Delay Variation Applicability Statement

First Draft

November 7, 2006

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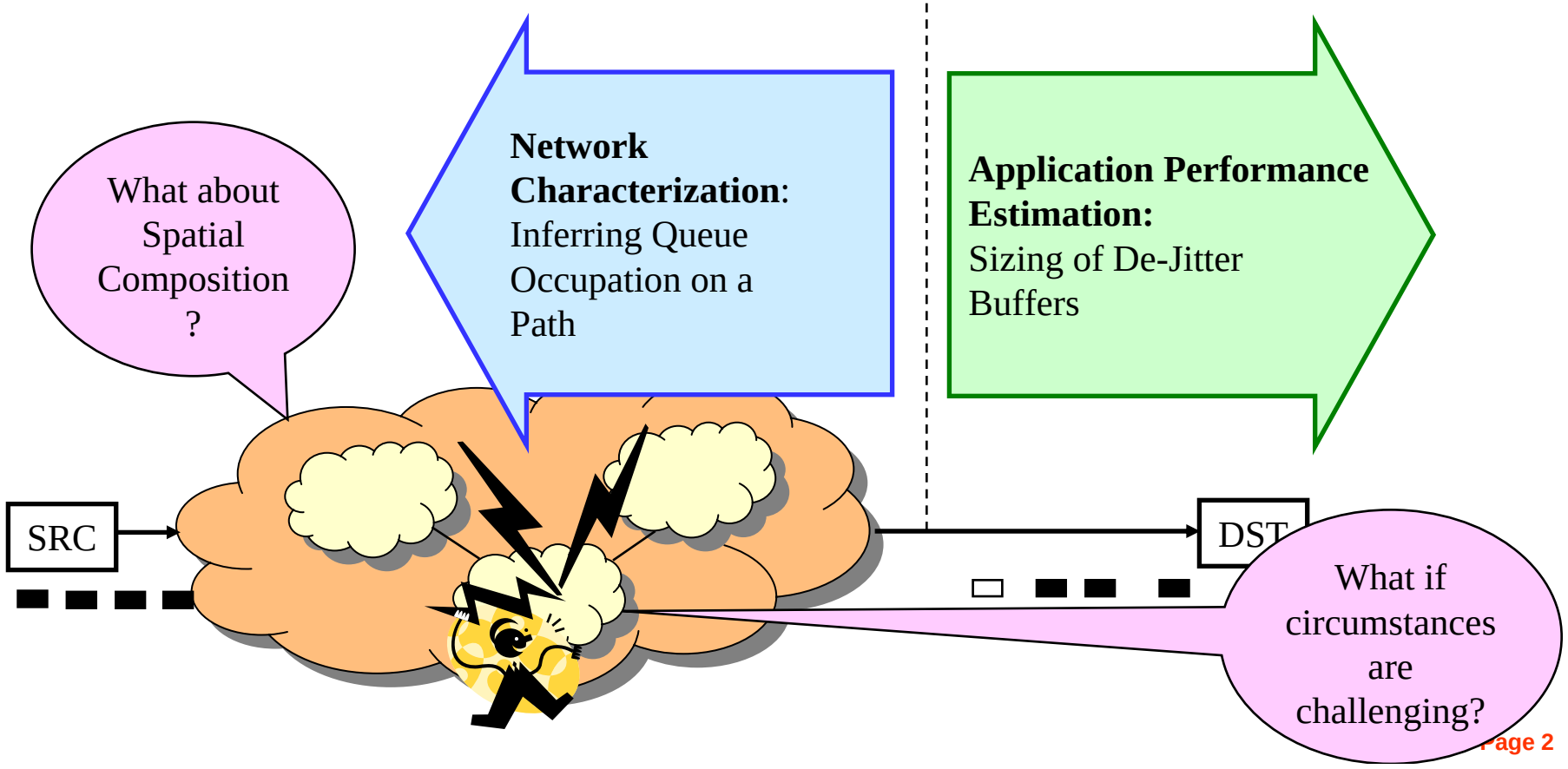
**“Good advice is always certain to be ignored,
but that's no reason not to give it.”
Agatha Christie**

"How will the results be used?"

