Defining Packet Reordering Metric

draft-shalunov-reordering-definition-00.txt

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Overview

- My definition: `draft-shalunov-reordering-definition-00.txt`
- Comments on `draft-critchley-mlas-reordering-00.txt`
- Comments on `draft-morton-ippm-nonrev-reordering-00.txt`

`draft-shalunov- ...`: Requirements

- Recognize that more parametrization is required than in the case of, e.g., delay
  - Poisson stream of test packets isn't enough any longer
  - Intrusive testing may be required
  - Short inter-packet-arrival times probably are required
  - Different applications care about different degrees of re-ordering
- Must be relevant for (at least some!) applications
- Must be computable on the fly for huge samples
- Would be very nice to be able to do algebra on it

`draft-shalunov- ...`: Definition

Notation: Let N be a non-negative integer (a parameter). Let K be a positive integer (sample size, the number of packets sent). Let L be a non-negative integer representing the number of packets that were received out of the K packets sent. Assign each sent packet a sequence number, 1 to K. Let $\langle S_1, \ldots, S_L \rangle$ be the original sequence numbers of the received packets, in the order of arrival.

Definition 1: Received packet number I ($1 \leq I \leq L$) is called *N-reordered* IFF there exist $N + 1$ different numbers I_J ($J = 1, \ldots, N + 1$) such that for all J, $I_J < I$ and $S_{I_J} > S_I$.

Let M be the number of N-reordered packets in the sample.

Definition 2: *The degree of N-reordering* of the sample is M/K.

This is essentially all there is to the draft.

`draft-shalunov- ...`: Metric's Properties

- Can be computed on the fly as packets come ("in a single pass"), just as delay, loss, and variance of delay
- requires $O(N)$ memory for any sample size (useful values of N are $0 \ldots 10$, so in practice a page of RAM is usually enough)
- Directly relevant to at least the following applications:
  - Audio/video with a fixed reordering correction buffer of N slots: effective loss = loss + N-reordering
  - TCP with a fixed `tcprexmtthresh` (BSD heritage dictates: `tcprexmtthresh` = 3): effective loss = loss + 3-reordering;

$$\text{Conjecture}: \qquad \text{throughput} \approx 0.7 \frac{\text{MSS}}{\text{delay}\sqrt{\text{effective loss}}}$$

- Reordering of path concatetation computes by convolution

Any questions before I move on to the other definitions?

`draft-critchley- ...`: Memory Use

- The draft states you need O(sample size) of memory
- Suppose we're interested in measuring reordering for the purposes of estimating its impact on TCP
- Suppose our target sustained TCP throughput is 1 Gb/s with MSS = 1500 B and delay = 70 ms
- How many packets are there required to measure loss or reordering adequately? Many times

$$2 \times (\text{throughput} \times \text{delay}/\text{MSS})^2 \approx 7 \times 10^7.$$

  So, perhaps 10^9 or 10^{10} packets would be enough.
- MLAS algorithm would require only 8–80 GB of RAM to compute the reordering metric (cf. 50 packets from section 3.1.1)

`draft-critchley- ...` : Application Relevance

- But even if we had 8–80 GB of RAM, what do we do with the metric once we obtain it?

- How does this metric affect our TCP throughput? It must be lower than what to give us 1 Gb/s TCP throughput with MSS = 1500B and delay = 70 ms?

- Or, for that matter, how do we understand and use that metric to predict or explain behavior of *any* application?

`draft-morton- ...`: cf. 0-reordering

- The definition of reordering from `draft-morton- ...` is exactly equivalent to 0-reordering from `draft-shalunov- ...`
- Discussion in paragraphs 2–5 on p. 4 is related to the more general case of $N \neq 0$.
- Lack of numeric measure for higher degrees of displacement than 1 would impede metric concatetation (convolution only works on whole distributions)
- Said lack also makes applying the metric to, e.g., TCP not directly possible
- It might make sense to merge the documents.

Summary

- The two drafts `draft-shalunov-reordering-definition-00.txt` and `draft-morton-ippm-nonrev-reordering-00.txt` appear to be similar and could probably be merged

- `draft-critchley-mlas-reordering-00.txt` is, on the other hand, very different. I find it problematic on two counts:
  - Perceived lack of relevance for any application
  - Impossible memory utilization requirements

Questions? Comments?