

Suitability of Packet Timing Metrics in Real Applications

ITSF November 2008

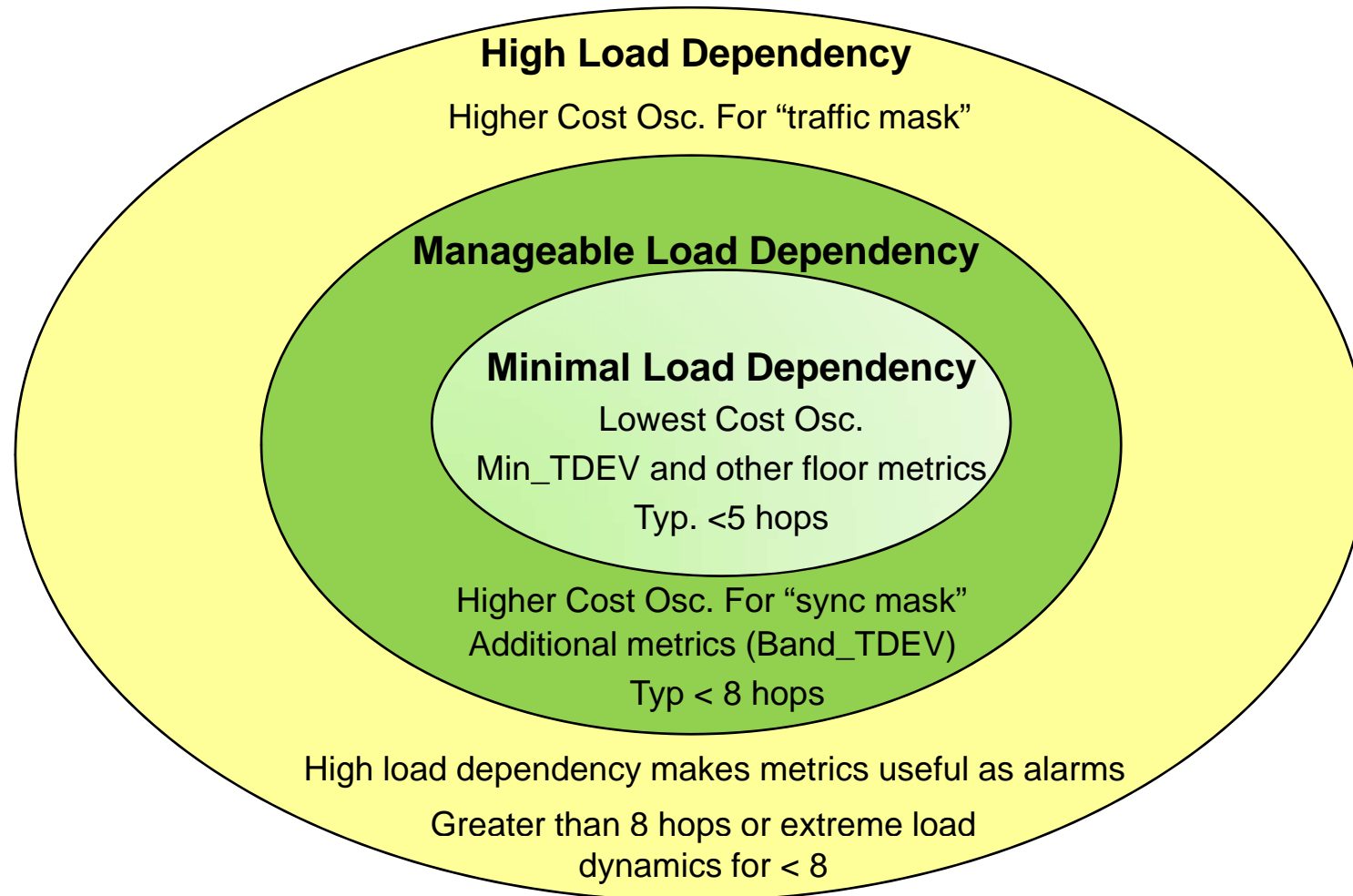
