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2. Abstract

Various pieces of network testing equipment currently often report a characteristic that is referred to as a "degree (or percentage) of packet reordering". The way this metric is computed is often undocumented and it differs between vendors. Having a useful numeric measure of the degree of packet reordering is important for applications such as TCP and VoIP on different ends of the spectrum. However, the metric that makes sense for one application may have no or little applicability to another. This document introduces a definition of reordering metric that is hoped to be applicable to a number of different applications by parametrizing the metric.
3. N-Reordering Metric 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 <S_1, ..., S_L> be the original sequence numbers of the received packets, in the order of arrival.

Definition 1: Received packet number I (1 <= I <= L) is called *N-reordered* IFF there exist N+1 different numbers I_J (J = 1, ..., 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.

The degree of N-reordering may be expressed in percentage points, in which case the number from definition 2 is multiplied by 100.

4. Examples

This section is non-normative.

For sample size 2 and received packets with sequence numbers <2, 1> the degree of 0-reordering is 0.5 (or 50%). The degree of N-reordering for N > 0 is 0. (Informally, an application that processes packets as they arrive and has a reordering buffer of size 0, one packet—or 50% of packets sent—will be as good as lost; for any larger reordering buffer size, no packets will be as good as lost.)

For sample size 5 and received packets with sequence numbers <1, 4, 3, 2, 5> the degree of 0-reordering is 0.4; the degree of 1-reordering is 0.2; the degree of N-reordering for N > 1 is 0.

For sample size 5 and received packets with sequence numbers <1, 4, 3, 2> the degrees of N-reordering are the same as in previous example for all non-negative integers N.

For sample size 5 and received packets with sequence numbers <5, 4, 3, 2, 1> the degree of 0-reordering is 0.8; the degree of 1-reordering is 0.6; the degree of 2-reordering is 0.4; the degree of 3-reordering is 0.2; the degree of N-reordering for N > 3 is 0.
5. **RFC 2330 Considerations**

Within the framework of [RFC2330], the N-reordering metrics can only be interpreted in a meaningful fashion if, along with the metrics themselves and sample size, type of each packet and time when each packet was sent is reported.

6. **Area of Applicability and Choice of Parameter Values**

This section is non-normative.

Different applications will require different parameter values to obtain a metric that will be relevant to them.

For example, for a (hypothetical) VoIP application that has no buffer to accommodate reordering, 0-reordering metric on its traffic is meaningful. Namely, the sum of loss and 0-reordering will be the percentage of packets that the application cannot play back.

For bulk TCP, 2- or 3-reordering (plus loss) of its traffic will be more meaningful (because of Fast Retransmit).

If the metrics were to be computed with simulated traffic so that behavior of real applications with their real traffic could be extrapolated, different types of packets and different send schedules would of course be required to come up with meaningful numbers (e.g., not implying that these are necessarily the best choices, it could be evenly spaced stream of small UDP packets for VoIP or bursts of back-to-back MTU-sized TCP packets for TCP).

7. **Security Considerations**

This document doesn't define any protocol. The metric definition per se is believed to have no security implications.

8. **IANA Considerations**

This document requires nothing from IANA.
9. References


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