Count: set to 255

* Protocol: Set to 17 (UDP)

o UDP header values:

* Checksum: the checksum MUST be calculated and included in the header

o UDP Payload: TWAMP Test Packet Formats, Section 4.1.2 of [RFC5357]

* Security features in use influence the number of Padding octets.

* 142 octets total, including the TWAMP format

Other measurement parameters:

Tmax: a loss threshold waiting time with value 3.0, expressed in units of seconds, as a positive value of type decimal64 with fraction digits = 4 (see section 9.3 of [RFC6020]) and with resolution of 0.0001 seconds (0.1 ms), with lossless conversion to/from the 32-bit NTP timestamp as per section 6 of [RFC5905].

See the Packet Stream generation category for two additional Fixed Parameters.

8.3. Method of Measurement

This category includes columns for references to relevant sections of the RFC(s) and any supplemental information needed to ensure an unambiguous methods for implementations.

8.3.1. Reference Method

<for metric, insert relevant section references and supplemental info>

The methodology for this metric is defined as Type-P-One-way-Delay-Poisson-Stream in section 3.6 of [RFC7679] and section 4.6 of [RFC7679] using the Type-P and Tmax defined under Fixed Parameters.

The reference method distinguishes between long-delayed packets and
lost packets by implementing a maximum waiting time for packet
arrival. Tmax is the waiting time used as the threshold to declare a
packet lost. Lost packets SHALL be designated as having undefined
delay, and counted for the OWLoss metric.

The calculations on the one-way delay SHALL be performed on the
conditional distribution, conditioned on successful packet arrival
within Tmax. Also, when all packet delays are stored, the process
which calculates the one-way delay value MAY enforce the Tmax
threshold on stored values before calculations. See section 4.1 of
[RFC3393] for details on the conditional distribution to exclude
undefined values of delay, and Section 5 of [RFC6703] for background
on this analysis choice.

The reference method requires some way to distinguish between
different packets in a stream to establish correspondence between
sending times and receiving times for each successfully-arriving
packet. Sequence numbers or other send-order identification MUST be
retained at the Src or included with each packet to dis-ambiguate
packet reordering if it occurs.

Since a standard measurement protocol is employed [RFC5357], then the
measurement process will determine the sequence numbers or timestamps
applied to test packets after the Fixed and Runtime parameters are
passed to that process. The measurement protocol dictates the format
of sequence numbers and time-stamps conveyed in the TWAMP-Test packet
payload.

8.3.2. Packet Stream Generation

<list of generation parameters and section/spec references if needed>

This section gives the details of the packet traffic which is the
basis for measurement. In IPPM metrics, this is called the Stream,
and can easily be described by providing the list of stream
parameters.

Section 3 of [RFC3432] prescribes the method for generating Periodic
streams using associated parameters.

incT the nominal duration of inter-packet interval, first bit to
   first bit

dT the duration of the interval for allowed sample start times

T0 the actual start time of the periodic stream

   NOTE: an initiation process with a number of control exchanges
   resulting in unpredictable start times (within a time interval) may
   be sufficient to avoid synchronization of periodic streams, and
   therefore a valid replacement for selecting a start time at random
   from a fixed interval.

   These stream parameters will be specified as Run-time parameters.

8.3.3. Traffic Filtering (observation) Details

   NA

8.3.4. Sampling Distribution

   NA

8.3.5. Run-time Parameters and Data Format

   Run-time Parameters are input factors that must be determined,
   configured into the measurement system, and reported with the results
   for the context to be complete.

   <list of run-time parameters, and their data formats>

   Src the IP address of the host in the Src Role (format ipv4-address-
      no-zone value for IPv4, or ipv6-address-no-zone value for IPv6,
      see Section 4 of [RFC6991])

   Dst the IP address of the host in the Dst Role (format ipv4-address-
      no-zone value for IPv4, or ipv6-address-no-zone value for IPv6,
      see section 4 of [RFC6991])

   T0 a time, the start of a measurement interval, (format "date-and-
      time" as specified in Section 5.6 of [RFC3339], see also Section 3
      of [RFC6991]). The UTC Time Zone is required by Section 6.1 of
      [RFC2330]. When T0 is "all-zeros", a start time is unspecified
      and Tf is to be interpreted as the Duration of the measurement
      interval. The start time is controlled through other means.