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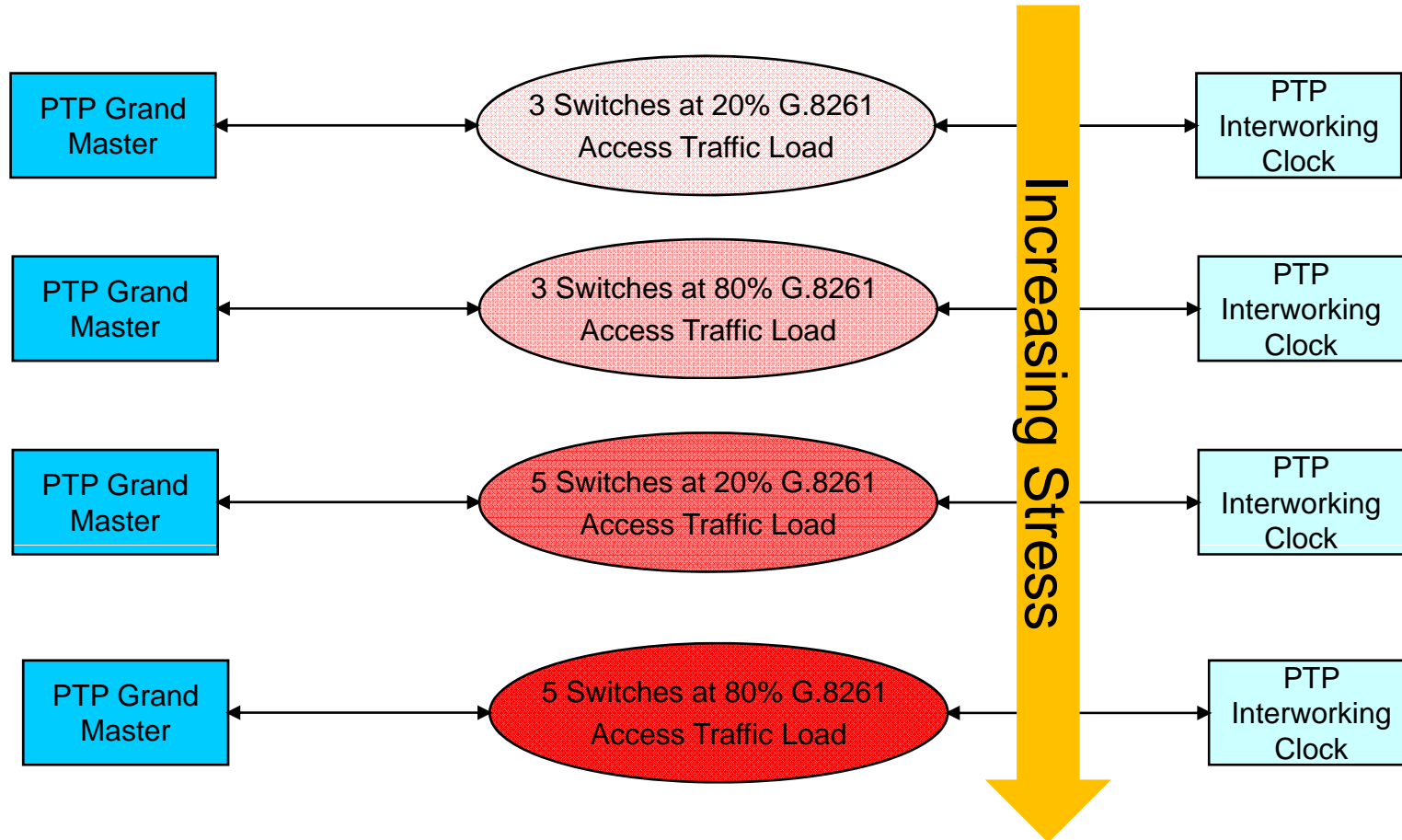


