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Phase Delivery over PTP Unaware Networks

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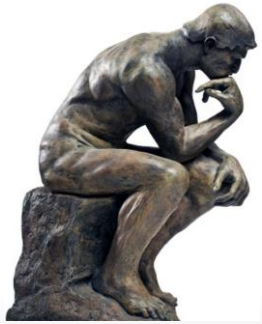
Phase Delivery Challenges in Brownfield Deployments

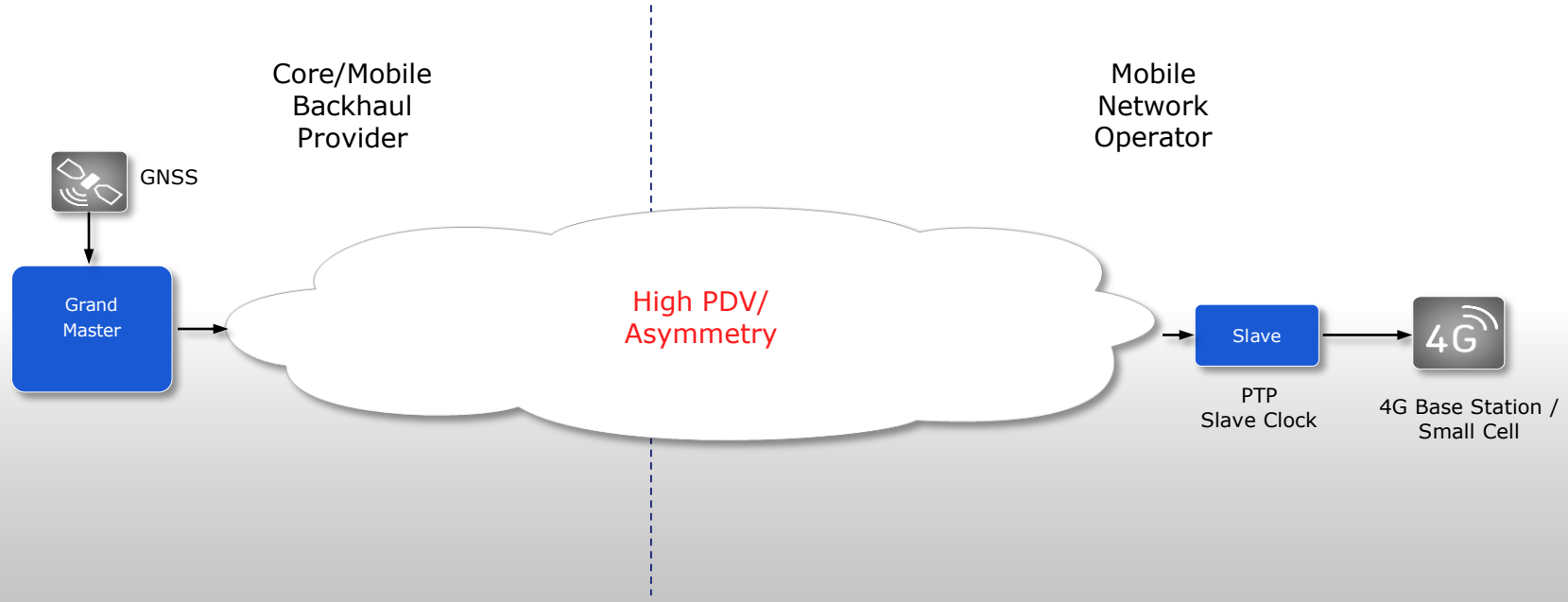
- Existing network introduce high level of asymmetry and PDV
- The asymmetry and PDV varies over time
- Existing networks include different transport technologies
- Upgrading/forklifting the existing NE to Sync-E/BC is very costly



Do we really need frequency and phase in the core network?

The Solution

Bypass the problem:
Get the Grand Master closer to the Slave



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The Solution

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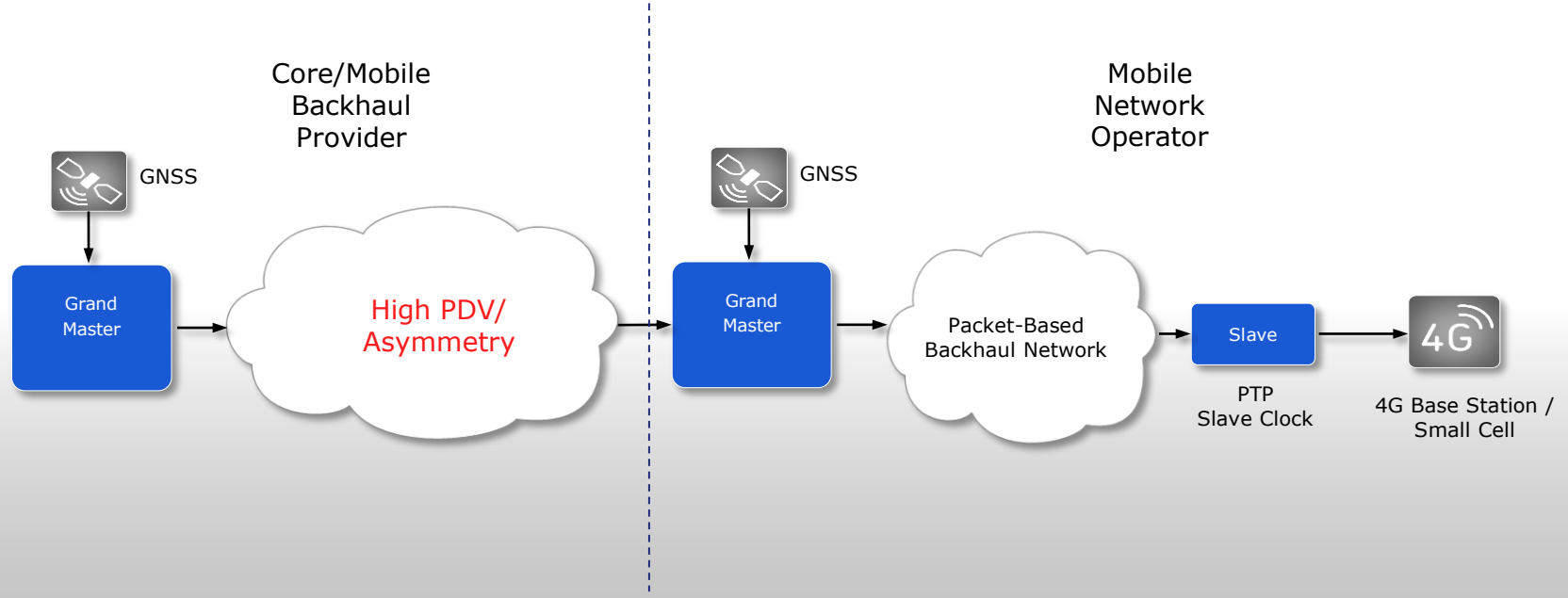
Get the Grand Master closer to the Slave



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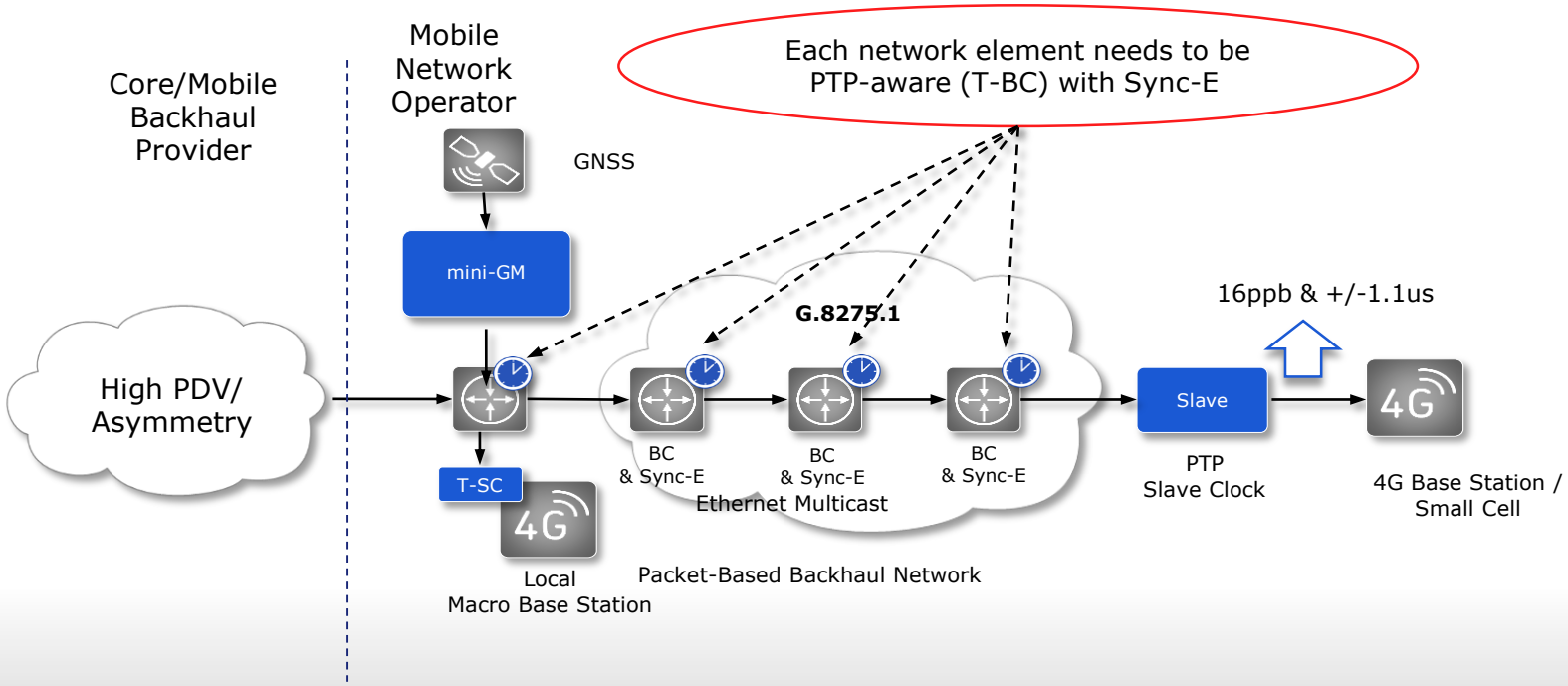
Phase Delivery:
Small Scale GM & G.8275.1 – Last Mile

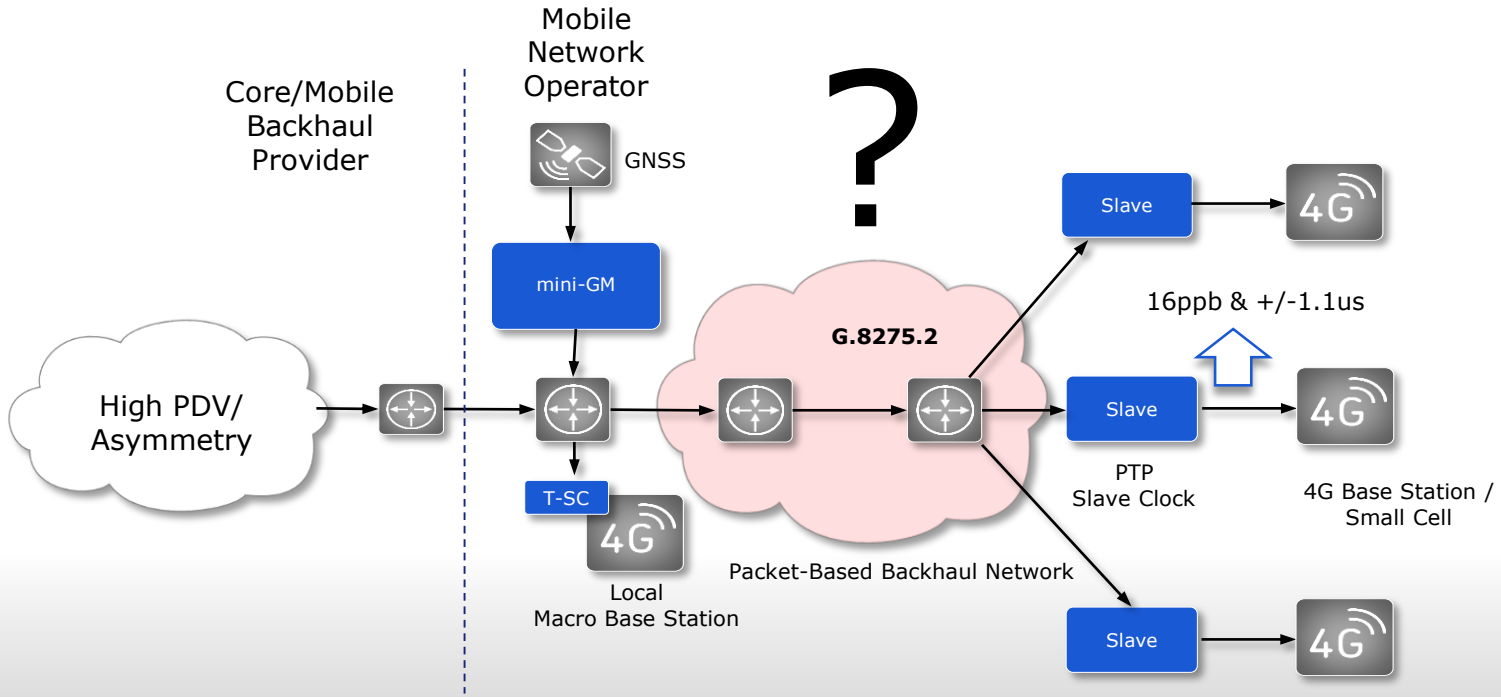
- G.8275.1 – Uses hop by hop , Ethernet multicast



