Using IEEE-1588™ Hardware as a PDV Measurement Tool

Conference on IEEE-1588

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Presentation Outline

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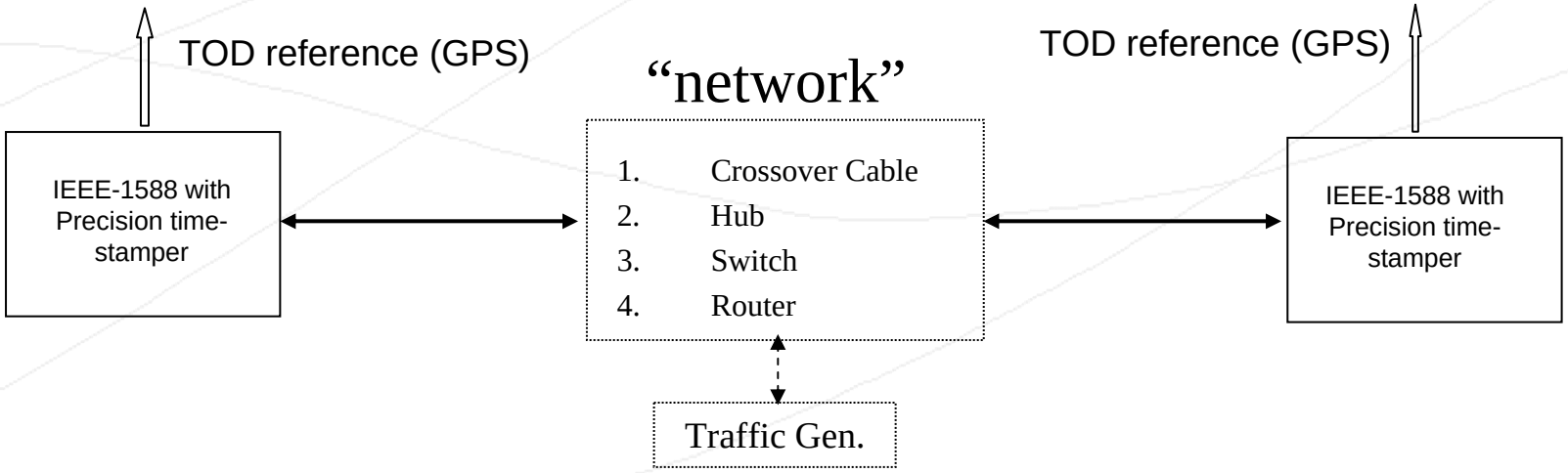
- Measurement Set-Up
  - Network configurations
- Performance Metrics
  - Phase data, sequential Time Interval Error data
  - Maximum Time Interval Error, MTIE
  - Time Deviation, TDEV
  - Standard Deviation of the Time Error
- Observations

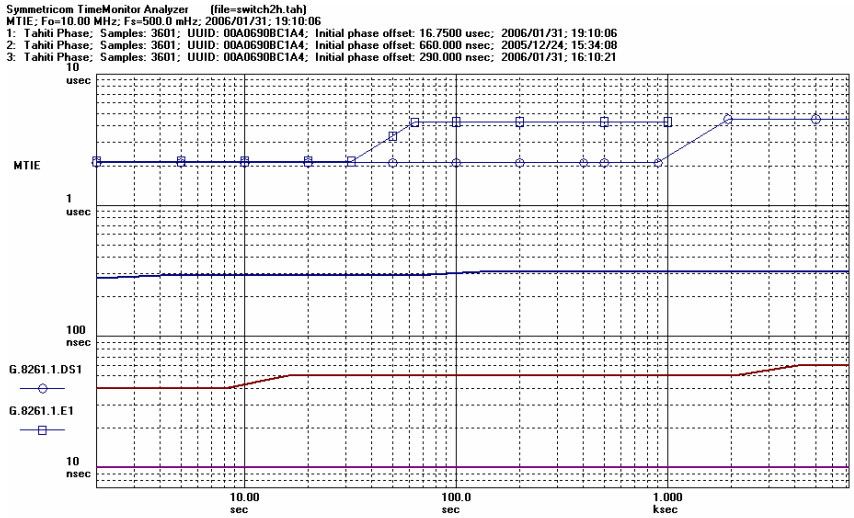
SET-UP

- Measurement equipment that has a precise hardware time-stamping feature on each 1588 port
- GPS time-of-day reference in each unit
  - Required for sub-microsecond end-to-end analysis
  - Log-files of the time-stamp data is post-processed
- Network configurations
  - Baseline, e.g. no traffic
  - With traffic load, based upon G.8261 “Data” profile