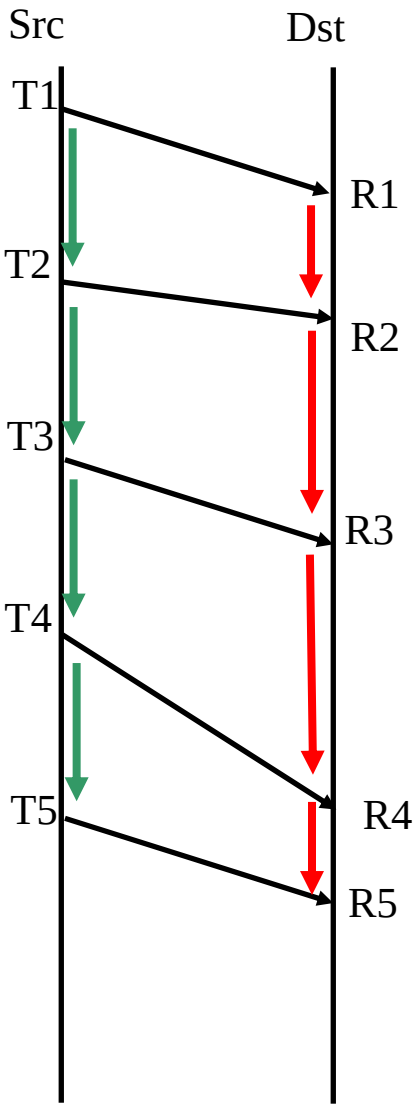
- **Krzanowski introduced the Delay Variation Problem at IETF-64**
- **"How" Question asked at IETF-65, no suggestions yet**
- **RFC 3393 lists two key uses for the Delay Variation Metric**
- **Memo Considers these 2 Tasks and 2 Special Circumstances**



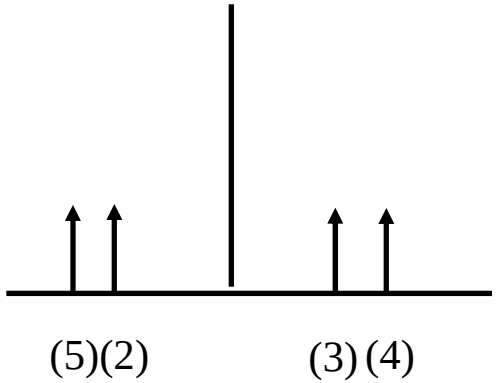
Outline of the Draft

- 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 = previous packet)

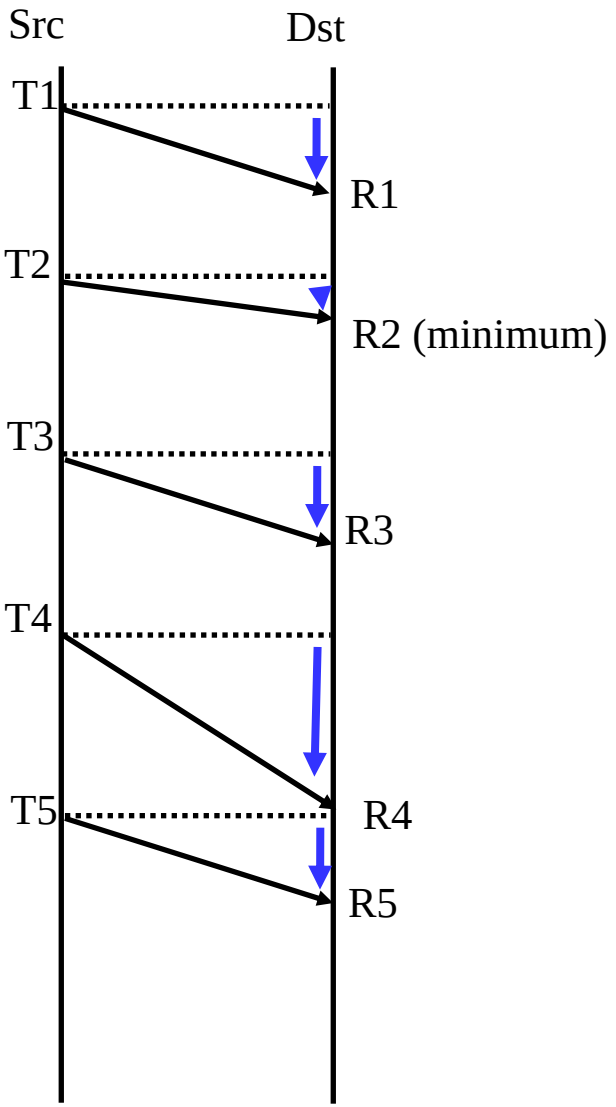


IPDV(2) = (R2-R1) – (T2-T1)