Last mile full on path support
Small Scale GM as a head of G.8275.1 chain

Phase Delivery:
Small Scale GM & G.8275.2 – Last Mile

- G.8275.2 – Uses IP unicast for phase delivery over last mile



Small Scale GM as a head of G.8275.2 chain

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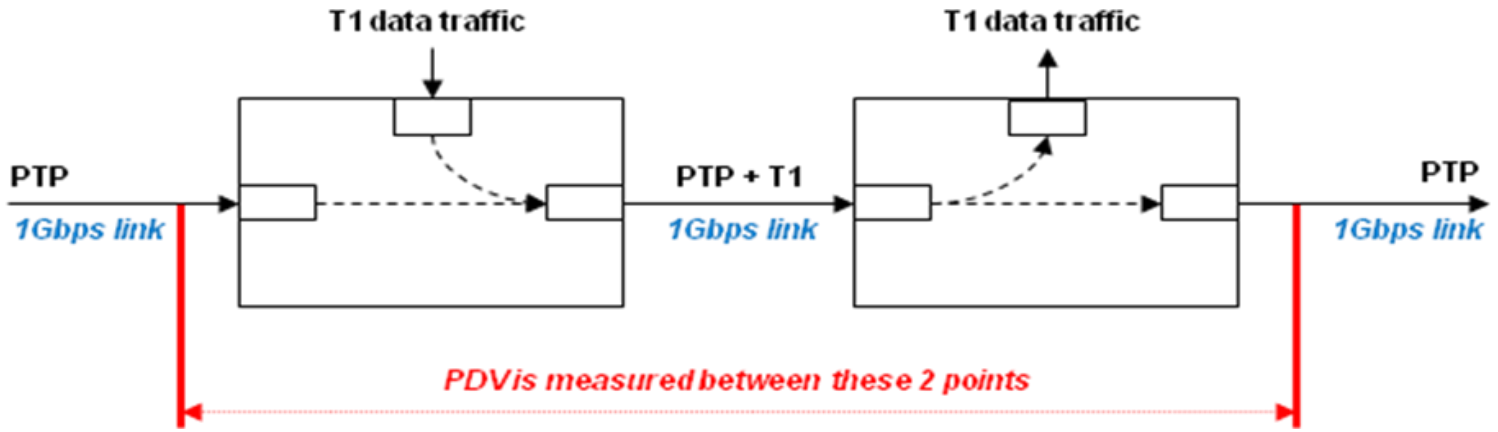
PDV of a single NE

- Single congestion point



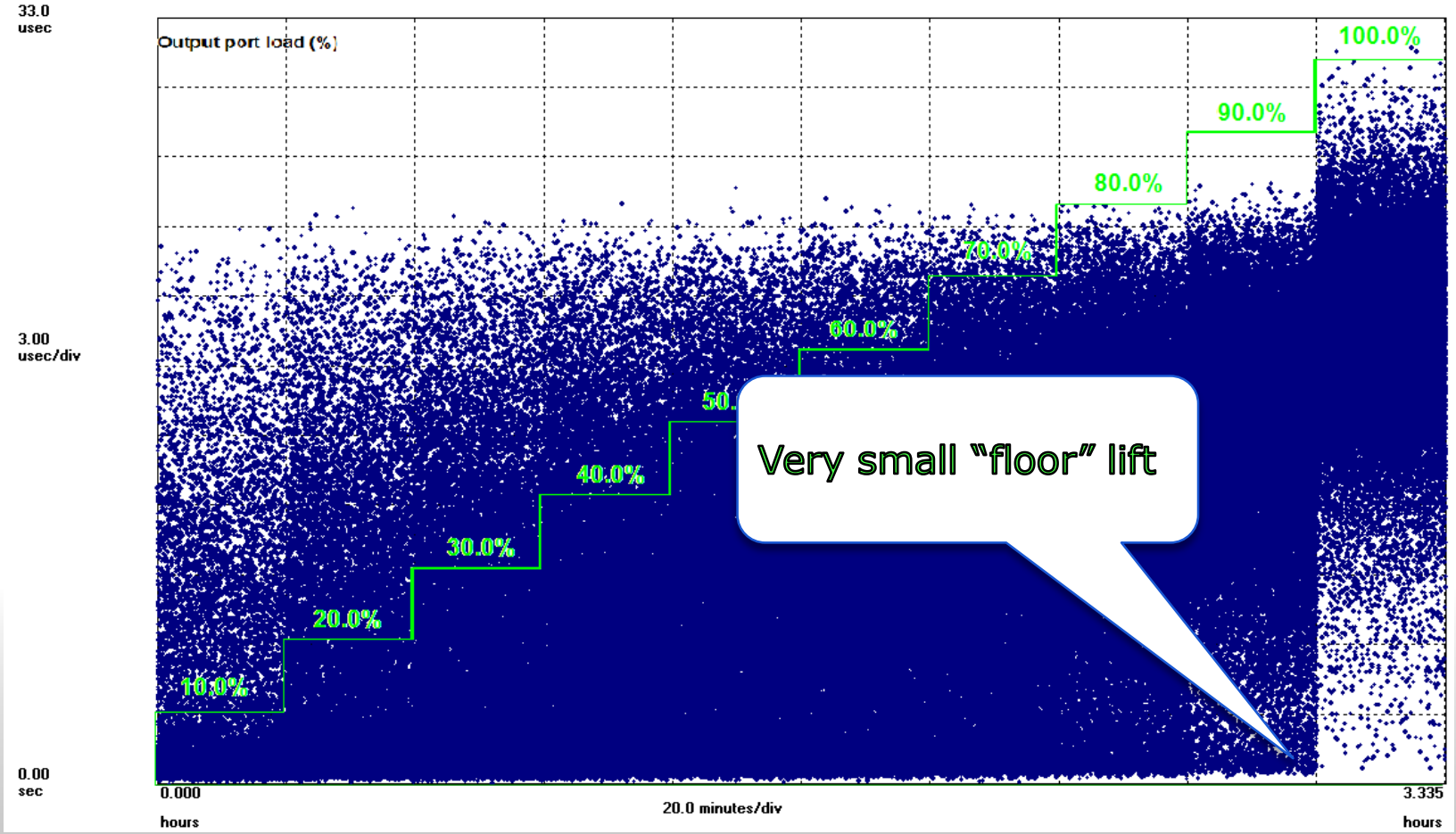
Two types of traffic loads have been considered:

- **Case A**: The size of the data traffic packets was variable, from 64 bytes to 1518 bytes
- **Case B**: All the data traffic packets have a 1518 bytes fixed size

Source - France Télécom Orange

PDV of a single NE – Case A

1Gbps, variable size data traffic:



Source - France Télécom Orange

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PDV of a single NE – Case B

1Gbps, 1518 bytes data traffic:

Source - France Télécom Orange

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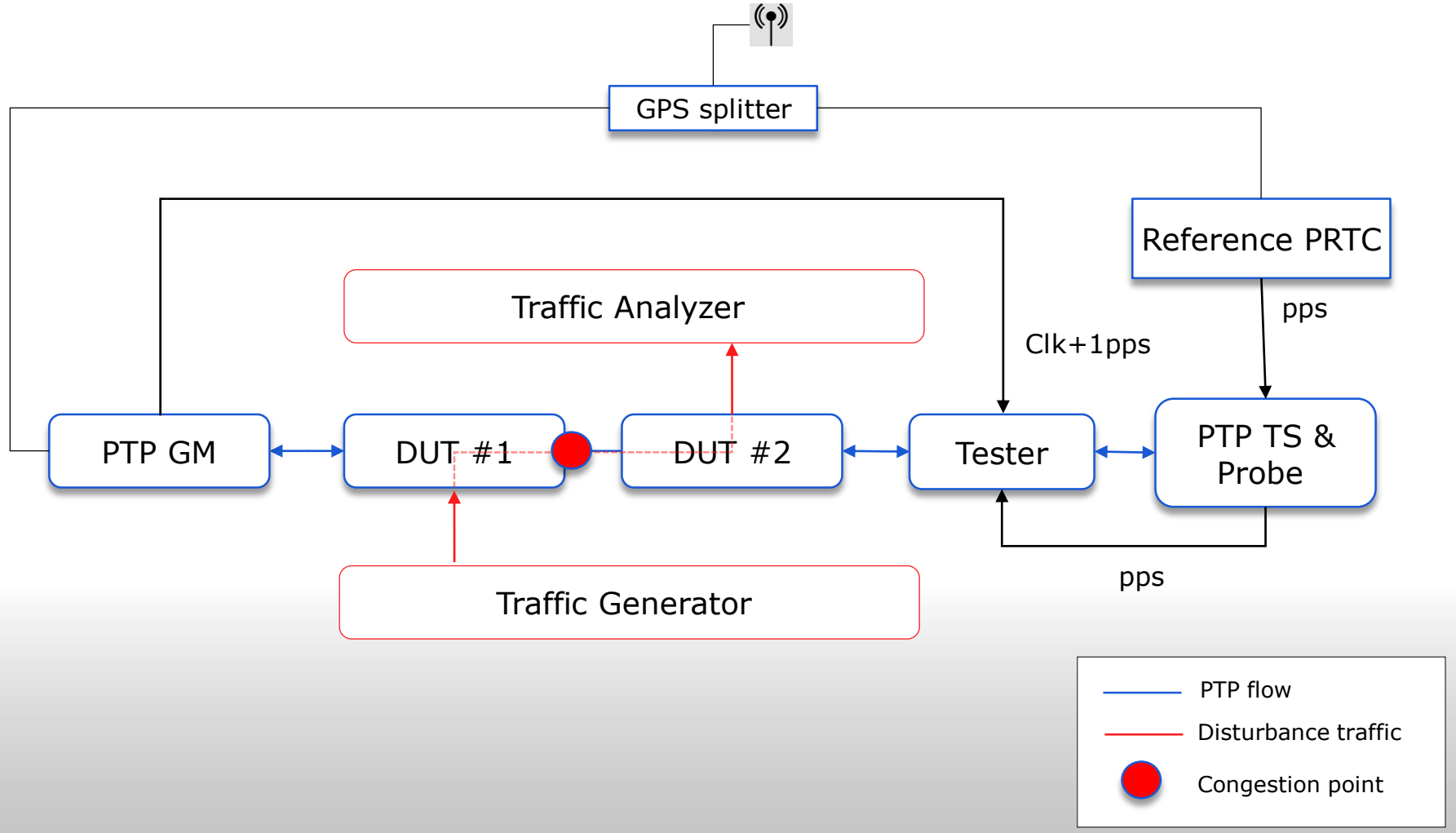
Setup #1



