A Hardware Timestamper for One-Way Delay Measurements

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Overview

- Why using hardware timestamper?
- Features of the hardware timestamper
- Measurements
- Summary

Why This Hardware Timestamper?

- We need more accurate timestamp for high-precision measurements, however,
  - Error of timestamp based on NTP can be several ms, or even worse when asymmetric routes are used
  - We can directly connect the measurement system to external time source (e.g. through RS232C), but the precision is still subject to software overhead

An OWAMP-Compliant Hardware Timestamper

- Features
  - PCI POS NIC (OC3/12)
  - Generates timestamps when sending or receiving a UDP packet
    - Supports both IPv4 and IPv6
    - The timestamp conforms to the format of OWAMP test packet
    - Currently only supports test packets in unauthenticated mode
    - Only generates timestamps for UDP packets using a specific port number, which is configurable
  - The clock can be synchronized with external time sources
    - Two kinds of signals: 1PPS,10MHz
  - Used external time sources
    - Symmetricom TymServe 2100 and HP 58503A
    - Both use GPS signal as input

Accuracy	HP 58503A	TymServe 2100
1PPS	<110ns	<2us
10MHz	1x10^(-12)s /day	48ms/day

Sender Behavior

OWAMP test datagram (with sender timestamp cleared)

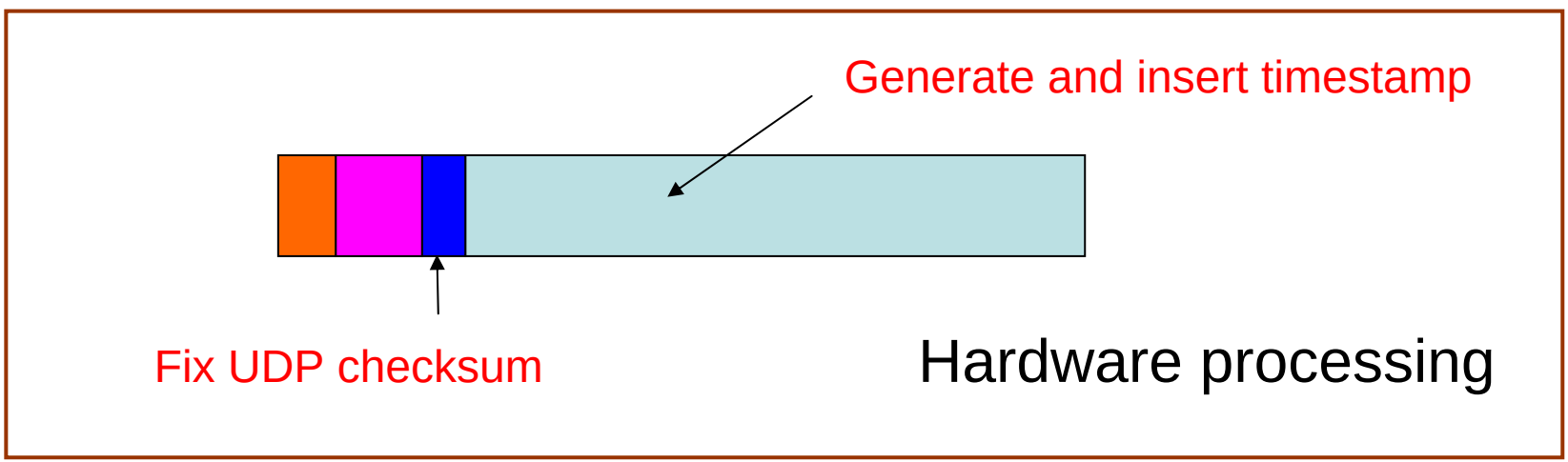
User ground

OWAMP application

Kernel

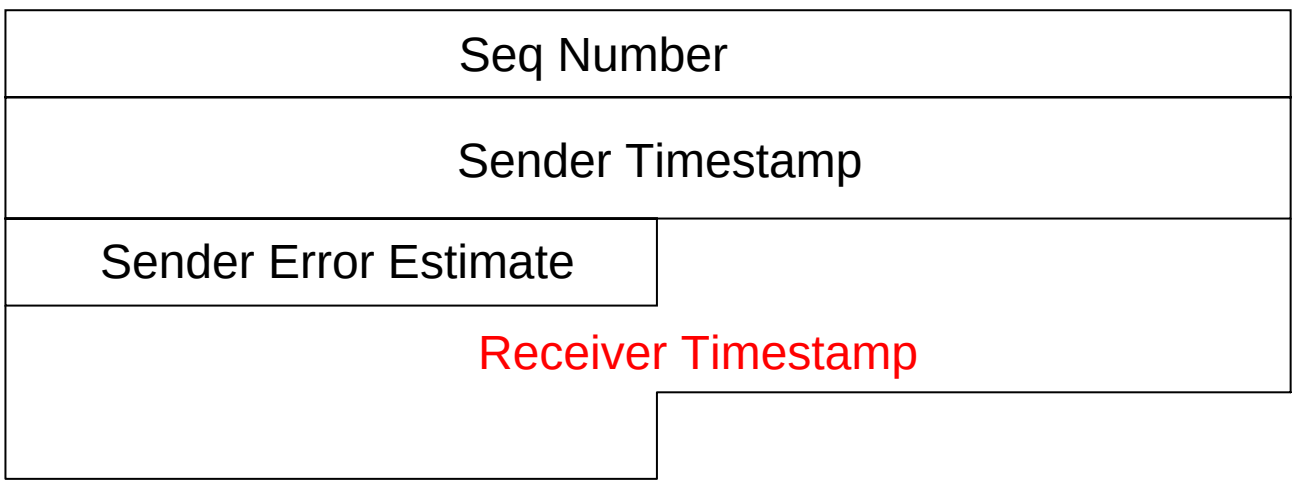
TCP/IP stack and driver routine

POS frame header IP header UDP header



Receiver Behavior

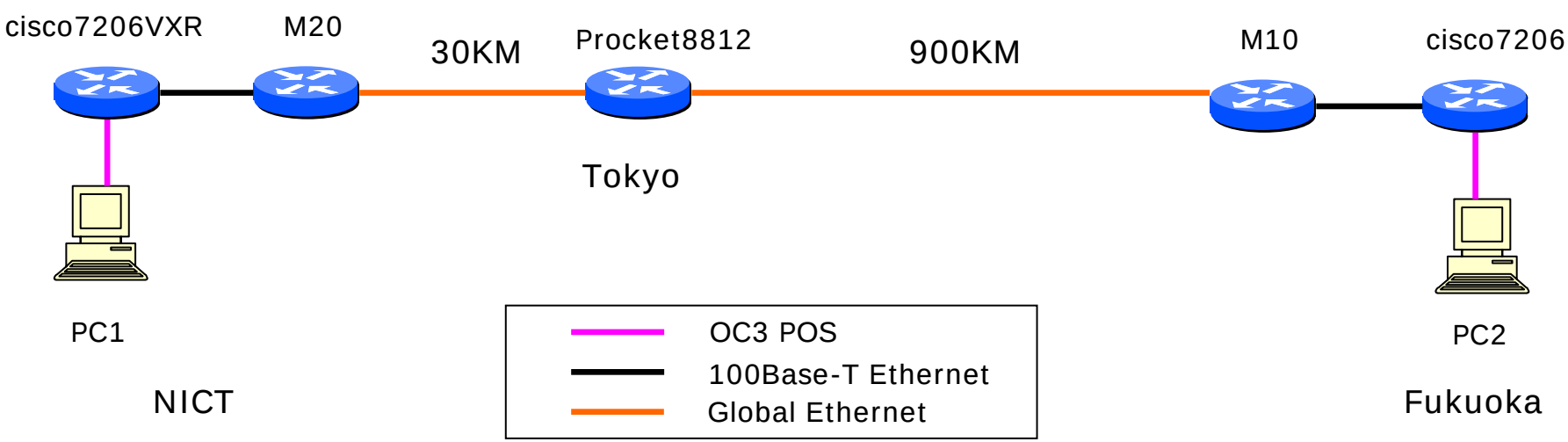
- When a packet arrives at the interface, it
  - Generates a timestamp (hardware)
  - Inserts the timestamp
  - Clears UDP checksum
  - Passes the packet to upper layer



