



Reordering Metric for IPPM using Non-Reversing Sequence

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<http://www.ietf.org/internet-drafts/draft-morton-ippm-nonrev-reordering-00.txt>

Summary

- **Problem Statement - 2 parts**
 1. Determine whether or not packet sequence is maintained.
 2. Quantify the extent of sequence change (this will have many useful solutions).
- **Motivation - Sequence is often assumed**
 - ➔ Some technologies assume circuits, DKA Encapsulation
 - ➔ Restoring order requires detection/operations, finite ability
 - ➔ Multiple paths, processors, queues can cause it
- **Applicability (nonrev)**
 - ➔ Both Passive and Active
 - ➔ In/Out of Sequence declaration “on the fly”
 - ➔ Can be a Single Point Measurement
- **Sampling frequency and method influences results**

Definition Type-P-Sequence

- Src applies a Message Number, Payload Number, or Time Stamp as the basis for determining sequence.
- Dst knows the “Next Expected” = Reference Number

An out-of-sequence (OOS) packet outcome occurs when :

The packet has a Src sequence number lower than the Reference Number, and therefore the packet is late. The Reference Number does not change on the arrival of this packet.

On successful arrival of a packet with sequence number n:

```
if n >= RefNum, then  /* packet in-sequence */  
    RefNum = n + payload_size + 1;  
else                  /* when n < RefNum */  
    designate packet n as OOS;
```

Sample Metrics and Quantification (prob#2)

Type-P-Sequence-Poisson/Periodic-Stream

- Report count of OOS packets or ratio to total packets sent
- Sequence Discontinuities *may* be identified when $n > \text{RefNum}$, count them as sequence gaps/events

Quantification of sequence change

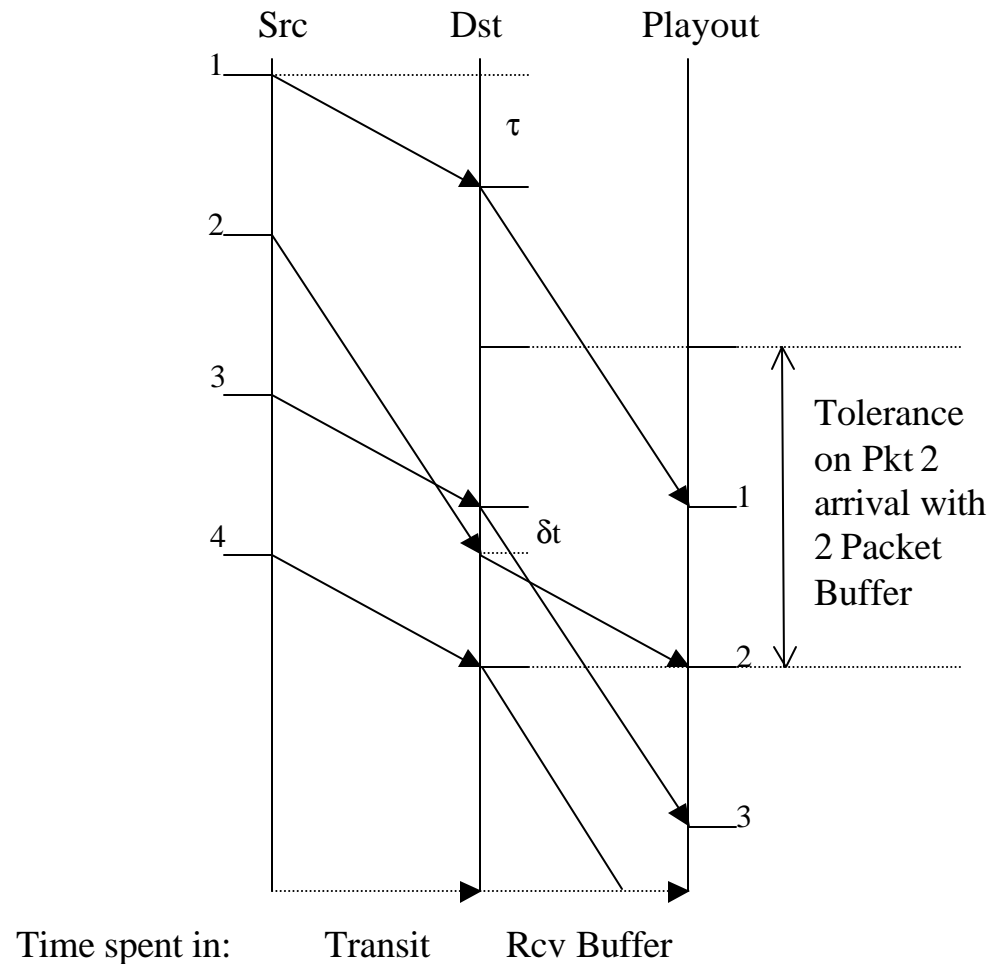
- Associate OOS (or Late) Packets with a specific sequence discon.
 - (the arrival that skipped over their sequence number)
- Late Offset = $\text{DstOrder}(\text{OOS pkt}) - \text{DstOrder}(\text{pkt at discontinuity})$
- Late Time = $\text{DstTime}(\text{OOS pkt}) - \text{DstTime}(\text{pkt at discontinuity})$

Example using Non-Reversing Sequence

Arriving Packets are compared with the “next expected” RefNum.