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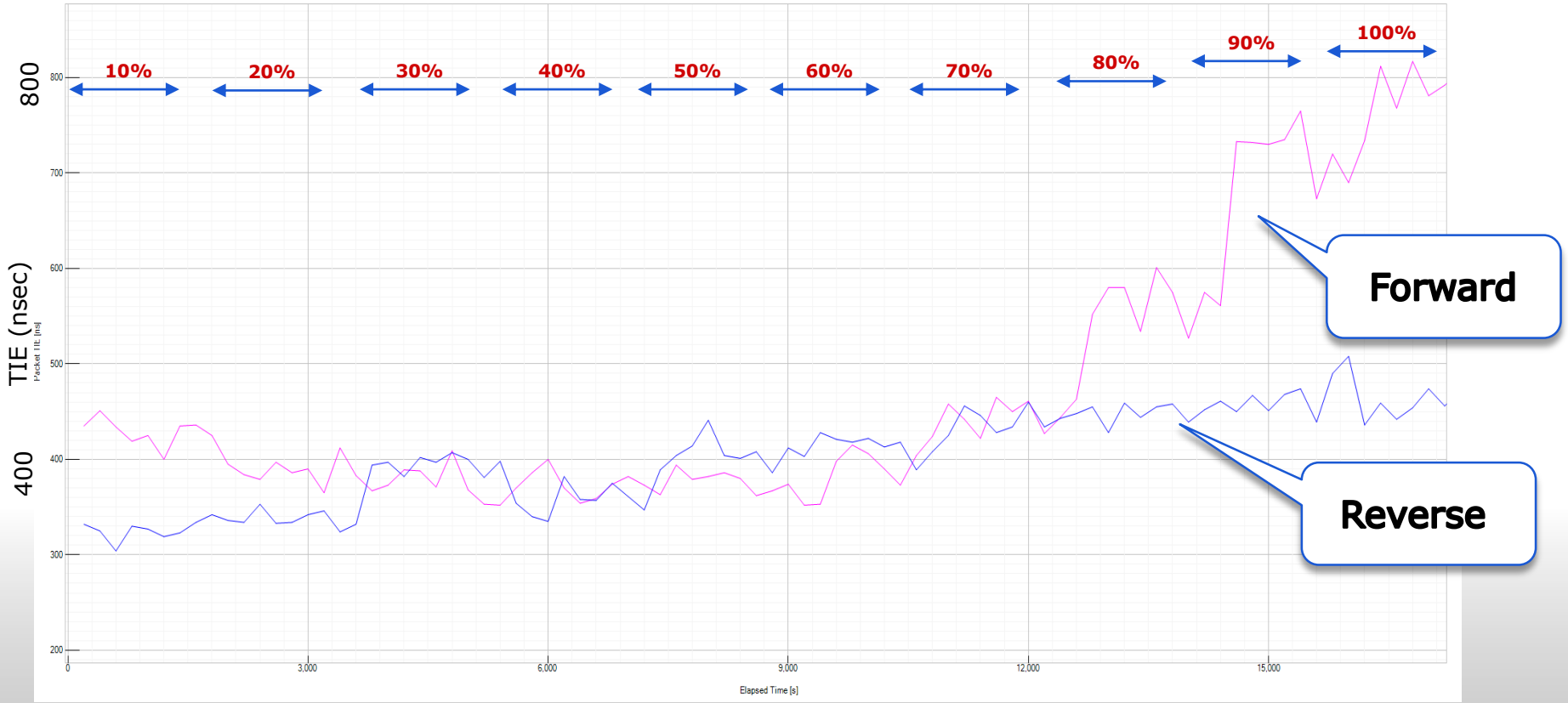
Test 1: G.8261 Traffic model #1

- Single Congestion , VLAN Priority
- PTP - 64 packets per second (on both directions)
- Single congestion point (on forward)
- Forward load traffic (no load on reverse direction)
  - 80% -minimum size packets (64 octets)
  - **15% - maximum size packets (1518 octets)**
  - 5% - medium size packets (576 octets)

Test #1 - Forward & Reverse Filtered Packet TIE (Tester)

- Window size – 200 sec , 0.3%



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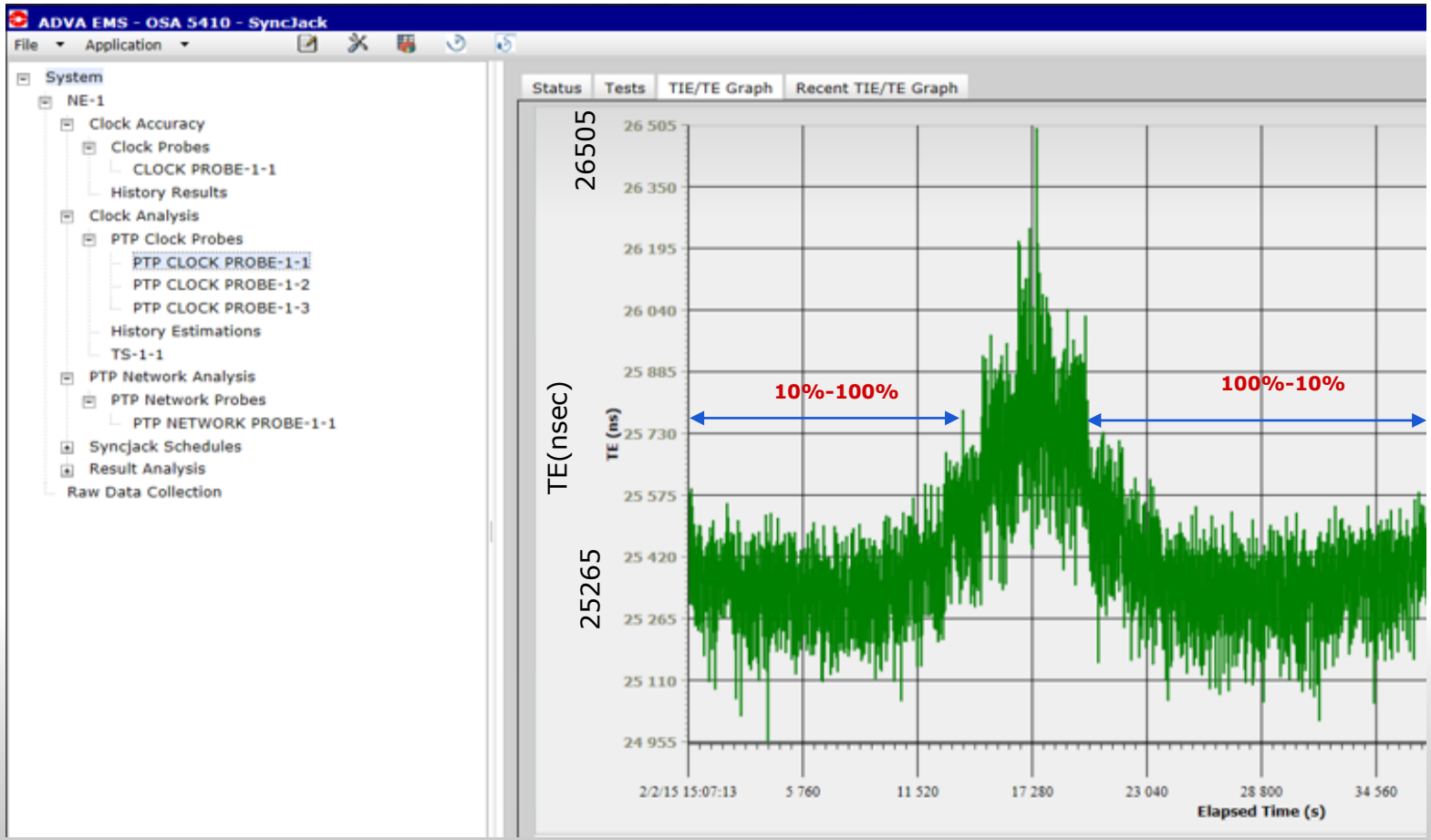
Test #1 – Probe Measured Forward Delay

- Window size – 5sec , Lucky packet



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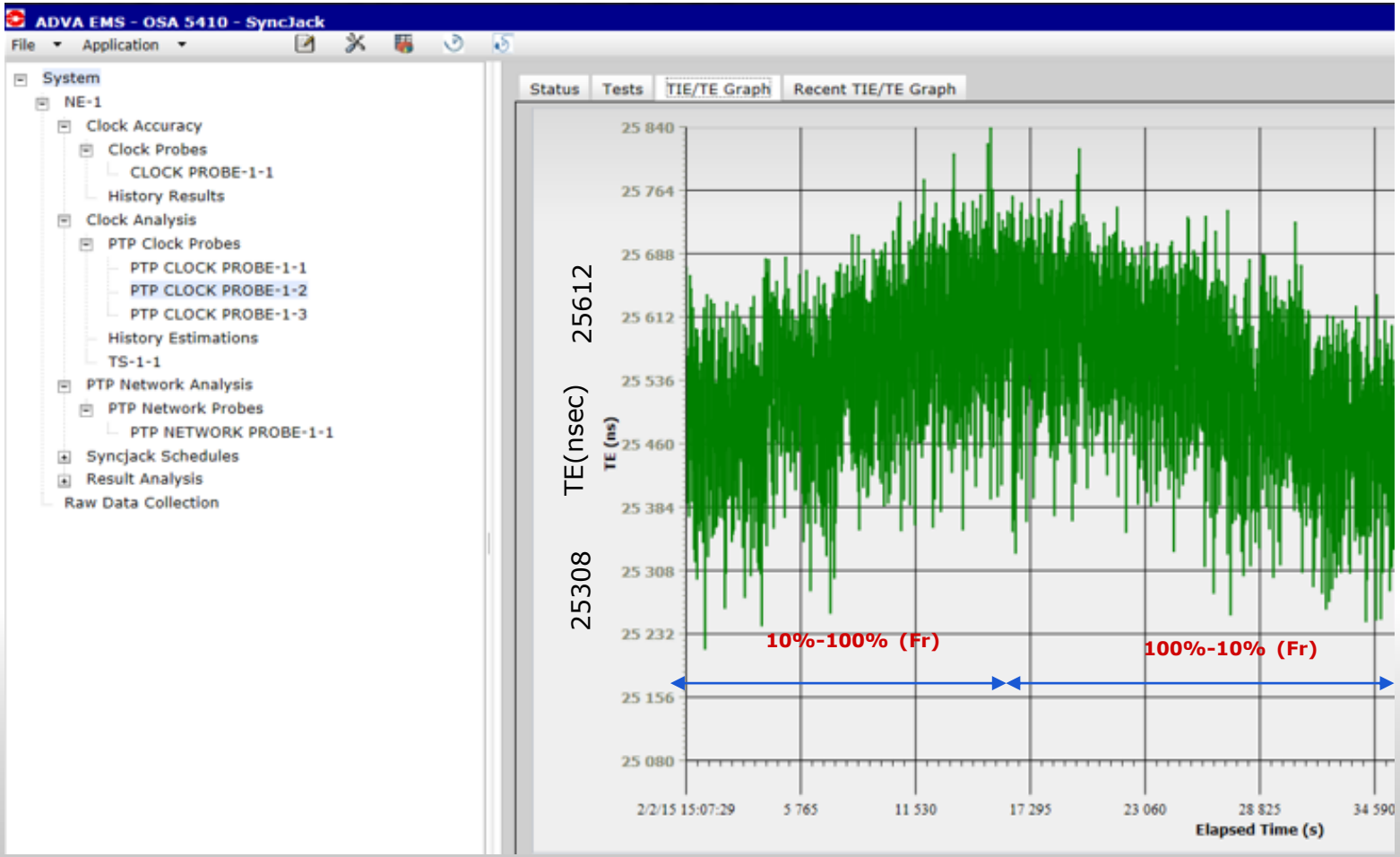
Test #1 – Probe Measured Reverse Delay