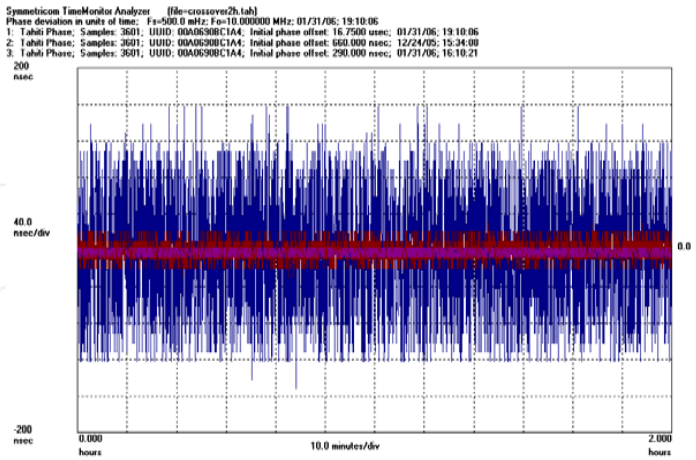


Performance Metrics

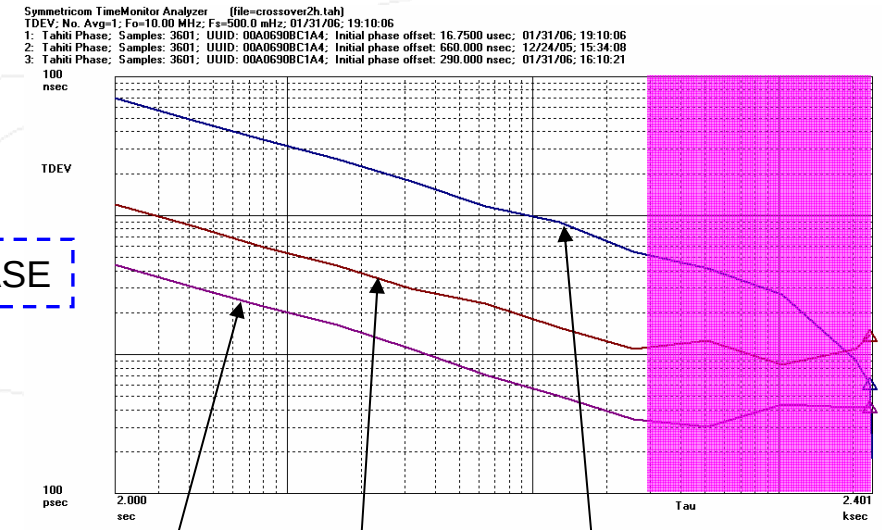
- Time Interval Error, TIE or Phase
  - Basis for all PM data sets
- Maximum Time Interval Error
  - defined in G.8261
- Time Deviation, TDEV
  - Defined in ANSI T1.101



