

#### Phase Delivery over PTP Unaware Networks

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#### Phase Delivery Challenges in Brownfield Deployments



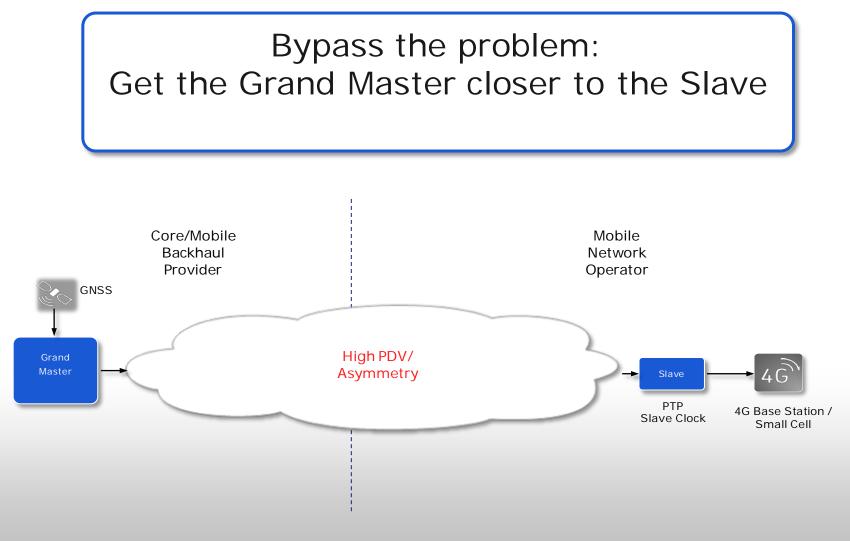
- Existing network introduce high level of asymmetry and PDV
- The asymmetry and PDV varies over time
- Existing networks include different transport technologies
- Upgrading/forklifting the existing NE to Sync-E/BC is very costly