- Window size – 5sec , Lucky packet



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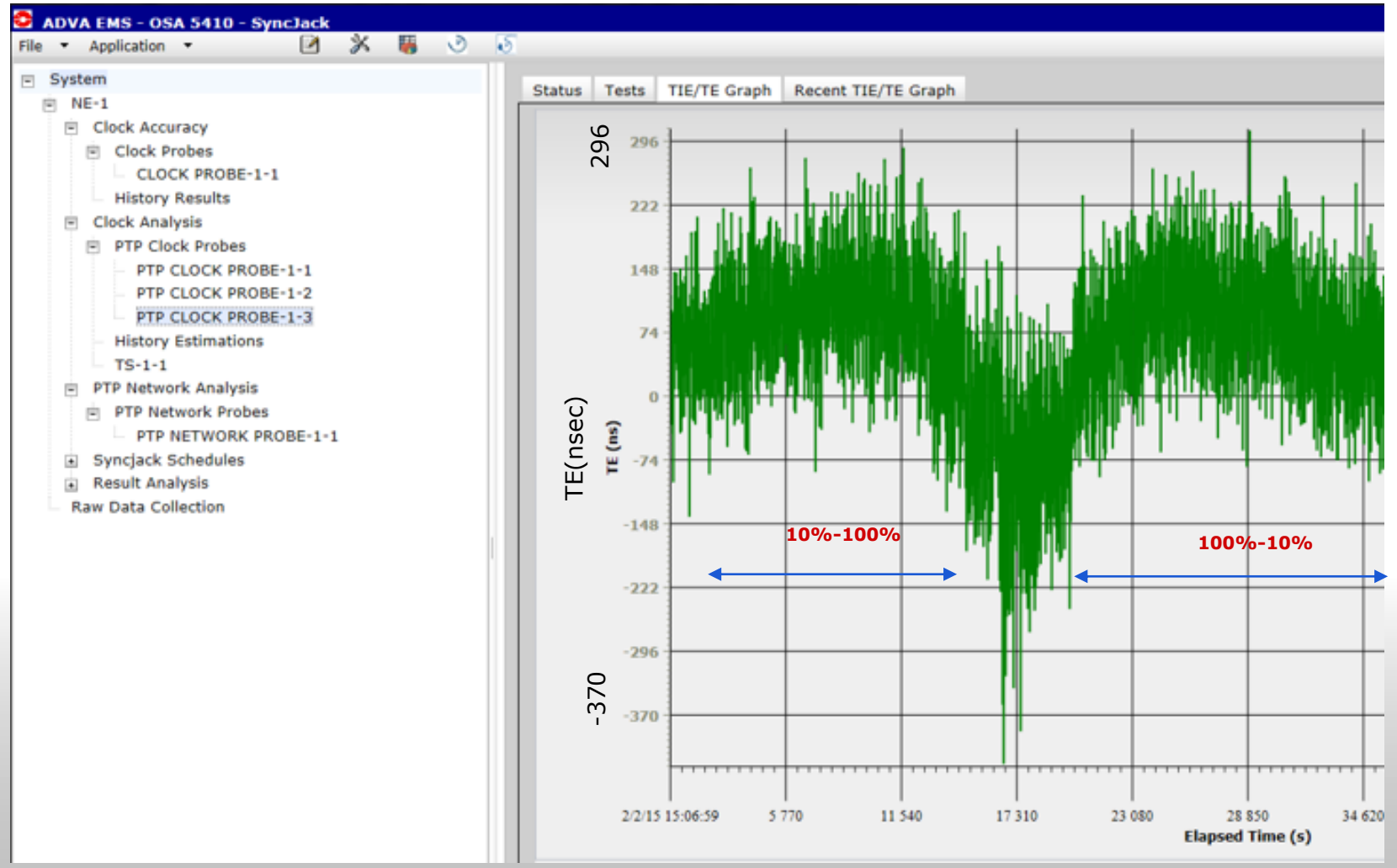
Test #1 – Probe Measured Asymmetry

- Window size – 5sec , Lucky packet



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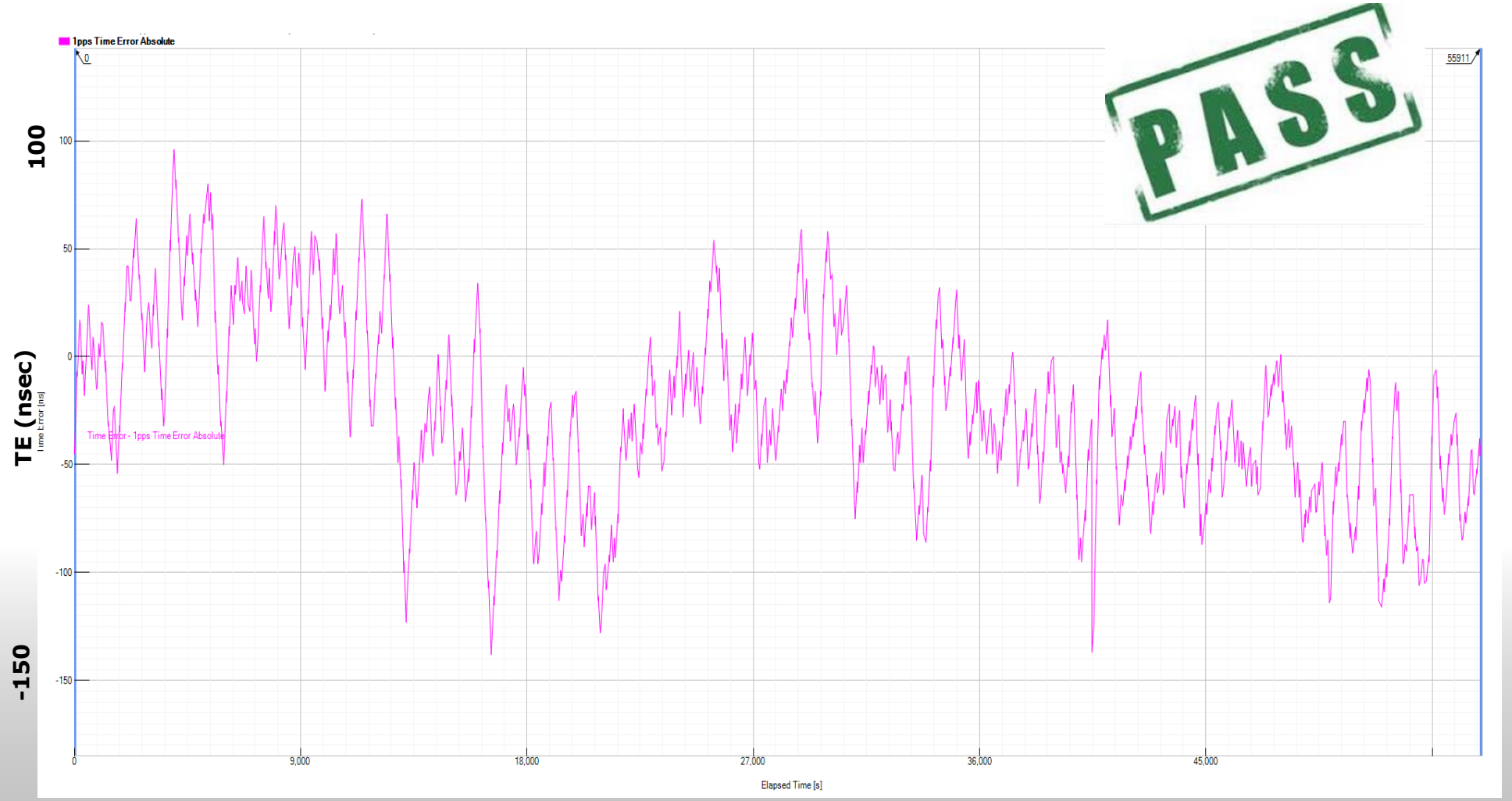
Test #1 – 1PPS TE (Tester)

- Time Error within +/- 150nsec – well within +/- 1100nsec



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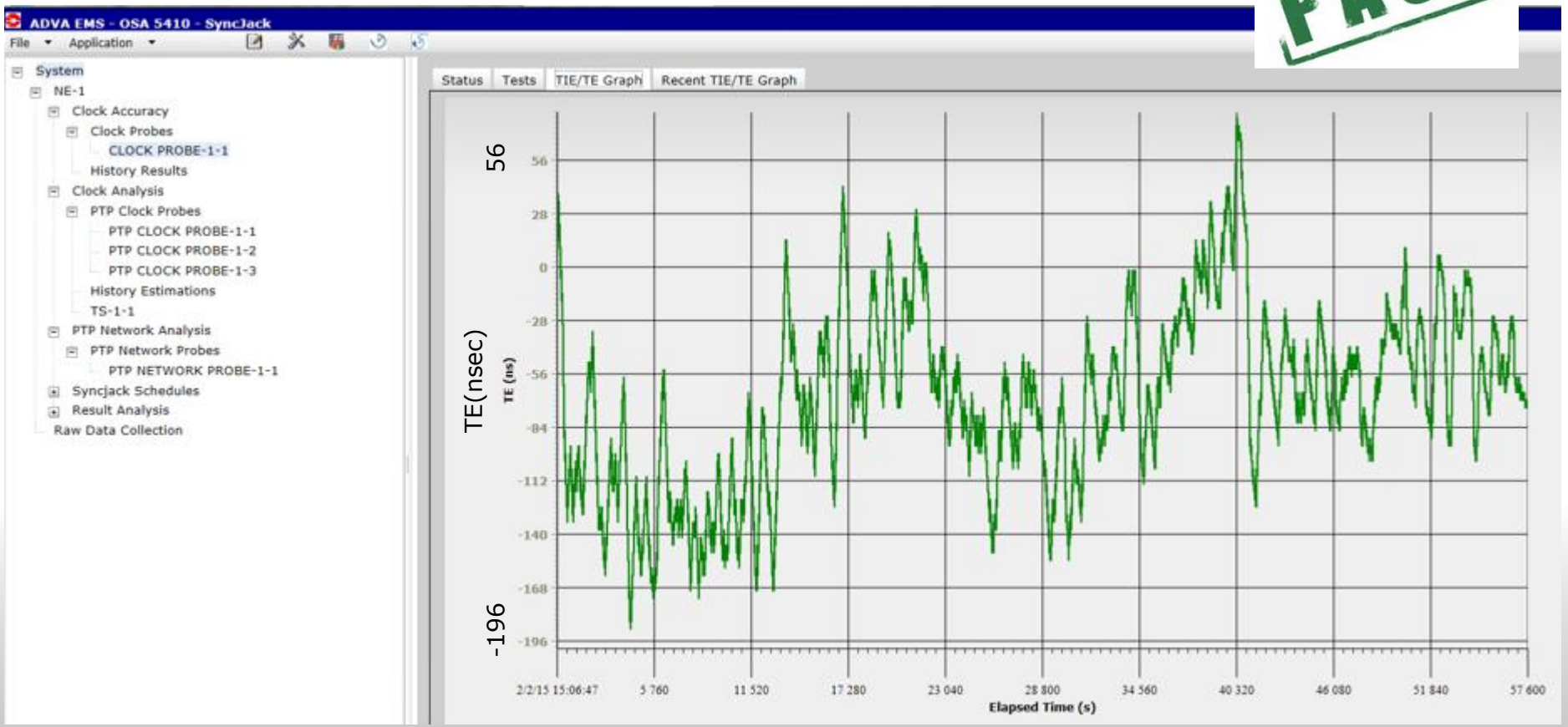
Test #1 – 1PPS TE Probe Vs ref PRTC