- ▶ Packet Timing Operating Principles
- ▶ Testing Scenarios
 - Test Networks
 - PTP Reference Clock Model
 - Metrics
- ▶ Testing Results
 - Best Case
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- ▶ Metric Suitability Examined

Packet Timing Operating Principles



Test Networks



The Symmetricom reference interworking clock ⁽¹⁾ utilizes the following parameter settings :

- Proportional TAU: 60s;
- Damping Factor: 2.0
- Oscillator Model (Type 1 OCXO for test purposes)
- Update rate: 64 Hz (Sync Message Rate)
- Floor selection window: 16s.
- Floor selection method: percentile offset
- Offset measurement noise floor: 5ns.

(1): ITU SG15 – C644 *Packet Timing (IEEE 1588, NTP) Telecom Reference Clock Model*, Symmetricom, May 2008

The following metrics are collected for each case:

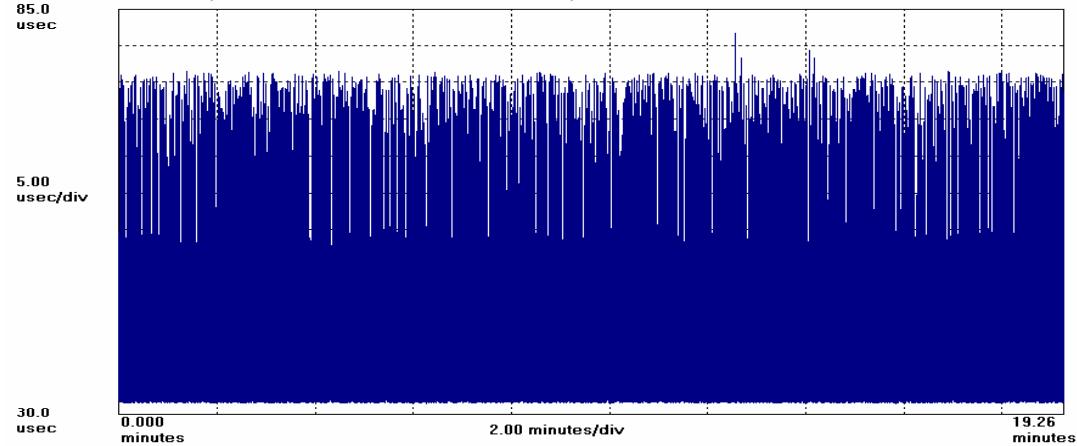
- **Reference PDV:** One-way offset of sync packets from the Grandmaster clock to the PTP interworking clock. The offset data is observed using two packet timing probes operating in a passive mode at both the ingress and egress points with common (Caesium) **Reference** .
- The probe data collected above is post processed to extract an estimate of TDEV, min_TDEV and percentile TDEV ⁽²⁾. The Symmetricom Time Analyzer application is used to perform this function.
- The Symmetricom Reference client provides TDEV family Performance Monitoring data (*without common reference*). Four windows are reported: 2, 4, 8 and 16 seconds. A noise reduction factor is also reported for enhanced estimation as discussed later.

(2): Metrics first described in Symmetricom ITU SG15 – C363, C364, C360, C359 , 2007

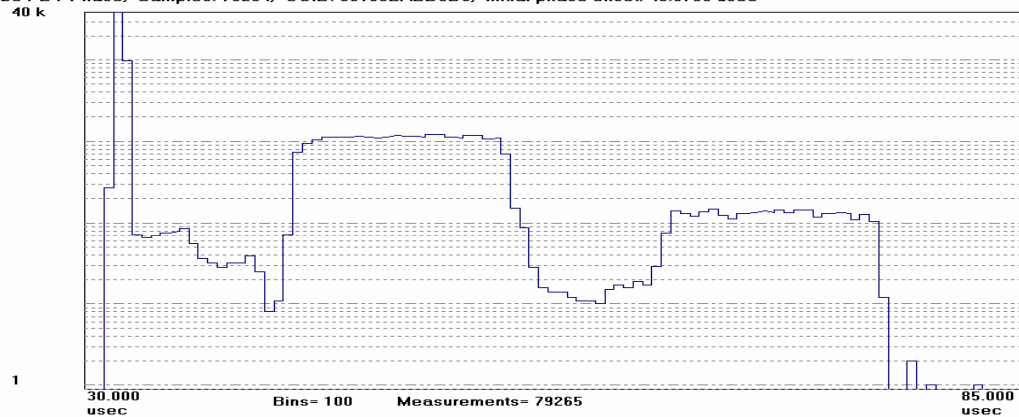
Best Case A: 3 Nodes 20% Load PDV offset histogram and raw data