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

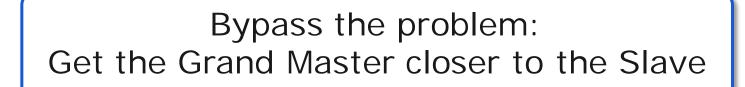


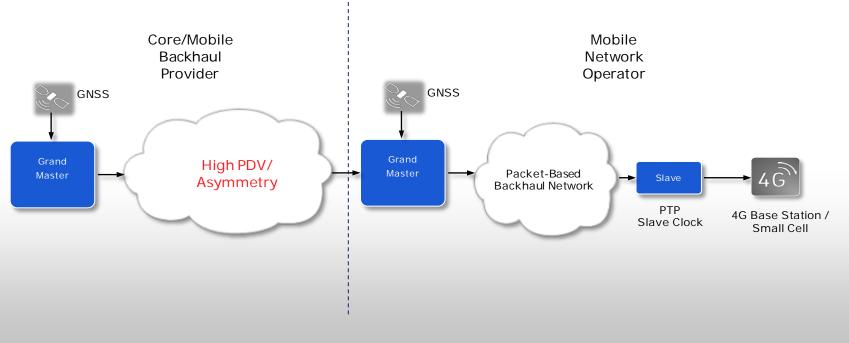
#### The Solution





#### The Solution

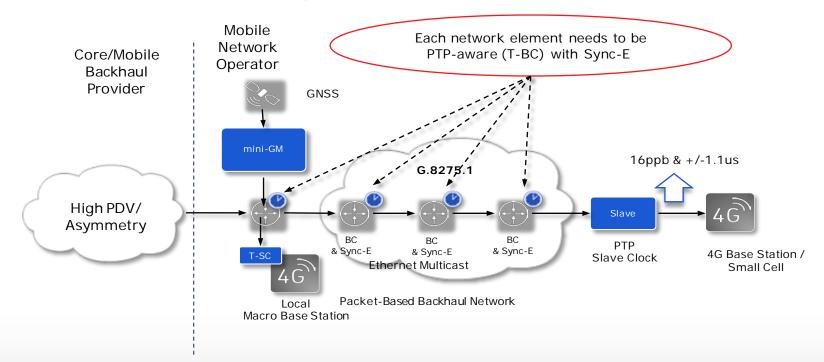






#### Phase Delivery: Small Scale GM & G.8275.1 – Last Mile

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

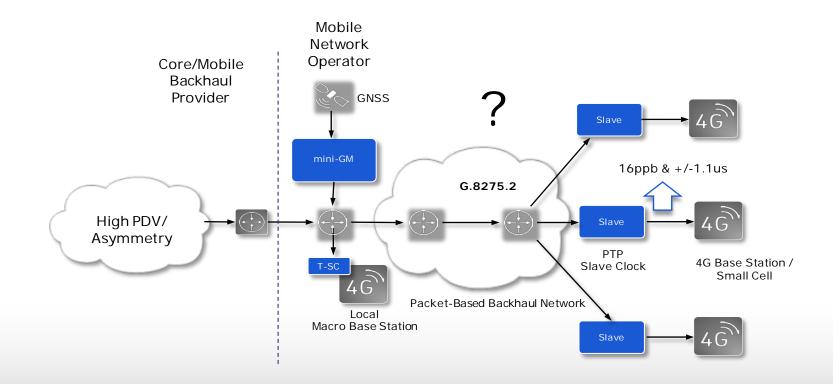


#### Last mile full on path support Small Scale GM as a head of G.8275.1 chain



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

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

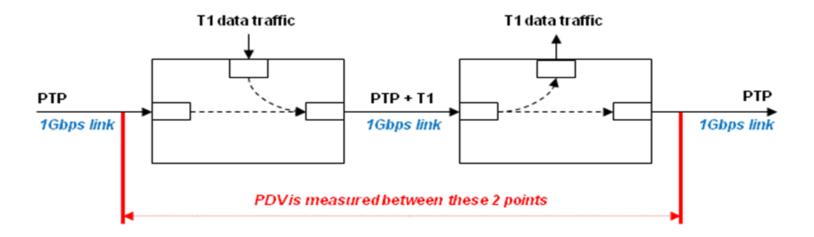


Small Scale GM as a head of G.8275.2 chain



### PDV of a single NE

Single congestion point



Two types of traffic loads have been considered:

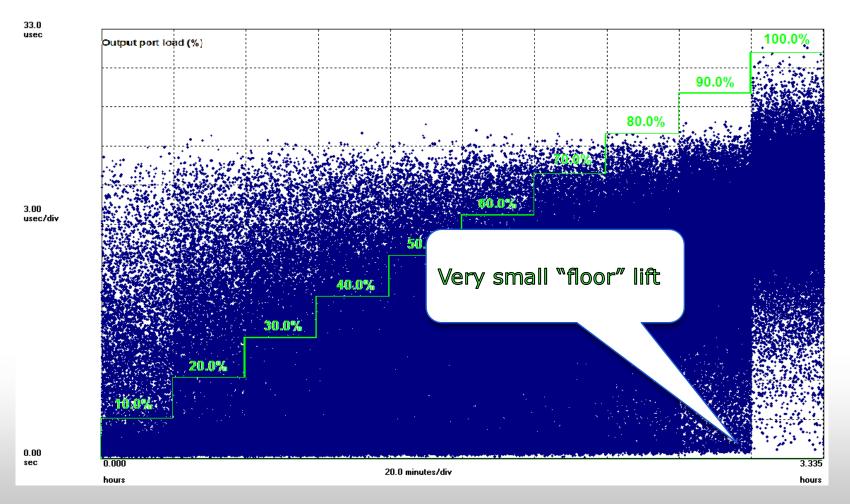
- **Case A**: The size of the data traffic packets was variable, from 64 bytes to 1518 bytes
- Case B: All the data traffic packets have a 1518 bytes fixed size

Source - France Télécom Orange



### PDV of a single NE – Case A

1Gbps, variable size data traffic:



Source - France Télécom Orange

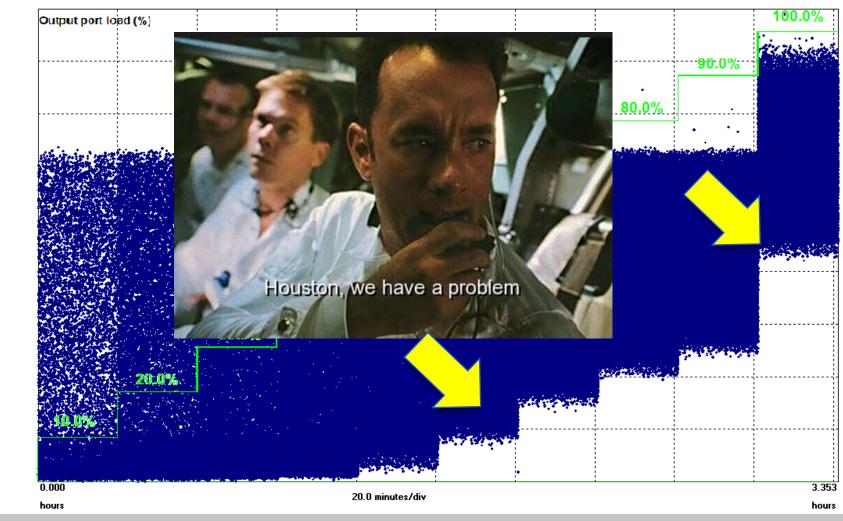


#### PDV of a single NE – Case B

1Gbps, 1518 bytes data traffic:



4.00 usec/div

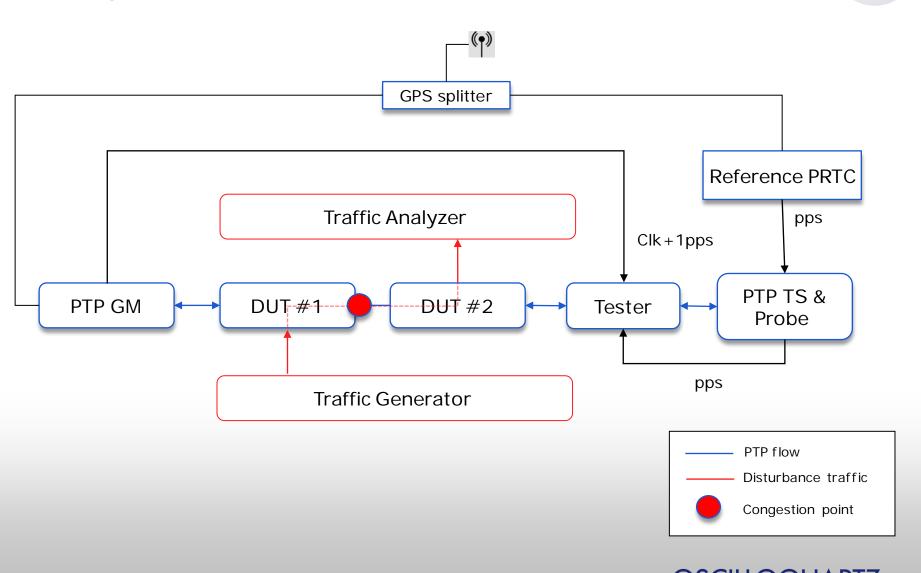




#### Source - France Télécom Orange

0.00 sec

#### Setup #1



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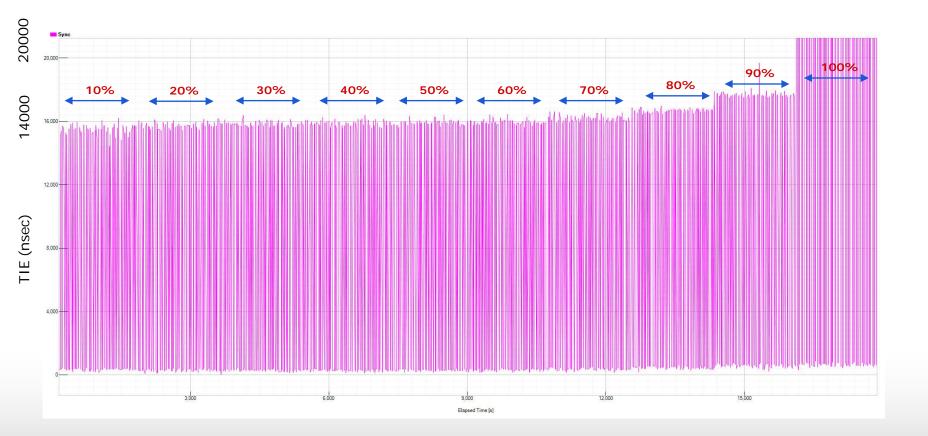
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### Test 1: G.8261 Traffic model #1

- 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)



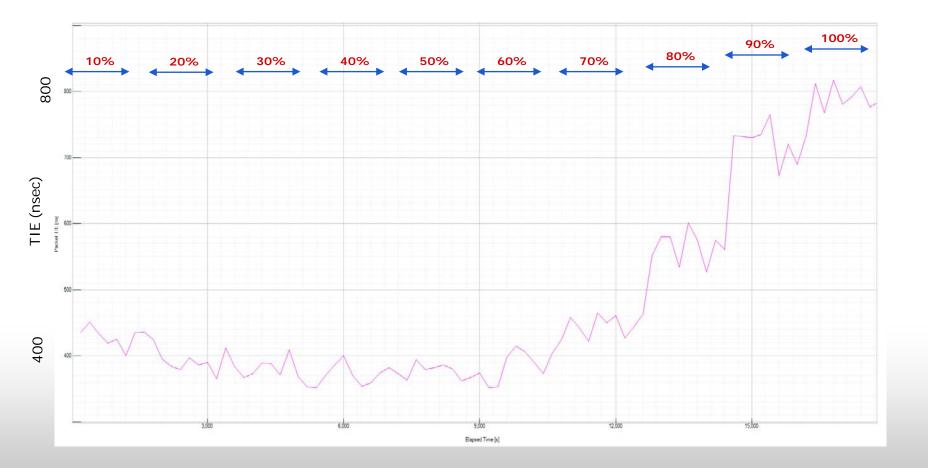
#### Test #1 - Forward Packet TIE (Tester)