- Time Error within +/- 150nsec – well within +/- 1100nsec



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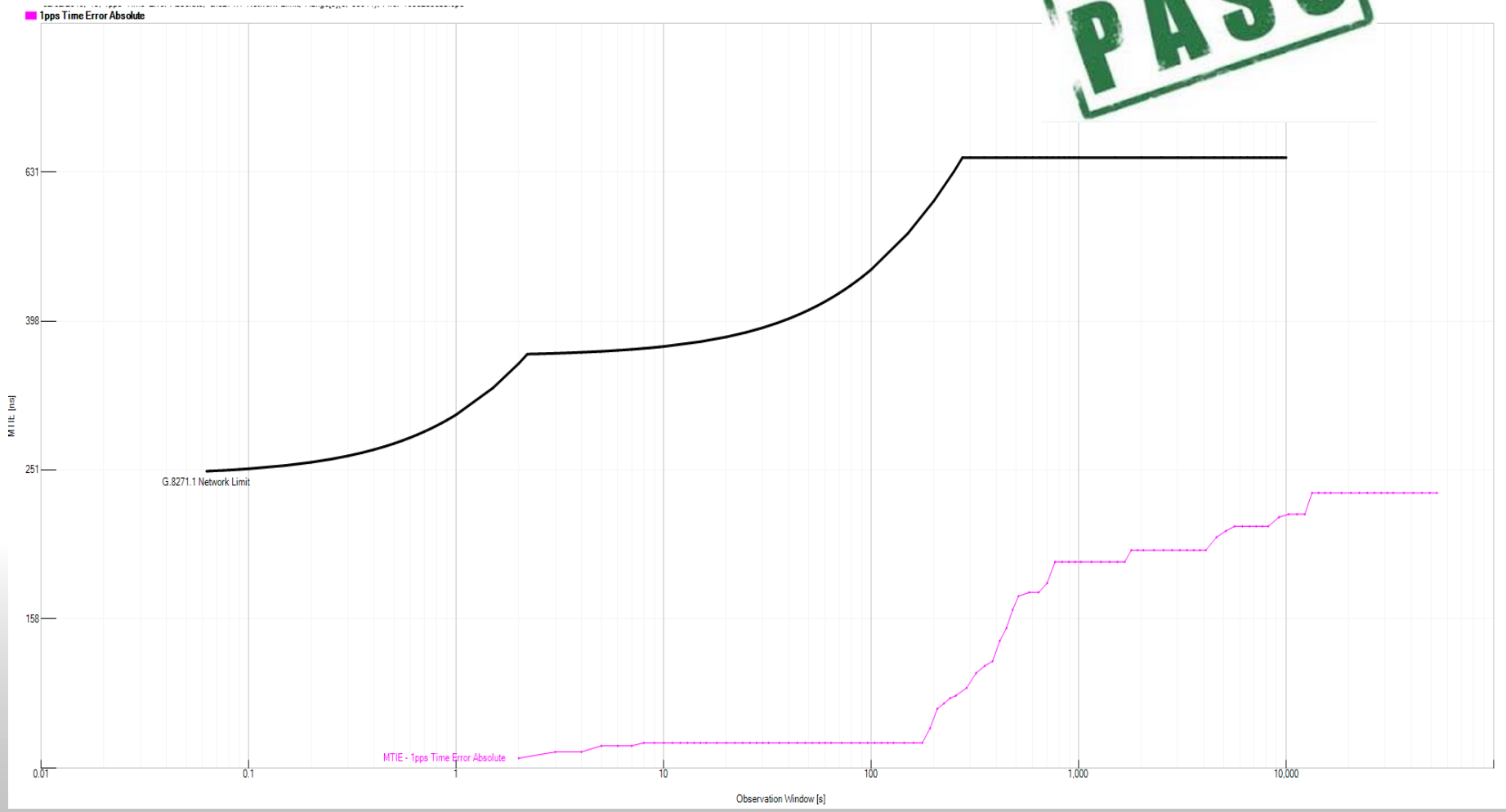
Test #1 – 1PPS MTIE (Tester)

- MTIE well under G.8271.1 network limits mask



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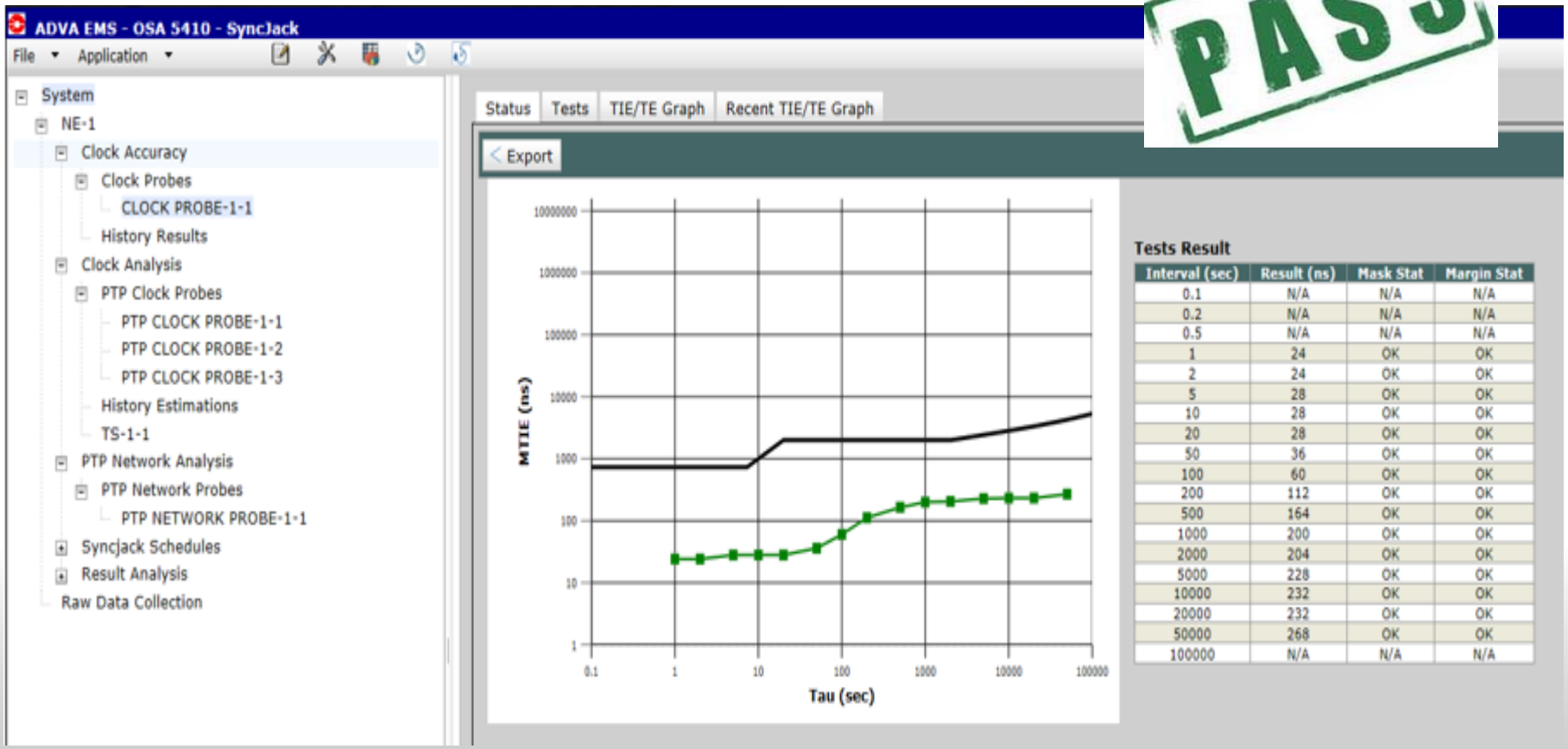
Test #1 – 1PPS MTIE Probe Vs Ref PRTC

- MTIE well under G.823 pdh mask



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Test 2: G.8261 Traffic model #2

- Single Congestion , VLAN Priority
- PTP - 64 packets per second (on both directions)
- Single congestion point (on forward)
- Forward load traffic (no load on reverse direction)
  - 30% -minimum size packets (64 octets)
  - **60% - maximum size packets (1518 octets)**
  - 10% - medium size packets (576 octets)

Test #2 - Forward & Reverse Filtered Packet TIE (Tester)

- Window size – 200 sec , 0.3%

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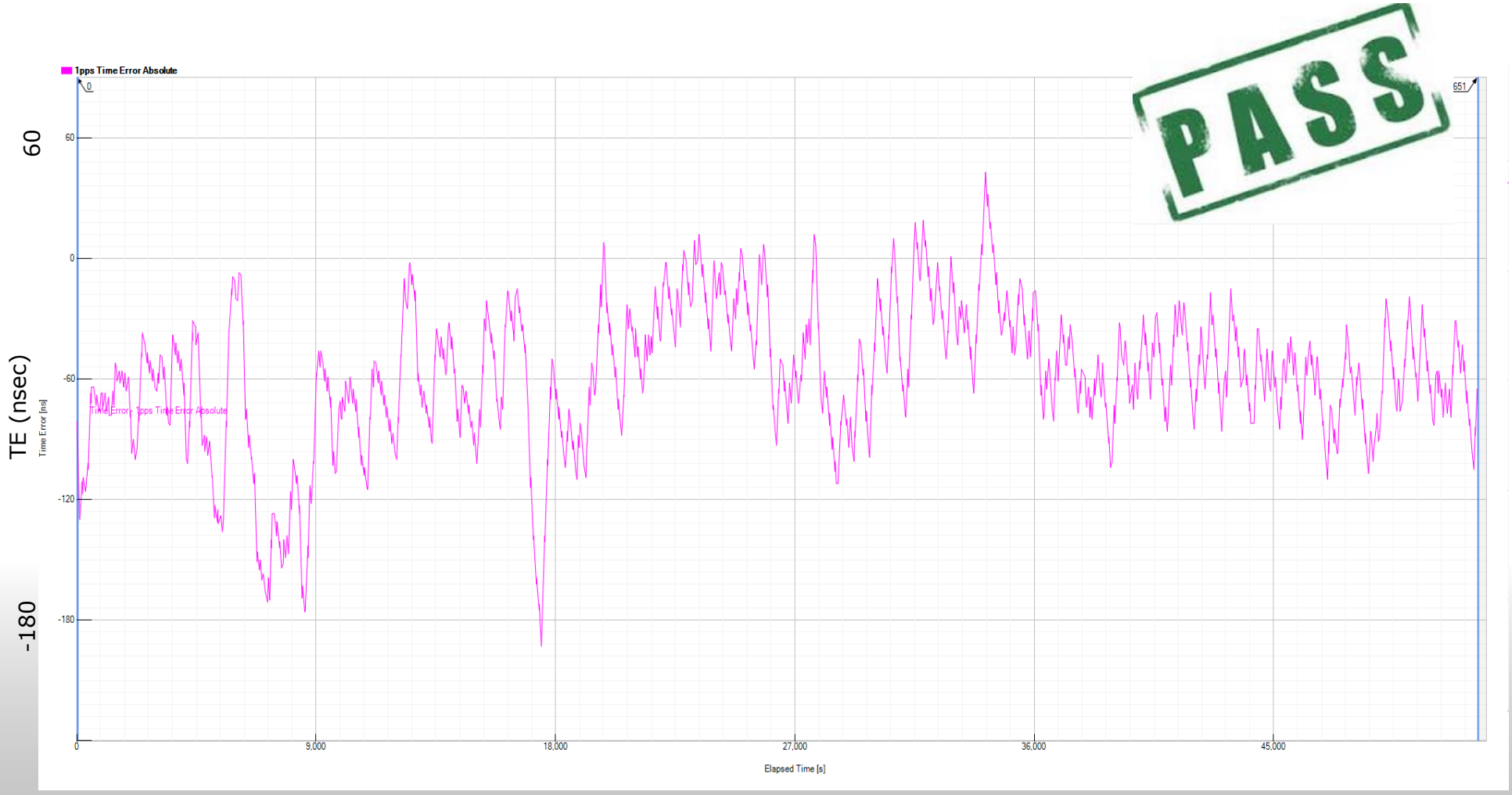
Test #2 – 1PPS TE (Tester)