Symmetricom TimeMonitor Analyzer
Phase deviation in units of time: Fs=68.59 Hz; Fo=10.000000 MHz; 2008/04/14 18:48:51
Phase: Samples: 79265
Probe PDV Phase: Samples: 79264; UUID: 00188BABD0D9; Initial phase offset: 46.5760 usec



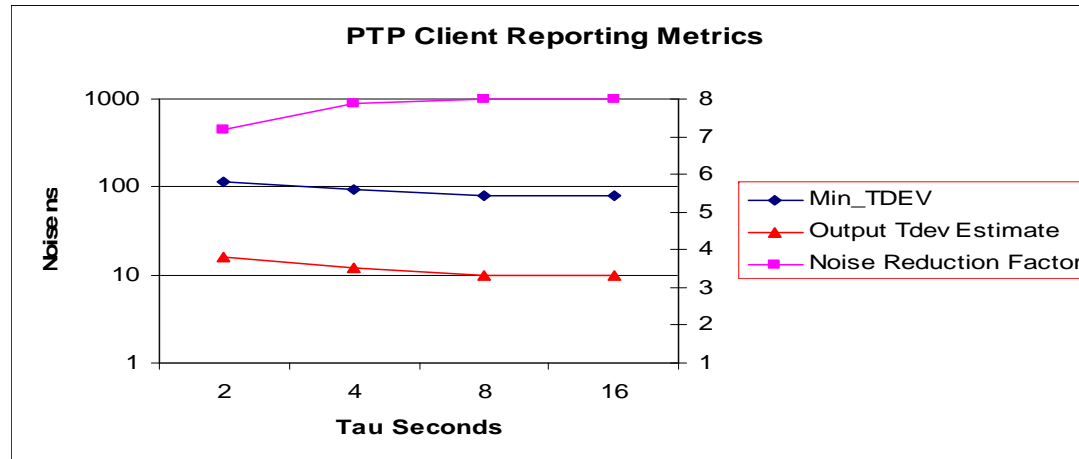
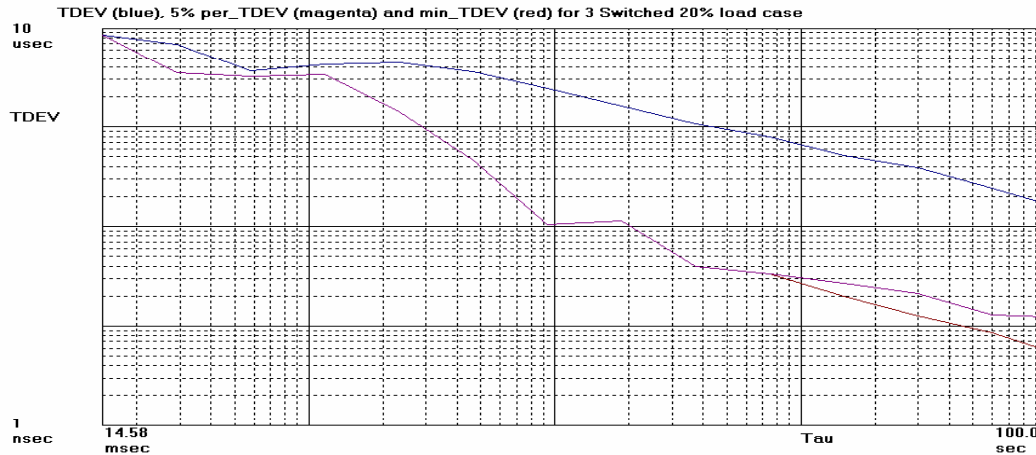
Symmetricom TimeMonitor Analyzer
Phase Deviation Histogram; Fs=68.59 Hz; Fo=10.00 MHz; 2008/04/14 18:48:51
Phase: Samples: 79265
Probe PDV Phase: Samples: 79264; UUID: 00188BABD0D9; Initial phase offset: 46.5760 usec



