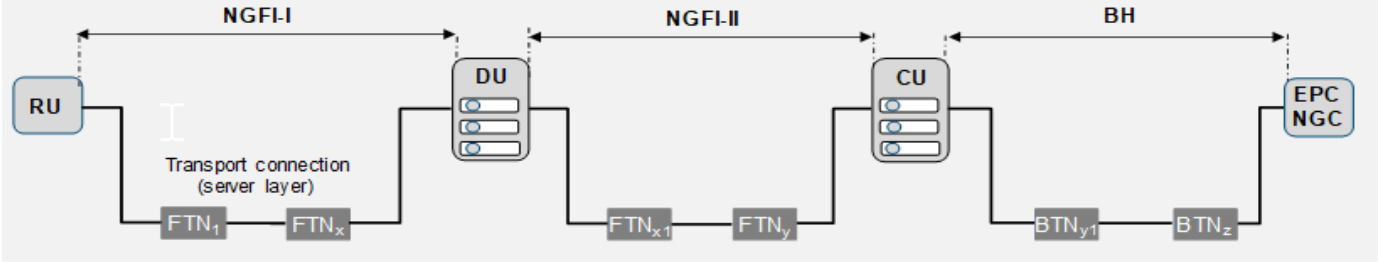
# Does PTP Synchronization Get Easier When Network Speed Increases?

Karim Traore, Cindy Peng, George Zampetti
Science and Technology
Microchip/Microsemi Frequency and Time Division

# 10 Years of PTP deployments

- 2008: Wide deployment of IEEE 1588 PTP for frequency
  - Debates on whether PTP will work or not ?
    - How many hops ?
    - Metrics ?
    - Will it work for phase/time ? G.8275.1 vs G.8275.2 ?
    - GPS primary source, PTP as back-up ?

- 2018: 5G
  - RRUs connected to BBUs using new network segment (Fronthaul network)