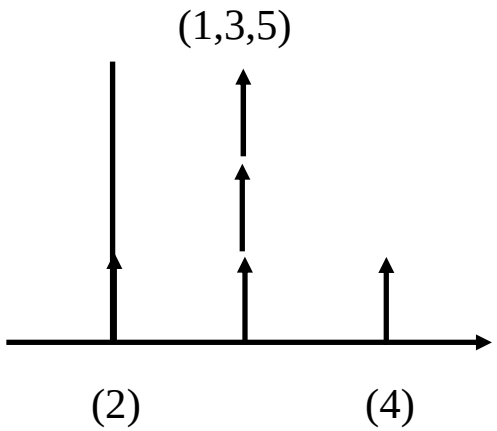


IPDV(4) = (R4-R3) – (T4-T3)

Packet Delay Variation (selection f = minimum delay pkt in stream)



PDV(3) = (R3-T3) – (R2-T2)

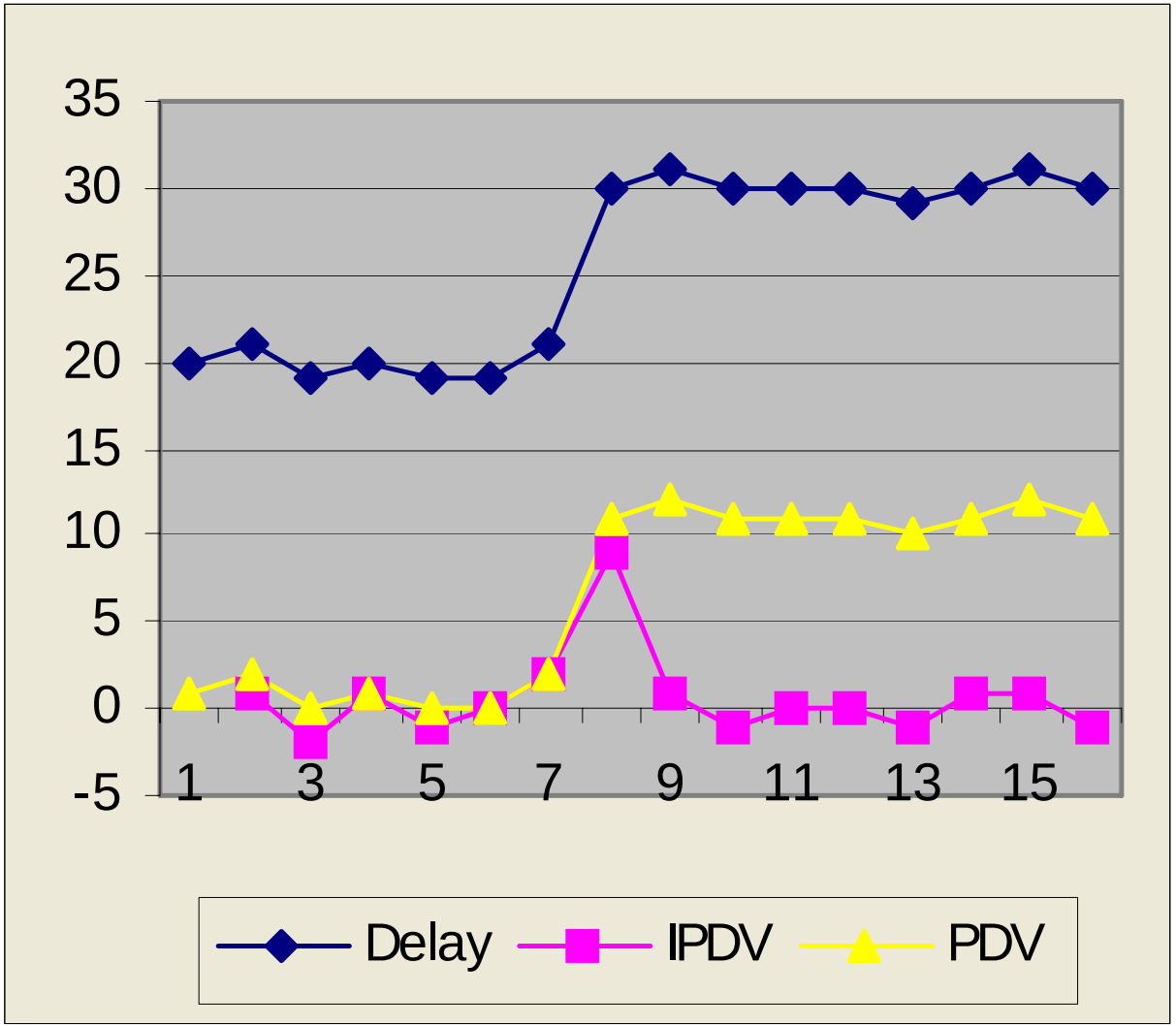


PDV(4) = (R4-T4) – (R2-T2)