Best Case A: 3 Nodes 20% Load Derived Packet Related Performance Metrics



Symmetricom TimeMonitor Analyzer
: 2008/04/14: 18:48:51

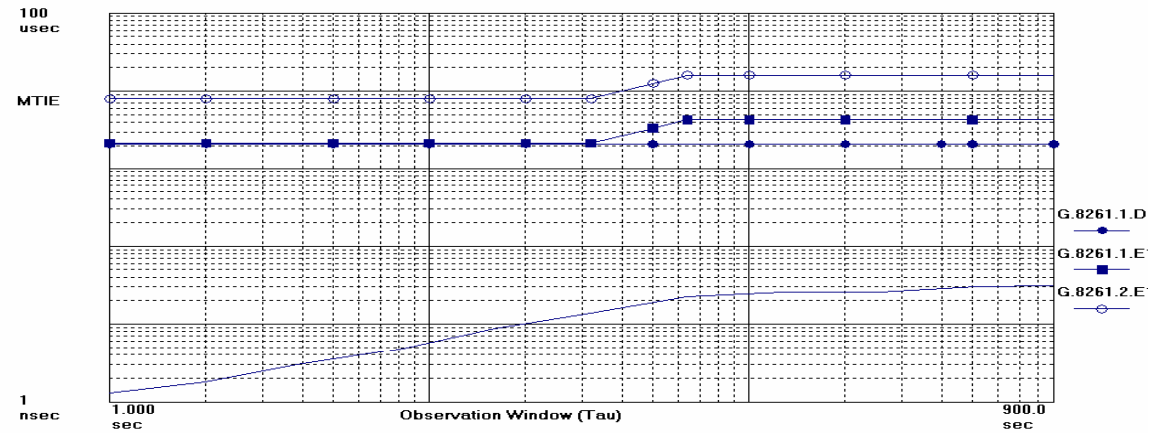


Note Output TDEV is under Min_TDEV level because of noise reduction factor in servo

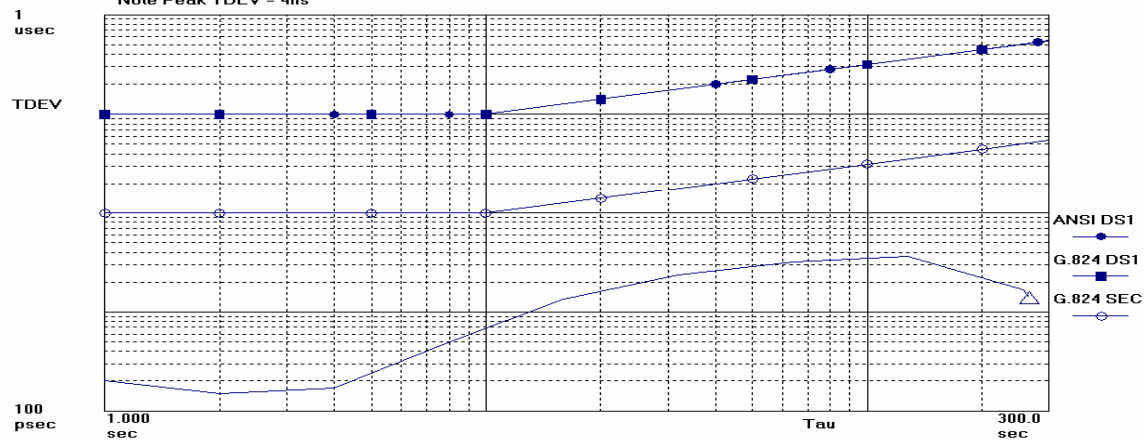
Best Case A: 3 Nodes 20% Load Interworking Clock Actual Output Performance



Symmetricon TimeMonitor Analyzer
MTIE Compliance Symm PTP Interworking Clock Output: 2008/04/14: 11:49:32
3 Switches 20% Load case



