Delay Variation Applicability Statement

First Draft

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Al Morton

“Good advice is always certain to be ignored, but that’s no reason not to give it.”
Agatha Christie
“How will the results be used?”

- Krzanowski introduced the Delay Variation Problem at IETF-64
- “How” Question asked at IETF-65, no suggestions yet
- RFC 3393 lists two key uses for the Delay Variation Metric
- Memo Considers these 2 Tasks and 2 Special Circumstances

What about Spatial Composition?

Network Characterization: Inferring Queue Occupation on a Path

Application Performance Estimation: Sizing of De-Jitter Buffers

What if circumstances are challenging?
Outline of the Draft

1. Introduction

2. Purpose and Scope

3. Uses of Delay Variation Metrics
   - 3.1. Determine De-jitter Buff. Size
   - 3.2. Inferring Queue Occupation
   - 3.3. Spatial Composition
   - 3.4. Challenging Circumstances
   - 3.5. <your favorite here>

4. Formulations of IPDV and PDV
   - 4.1. Inter-Packet Delay Variation
   - 4.2. Packet Delay Variation
   - 4.3. Examples and Initial Comparisons

5. Earlier Comparisons
   - 5.1. Demichelis' Comparison
   - 5.2. Ciavattone et al.
   - 5.3. IPPM List Discussion - 2001
   - 5.4. Y.1540 Appendix II

6. Additional Properties and Comparisons
   - 6.1. Jitter in RTCP Reports
   - 6.2. Path Changes
     - 6.2.1. Lossless Path Change
     - 6.2.2. Path Change with Loss
   - 6.3. Measurement Clock Issues
   - 6.4. Reporting a Single Number
   - 6.5. MAPDV2

7. Applicability of the Delay Variation Forms with Tasks
**Inter-Packet Delay Var. (selection \( f = \text{previous packet} \))**

\[
\text{IPDV}(2) = (R2 - R1) - (T2 - T1)
\]

\[
\text{IPDV}(4) = (R4 - R3) - (T4 - T3)
\]
Packet Delay Variation
(selection $f = \text{minimum delay pkt in stream}$)

\[ PDV(3) = (R3-T3) - (R2-T2) \]

\[ PDV(4) = (R4-T4) - (R2-T2) \]
Summary of Comparisons

● Challenging Circumstances for measurement:
  ➔ IPDV form offers advantages when
    ✩ Path changes are Frequent
    ✩ Meas. System Clocks exhibit significant Skew
  ➔ PDV form is less sensitive to Packet Loss

● Spatial Composition of DV metric:
  ➔ All known methods use PDV,
    ✩ IPDV sensitivity to sequence is an issue

● Estimate of Queuing Time & Variation:
  ➔ PDV estimates this, especially when sample min = true min

● Determine De-jitter Buffer Size Required
  ➔ PDV “pseudo-range” reveals this property by anchoring the distribution at the minimum delay
Path Change example

![Graph showing Path Change example]
Congested Buffer example
Packet Sequence Change example (2nd & 3rd reversed)
Sources of Delay in Packet Xfer of Real-Time Streams

Source Delays
- Packetization
- Minimum Additional Source Delay

Network Transfer Delays
- Minimum Transfer Delay
- Variable Transfer Delay (queuing)
- De-Jitter Buffer
  - Accommodates Delay Variation from Network and Source terminal

Other Destination Delays
- Max or 99.9%-tile Transfer Delay
- Minimum/Playout Buffer
- DSP & other Processing
Summary

- IPDV and PDV each have their Strengths and Weaknesses
- Suggestions for additional Tasks & Circumstances
- Should this become the draft that addresses the WG Milestone on this topic?
**How do you want to use the DV results?**

1. **Compare with Requirements/SLA/Maint. Threshold?**
   -- but how are your customers using the Req/SLA/MainThresh?

2. **Real-Time Application Planning: How big should my De-jitter buffer be?**
   -- Note that even Adaptive DJB use a fixed reference between adjustments.

3. <insert your answer here>

4. **ACM’s answer:**
   Doing (1.), to support (2.), with Composed Metrics (earlier talk), in a multi-operator environment
**IPDV (selection f = previous packet)**

- Dynamic Reference for assessing variation
- Possible to relate to RFC 3550 Jitter (smoothed est.)
- Minimal Dst Clock stability required
- Path Change WITH Loss is effectively IGNORED
- Path Change WITHOUT Loss affects 2 IPDV readings
**PDV** *(selection \( f = \) minimum delay pkt in stream)*

- Single, Fixed Reference, normalizes delay distrib.
- No clear relationship to RFC 3550 Jitter
- Dst Clock for 1-way delay, but in practice only stability matters over a longer evaluation interval
- Path Change WITH Loss causes Bi-Modal Distrib.
  - Practical fix: Could terminate a sub-interval after loss of \( x \) packets
- Path Change WITHOUT Loss \( \rightarrow \) Bi-Modal Distrib.
  - But that’s what a de-jitter buffer would experience, too…