    - Network technology changes due to bandwidth scalability issues
      - Synchronization going from pure physical technology (CPRI) -> Packet based technology (Ethernet)
  - **PTP is becoming preferred primary synchronization source for 5G**
  - **Sync phase/time reqs are getting tighter (3GPP wants to lower 1.5 us phase req)**
  - **Fronthaul speed: 10G/25G/100G**
    - RU interfaces @ 10G and 25G



# ITU-T G.8261 Test case 14 (ramp test)

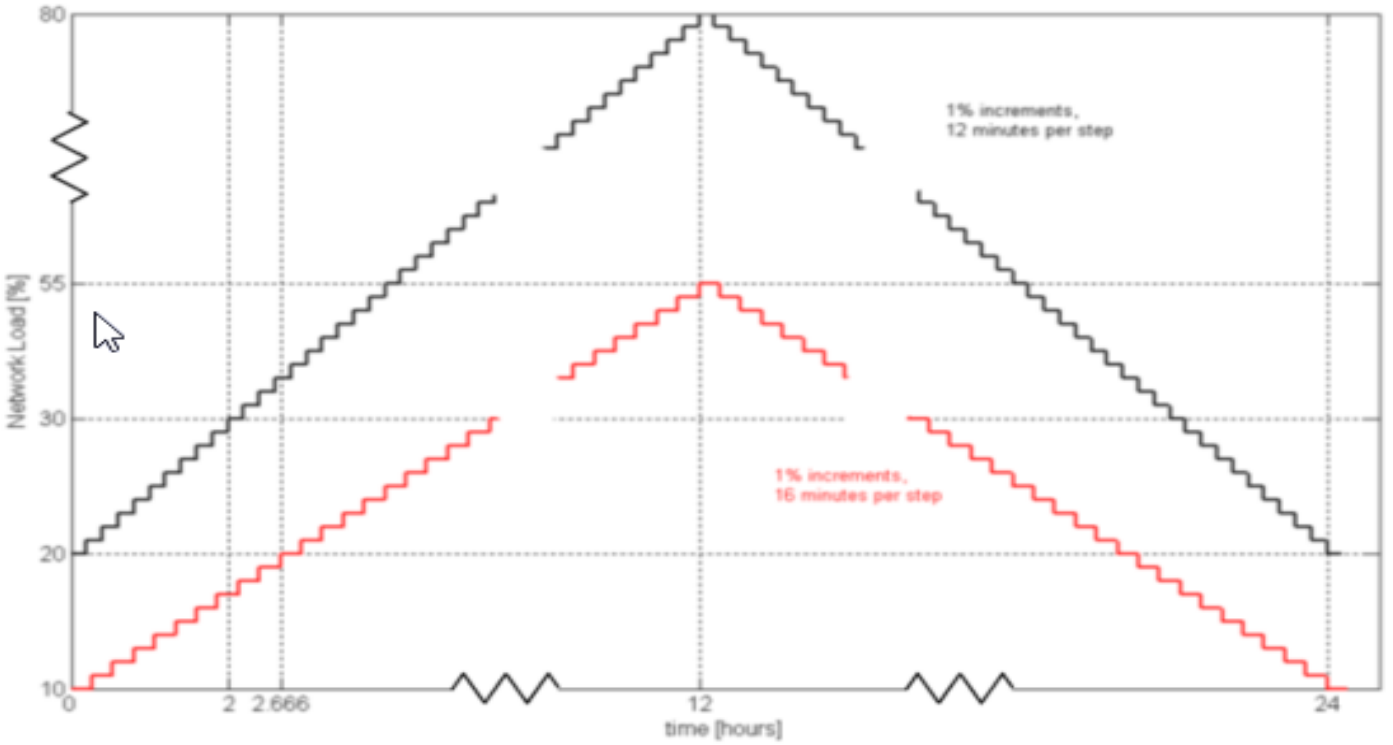
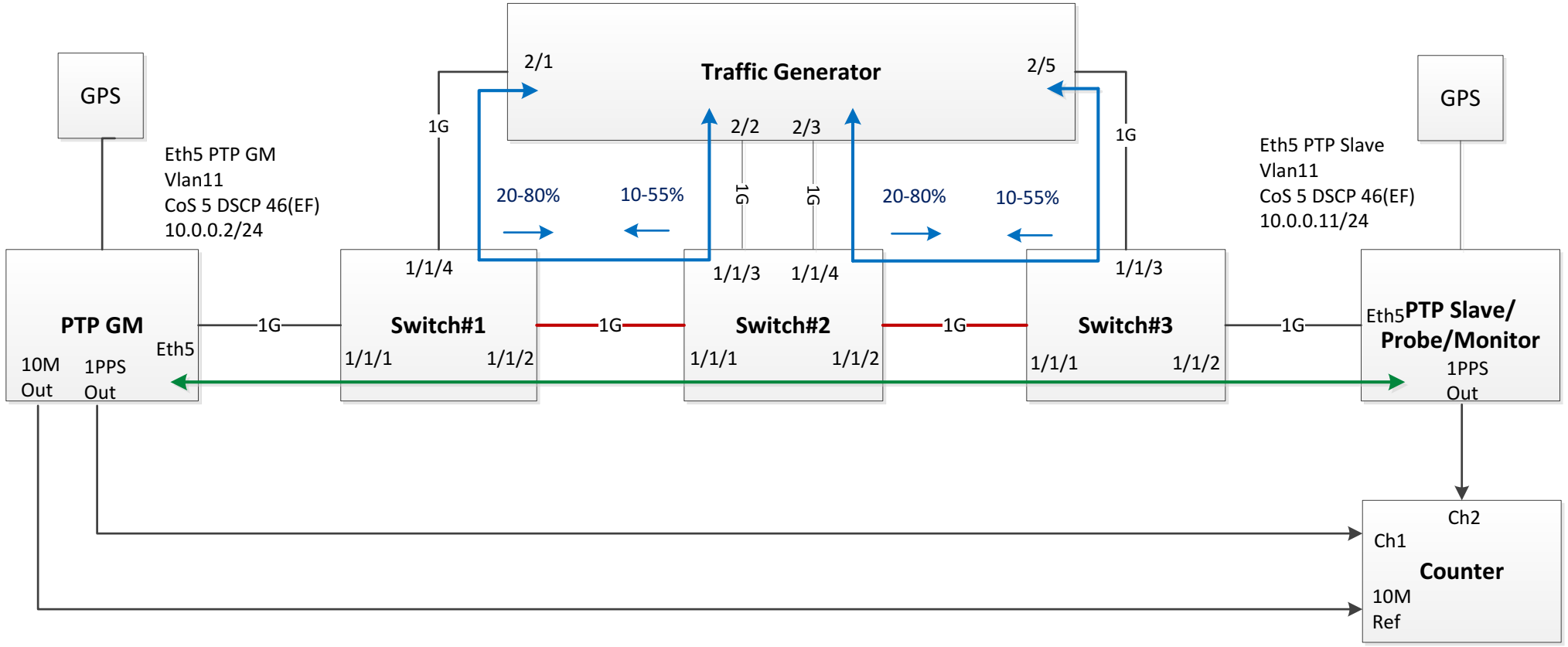