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

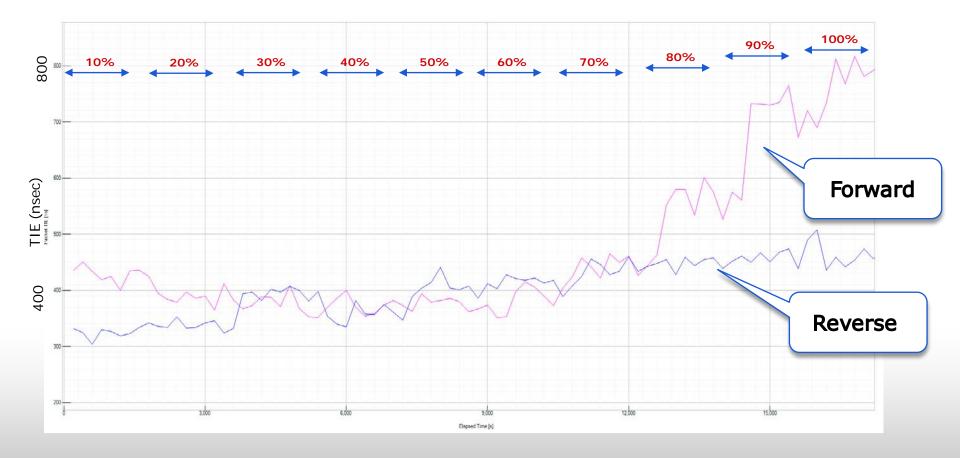
Window size – 200 sec , band 0.3%





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

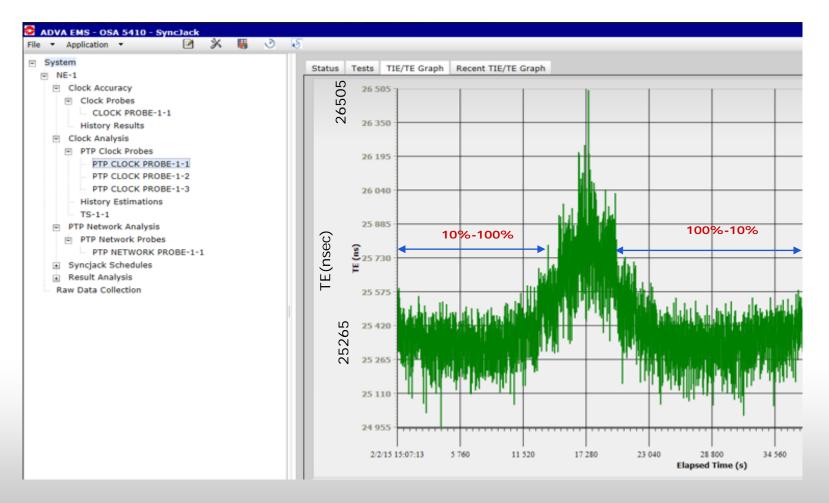
• Window size – 200 sec , 0.3%





### Test #1 – Probe Measured Forward Delay

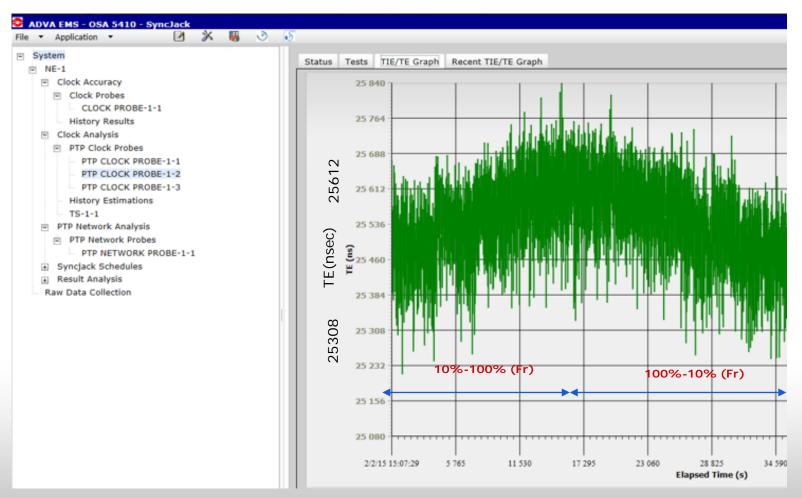
#### Window size – 5sec , Lucky packet





### Test #1 – Probe Measured Reverse Delay

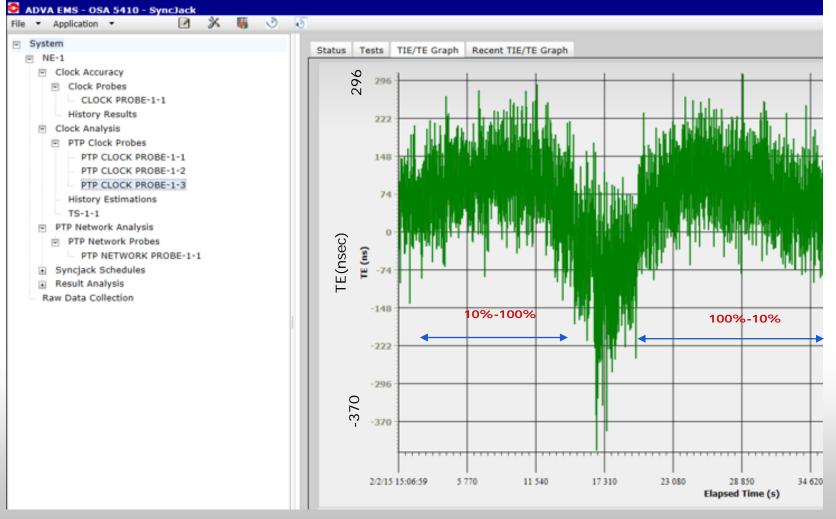
#### • Window size – 5sec , Lucky packet