   Tf a time, the end of a measurement interval, (format "date-and-time"
      as specified in Section 5.6 of [RFC3339], see also Section 3 of
      [RFC6991]). The UTC Time Zone is required by Section 6.1 of
      [RFC2330]. When T0 is "all-zeros", a end time date is ignored and
      Tf is interpreted as the Duration of the measurement interval.

   >>> should Periodic run-time params be fixed instead? probably yes if
   modeling a specific version of tests. Note in the NAME, i.e.
   Poisson3.3

8.3.6. Roles

   <lists the names of the different roles from the measurement method>

   Src launches each packet and waits for return transmissions from
      Dst. This is the TWAMP Session-Sender.

   Dst waits for each packet from Src and sends a return packet to Src.
      This is the TWAMP Session-Reflector.

8.4. Output

   This category specifies all details of the Output of measurements
   using the metric.

8.4.1. Type

   <insert name of the output type, raw or a selected summary statistic>

   See subsection titles in Data Format for Types.

8.4.2. Reference Definition

   <describe the data format for each type of result>

   For all output types ---

   T0 the start of a measurement interval, (format "date-and-time" as
      specified in Section 5.6 of [RFC3339], see also Section 3 of
      [RFC6991]). The UTC Time Zone is required by Section 6.1 of
      [RFC2330].

   Tf the end of a measurement interval, (format "date-and-time" as
      specified in Section 5.6 of [RFC3339], see also Section 3 of
      [RFC6991]). The UTC Time Zone is required by Section 6.1 of
      [RFC2330].

   For LossRatio -- the count of lost packets to total packets sent is
   the basis for the loss ratio calculation as per Section 4.1 of
   [RFC7680].

   For each <statistic>, one of the following sub-sections apply:

8.4.2.1. Percentile95

   The 95th percentile SHALL be calculated using the conditional
   distribution of all packets with a finite value of One-way delay
   (undefined delays are excluded), a single value as follows:

See section 4.1 of [RFC3393] for details on the conditional
distribution to exclude undefined values of delay, and Section 5 of
    [RFC6703] for background on this analysis choice.

See section 4.3 of [RFC3393] for details on the percentile statistic
(where Round-trip delay should be substituted for "ipdv").

The percentile = 95, meaning that the reported delay, "95Percentile",
is the smallest value of one-way delay for which the Empirical
Distribution Function (EDF), F(95Percentile) >= 95% of the singleton
one-way delay values in the conditional distribution. See section
11.3 of [RFC2330] for the definition of the percentile statistic
using the EDF.

95Percentile The time value of the result is expressed in units of
   seconds, as a positive value of type decimal64 with fraction
   digits = 9 (see section 9.3 of [RFC6020]) with resolution of
   0.000000001 seconds (1.0 ns), and with lossless conversion to/from
   the 64-bit NTP timestamp as per section 6 of RFC [RFC5905]

8.4.2.2. Mean

The mean SHALL be calculated using the conditional distribution of
all packets with a finite value of One-way delay (undefined delays
are excluded), a single value as follows:

See section 4.1 of [RFC3393] for details on the conditional
distribution to exclude undefined values of delay, and Section 5 of
    [RFC6703] for background on this analysis choice.

See section 4.2.2 of [RFC6049] for details on calculating this
statistic, and 4.2.3 of [RFC6049].

Mean The time value of the result is expressed in units of seconds,
   as a positive value of type decimal64 with fraction digits = 9
   (see section 9.3 of [RFC6020]) with resolution of 0.000000001
   seconds (1.0 ns), and with lossless conversion to/from the 64-bit
   NTP timestamp as per section 6 of RFC [RFC5905]

8.4.2.3. Min

The minimum SHALL be calculated using the conditional distribution of
all packets with a finite value of One-way delay (undefined delays
are excluded), a single value as follows:

See section 4.1 of [RFC3393] for details on the conditional
distribution to exclude undefined values of delay, and Section 5 of
    [RFC6703] for background on this analysis choice.