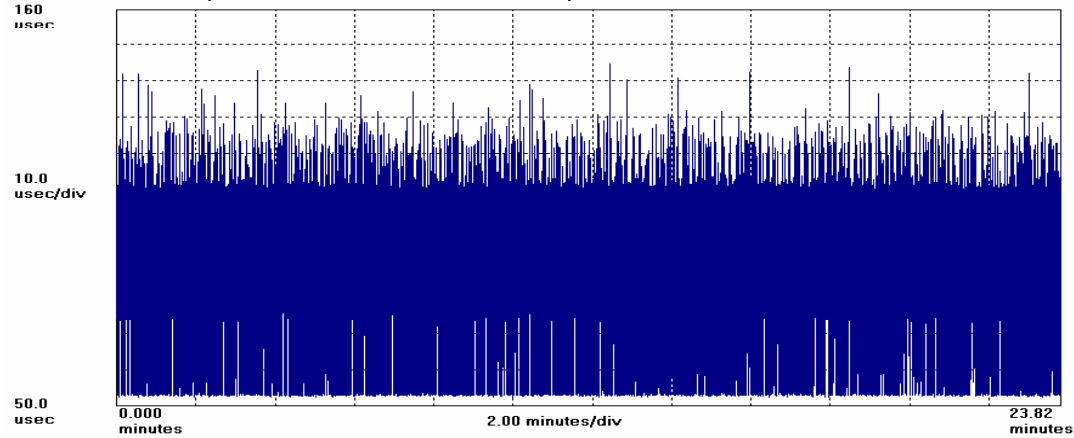
Symmetricon TimeMonitor Analyzer
: 2008/04/14: 11:49:32
3 Switches 20% Load case
Note Peak TDEV = 4ns



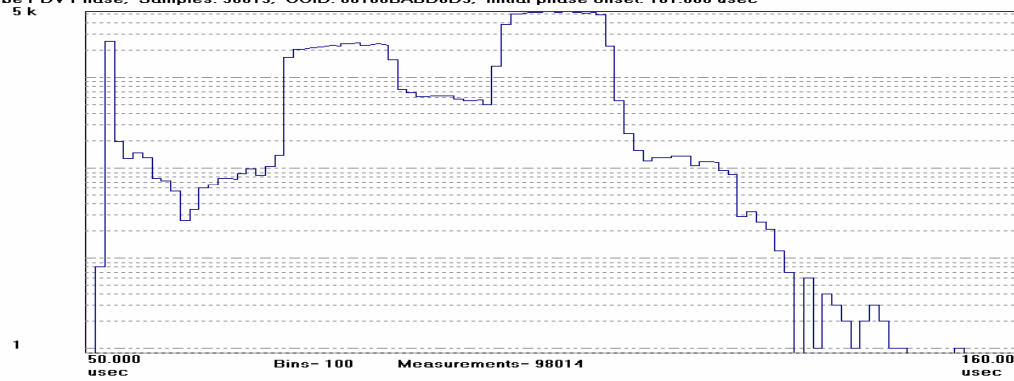
Worse Case D: 5 Nodes 80% Load PDV offset histogram and raw data



Symmetricom TimeMonitor Analyzer
Phase deviation in units of time: Fs=68.58 Hz; Fo=10.000000 MHz; 2008/04/14 16:35:12
Phase: Samples: 98014
Probe PDV Phase; Samples: 98013; UUID: 00188BABD0D9; Initial phase offset: 101.800 usec



