draft-duffield-ippm-burst-loss-metrics-01.txt

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History of draft-duffield-ippm-burst-loss-metrics

- Aim: standardize burst loss probing methodology [SBDR08]
- Initial presentations IETF 72, 73
- -00 individual draft published prior to IETF 74
- IPR disclosures for -00 draft completed April 2009
- -01 draft published July 2009

Motivation Recap

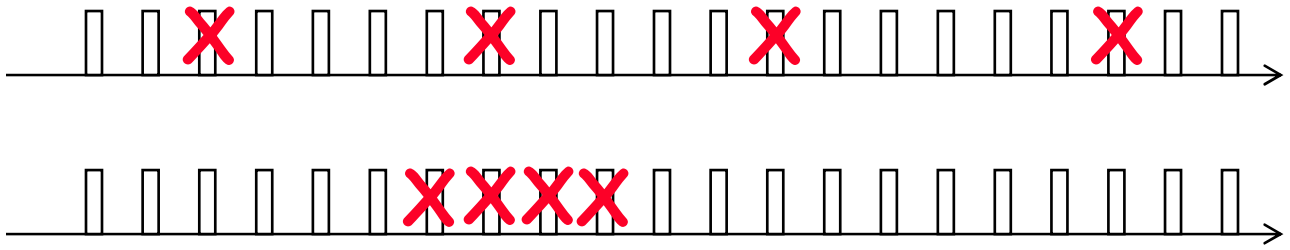
- Motivation
  - One-way packet loss metrics
  - Current standards (mostly) concerned with average loss
  - Applications performance can be sensitive to patterns of loss
- Develop Burst Loss Metrics
  - Characterize packet burst loss patterns by two metrics
    - Average Loss Rate (as before)
    - Average Loss Episode Duration
    - Average Loss Episode Frequency (i.e. #of episodes per unit time)
  - Probing Methodology
    - Need more than usual Poisson probes to accurately measure burst loss
  - Build on Framework/Terms/Ideas from existing IPPM RFCs
    - RFC 2680, RFC3357, RFC3393, RFC3611

Related IPPM Standards

- RFC 2680: *A One-way Packet Loss Metric for IPPM*
  - Average Loss Metric: Type-P-One-way-Packet-Loss
  - Samples: Type-P-One-way-Packet-Loss-Poisson-Stream
- RFC 3393: IP Packet Delay Variation Metric for IPPM
  - Focus on delay variation.
  - Useful Ingredient: selection function F specifies which packets used
- RFC 3357: One-way Loss Pattern Sample Metrics
  - Per packet detail on packet loss e.g.
    {<T1,0>,<T2,1>,<T3,0>,<T4,0>,<T5,1>,<T6,0>,<T7,1>,<T8,0>, <T9,1>,<T10,1>}
- RFC 3611: RTP Control Protocol Extended Reports (RTCP XR)
  - Burst Loss metrics for VoIP quality reporting
  - Burst and gap loss statistics on seqno of received packets
    - Related to parameters of 2-state Gilbert Model

Burst Loss vs. Average Loss

- Example VoIP
  - Frequent small glitches vs. local burst (at same average loss rate)



  - Suppose users don't distinguish shorter from longer burst losses
    - At least for burst lengths in some range
  - Relevant metric: #of loss bursts
- Other examples:
  - MPEG video: compare burst loss duration to frame duration
  - TCP: compare burst loss duration to RTT

Methodology Idea

- Loss Episode
  - Defined as maximal sets of consecutive lost packets
  - Want to estimate duration of loss episodes
- Probe pairs sample transitions into and out of loss episodes
  - Loss Pair = a Bi-packet possible outcome from (0,0), (0,1), (1,0), (1,1)
  - 1 = loss, 0= no loss
- Poisson stream of bi-packet probes
  - Only need to *sample* from set of possible loss pairs
- Estimate loss episode frequencies and durations
  - From measured frequencies of bi-packet outcomes

Organization of -01 draft

- Section 2: bi-packet loss singleton metrics
  - a loss pair
- Section 3: general definition of samples for bi-packet loss
  - sets of loss pairs
- Section 4: active probing methodologies
  - sets of loss pairs produced by Poisson loss pair probes
- Section 5: burst loss proto-metrics
  - express burst loss metrics in terms of generic sets of loss pairs
- Section 6: burst loss metrics
  - these result by applying burst loss proto metrics to Poisson loss pairs of Sec. 4
- New in -01 draft
  - Use of burst loss proto metrics + organization of Sections 4,5,6
  - (Hopefully) more intuitive burst loss metrics names (see later)
  - Filled in RFC 2680 template (explicitly or by reference) for metric defintions

-01 Draft: Metrics and Associated Quantities

- Loss Pair
  - Generic outcomes from a bi-packet probes
- Type-P-One-way-Bi-Packet-Loss
  - Loss pair resulting from a bi-packet probe

Basic Bi-packet probe

- Type-P-One-way-Bi-Packet-Loss-Stream
  - Loss pairs resulting from a set of bi-packet probes
- Type-P-One-way-Bi-Packet-Loss-Geometric-Stream
  - Loss pairs from a discrete Poisson bi-packet probe stream (samples)

Streams of Bi-packet probes.