See section 4.3.2 of [RFC6049] for details on calculating this
statistic, and 4.3.3 of [RFC6049].

Min The time value of the result is expressed in units of seconds,
     as a positive value of type decimal64 with fraction digits = 9
     (see section 9.3 of [RFC6020]) with resolution of 0.000000001
     seconds (1.0 ns), and with lossless conversion to/from the 64-bit
     NTP timestamp as per section 6 of RFC [RFC5905]

8.4.2.4. Max

The maximum SHALL be calculated using the conditional distribution of
all packets with a finite value of One-way delay (undefined delays
are excluded), a single value as follows:

See section 4.1 of [RFC3393] for details on the conditional
distribution to exclude undefined values of delay, and Section 5 of
[RFC6703] for background on this analysis choice.

See section 4.3.2 of [RFC6049] for a closely related method for
calculating this statistic, and 4.3.3 of [RFC6049]. The formula is
as follows:

        Max = (FiniteDelay [j])

                such that for some index, j, where 1 <= j <= N
                FiniteDelay[j] >= FiniteDelay[n] for all n

Max The time value of the result is expressed in units of seconds,
     as a positive value of type decimal64 with fraction digits = 9
     (see section 9.3 of [RFC6020]) with resolution of 0.000000001
     seconds (1.0 ns), and with lossless conversion to/from the 64-bit
     NTP timestamp as per section 6 of RFC [RFC5905]

8.4.2.5. Std_Dev

The Std_Dev SHALL be calculated using the conditional distribution of
all packets with a finite value of One-way delay (undefined delays
are excluded), a single value as follows:

See section 4.1 of [RFC3393] for details on the conditional
distribution to exclude undefined values of delay, and Section 5 of
[RFC6703] for background on this analysis choice.

See section 4.3.2 of [RFC6049] for a closely related method for
calculating this statistic, and 4.3.3 of [RFC6049]. The formula is
the classic calculation for standard deviation of a population.

Std_Dev The time value of the result is expressed in units of
   seconds, as a positive value of type decimal64 with fraction
   digits = 9 (see section 9.3 of [RFC6020]) with resolution of
   0.000000001 seconds (1.0 ns), and with lossless conversion to/from
   the 64-bit NTP timestamp as per section 6 of RFC [RFC5905]

8.4.3. Metric Units

<insert units for the measured results, and the reference
specification>.

The <statistic> of One-way Delay is expressed in seconds.

The One-way Loss Ratio is expressed as a percentage of lost packets
to total packets sent.

8.4.4. Calibration

Section 3.7.3 of [RFC7679] provides a means to quantify the
systematic and random errors of a time measurement. In-situ
calibration could be enabled with an internal loopback that includes
as much of the measurement system as possible, performs address
manipulation as needed, and provides some form of isolation (e.g.,
deterministic delay) to avoid send-receive interface contention.
Some portion of the random and systematic error can be characterized
this way.

For one-way delay measurements, the error calibration must include an
assessment of the internal clock synchronization with its external
reference (this internal clock is supplying timestamps for
measurement). In practice, the time offsets of clocks at both the
source and destination are needed to estimate the systematic error
due to imperfect clock synchronization (the time offsets are
smoothed, thus the random variation is not usually represented in the
results).

time_offset The time value of the result is expressed in units of
   seconds, as a signed value of type decimal64 with fraction digits
   = 9 (see section 9.3 of [RFC6020]) with resolution of 0.000000001
   seconds (1.0 ns), and with lossless conversion to/from the 64-bit
   NTP timestamp as per section 6 of RFC [RFC5905]

When a measurement controller requests a calibration measurement, the
loopback is applied and the result is output in the same format as a
normal measurement with additional indication that it is a
calibration result. In any measurement, the measurement function
SHOULD report its current estimate of time offset as an indicator of
the degree of synchronization.