### Test #1 – Probe Measured Asymmetry

Window size – 5sec , Lucky packet





#### Test #1 – 1PPS TE (Tester)

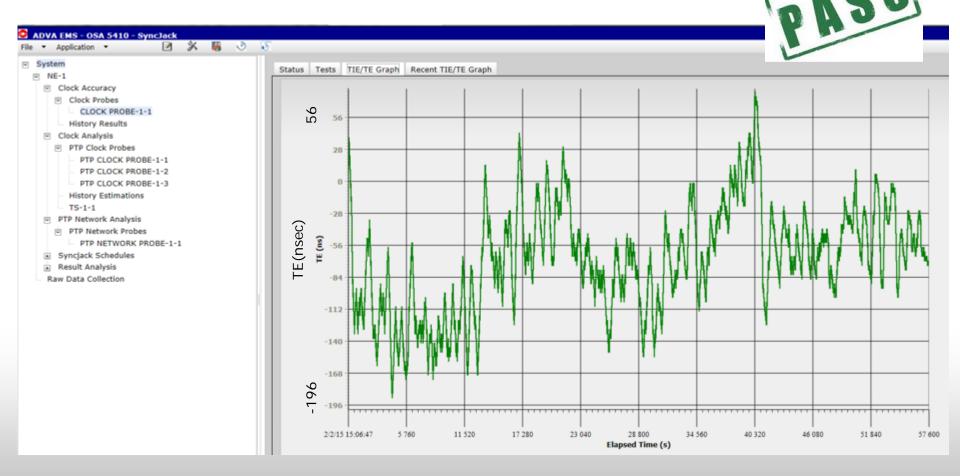
• Time Error within +/- 150nsec – well within +/- 1100nsec



