Relating ITU and IPPM Metrics: Framework, Loss, and Delay

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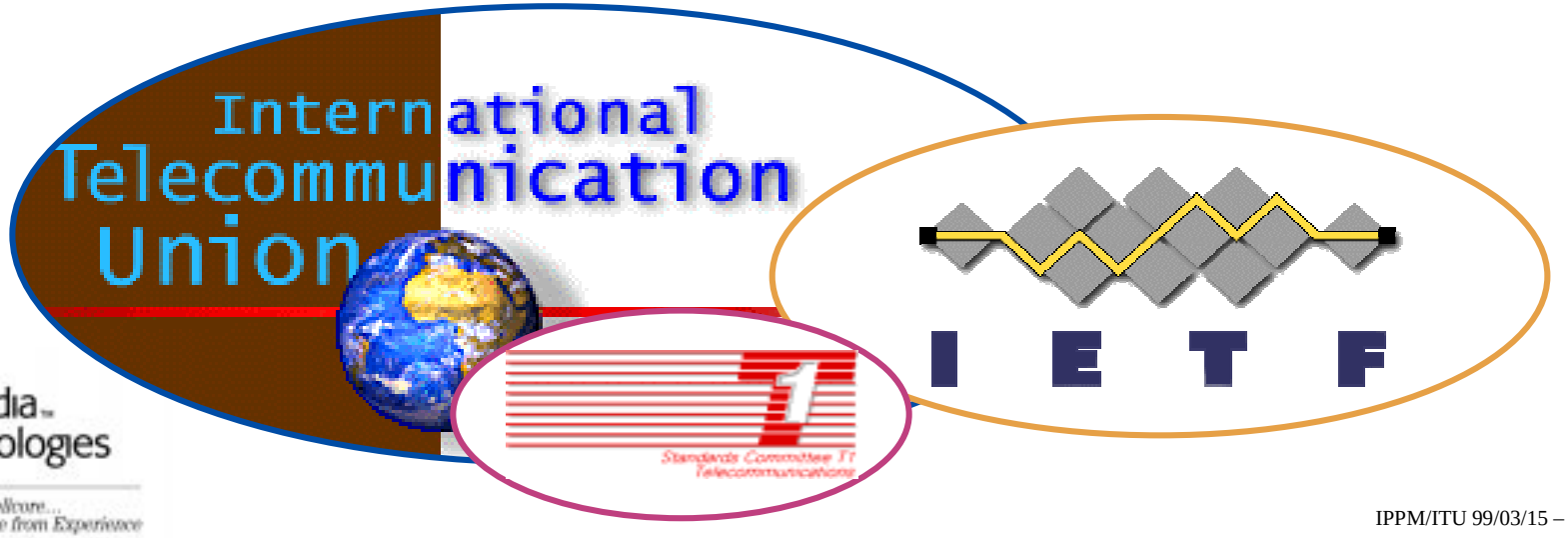
15 March 1999

Relating ITU and IPPM Metrics

- Nobody wants multiple standards for the same thing!
  - Clear statement of the area of overlap
  - Consilience within overlap
- How do we get there?
  - Goals of IPPM and ITU/ANSI Internet metrics
  - Terminology
  - Technical details of specific metrics



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Common Goals for Internet Metrics

Support accurate, consistent understanding of internet performance and reliability

- Usefulness
- Clear, unambiguous standards
- Independence from technology and implementation
- Wide applicability
- Reproducible methodology
- Comparable measurements
- Fairness
- Lack of artifacts

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Different Emphasis

ITU

- Focus: evaluate service
- Define grades of service
  ⇒ Overall measures (statistical)
- Exclude unfair uses
- Emphasize passive observation
  Without forbidding active probes
- Precisely define required quantities
- Model IP layer of network
  ⇒ Exclude other levels

IPPM

- Focus: measure network
- Characterize “absolute” behavior
  ⇒ Singleton measurements
- Avoid biased sampling
- Emphasize active probing
  Without forbidding passive tools
- Discuss implementation issues
- Measure network properties
  ⇒ Exclude host effects

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Shared Terminology

- Host
- Router (special case of host)
- Link
- Identity based on IP address (not DNS name)

  $\Rightarrow$ interface, not processor
- ...

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Approximately Equivalent Terminology

ITU	IPPM
• Network section: set of hosts in one jurisdiction and all their links	• Cloud: undirected graph of routers and links
• Circuit section: link between host and router in another jurisdiction	• Exchange: host-to-cloud or cloud-to-cloud link
• Corresponding events: an association between packets crossing different measurement points	• Single packet: identification of a packet sent with a specific packet received

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Terminology without Exact Equivalents

ITU	IPPM
• IP packet transfer reference event (IPRE) requires valid IP header, SRC, DST	• <no defined term>
• <no defined term> only reality is visibility at measurement point (MP)	• Wiretime: when bits pass interface; measurement processing isn't of interest
• Errored or spurious packet	• Well-formed packet
• Permissible measurement point	• <no defined term>
• <no defined term> for a given packet, roughly a sequence of IPREs	• Path: unidirectional sequence of hosts and links, starting and ending with a host

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Differences in What's Explicit

ITU	IPPM
• Audience: IP users, providers, & equipment manufacturers (no intent to exclude software developers)	• Audience: IP users and providers (no intent to exclude equipment manufacturers or software developers)
• Emphasis on network structure	• Emphasis on measured path
• Require true time	• Discussion of deviation of measured from true time
• Measurement points	• Measurement procedures

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Technical Differences in Loss & Delay
(with several kinds of reconciliation)

- Missing but not incompatible
  - Composition of metrics (in IPPM)
  - Periodic sampling (in I.380 and IPPM Framework but not Loss and Delay documents)
  - Explicit mention of passive measurement (in I.380)
  - Explicit application to internal segments of path (in I.380)
- Formal translation: ITU ⇔ IPPM
  - IP packet transfer delay ⇔ Type-P-One-Way-Delay
  - Loss ⇔ undefined delay
  - Statistical aggregate (e.g., quantile) ⇔ same aggregate function applied to finite delays

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Technical Differences in Loss & Delay (continued)

- Empirical map
  - IPRE ⇔ wiretime
    characterize processing delay between wiretime and MP visibility
    Note that this relationship may be different for host entry or exit events than for network ingress or egress events
  - Corresponding events ⇔ same packet
    The intent of the standards is to make these concepts consistent; the adequacy of specific approaches requires study
- No feasible exact map
  - Misdirected, spurious, errored, lost vs undefined-delay packet
    (note that a long-delayed packet may be classified as spurious)

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Technical Differences in Loss & Delay (continued)

- Undefined in one framework
  - Undefined in ITU model
    - clock offset, skew, and drift
    - time measurement uncertainty
    - security considerations
  - Undefined in IPPM model
    - misdirected packet
    - spurious packet
    - metrics for errored packets

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Which Differences Matter?
"Don't Panic!"

- Most differences in approach and emphasis serve differences in intended use, but have no operational significance
- A few could be confusing:
  - IPPM does not discuss aggregate statistics for finite-delay packets
  - I.380 views a packet that traversed a non-permissible MP as lost
  - I.380 does not discuss differences between actual reference-event time and measured time
  - I.380 implies reference-event time is at IP layer of host stack, while IPPM uses network ingress or egress
  - IPPM does not define metrics for nonconforming packets, such as misdirected, spurious, and errored
- Would this kind of information be appropriate for an IPPM Informational RFC?

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