Both internal loopback calibration and clock synchronization can be
used to estimate the *available accuracy* of the Output Metric Units.
For example, repeated loopback delay measurements will reveal the
portion of the Output result resolution which is the result of system
noise, and thus inaccurate.

8.5. Administrative items

8.5.1. Status

<current or depricated>

8.5.2. Requestor (keep?)

name or RFC, etc.

8.5.3. Revision

1.0

8.5.4. Revision Date

YYYY-MM-DD

8.6. Comments and Remarks

Additional (Informational) details for this entry

9. ver08 BLANK Registry Entry

This section gives an initial registry entry for ....

9.1. Summary

This category includes multiple indexes to the registry entries, the
element ID and metric name.

9.1.1. ID (Identifier)

<insert numeric identifier, an integer>

9.1.2. Name

<insert name according to metric naming convention>

9.1.3. URIs

URI: Prefix urn:ietf:metrics:perf:<name>

URL:

9.1.4. Description

TBD.

9.1.5. Reference

<reference to the RFC of spec where the registry entry is defined>

9.1.6. Change Controller

<org or person >

9.1.7. Version (of Registry Format)

<currently 1.0>

9.2. Metric Definition

This category includes columns to prompt the entry of all necessary
details related to the metric definition, including the RFC reference
and values of input factors, called fixed parameters.

9.2.1. Reference Definition

<Full bibliographic reference to an immutable doc.>

<specific section reference and additional clarifications, if needed>

9.2.2. Fixed Parameters

<list and specify Fixed Parameters, input factors that must be
determined and embedded in the measurement system for use when
needed>

9.3. Method of Measurement

This category includes columns for references to relevant sections of
the RFC(s) and any supplemental information needed to ensure an
unambiguous methods for implementations.

9.3.1. Reference Method

   <for metric, insert relevant section references and supplemental
   info>

9.3.2. Packet Stream Generation

   <list of generation parameters and section/spec references if needed>

9.3.3. Traffic Filtering (observation) Details

   <insert the measured results based on a filtered version of the
   packets observed, and this section provides the filter details (when
   present), and section reference>.

9.3.4. Sampling Distribution

   <insert time distribution details, or how this is diff from the
   filter>

9.3.5. Run-time Parameters and Data Format

   <list of run-time parameters, and any reference(s)>.

9.3.6. Roles

   <lists the names of the different roles from the measurement method>

9.4. Output

   This category specifies all details of the Output of measurements
   using the metric.

9.4.1. Type

   <insert name of the output type, raw or a selected summary statistic>

9.4.2. Reference Definition

   <pointer to section/spec where output type/format is defined>

9.4.3. Metric Units

   <insert units for the measured results, and the reference
   specification>.

9.4.4. Calibration

<describe the error calibration, a way to indicate that the results were collected in a calbration mode of operation, and a way to report internal status metrics related to calibration, such as time offset>

9.5. Administrative items

9.5.1. Status

<current or depricated>

9.5.2. Requestor

<name of individual or Internet Draft, etc.>

9.5.3. Revision

1.0

9.5.4. Revision Date

YYYY-MM-DD

9.6. Comments and Remarks

Additional (Informational) details for this entry

10. Example RTCP-XR Registry Entry

This section is MAY BE DELETED or adapted before submission.

This section gives an example registry entry for the end-point metric described in RFC 7003 [RFC7003], for RTCP-XR Burst/Gap Discard Metric reporting.

10.1. Registry Indexes

This category includes multiple indexes to the registry entries, the element ID and metric name.

10.1.1. Identifier

An integer having enough digits to uniquely identify each entry in the Registry.

10.1.2. Name

A metric naming convention is TBD.

10.1.3. URI

Prefix urn:ietf:metrics:param:<name>

10.1.4. Status

current

10.1.5. Requestor

Alcelip Mornuley

10.1.6. Revision

1.0

10.1.7. Revision Date

2014-07-04

10.1.8. Description

TBD.