Figure VI.12/G.8261 - Slow Network Load Modulation for two-way

# Dynamic Time Error Network Setup – 1G




PTP Traffic: IPv4 ITU-T G8275.2

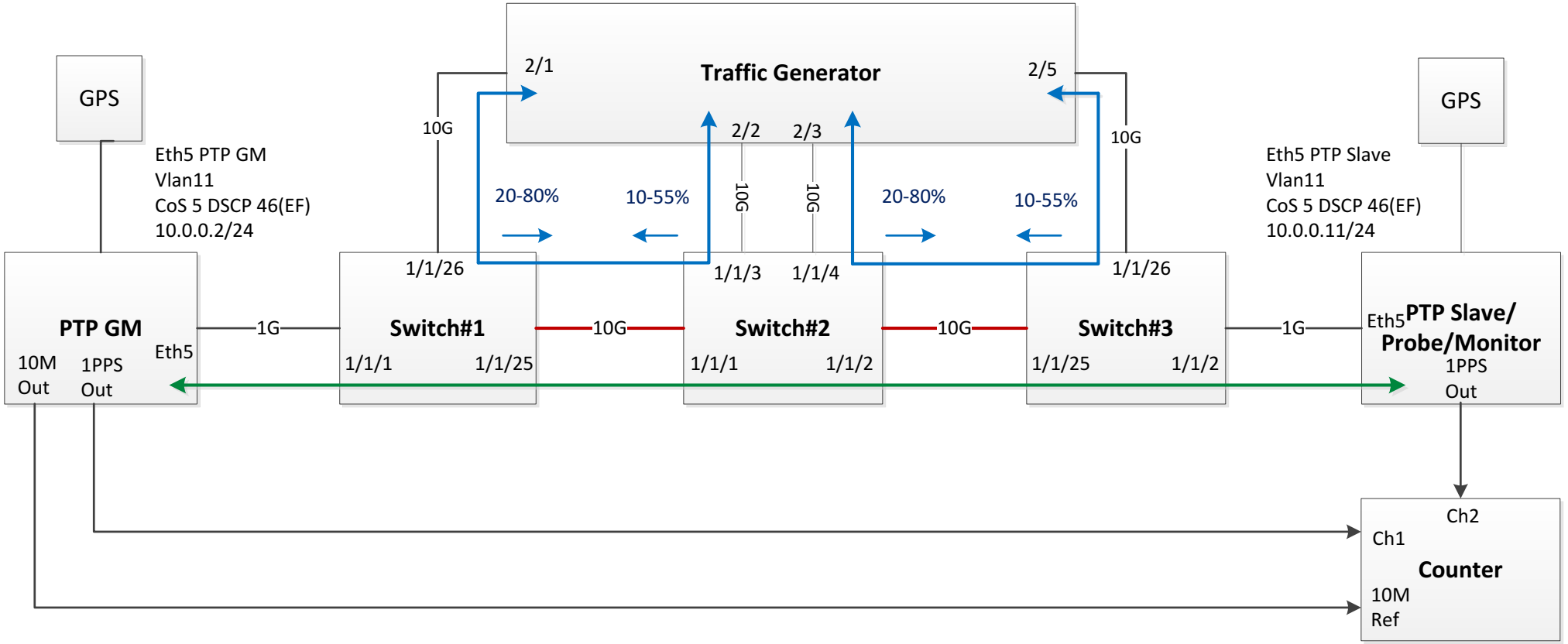
Disturbance Traffic: IPv4 IMIX TC14

PTP and Disturbance Traffic Shared Path



# Dynamic Time Error Network Setup – 10G




PTP Traffic: IPv4 ITU-T G8275.2