Prime example: geometric samples

- Burst Loss Proto-Metrics
  - Loss-Pair-Counts
    - Counts of different types of loss pair present in a sample
  - Bi-Packet-Loss-Ratio
    - Estimate of packet loss ratio from loss-pair-counts
  - Bi-Packet-Loss-Episode-Duration
    - Estimate of average loss episode duration from loss pair counts
  - Bi-Packet-Loss-Episode-Frequency .
    - Estimate of loss episode frequency form loss pair counts

Burst metrics from generic sets of loss pairs

- Type-P-One-way-Bi-Packet-Loss-Geometric-Stream-Ratio
  - Packet loss ratio derived from loss counts of Type-P-One-way-Bi-Packet-Loss-Geometric-Stream
- Type-P-One-way-Bi-Packet-Loss-Geometric-Stream-Episode-Duration
  - Average burst duration derived loss counts of Type-P-One-way-Bi-Packet-Loss-Geometric-Stream
- Type-P-One-way-Bi-Packet-Loss-Geometric-Stream-Episode-Frequency
  - Average burst freq. derived from loss counts of Type-P-One-way-Bi-Packet-Loss-Geometric-Stream

Final burst loss metrics: proto metrics acting on loss pairs of geometric probe stream

Type-P-One-way-Bi-Packet-Loss (as in -00 draft)

- Elementary 2 packet loss metric
- Parameters
  - Src, Dst IP address
  - T1 = sending time of the first packet
  - T2 = sending time of the second packet
  - F = a selection function
  - P = the specification of the packet type
- Metric Units
  - Loss Pair

Type-P-One-way-Bi-Packet-Loss-Stream (as -00 draft)

- Loss pairs resulting from set of bi-packet probes
- Parameters
  - Src, Dst IP address
  - (T11,T12), (T21,T22)....,(Tn1,Tn2) a set of n times of sending times for packet pairs, with T11 < T12 <= T21 < T22 <=...<= Tn1 < Tn2
  - F, a selection function
  - P, the specification of the packet type
- Metric Units
  - Resulting loss pairs L1, L2,...,Ln

Type-P-One-way-Bi-Packet-Loss-Geometric-Stream (as -00 draft)

- (Discrete time) Poisson set of bi-packet probes
  - Interval between probes = interval between packets within probe
- Parameters
  - Src, Dst, IP address
  - T time of first probe
  - d, time interval
  - n, number of posibble probe launches
  - q, per probe launch probability
  - F, selection function
  - P, the specification of the packet type
- Units
  - Loss pairs L1, L2, ..., Lm for some m <= n

Burst Loss Proto Metrics

- Convert set of loss pairs into burst loss metrics
  - Input: set of n loss pairs L1,…,Ln
- Pair Counts
  - Output: N(i,j) = #{loss pair type (i,j)} for (i,j) = (0,0), (0,1), (1,0), (1,1)
- Bi-Packet Loss Ratio
  - Output: (N(1,0) +N(1,1))/(2*n)
    - Average of single packet loss
    - Formally equivalent to Type-P-One-way- Packet-Loss-Average / RFC 2680
- Bi-Packet-Loss-Episode-Duration
  - Output:
    - 2*(N(0,1) + N(1,0) + N(1,1)/ (N(0,1)+N(1,0)) - 1 (when N(0,1) + N(1,0) >0)
    - 0 if N(0,1) + N(1,0) + N(1,1) = 0 (no probes lost)
  - Mean number of probe packets in a loss episode
- Bi-Packet-Loss-Episode-Frequency
  - Output:
    - (N(1,0)+N(1,1)) * (N(0,1)+N(1,0)) / (2*N(1,1)+N(0,1)+N(1,0)) / n if N(0,1)+N(0,1) > 0
    - 0 if N(0,1)+N(1,0) +N(1,1) = 0 (no loss), 1 if N(0,1) +N(1,0) +N(0,0) = 0 (all loss)
  - Average number of loss episodes per inter-probe time

Type-P-One-way-Bi-Packet-Loss-Geometric-Stream-Ratio

- Loss Ratio estimate from discrete Poisson set of bi-packet probes
- Parameters (as Type-P-One-way-Bi-Packet-Loss-Geometric-Stream)
  - Src, Dst, IP address
  - T time of first probe
  - d, time interval
  - n, number of possible probe launches
  - q, per probe launch probability
  - F, selection function
  - P, the specification of the packet type
- Units
  - A number in the interval [0,1]

Type-P-One-way-Bi-Packet-Loss-Geometric-Stream-Episode-Duration

- Loss episode duration estimate from set of discrete Poisson bi-packet probes
- Parameters (as Type-P-One-way-Bi-Packet-Loss-Geometric-Stream)
  - Src, Dst, IP address
  - T time of first probe
  - d, time interval
  - n, number of posibble probe launches
  - q, per probe launch probability
  - F, selection function
  - P, the specification of the packet type
- Units
  - A non-negative number

Type-P-One-way-Bi-Packet-Loss-Geometric-Stream-Episode-Frequency

- Loss episode frequency estimate from set of discrete Poisson bi-packet probes
- Parameters (as Type-P-One-way-Bi-Packet-Loss-Geometric-Stream)
  - Src, Dst, IP address
  - T time of first probe
  - d, time interval
  - n, number of posibble probe launches
  - q, per probe launch probability
  - F, selection function
  - P, the specification of the packet type
- Units
  - A non-negative number

Status and Next Steps

- Please read and comment
- Adoption as WG draft?