- Time Error within +/- 200nsec – well within +/- 1100nsec



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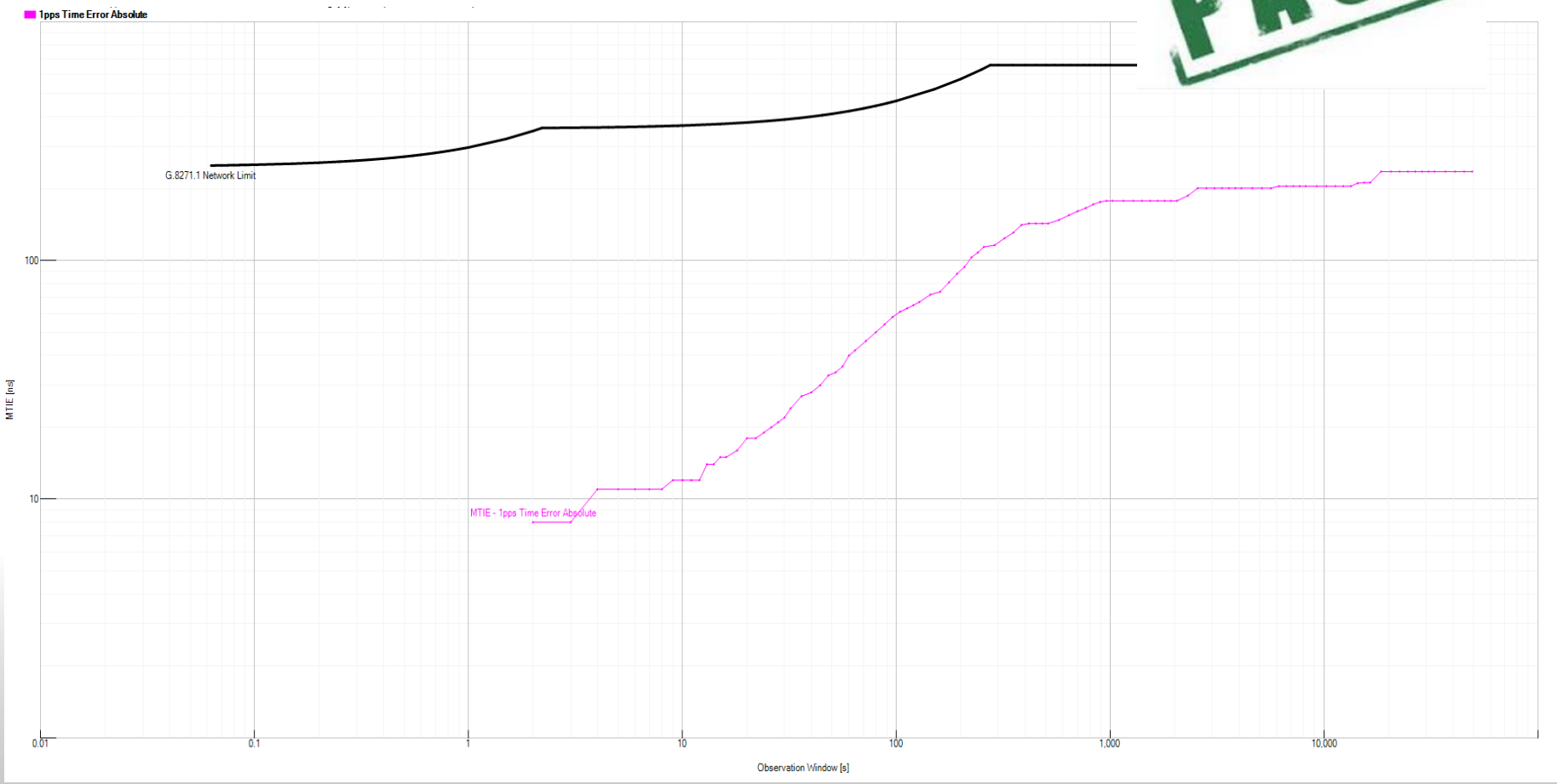
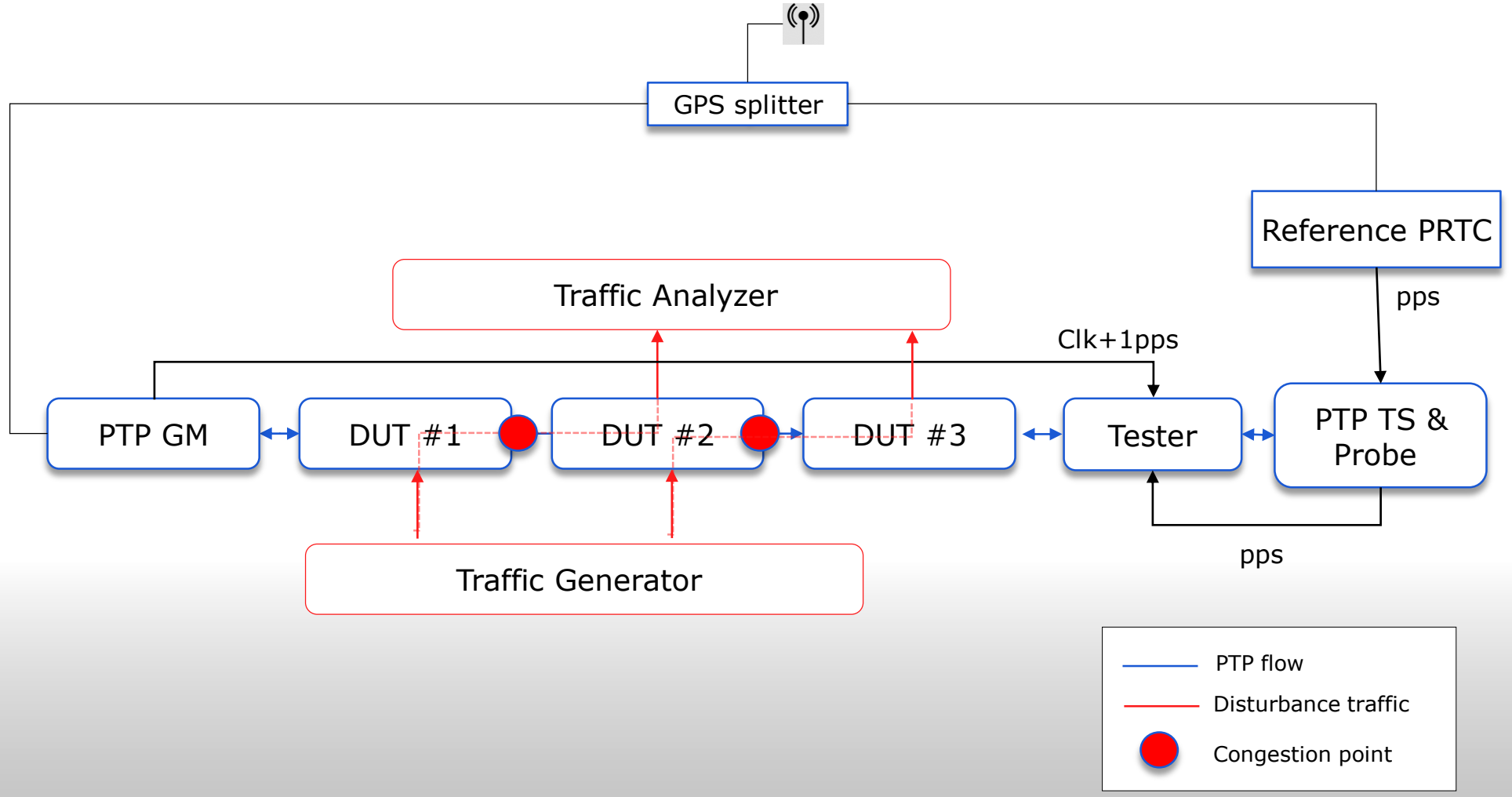
Test #2 – 1PPS MTIE (Tester)

- MTIE well under G.8271.1 network limits mask



Setup #2



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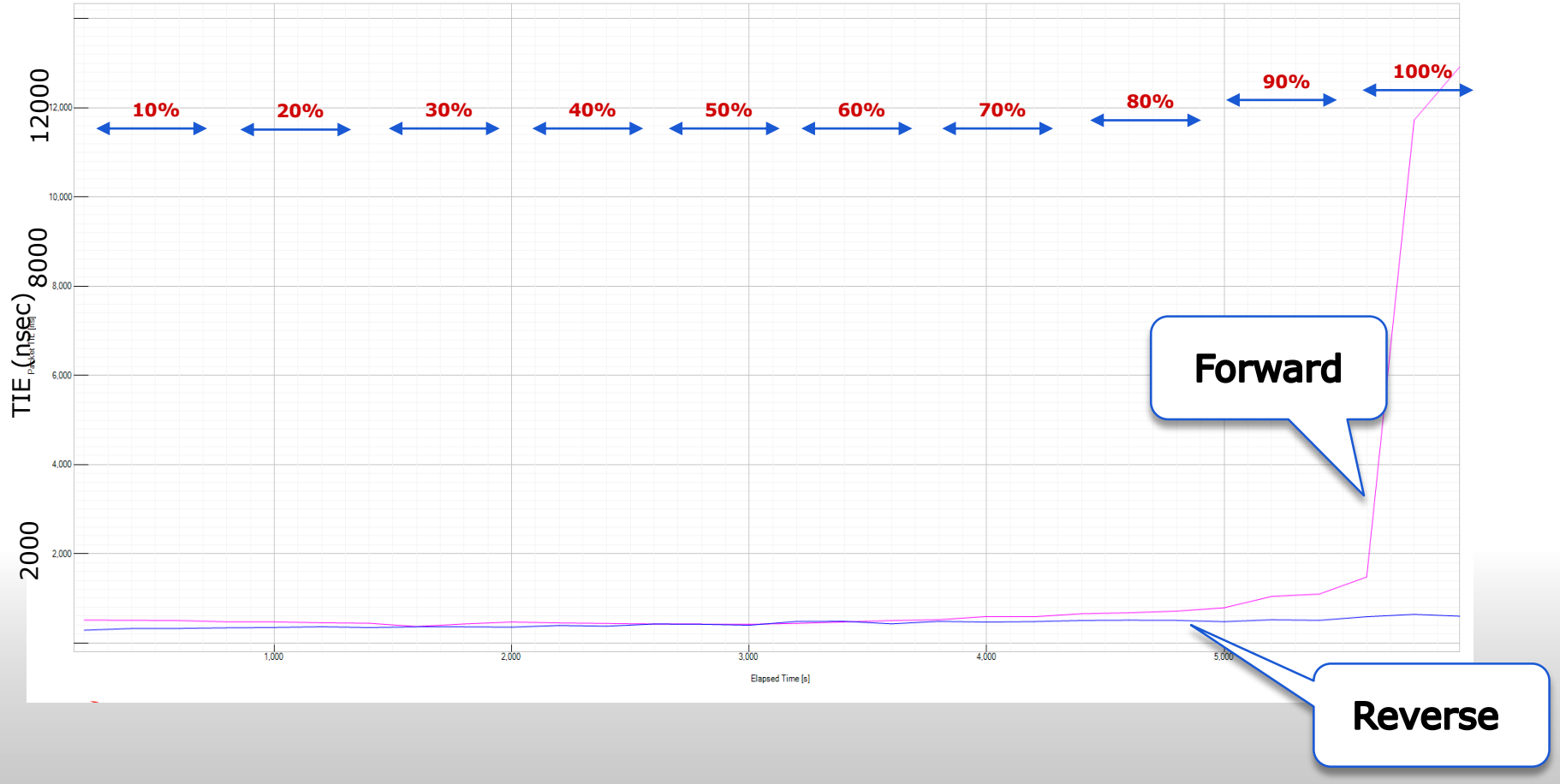
Test 3: G.8261 Traffic model #1

- Two Congestion points , VLAN Priority
- PTP - 64 packets per second (on both directions)
- Single congestion point (on forward)
- Forward load traffic (no load on reverse direction)
  - 60% -minimum size packets (64 octets)
  - **15% - maximum size packets (1518 octets)**
  - 5% - medium size packets (576 octets)

Test #3 - Forward & Reverse Filtered Packet TIE (Tester)