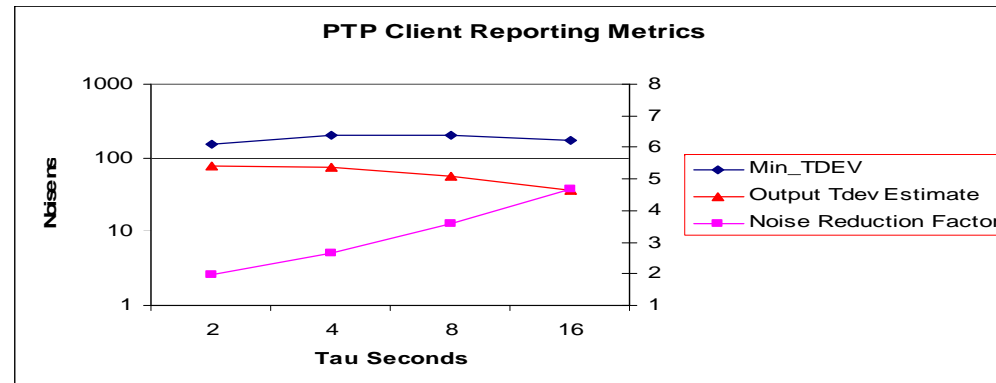
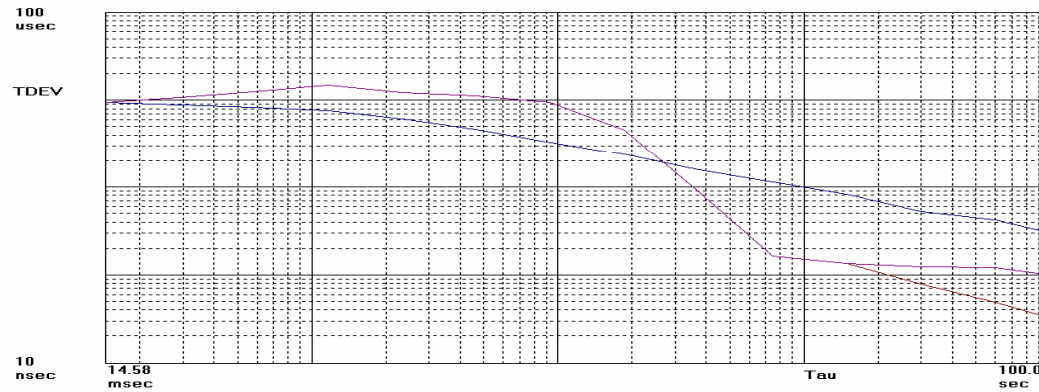
Symmetricom TimeMonitor Analyzer
Phase Deviation Histogram: Fs=68.58 Hz; Fo=10.00 MHz; 2008/04/14 16:35:12
Phase: Samples: 98014
Probe PDV Phase; Samples: 98013; UUID: 00188BABD0D9; Initial phase offset: 101.800 usec



Worse Case D: 5 Nodes 80% Load Derived Packet Related Performance Metrics



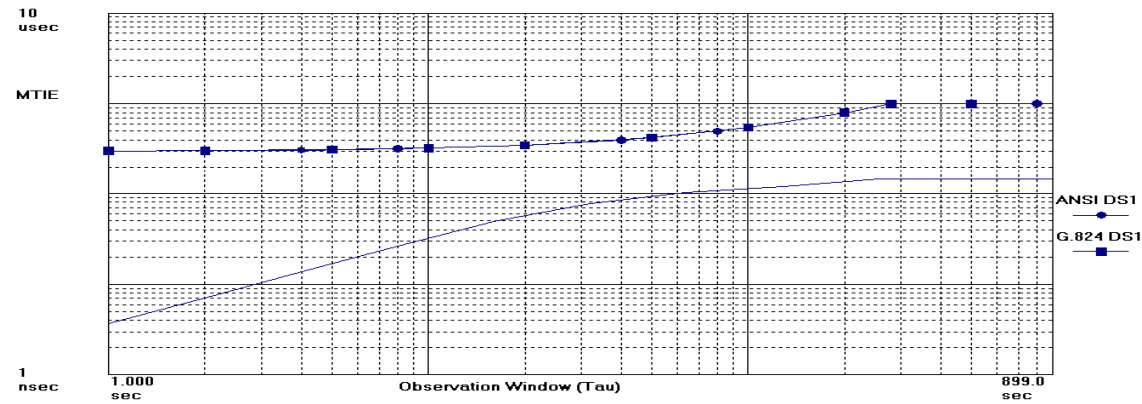
Symmetricom TimeMonitor Analyzer
TDEV Probe Metrics: TDEV (blue), 1% per_TDEV red, min_TDEV magenta; 2000/04/14: 16:35:12



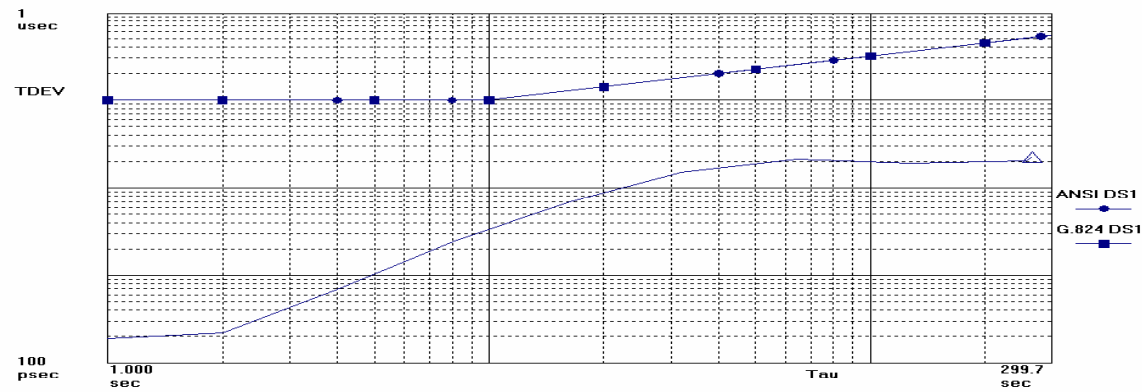
Worse Case D: 5 Nodes 80% Load Interworking Clock Actual Output Performance