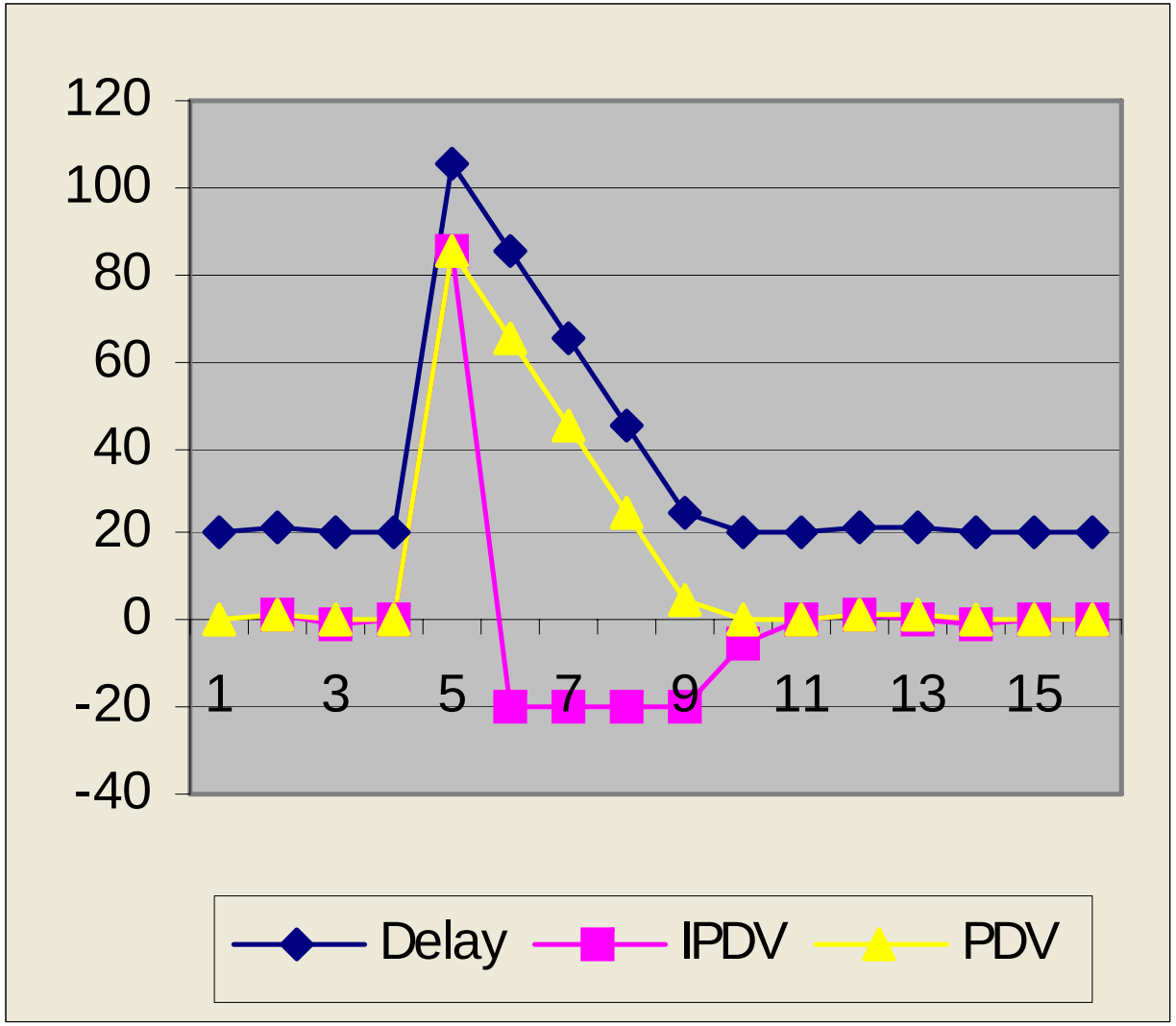
Summary of Comparisons

- **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**

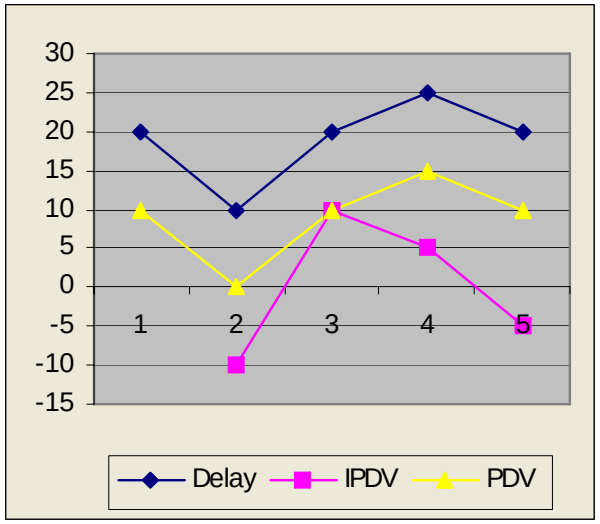
Path Change example