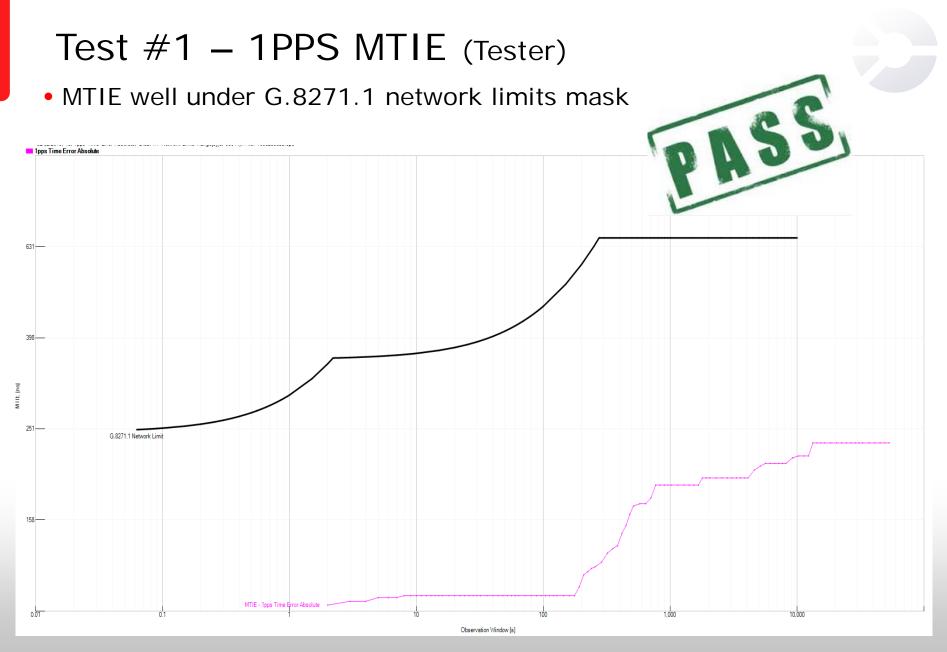


### Test #1 – 1PPS TE Probe Vs ref PRTC

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



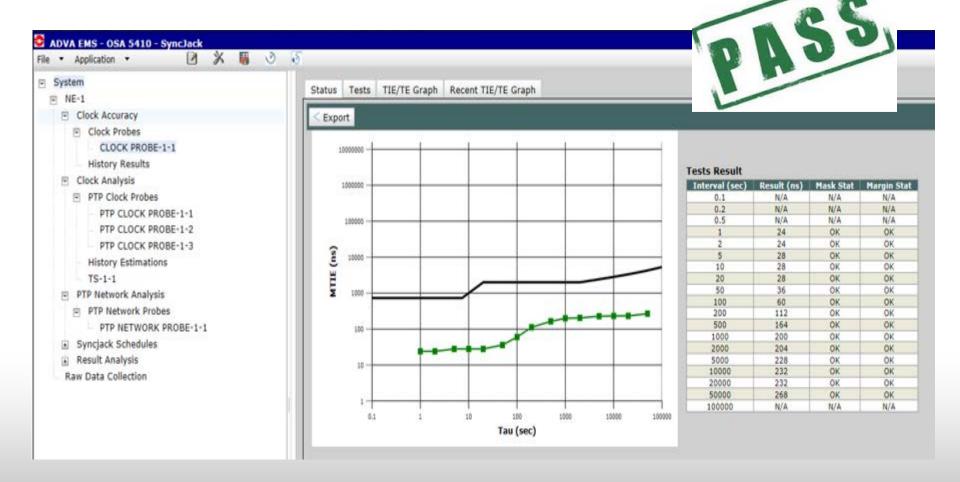






### Test #1 – 1PPS MTIE Probe Vs Ref PRTC

• MTIE well under G.823 pdh mask

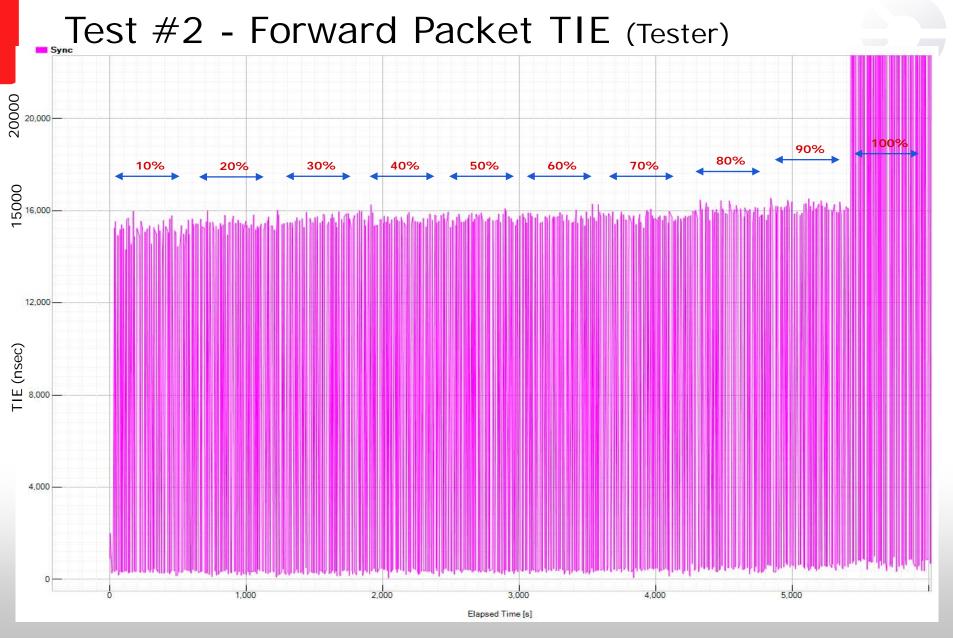




#### Test 2: G.8261 Traffic model #2

- 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)