Packet 2 arrives Out-of-Sequence, since Packet 3 has arrived and the “next expected” packet is Packet 4.

Packet 2 is Offset by 1 packet, or Late by the arrival time of Packet 2 - Packet 3 = δt

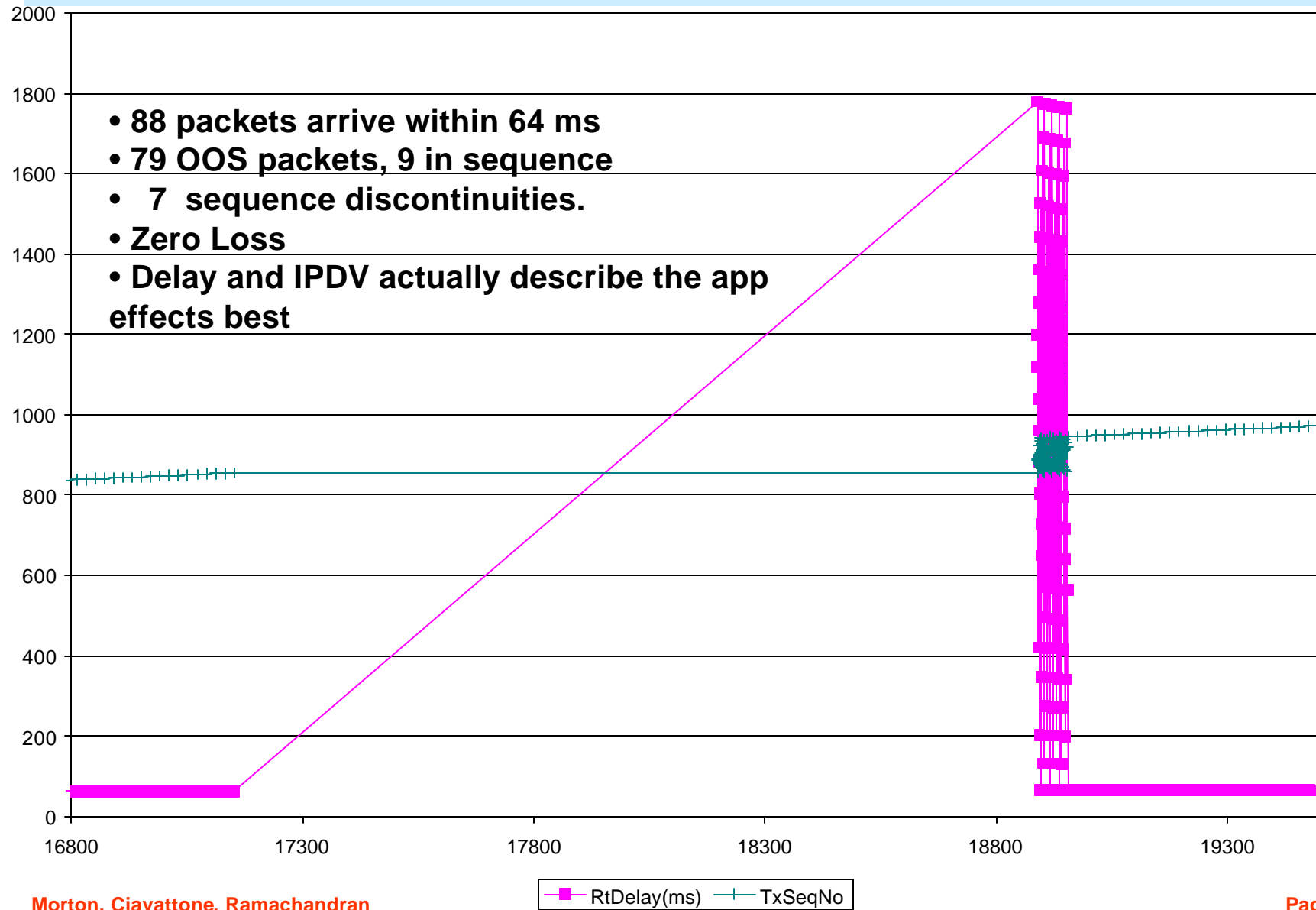


Example showing Late Offset and Time

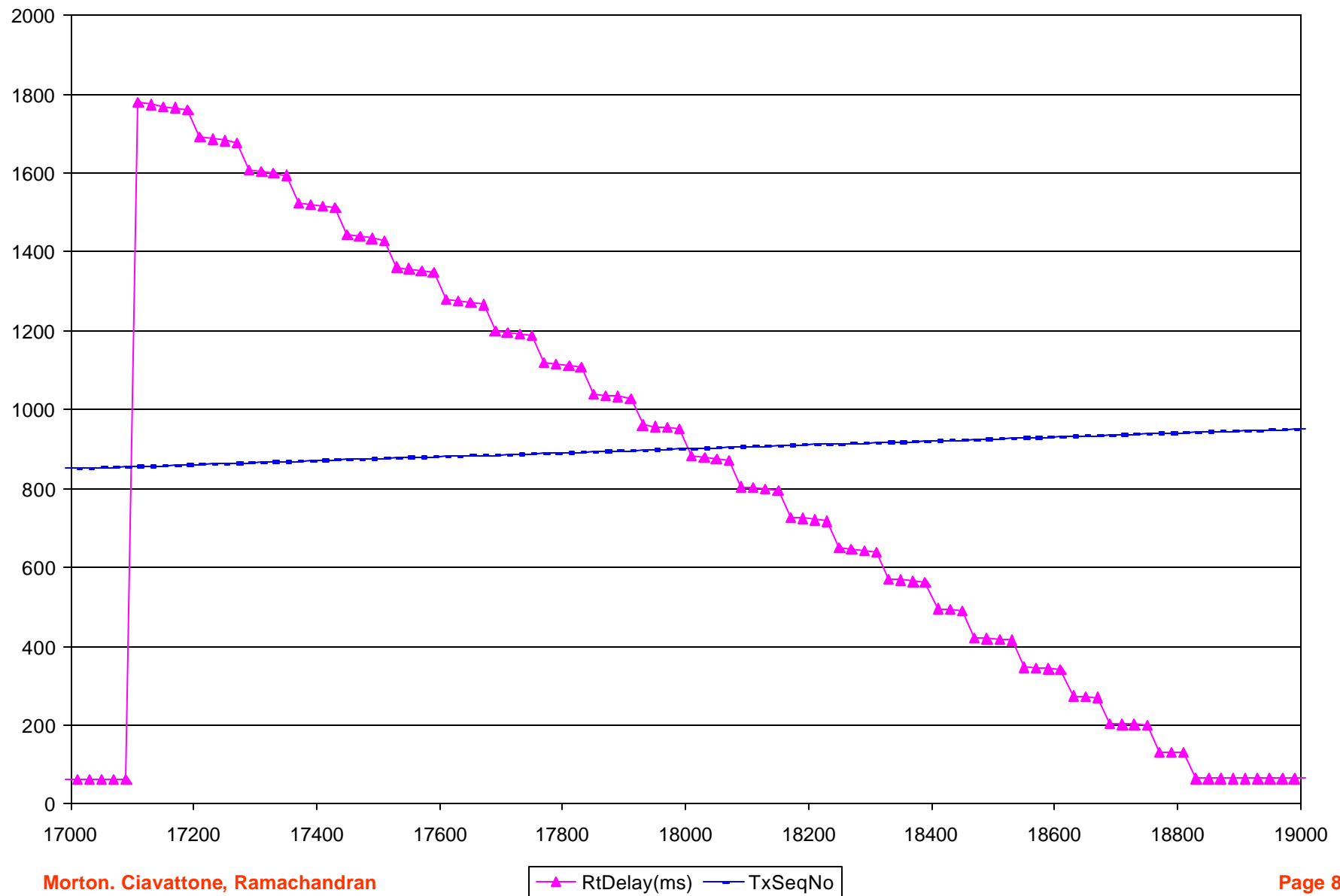
Late 4, Arrival order 1,2,3,5,6,7,8,4,9,10,11									
SrcNum		Time	Src	Dst			Dst	Late	Late
@Dst	RefNum	RefNum	Time	Time	Delay	IPDV	Order	Offset	Time
1	1	0	0	68	68		1		
2	2	1	20	88	68	0	2		
3	3	21	40	108	68	0	3		
5	4	41	80	148	68	-82	4		
6	6	81	100	168	68	0	5		
7	7	101	120	188	68	0	6		
8	8	121	140	208	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

Blender - Dst Time vs. Round Trip Delay



Blender - Src Time vs. RT Delay (SrcTime sort)



Comparison of Reordering Metrics

	nonrev	N-reordering (?)	MLAS (?)
Process to determine In/Out Seq.	Pkt-by-pkt, singleton definition	Need entire sequence to current Pkt	Need complete sequence
Sequence & 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

Conclusions (ours)

- **nonrev is a simple singleton metric for In/Out-of-Sequence, can use time/message/byte numbering.**
- **Late Offset and Late Time complement existing IPPM metrics (One-way Delay and IPDV) when describing the extent of sequence change**
- **N-reordering and MLAS quantify reordering in additional ways, some assessment efforts may find these useful**
- **All three drafts offer different ways to characterize sequence change - combine them on that basis**