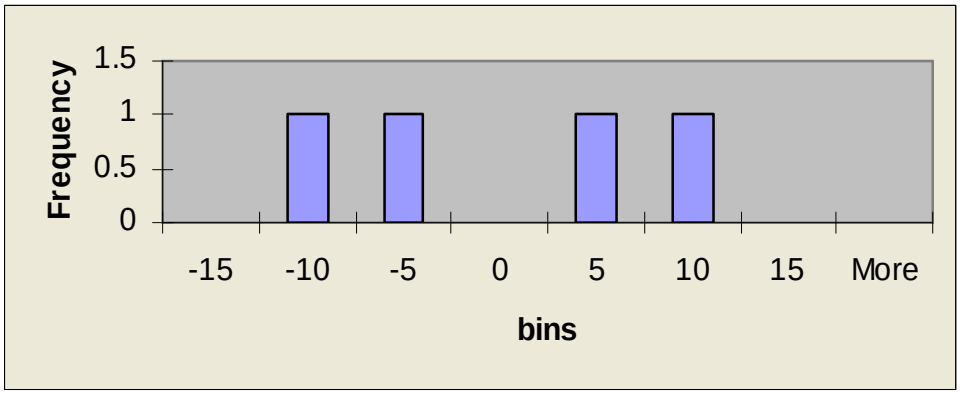


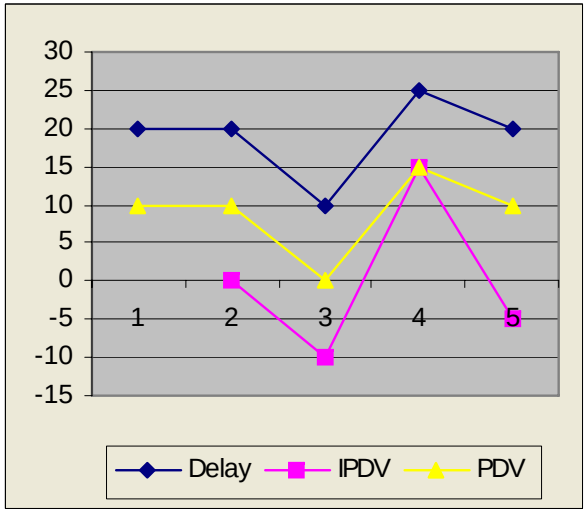
Congested Buffer example

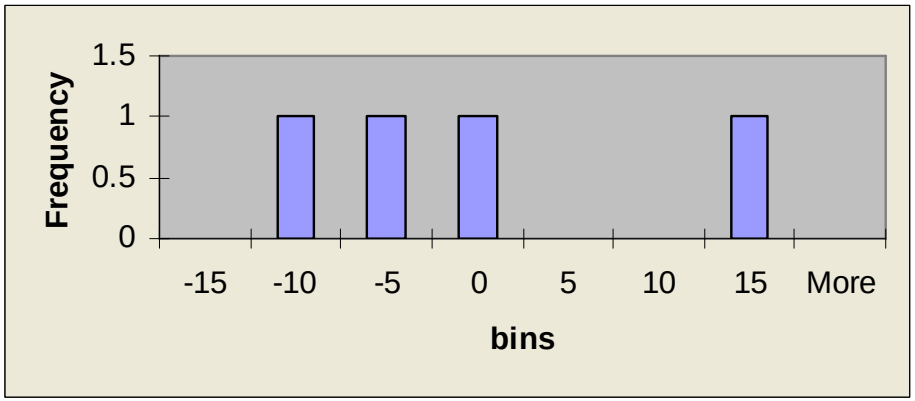


Packet Sequence Change example (2nd & 3rd reversed)