MTIE



PHASE



TDEV

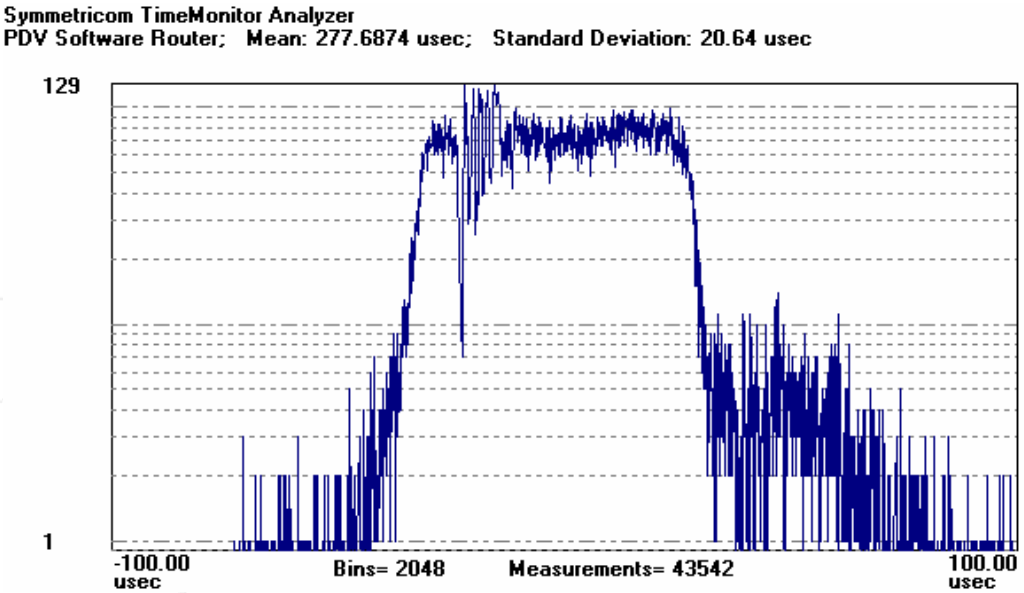
Crossover

Hub

Switch

Performance Metrics Con't

- Statistics
- Mean Deviation
- Peak to Peak Deviation
- Standard Deviation



Statistics

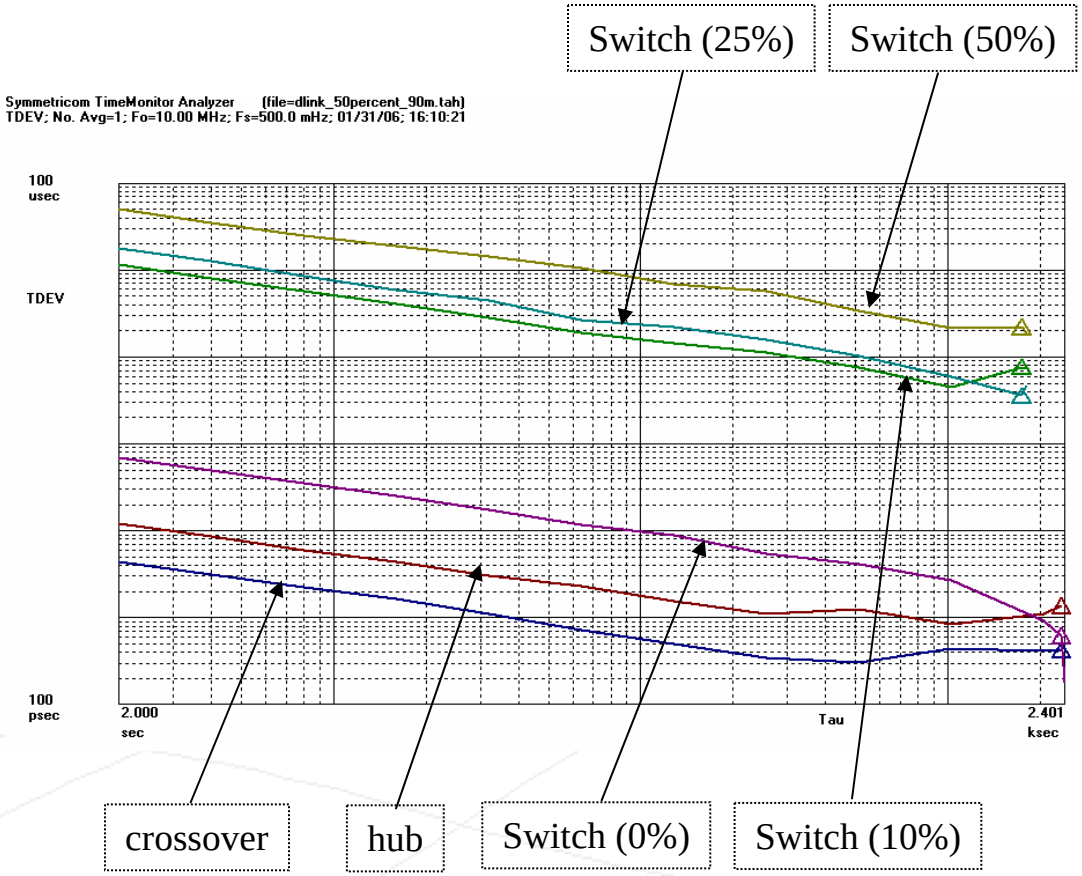
Crossover cable:
Mean: 287.2818 nsec
Peak to Peak: 10.01 nsec
Standard Deviation: 4.450 nsec

Hub:
Mean: 659.7955 nsec
Peak to Peak: 60.01 nsec
Standard Deviation: 12.13 nsec

Switch:
Mean: 16.75112 μsec
Peak to Peak: 310.0 nsec
Standard Deviation: 70.10 nsec

Router:
Mean: 277.6874 usec
Peak to Peak: 212.5 usec
Standard Deviation: 20.64 usec