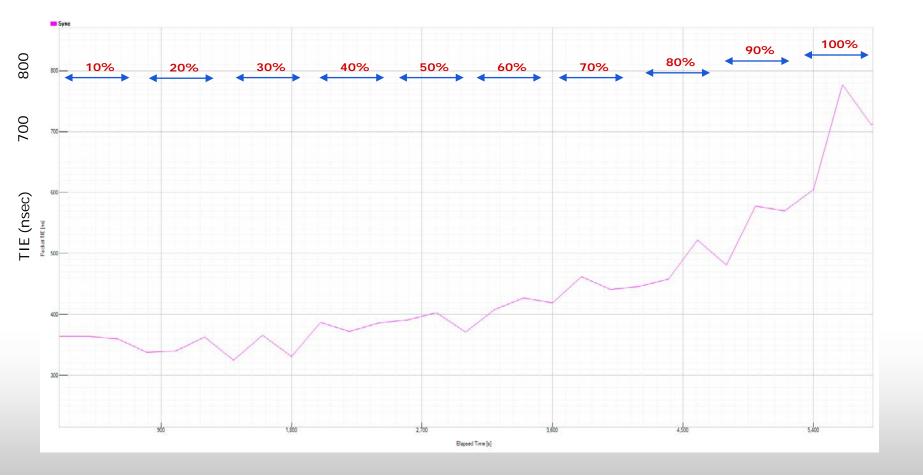






#### Test #2 - Forward Filtered Packet TIE (Tester)

Window size – 200 sec , band 0.3%





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

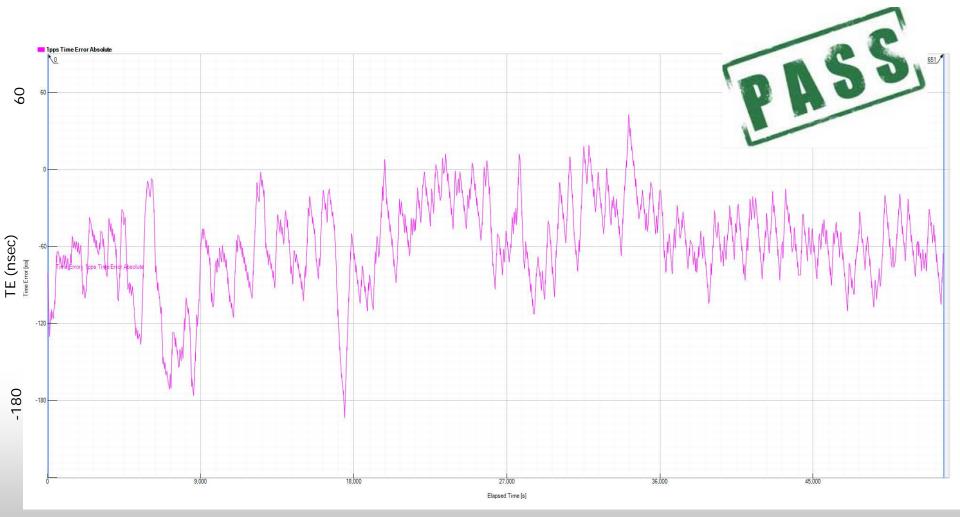
• Window size – 200 sec , 0.3%



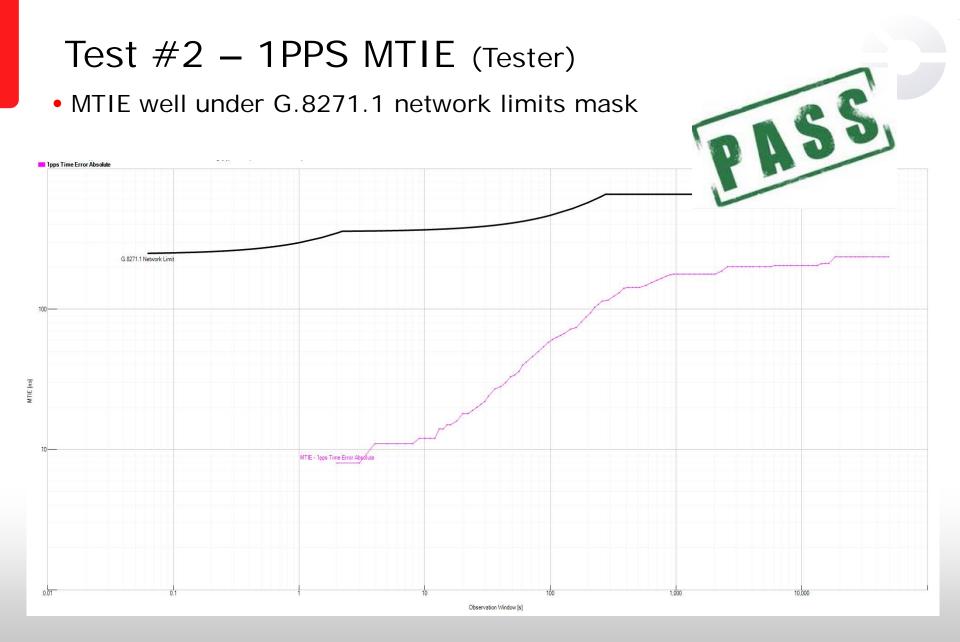


#### Test #2 – 1PPS TE (Tester)

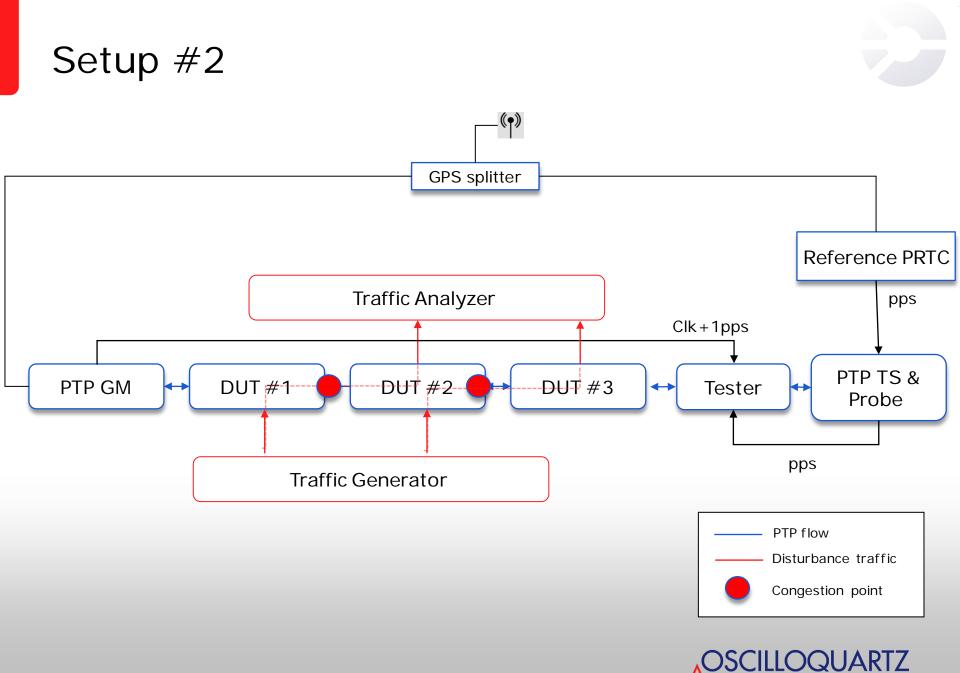
• Time Error within +/- 200nsec – well within +/- 1100nsec











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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)