- Window size – 200 sec , 0.3%



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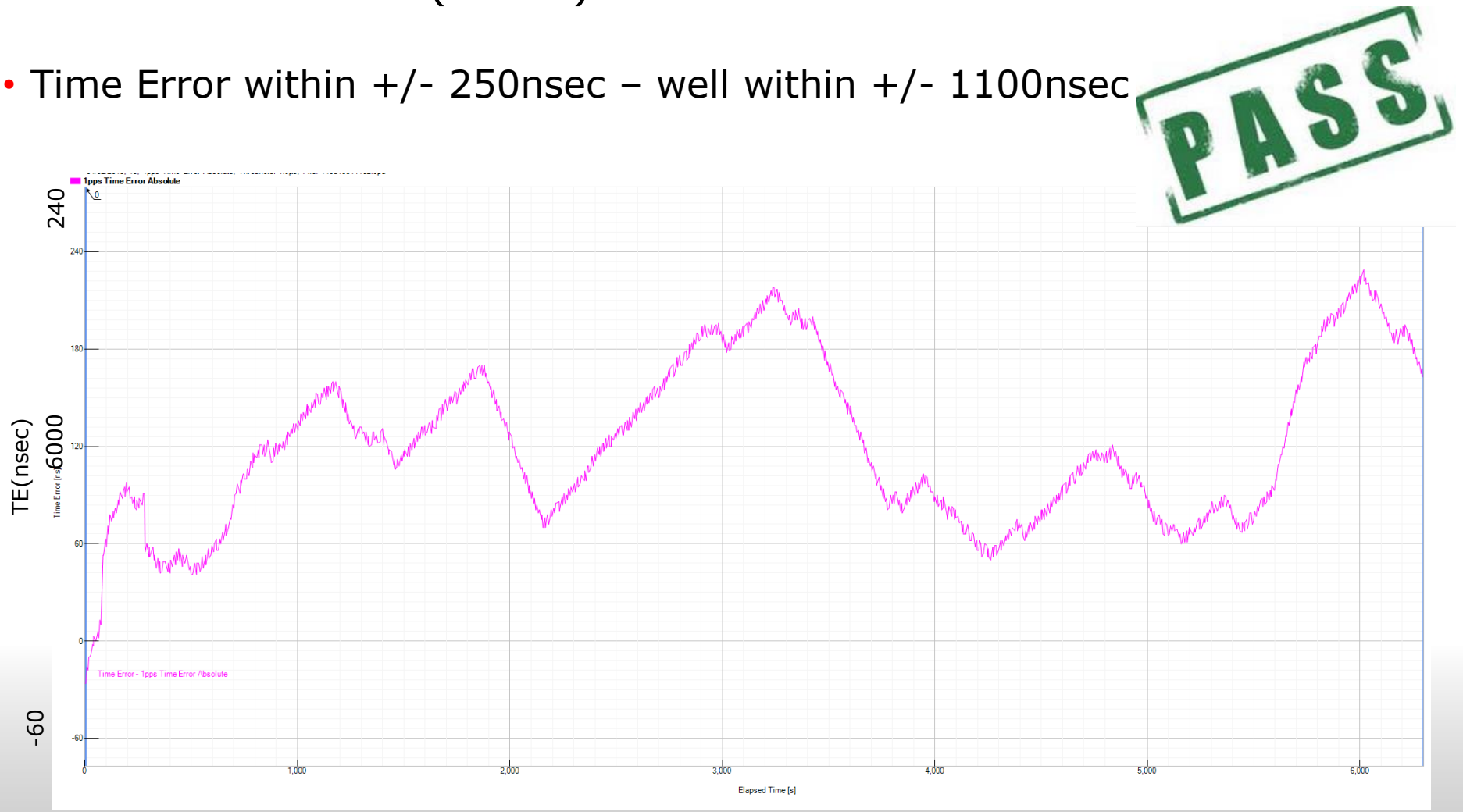
Test #3 – 1PPS TE (Tester)

- Time Error within +/- 250nsec – well within +/- 1100nsec



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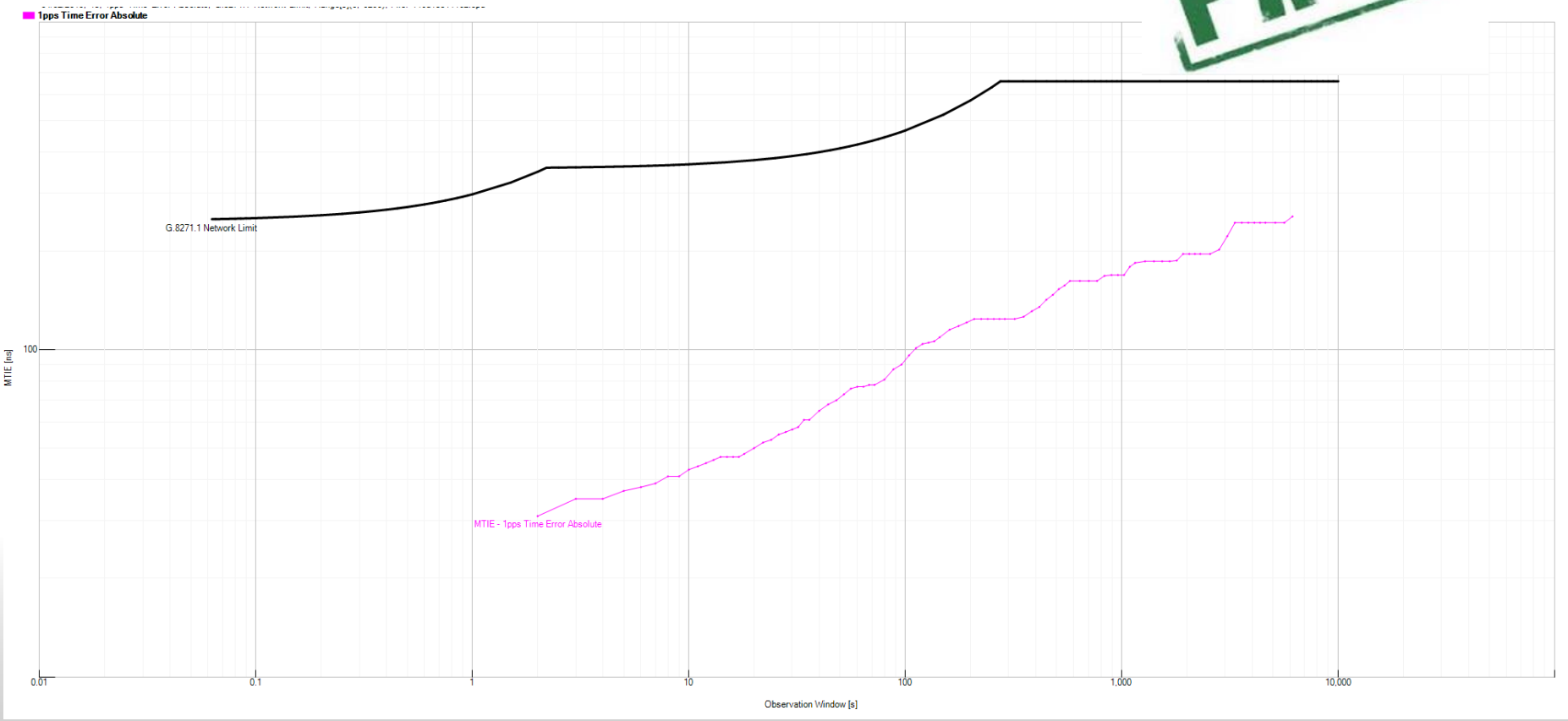
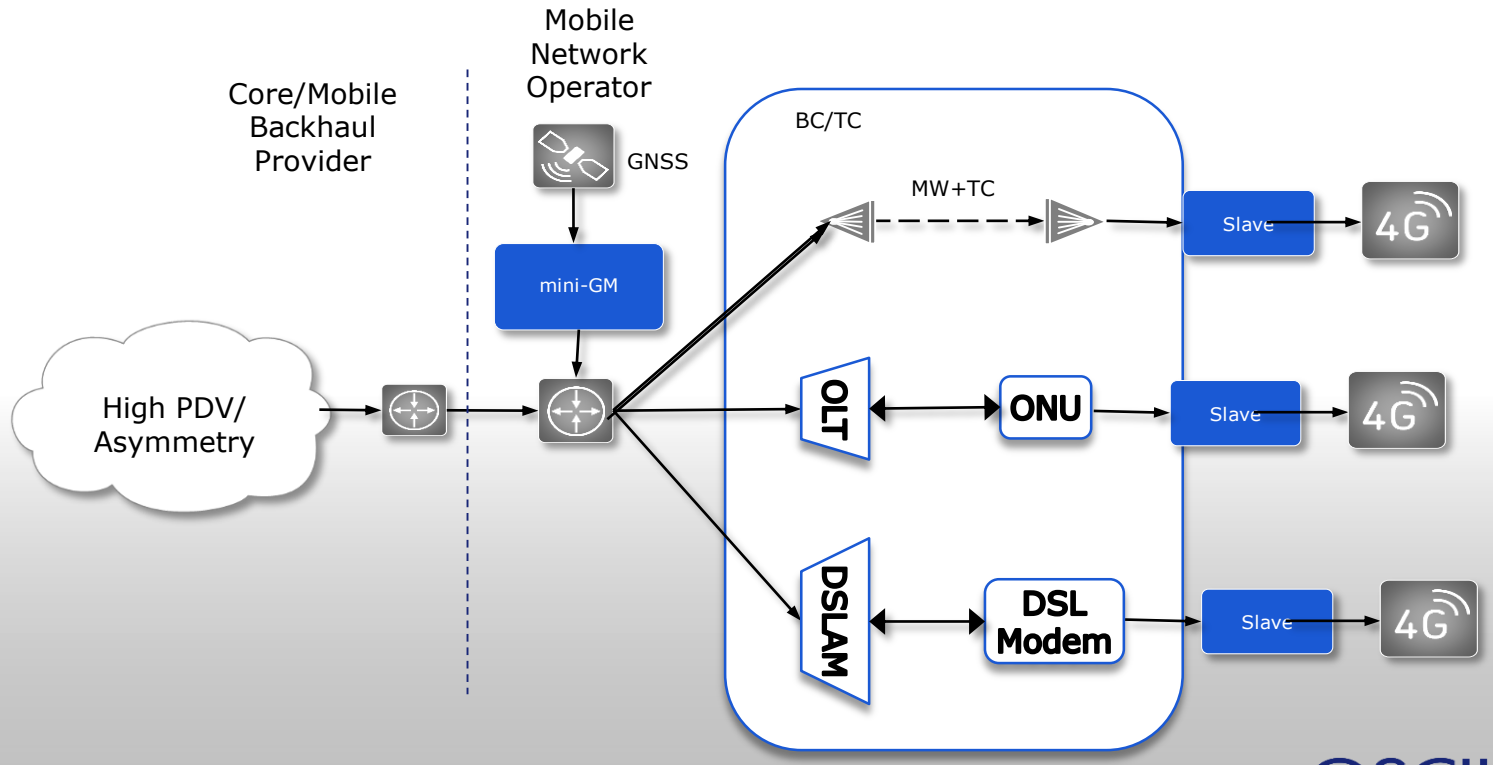
Test #3 – 1PPS MTIE (Tester)