Measurements Using the Hardware Timestamper

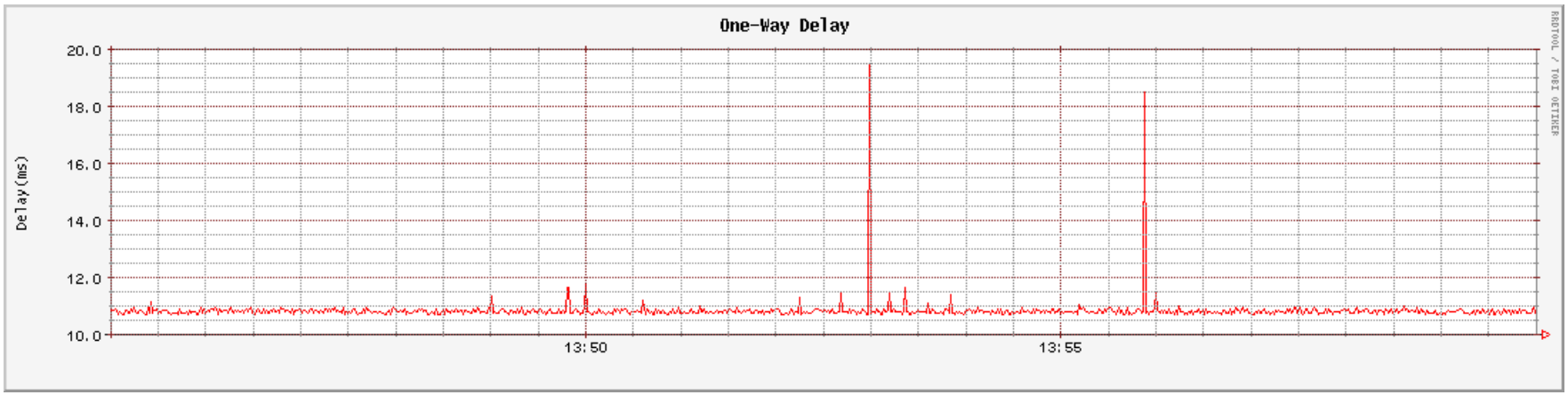
- Four kinds of OWAMP test packets used
  - IPv4, v6 packets with 64-byte, 1400-byte payload
  - One packet per second is sent for each type