Performance as a Function of Load



Statistics

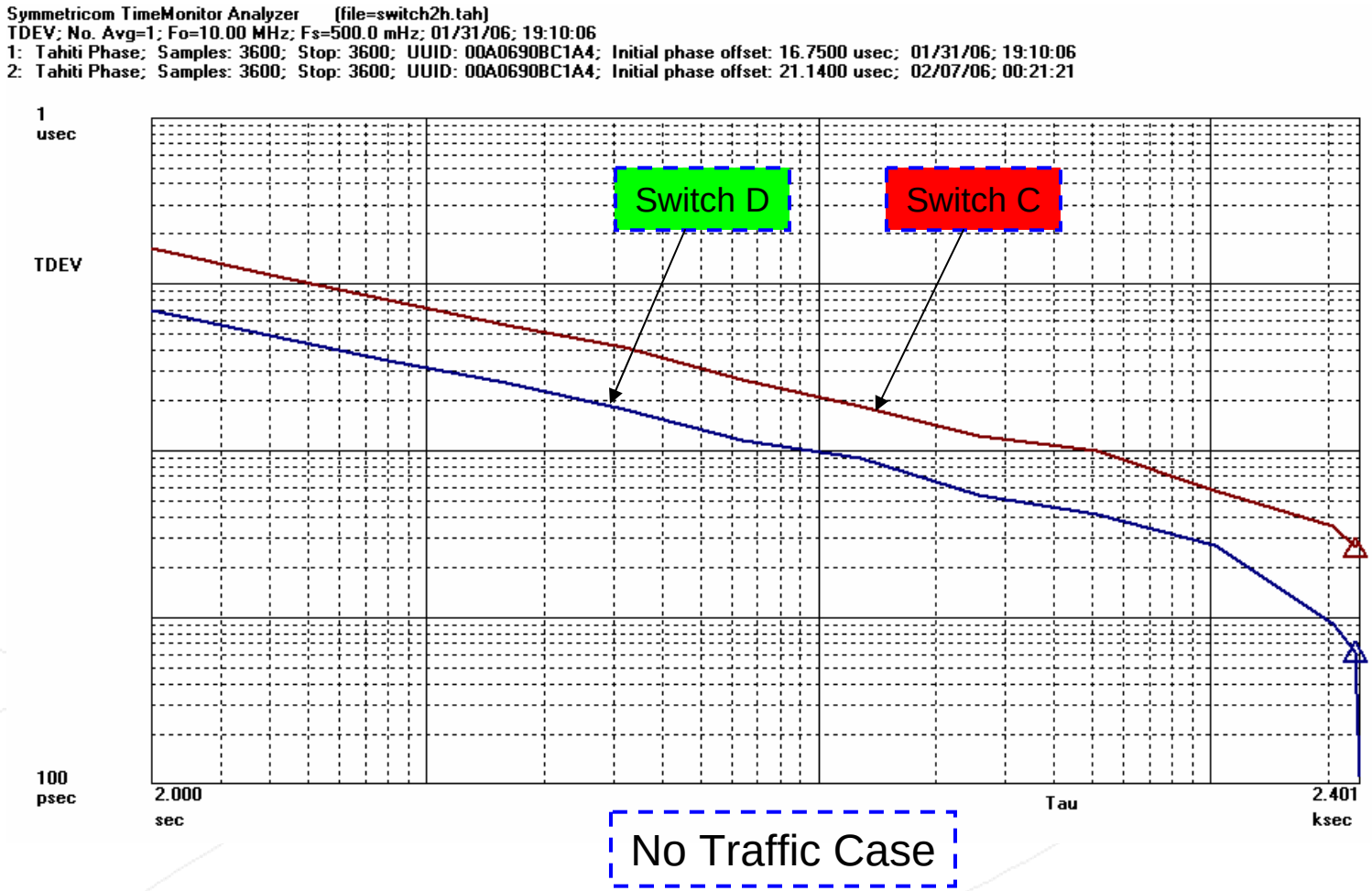
No traffic:
Mean: 16.75112 µsec
Peak to Peak: 310.0 nsec
Standard Deviation: 70.10 nsec

10% BW Utilization:
Mean: 17.93500 µsec
Peak to Peak: 121.4 µsec
Standard Deviation: 11.53 µsec

25% BW Utilization:
Mean: 19.62525 µsec
Peak to Peak: 122.6 µsec
Standard Deviation: 17.61 µsec

50% BW Utilization:
Mean: 47.99551 µsec
Peak to Peak: 122.8 µsec
Standard Deviation: 50.90 µsec