Disturbance Traffic: IPv4 IMIX TC14

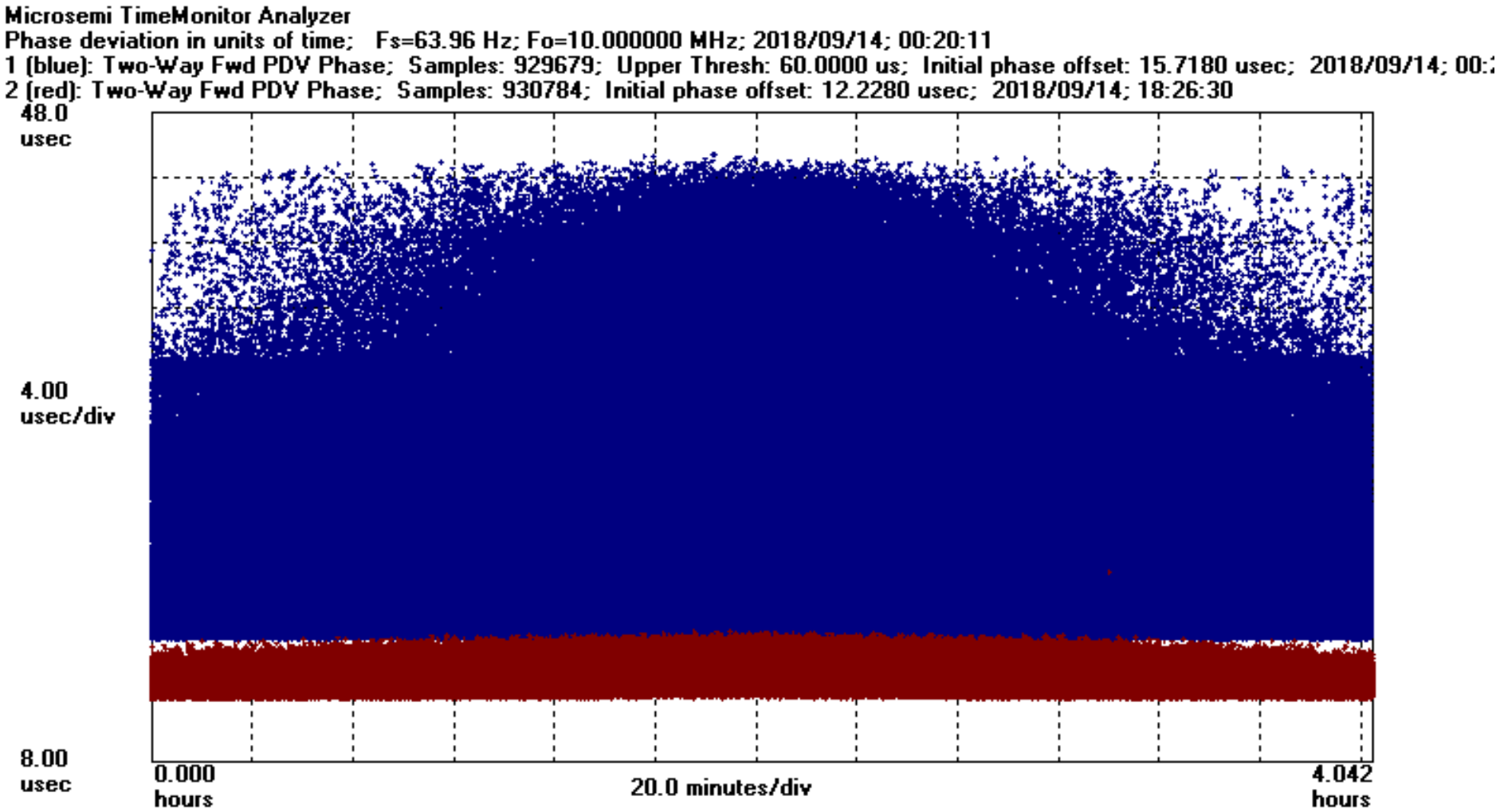
PTP and Disturbance Traffic Shared Path



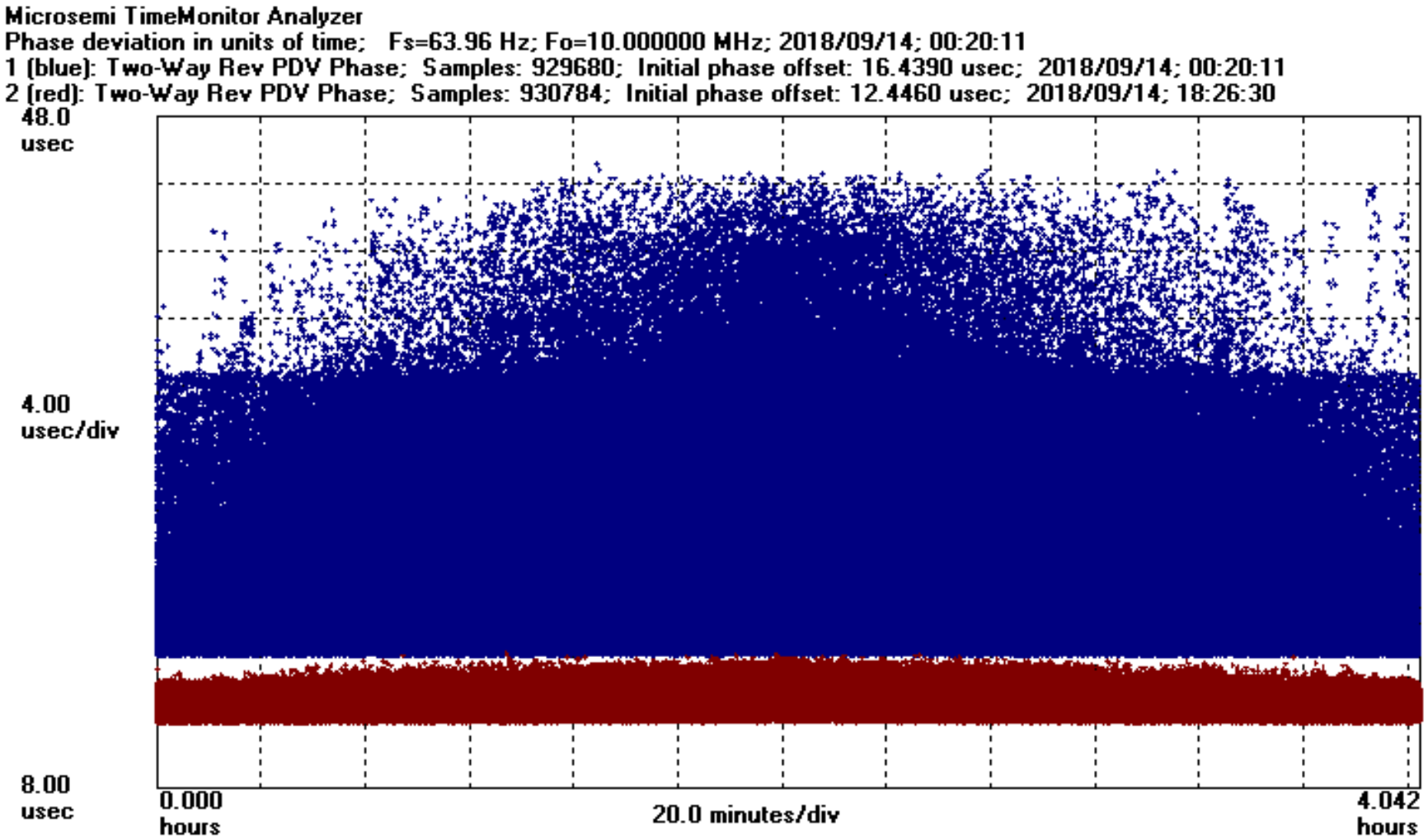
# PDV Overlay 1G vs 10G
# TC14 FW

- Blue: 1G, Red: 10G



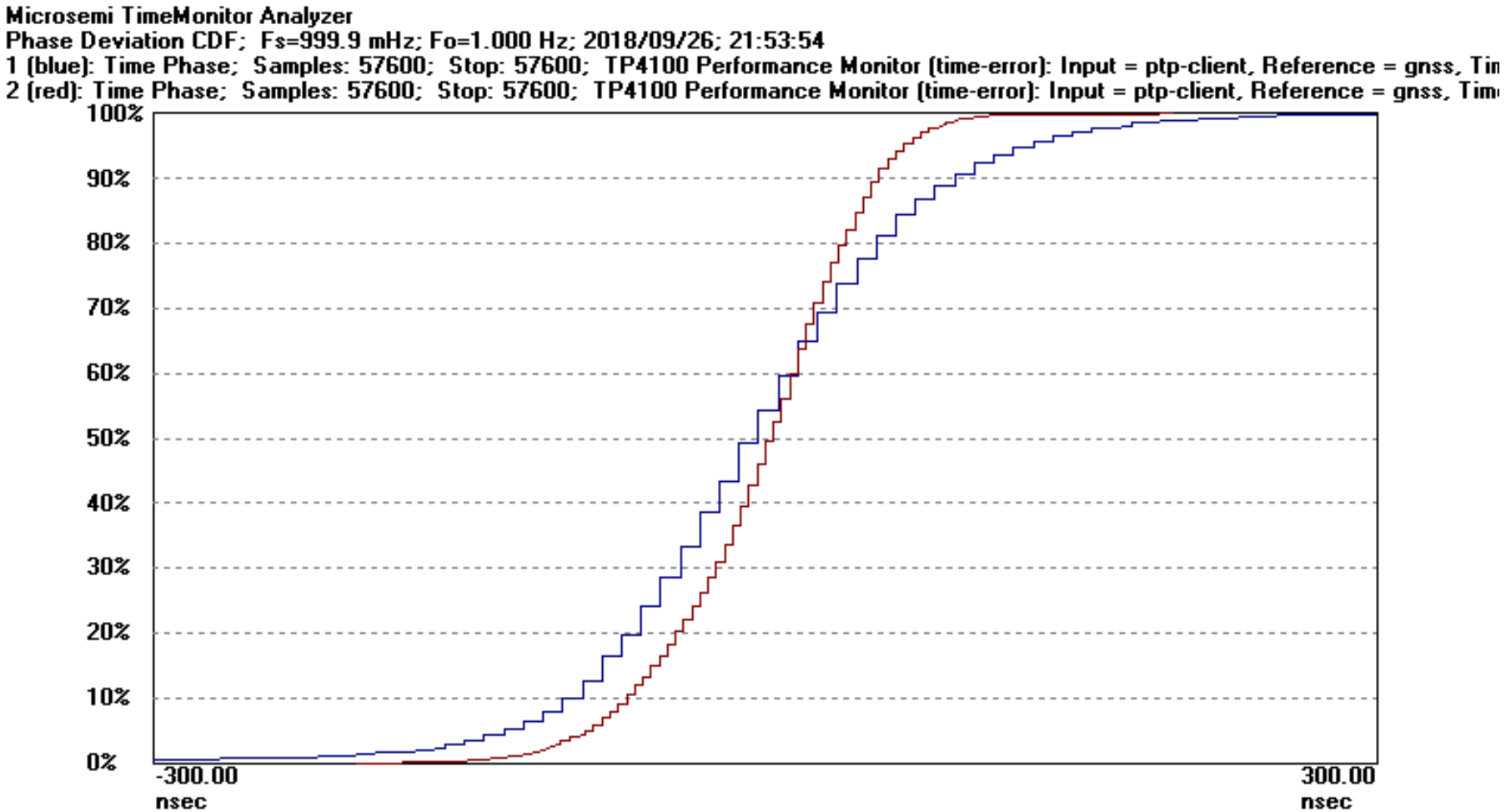
# PDV Overlay 1G vs 10G
# TC14 RV

- Blue: 1G, Red: 10G