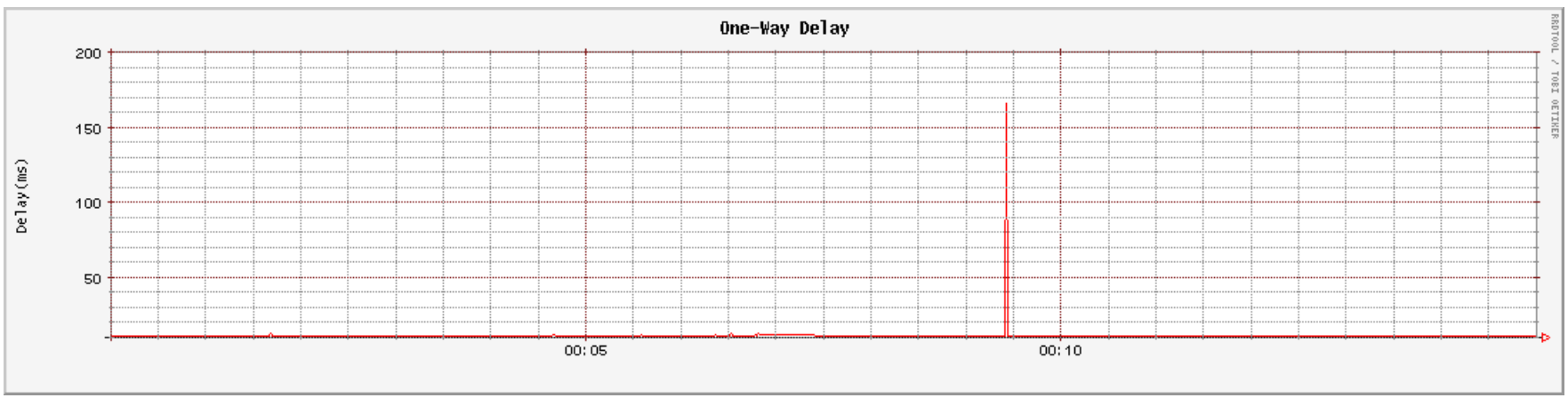
Topology of the measured network



Measurement Results (Cont'd)

7/27 IPv4, 64 bytes

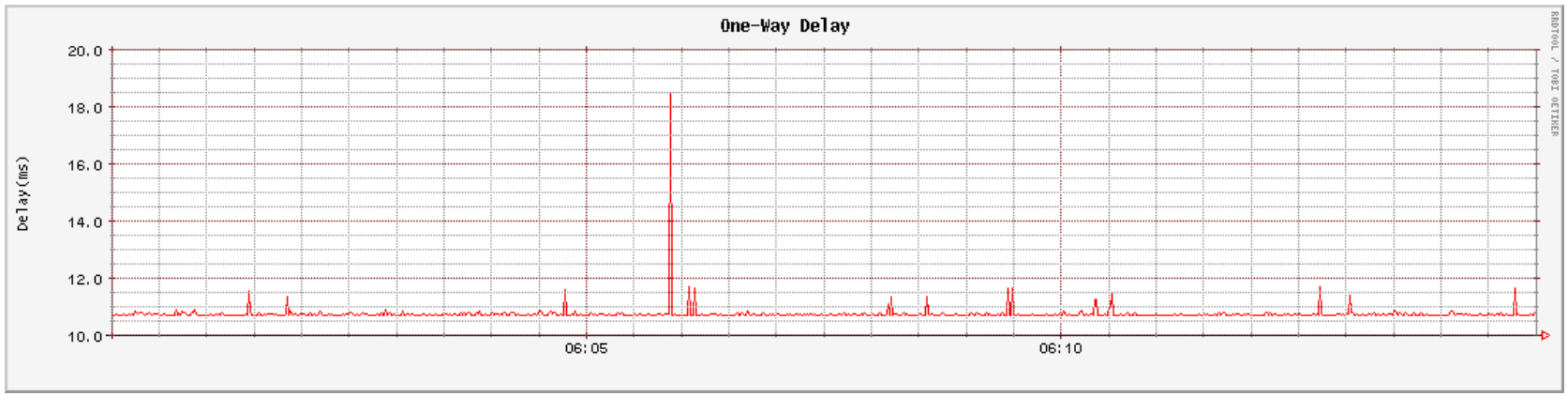




In most time, the one-way delay is around 10.7ms.

Measurement Results

7/27 IPv6, 64 bytes



- More measurement results are available at
  - http://pe2.koganei.wide.ad.jp/cgi-bin/owd-stat
  - http://qpe.jp.apan.net/cgi-bin/owd-stat

Summary

- A hardware timestamper which generates high-precision timestamp for OWAMP test packets
- It can be used in other OWAMP implementations with a few modifications
  - Specify port numbers of test packets in both the sender and receiver side
  - For receiver, use the hardware-generated timestamp when calculating one-way delay
- If the WG decides to publish an implementation report of OWAMP, we would like to contribute