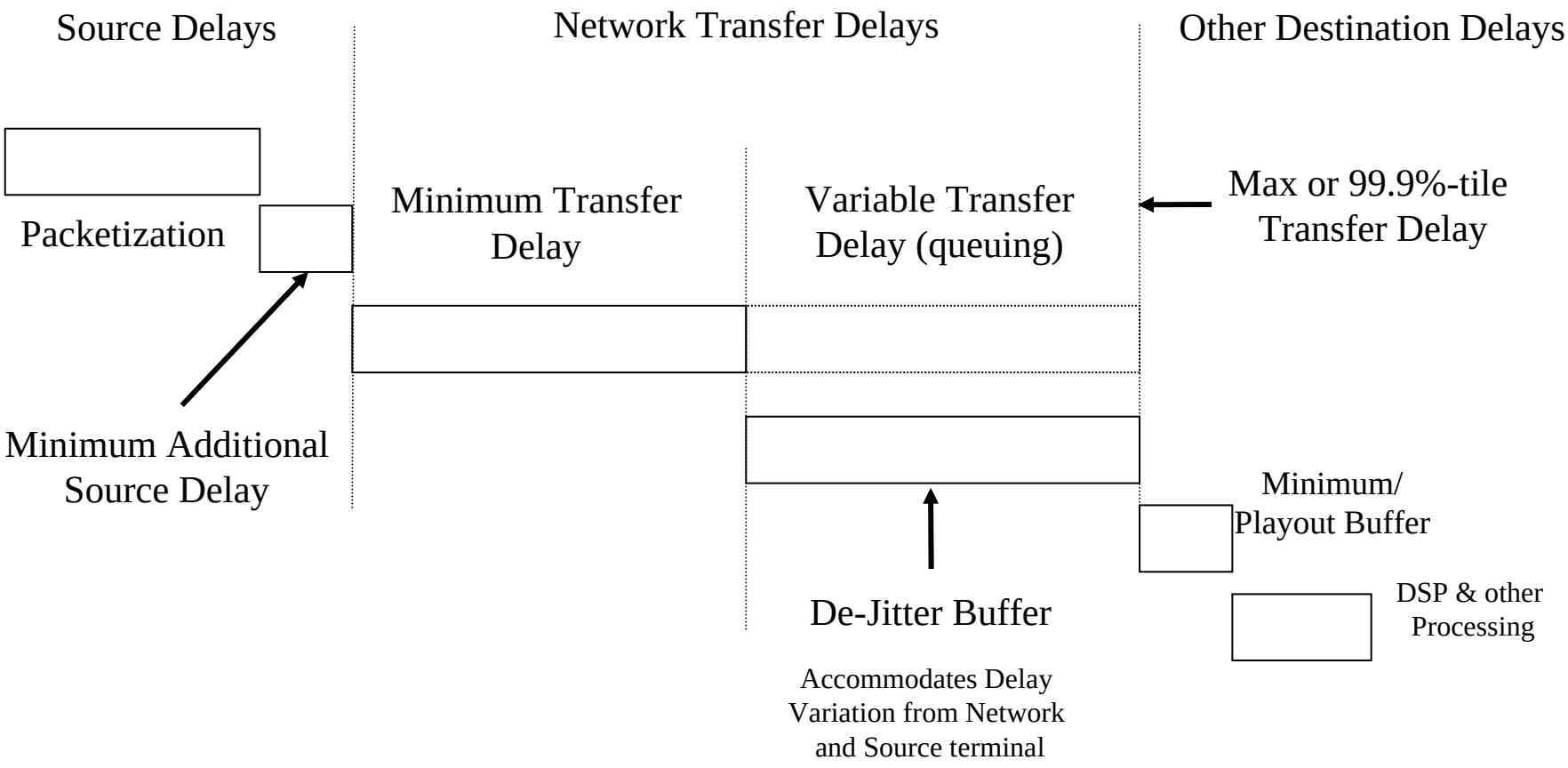








Sources of Delay in Packet Xfer of Real-Time Streams



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 <u>your customers</u> 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 -> Bi-Modal Distrib.**
  - ➔ **But that's what a de-jitter buffer would experience, too…**