10.1.9. Reference Specification(s)

[RFC3611][RFC4566][RFC6776][RFC6792][RFC7003]

10.2. Metric Definition

This category includes columns to prompt the entry of all necessary
details related to the metric definition, including the RFC reference
and values of input factors, called fixed parameters. Section 3.2 of
[RFC7003] provides the reference information for this category.

10.2.1. Reference Definition

Packets Discarded in Bursts:

The total number of packets discarded during discard bursts. The
measured value is unsigned value. If the measured value exceeds
0xFFFFFD, the value 0xFFFFFE MUST be reported to indicate an over-
range measurement. If the measurement is unavailable, the value
0xFFFFFF MUST be reported.

10.2.2. Fixed Parameters

   Fixed Parameters are input factors that must be determined and
   embedded in the measurement system for use when needed. The values
   of these parameters is specified in the Registry.

   Threshold: 8 bits, set to value = 3 packets.

   The Threshold is equivalent to Gmin in [RFC3611], i.e., the number of
   successive packets that must not be discarded prior to and following
   a discard packet in order for this discarded packet to be regarded as
   part of a gap. Note that the Threshold is set in accordance with the
   Gmin calculation defined in Section 4.7.2 of [RFC3611].

   Interval Metric flag: 2 bits, set to value 11=Cumulative Duration

   This field is used to indicate whether the burst/gap discard metrics
   are Sampled, Interval, or Cumulative metrics [RFC6792]:

   I=10: Interval Duration - the reported value applies to the most
   recent measurement interval duration between successive metrics
   reports.

   I=11: Cumulative Duration - the reported value applies to the
   accumulation period characteristic of cumulative measurements.

   Senders MUST NOT use the values I=00 or I=01.

10.3. Method of Measurement

   This category includes columns for references to relevant sections of
   the RFC(s) and any supplemental information needed to ensure an
   unambiguous methods for implementations. For the Burst/Gap Discard
   Metric, it appears that the only guidance on methods of measurement
   is in Section 3.0 of [RFC7003] and its supporting references.
   Relevant information is repeated below, although there appears to be
   no section titled "Method of Measurement" in [RFC7003].

10.3.1. Reference Method

   Metrics in this block report on burst/gap discard in the stream
   arriving at the RTP system. Measurements of these metrics are made
   at the receiving end of the RTP stream. 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.
Senders MUST send this block in the same compound RTCP packet as the
Measurement Information Block. Receivers MUST verify that the
measurement period is received in the same compound RTCP packet as
this metrics block. If not, this metrics block MUST be discarded.

10.3.2. Stream Type and Stream Parameters

Since RTCP-XR Measurements are conducted on live RTP traffic, the
complete description of the stream is contained in SDP messages that
proceed the establishment of a compatible stream between two or more
communicating hosts. See Run-time Parameters, below.

10.3.3. Output Type and Data Format

The output type defines the type of result that the metric produces.

o Value: Packets Discarded in Bursts

o Data Format: 24 bits

o Reference: Section 3.2 of [RFC7003]

10.3.4. Metric Units

The measured results are apparently expressed in packets, although
there is no section of [RFC7003] titled "Metric Units".

10.3.5. Run-time Parameters and Data Format

Run-Time Parameters are input factors that must be determined,
configured into the measurement system, and reported with the results
for the context to be complete. However, the values of these
parameters is not specified in the Registry, rather these parameters
are listed as an aid to the measurement system implementor or user
(they must be left as variables, and supplied on execution).

The Data Format of each Run-time Parameter SHALL be specified in this
column, to simplify the control and implementation of measurement
devices.

SSRC of Source: 32 bits As defined in Section 4.1 of [RFC3611].