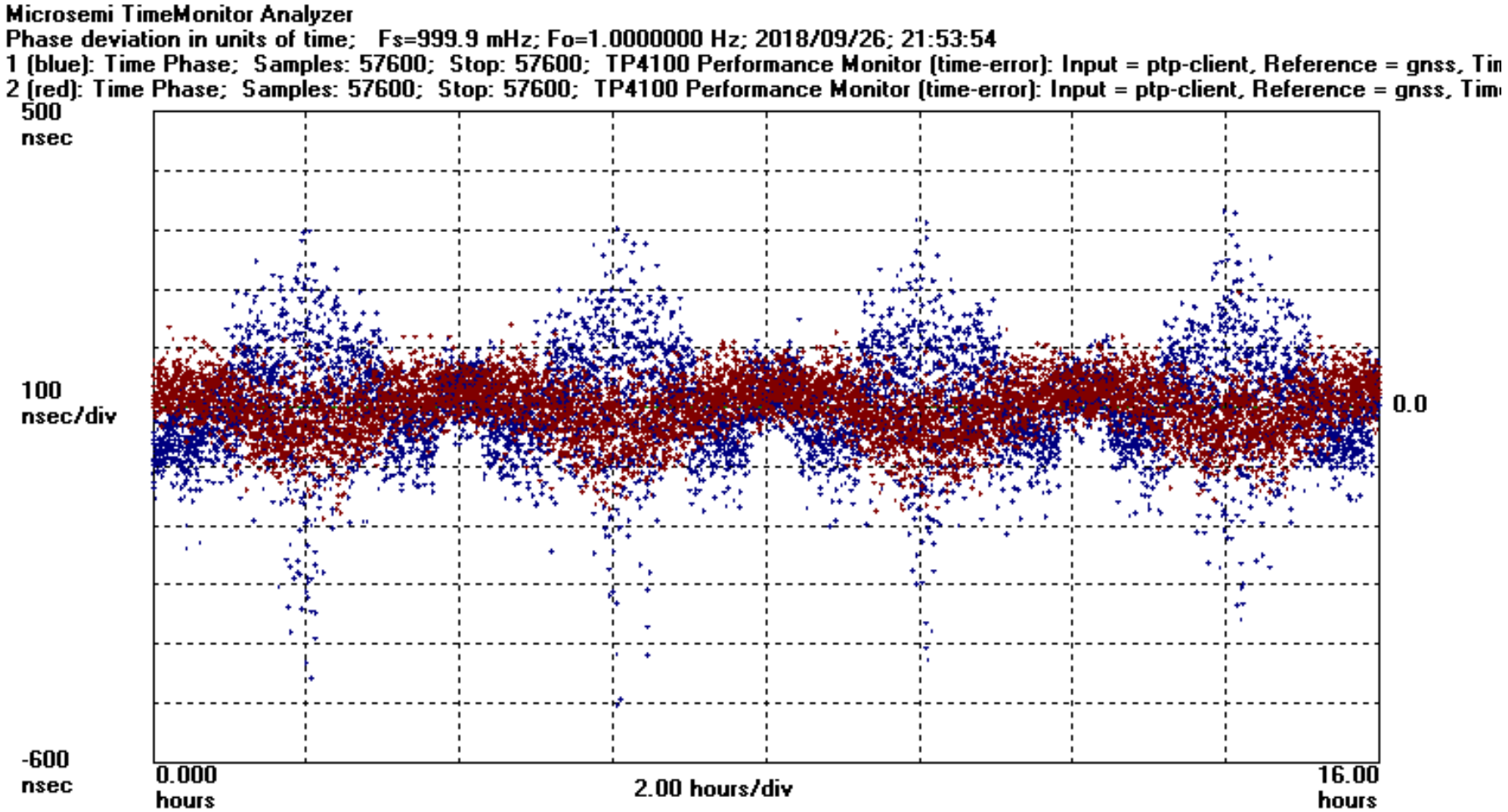
# PTP Monitor TE CDF Overlay
# TC14 (cumulative distribution function)

- Blue: 1G,  90pct: 92.80 ns;  95pct: 121.6 ns;  99pct: 198.4 ns;  99.9pct: 284.8 ns;
- Red: 10G, 90pct: 52.00 ns;  95pct: 68.00 ns;  99pct: 92.00 ns;  99.9pct: 116.0 ns;



