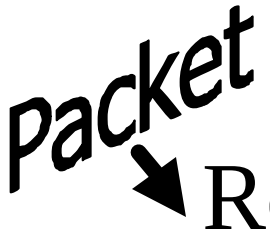

Reordering Metric for IPPM

`http://www.ietf.org/internet-drafts/draft-ietf-ippm-reordering-00.txt`

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July 15, 2002

Status of 00 draft

- **Three drafts considered in early 2002 and IETF-53**
  - ➔ **Support for this Metric, Combine all if possible**

	nonrev	N-reordering	MLAS
Process to determine In/Out Order	Pkt-by-pkt, singleton definition	Need partial sequence to current Pkt	Need complete sequence
Order & Quantificat. Dimensions	Message, Time, Byte Stream	Message (position only)	Message (position only)
Relation to App Perform	Yes, buffer analysis	Yes, buffer analysis	Yes, steps to restore order
Handles Packet Loss	Yes	Yes	Need complete sequence

- **Problem Statement - 2 parts**
  1. **Determine whether or not packet order is maintained (and which packets are reordered) *Section 4*.**
  2. **Quantify the extent of change (this will have many useful solutions) *Section 5*.**

Goals

- **Reordering Metrics MUST:**
  - ➔ **be relevant to 1 or more applications**
  - ➔ **be computable “on the fly”**
  - ➔ **work with Periodic/Poisson streams, & Duplic/lost packets**
- **Reordering Metrics SHOULD:**
  - ➔ **have concatenating results, also simplicity**
  - ➔ **be relevant to TCP or real-time performance assessment**

More to do:

- **Clarify Definition of N-Reordering**
- **More Examples with all Metrics**
- **Unify Notation**
- **More on "Sampling frequency and method influences results"**
- **More references to earlier work**
  - ➔ **Bennett, Partridge & Schectman, IEEE/ACM TransNet 10/99**
- ***Your comments ...***

Definition: Type-P-Non-Reversing-Order

- **Src applies a Message Number, Payload Number, or Time Stamp as the basis for determining order.**
- **Dst knows the "Next Expected"**

A reordered packet outcome occurs when :

The packet has a Src sequence number lower than the Next Expected, and therefore the packet is reordered. The Next Expected value does not change on the arrival of this packet.

On successful arrival of a packet with sequence number n:

```
if n >= NextExp, then    /* packet in-order */
        NextExp = n + payload_size + 1;
else                              /* when n < NextExp  */
        designate packet n as reordered;
```

Sample Metrics and Quantification (prob#2)

Type-P-packet-N-reordering-Poisson/Periodic-Stream

- **Let <S_1, S_2, . . . S_L> be the packet sequence numbers in order of arrival**

- **Definition 1:**
  Received packet I (N < I <= L) is called N-reordered IFF for all J such that I-N <= J < I we have S_J > S_I .

Sample Metrics and Quantification (prob#2)

Type-P-packet-Position-Offset-Poisson/Periodic-Stream

- Associate reordered packets with a specific sequence discontinuity (the arrival that skipped over their sequence number)

- Position Offset = DstOrder(reordered pkt) - DstOrder(pkt at discontinuity)

- or `The Position Offset of Reordered Packet I is M = I-J for min{J | 1 <= J < I} that satisfies S_J > S_I`

Type-P-packet-Late-Time-Poisson/Periodic-Stream

- Late Time = DstTime(reordered pkt) - DstTime(pkt at discontinuity)

Type-P-packet-Byte-Offset-Poisson/Periodic-Stream

- Byte Offset = (just the summation term ?)

Example 1

			4 reordered, Arrival order 1,2,3,5,6,7,8,4,9,10,11						
SrcNum		Time	Src	Dst			Dst	Posit.	Late
@Dst	NextExp	NextExp	Time	Time	Delay	IPDV	Order	Offset	Time
1	1	0	0	68	68		1		
2	2	1	20	88	68	0	2		
3	3	21	40	108	68	0	3		
5	4	41	80	148	68	-82	4		
6	6	81	100	168	68	0	5		
7	7	101	120	188	68	0	6		
8	8	121	140	208	68	0	7		
4	9	141	60	210	150	82	8	4	62
9	9	141	160	228	68	0	9		
10	10	181	180	248	68	0	10		

^^ when the ^^
packet arrives

In the notation of N-reordering, <S_1, … S_J, ... S_I, ..., S_L> the received packets are represented as:

1_1, 2_2, 3_3, 5_4, 6_5, 7_6, 8_7, 4_8, 9_9, 10_10

when N=1, 7<=J<8, and 8_7 > 4_8, so packet I=8 is 1-reordered.
when N=2, 6<=J<8, and 7_6 > 4_8, so packet I=8 is 2-reordered.
when N=3, 5<=J<8, and 6_5 > 4_8, so packet I=8 is 3-reordered.
when N=4, 4<=J<8, and 5_4 > 4_8, so packet I=8 is 4-reordered.
when N=5, 3<=J<8, and 3_3 < 4_8, so packet I=8 is not 5-reordered.
We note that the Position Offset is equal to the Max(N) with N-reordering.