SDP Parameters: As defined in [RFC4566]

Session description v= (protocol version number, currently only 0)

o= (originator and session identifier : username, id, version number, network address)

s= (session name : mandatory with at least one UTF-8-encoded character)

i=* (session title or short information) u=* (URI of description)

e=* (zero or more email address with optional name of contacts)

p=* (zero or more phone number with optional name of contacts)

c=* (connection information--not required if included in all media)

b=* (zero or more bandwidth information lines) One or more Time descriptions ("t=" and "r=" lines; see below)

z=* (time zone adjustments)

k=* (encryption key)

a=* (zero or more session attribute lines)

Zero or more Media descriptions (each one starting by an "m=" line; see below)

m= (media name and transport address)

i=* (media title or information field)

c=* (connection information -- optional if included at session level)

b=* (zero or more bandwidth information lines)

k=* (encryption key)

a=* (zero or more media attribute lines -- overriding the Session attribute lines)

An example Run-time SDP description follows:

v=0

o=jdoe 2890844526 2890842807 IN IP4 192.0.2.5

s=SDP Seminar i=A Seminar on the session description protocol

    u=http://www.example.com/seminars/sdp.pdf e=j.doe@example.com (Jane
    Doe)

    c=IN IP4 233.252.0.12/127

    t=2873397496 2873404696

    a=recvonly

    m=audio 49170 RTP/AVP 0

    m=video 51372 RTP/AVP 99

    a=rtpmap:99 h263-1998/90000

10.4. Comments and Remarks

    TBD.

11. Revision History

    This section may be removed for publication. It contains partial
    information on updtes.

    This draft replaced draft-mornuley-ippm-initial-registry.

    In version 02, Section 4 has been edited to reflect recent discussion
    on the ippm-list: * Removed the combination or "Raw" and left 95th
    percentile. * Hanging Indent on Run-time parameters (Fixed parameters
    use bullet lists and other indenting formats. * Payload format for
    measurement has been removed. * Explanation of Conditional delay
    distribution.

    Version 03 addressed Phil Eardley's comments and suggestions in
    sections 1-4. and resolved the definition of Percentiles.

    Version 04 * All section 4 parameters reference YANG types for
    alternate data formats. * Discussion has concluded that usecase(s)
    for machine parse-able registry columns are not needed.

12. Security Considerations

    These registry entries represent no known security implications for
    Internet Security. Each referenced Metric contains a Security
    Considerations section.

13. IANA Considerations

   IANA is requested to populate The Performance Metric Registry defined
   in [I-D.ietf-ippm-metric-registry] with the values defined above.

   See the IANA Considerations section of
   [I-D.ietf-ippm-metric-registry] for additional requests and
   considerations.

14. Acknowledgements

   The authors thank Brian Trammell for suggesting the term "Run-time
   Parameters", which led to the distinction between run-time and fixed
   parameters implemented in this memo, for identifying the IPFIX metric
   with Flow Key as an example, and for many other productive
   suggestions. Thanks to Peter Koch, who provided several useful
   suggestions for disambiguating successive DNS Queries in the DNS
   Response time metric.

   The authors also acknowledge the constructive reviews and helpful
   suggestions from Barbara Stark, Juergen Schoenwaelder, Tim Carey, and
   participants in the LMAP working group. Thanks to Michelle Cotton
   for her early IANA review, and to Amanda Barber for answering
   questions related to the presentation of the registry and
   accessibility of the complete template via URL.

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Authors' Addresses

    Al Morton
    AT&T Labs
    200 Laurel Avenue South
    Middletown,, NJ 07748
    USA

    Phone: +1 732 420 1571
    Fax: +1 732 368 1192
    Email: acmorton@att.com
    URI: http://home.comcast.net/~acmacm/

    Marcelo Bagnulo
    Universidad Carlos III de Madrid
    Av. Universidad 30
    Leganes, Madrid 28911
    SPAIN

    Phone: 34 91 6249500
    Email: marcelo@it.uc3m.es
    URI: http://www.it.uc3m.es

    Philip Eardley
    BT
    Adastral Park, Martlesham Heath
    Ipswich
    ENGLAND

    Email: philip.eardley@bt.com

    Kevin D'Souza
    AT&T Labs
    200 Laurel Avenue South
    Middletown,, NJ 07748
    USA

    Phone: +1 732 420 xxxx
    Email: kld@att.com