Not All Elements are *Equal*



No Traffic Case

Not All Elements are *Equal* Con't

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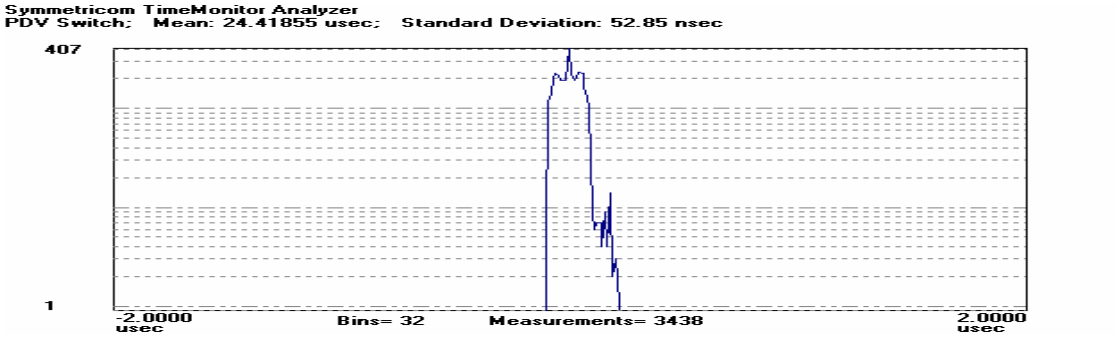
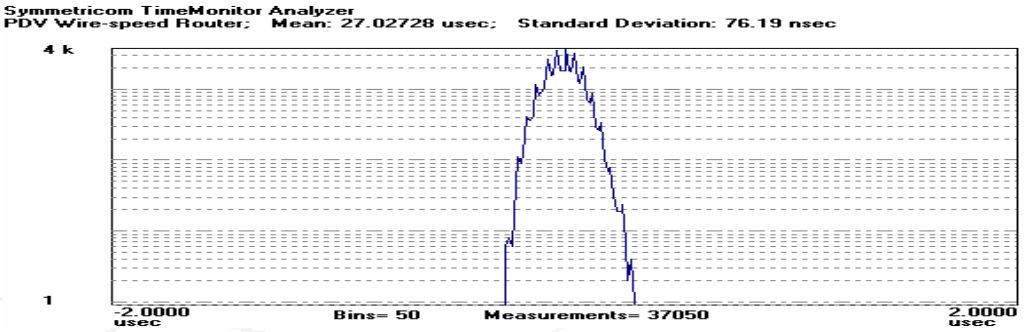
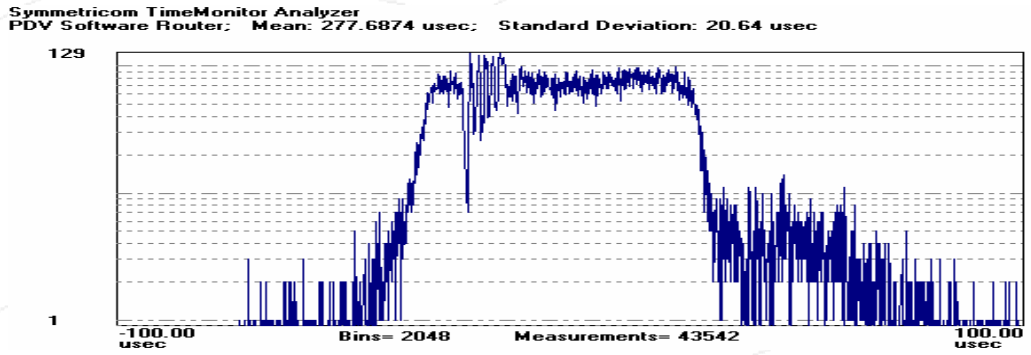
Switch vs. Wire-speed router vs. Software router







Statistics

Switch:

Mean: 24.41855 µsec

Peak to Peak: 334.8 nsec

Standard Deviation: 52.85 nsec

Wire-speed router:

Mean: 27.02728 µsec

Peak to Peak: 576.0 nsec

Standard Deviation: 76.19 nsec

Software router:

Mean: 277.6874 µsec

Peak to Peak: 212.5 µsec

Standard Deviation: 20.64 µsec

Observations

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- For constrained networks (few elements):
  - TDEV or Standard Deviation metrics for PDV provide network characterization and can be used in addition to existing QoS elements such as packet delay and loss
  - Hypotheses for TDEV or StDEV
    - Can be used to “compare” network element performance
    - Can be used to specify packet network performance (in conjunction with delay, loss, etc.)
    - Can be used to define network performance under load
    - Can be used to “tune” the network

Thank You

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Questions?

Suggestions?