Symmetricom TimeMonitor Analyzer
MTIE Compliance Symm PTP Interworking Clock: 2008/04/14: 09:42:48
5 Switches at 80% load



Symmetricom TimeMonitor Analyzer
TDEV Compliance Symm PTP Interworking Clock: 2008/04/14: 09:42:48
5 Switches at 80% load



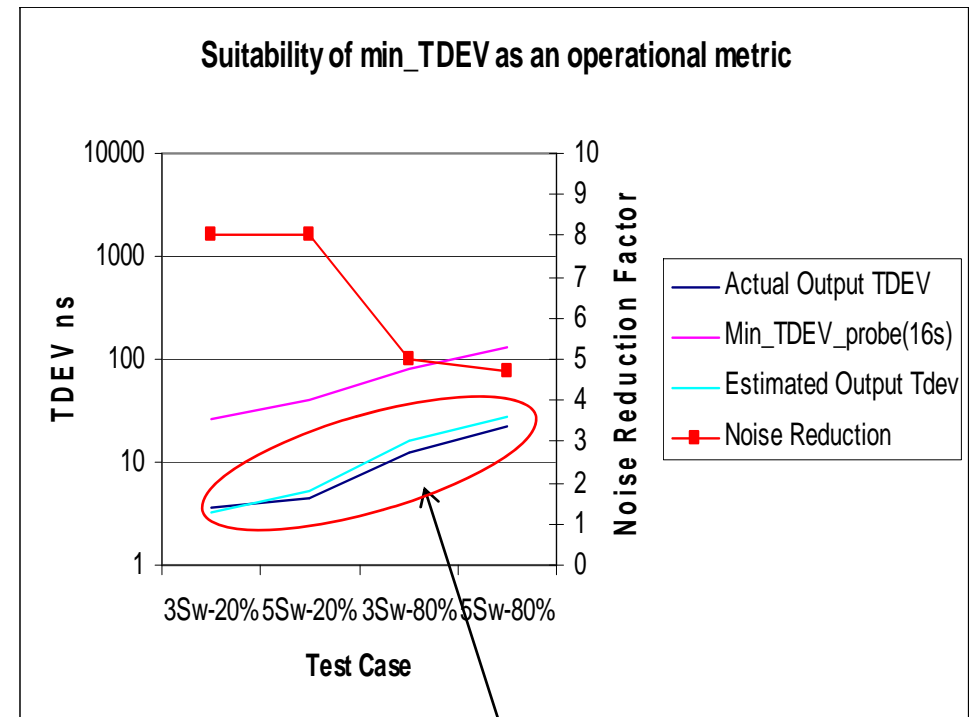
Suitability of min_TDEV Metric for this (Minimal Load Dependency) Use Case



The actual TDEV performance (dark blue) shows the output maximum TDEV as measured against the house caesium standard. The performance ranges from 4ns (20 Load 3 switches) to 22ns (80% Load 5 switches).

The Min_Tdev performance of the PTP packet flow at the input to the reference clock is also showed (magenta line). The Min_Tdev performance metric provides a good operational bound of the actual client performance.

The noise reduction factor is reported by the reference client (red line and the secondary axis). The improvement factor is based on the density of points near the minimum floor as well as the loop dynamics. The improvement factor ranges from 8 down to 4.5 for the four cases. The enhanced performance estimate termed estimated output TDEV (light blue line) shows excellent agreement with the actual measured performance for all four test cases.



Excellent Agreement between Metrics and Actual Performance