# PTP Monitor TE Overlay
# TC14

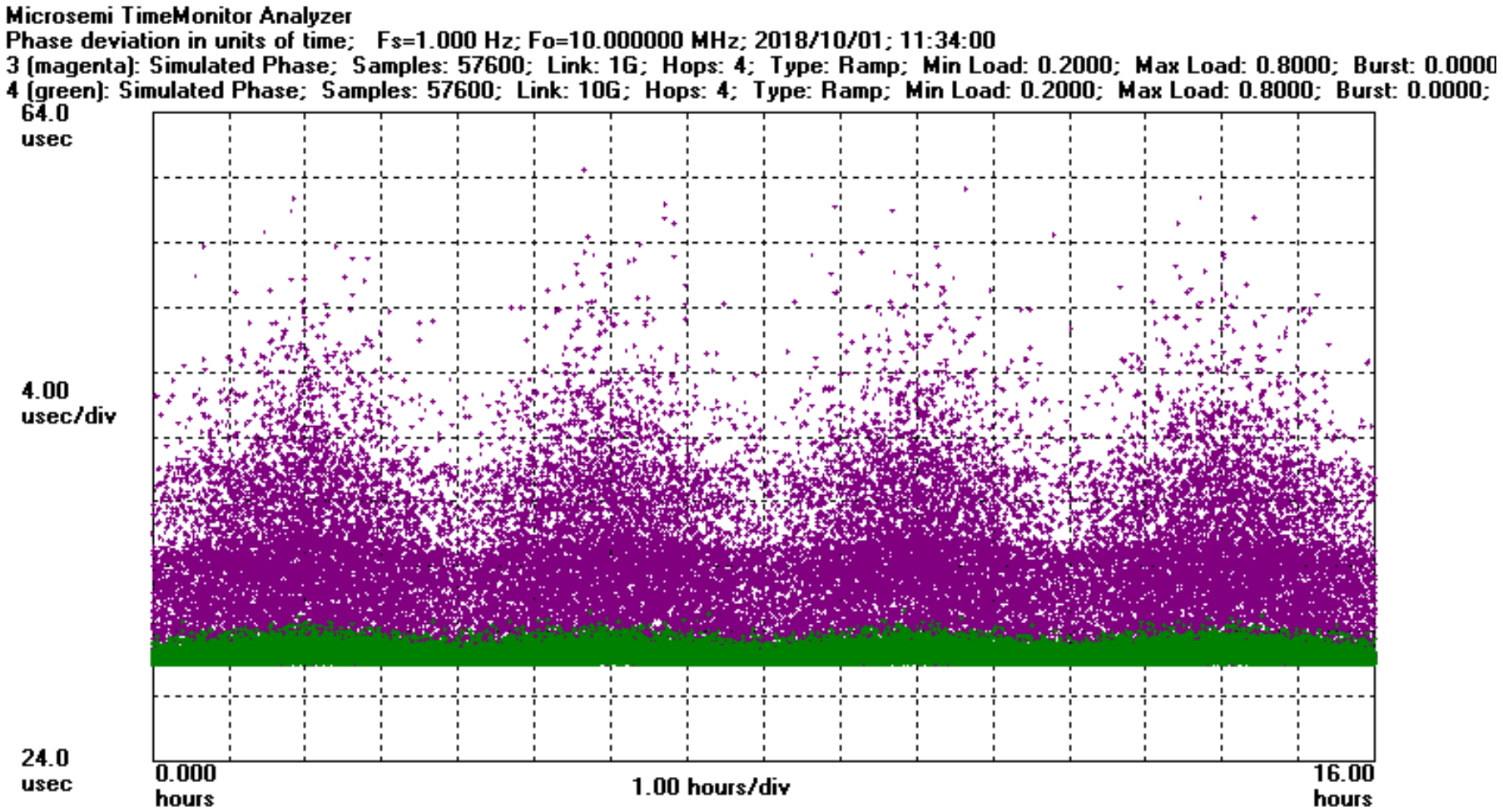
- Blue: 1G, Red: 10G



# Simulator PDV

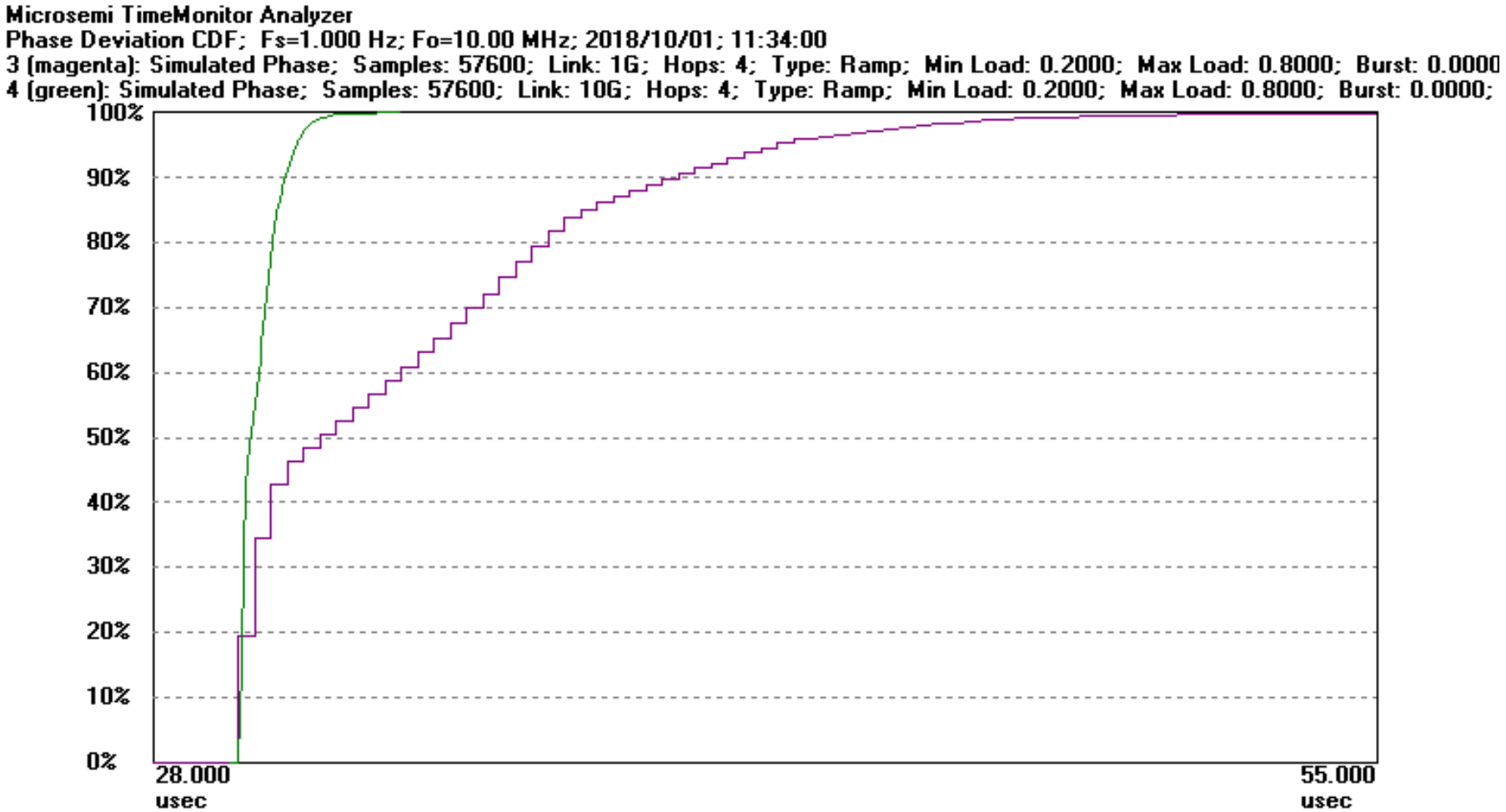