- MTIE well under G.8271.1 network limits mask



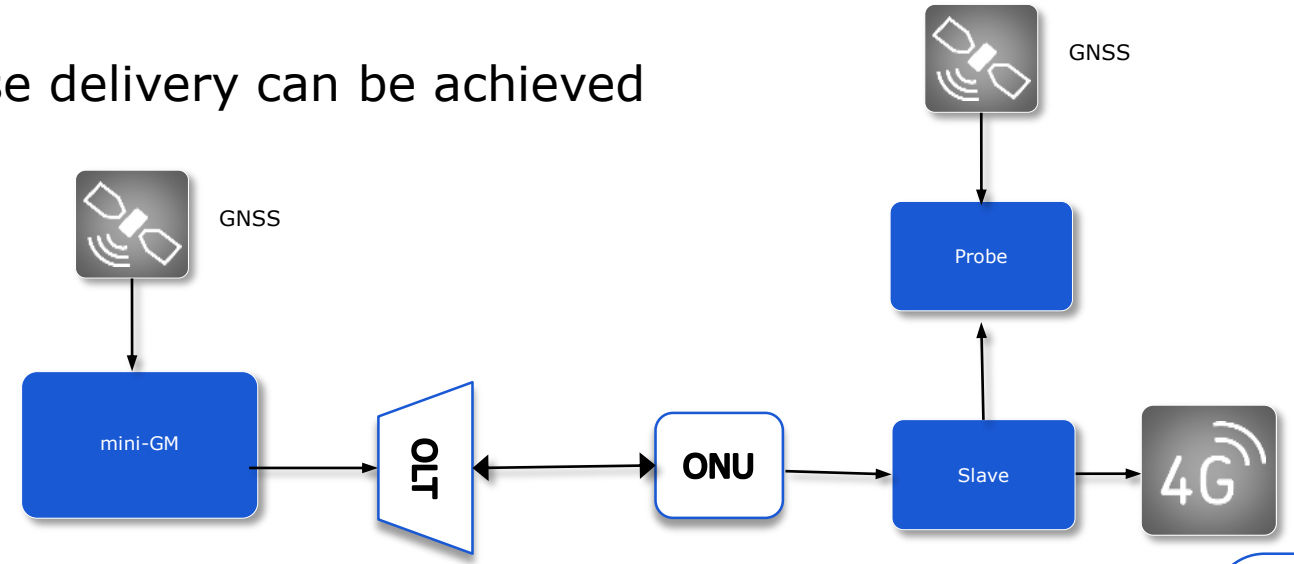
Other Access Technologies

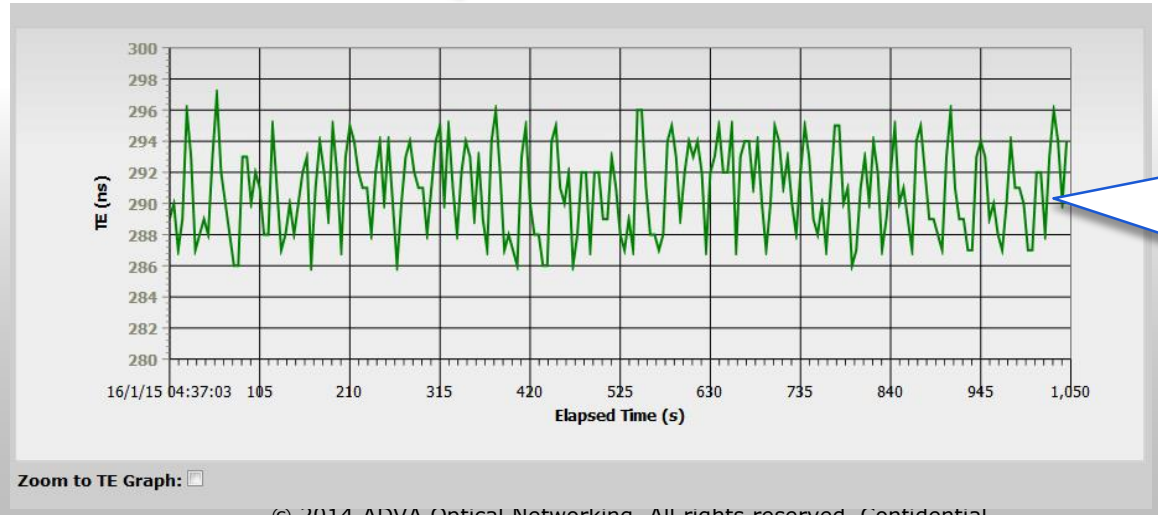
- WDM/GPON/DSLAM/MW tend to include high level of PDV & Asymmetry
- In most cases would require on path support (BC/TC) in order to deliver accurate phase
- Highly dependent on the vendor implementation – Sync Survey is recommended



GPON

- GPON G.984.3 include mechanism for Time of Day distribution over G-PON – interworking with PTP is still being developed but some proprietary solutions are already proposed
- Very accurate phase delivery can be achieved





Time Error below 500 nsec

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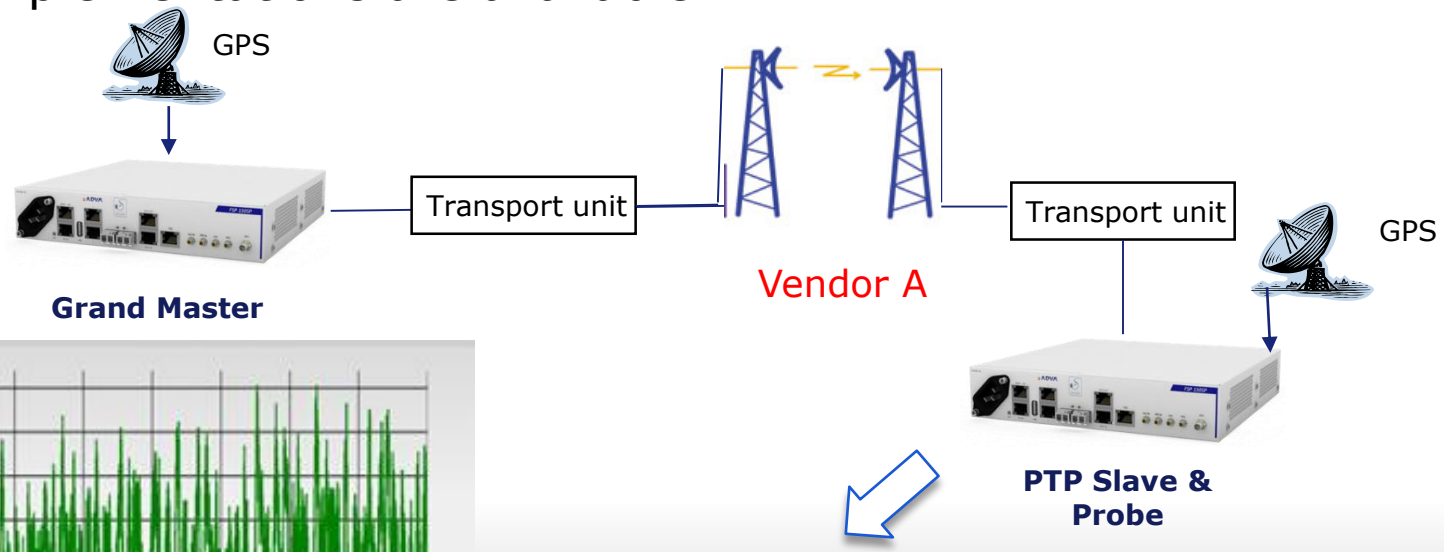
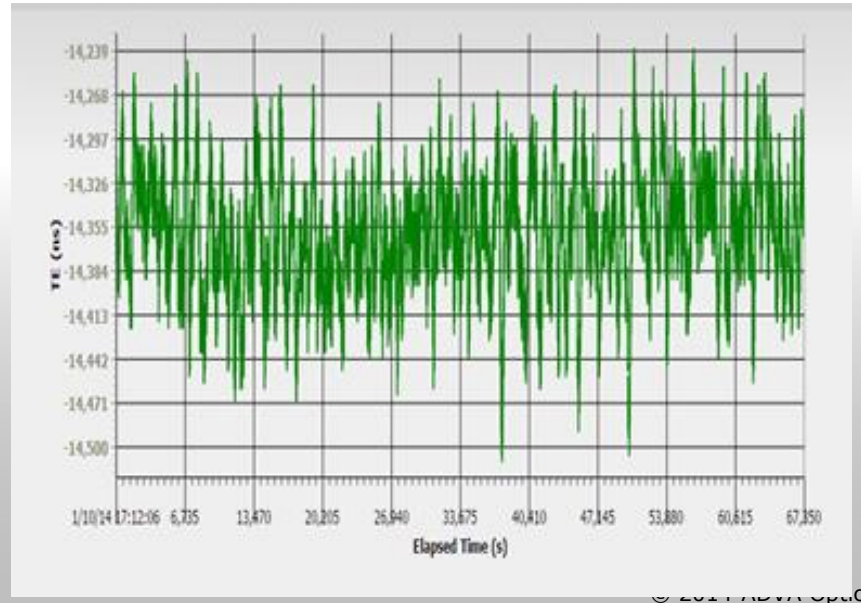
Microwave

- Highly dependent on the MW implementation
- PTP should be assigned to the highest QoS flow – can help reduce asymmetry and PDV caused by adaptive modulation
- Proprietary BC/TC implementations are available





Network asymmetry of **14usec** over single MW hop

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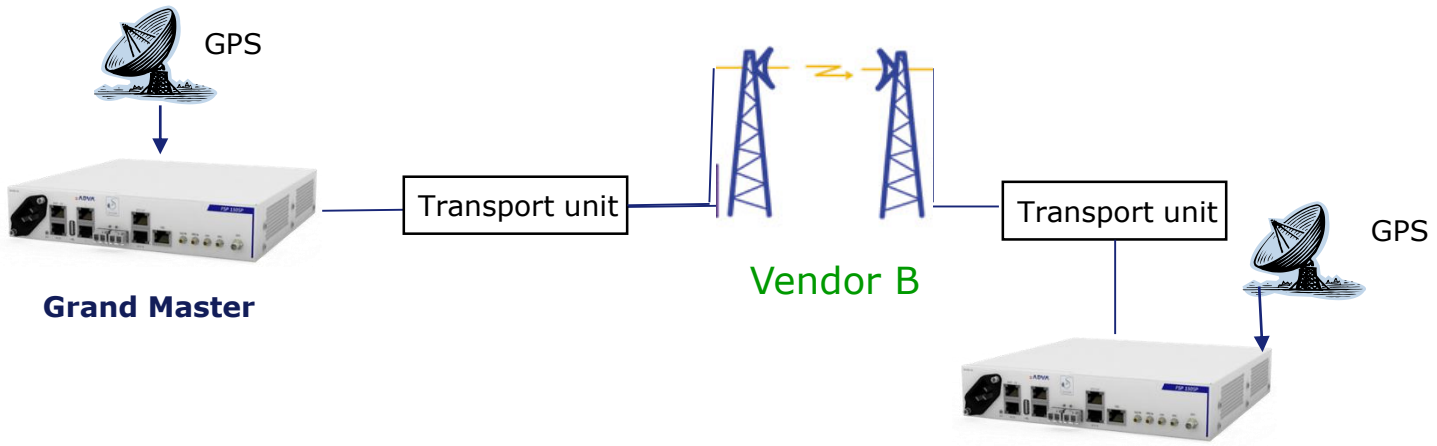
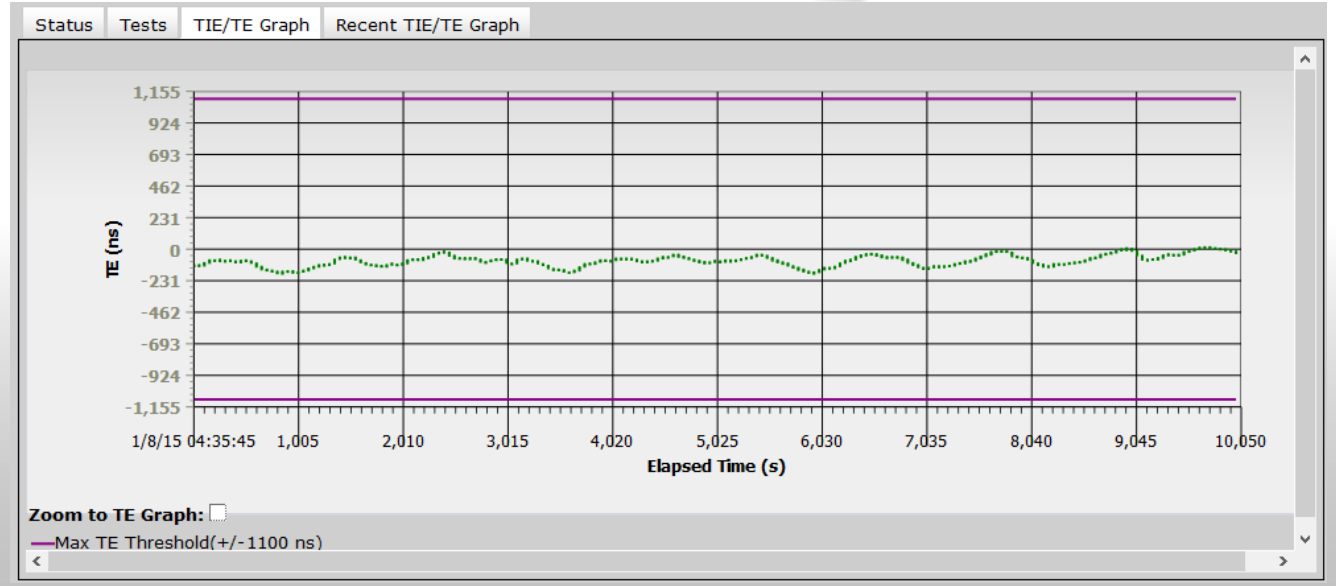
Microwave –Cont



Slave recovered clock within +/-**250nsec**



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Phase Delivery over PTP unaware networks

- Phase delivery over PTP unaware network elements is possible with the following network engineering guidelines:

  - Conduct Sync Survey - Test your access network elements PDV and asymmetry under realistic load scenario
  - Use QoS to prioritize PTP packets
  - Avoid speed mismatch (or compensate for known asymmetry generated by the mismatch)
  - Avoid network traffic utilization above 90%
  - If needed , use PTP aware network element for access technologies (MW/WDM/DSLAM/GPON)

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Questions? Thank you!

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