# 5-Switch PDV 1G vs 10G IMIX Ramp 20% to 80%

- Magenta: 1G, Green: 10G



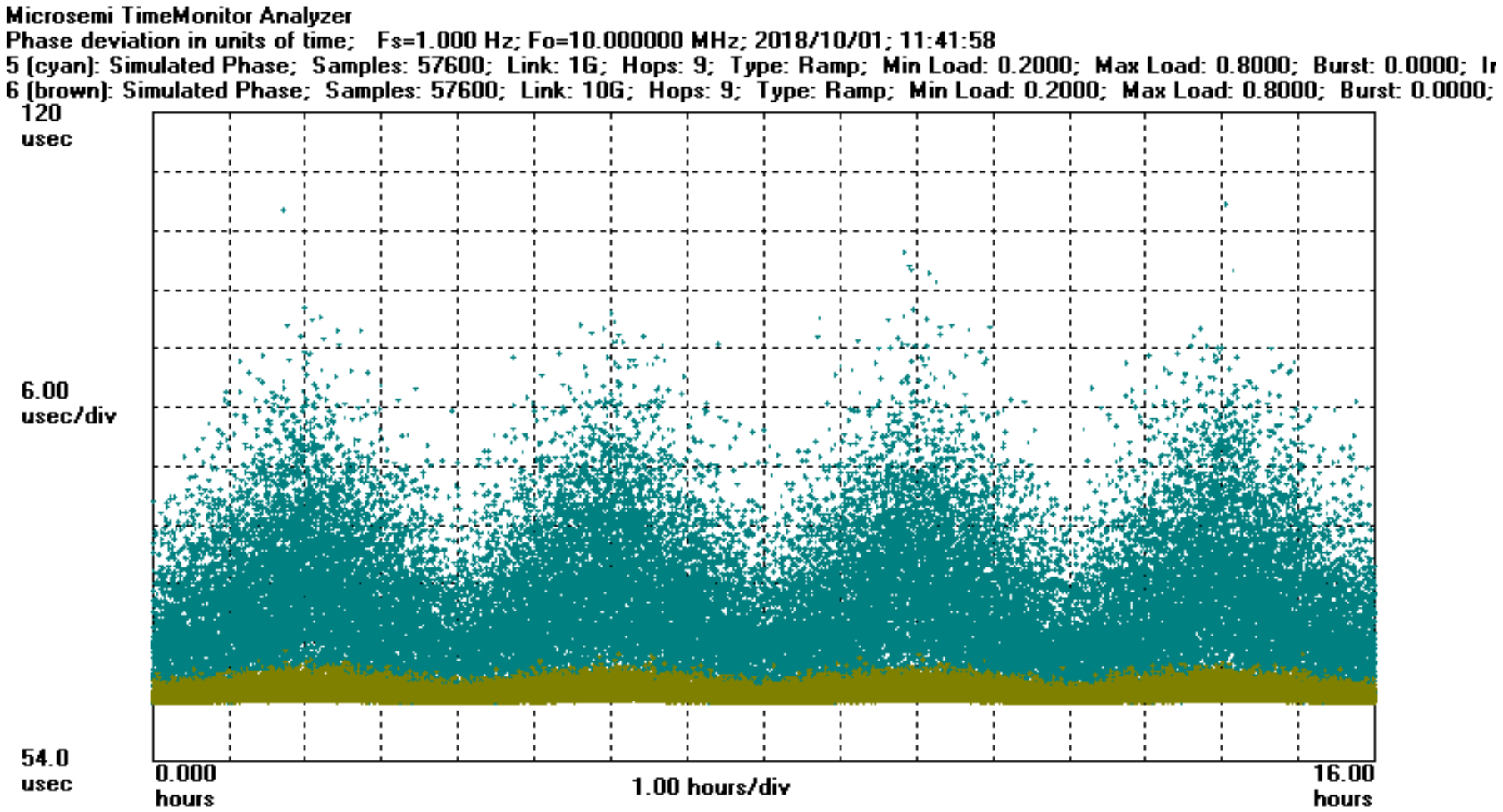
# 5-Switch PDV CDF 1G vs 10G IMIX Ramp 20% to 80%

- Magenta: 1G, Green: 10G



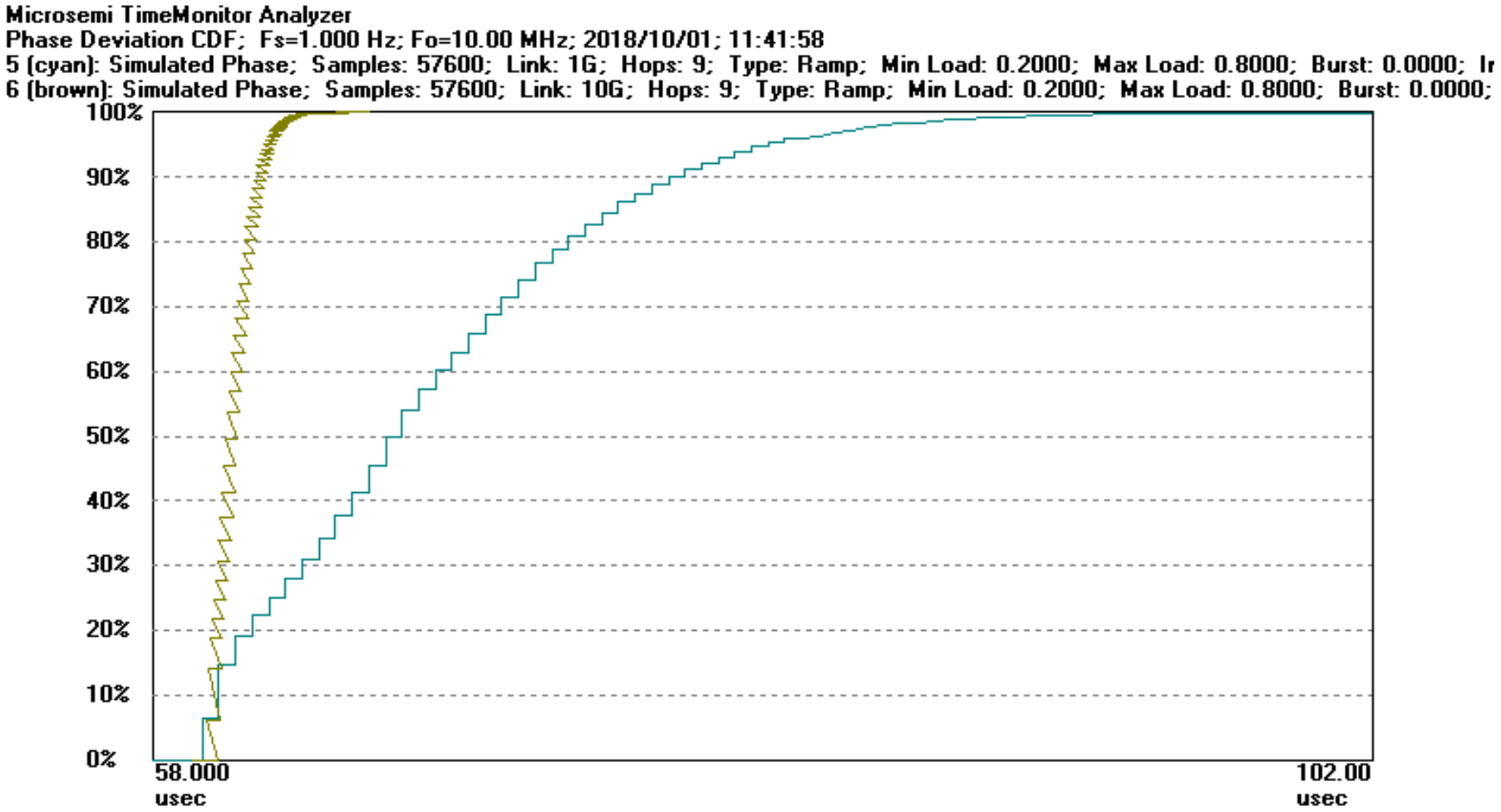
# 10-Switch PDV 1G vs 10G IMIX Ramp 20% to 80%

- Cyan: 1G, Brown: 10G



# 10-Switch PDV CDF 1G vs 10G IMIX Ramp 20% to 80%

- Magenta: 1G, Green: 10G



# Summary

- Fronthaul @ 100Gbps in future
  - PTP transport over 10G/25G/100G
  - Asymmetry errors
  - Traffic profile (70% to 90% of 5G traffic is video)
- Fronthaul latency reqs (URLLC services) limits distance between RUs and DUs/CUs
  - Strictest one-way latency: 50 usec between RU and DU (0.5 ms between PDCP layers)
    - 2 to 3 hops
- Time to re-establish a new requirement frontier for phase/time
- Good indications that servo algorithms can take advantage of fronthaul speed


Microsemi, a wholly owned subsidiary of Microchip Technology Inc. (Nasdaq: MCHP), offers a comprehensive portfolio of semiconductor and system solutions for aerospace & defense, communications, data center and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world's standard for time; voice processing devices; RF solutions; discrete components; enterprise storage and communication solutions, security technologies and scalable anti-tamper products; Ethernet solutions; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Learn more at www.microsemi.com.

**Microsemi Headquarters**
One Enterprise, Aliso Viejo, CA 92656 USA
Within the USA: +1 (800) 713-4113
Outside the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996
email: sales.support@microsemi.com
www.microsemi.com