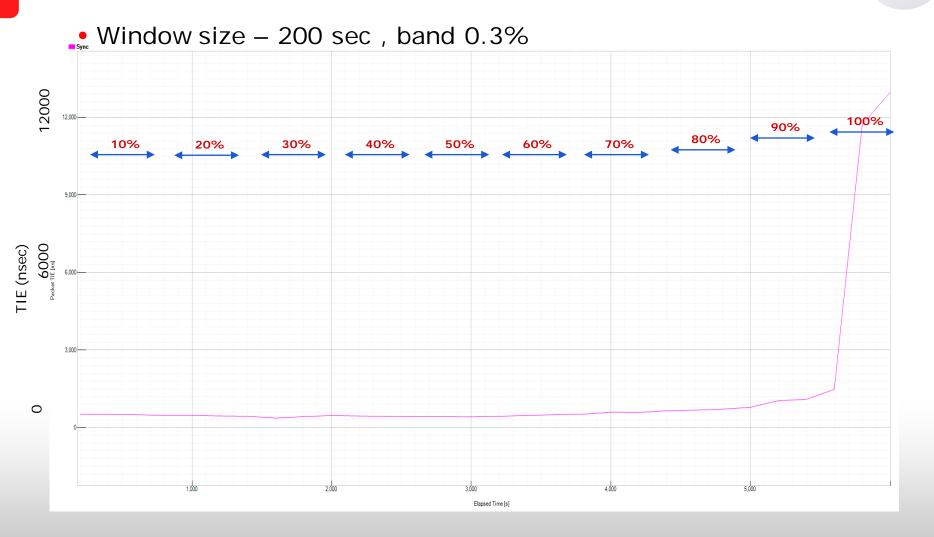


### Test #3 - Forward Packet TIE (Tester)





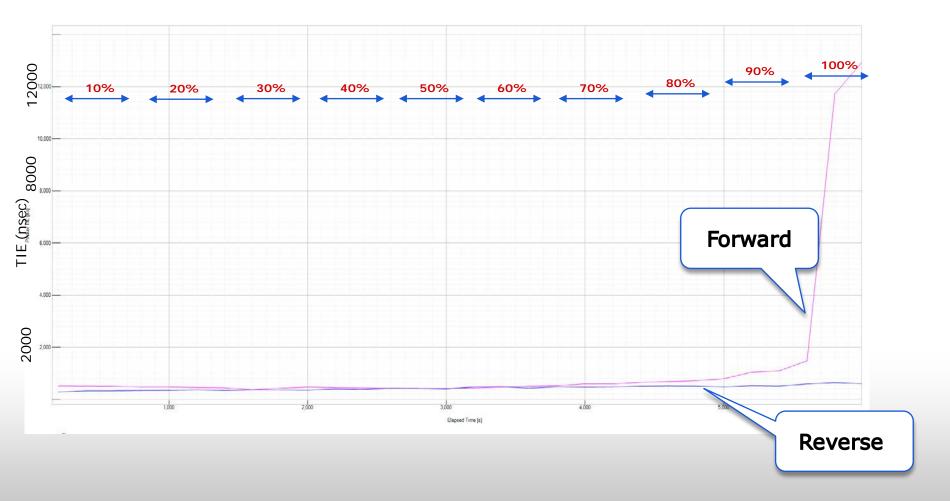
#### Test #3 - Forward Filtered Packet TIE (Tester)





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

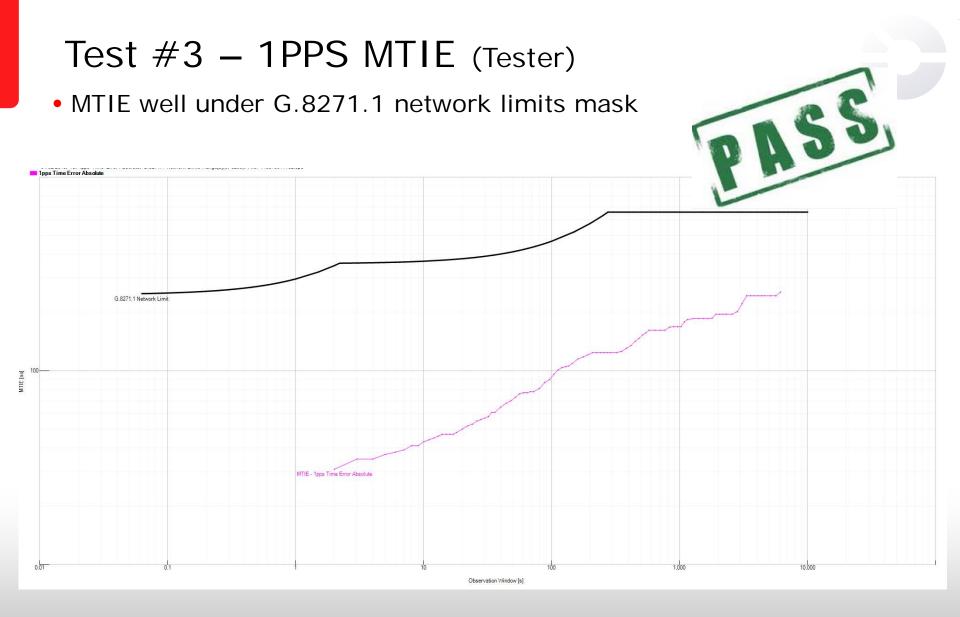
• Window size – 200 sec , 0.3%





## Test #3 – 1PPS TE (Tester) • Time Error within +/- 250nsec – well within +/- 1100nsec 1pps Time Error Absolute 240 190 TE(nsec) ime Error Insj6000 Time Error - 1pps Time Error Absolute -60 Elapsed Time [s]







#### Test 4: G.8261 Traffic model #2

- 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)
  - 30% -minimum size packets (64 octets)
  - •60% maximum size packets (1518 octets)
  - 10% medium size packets (576 octets)

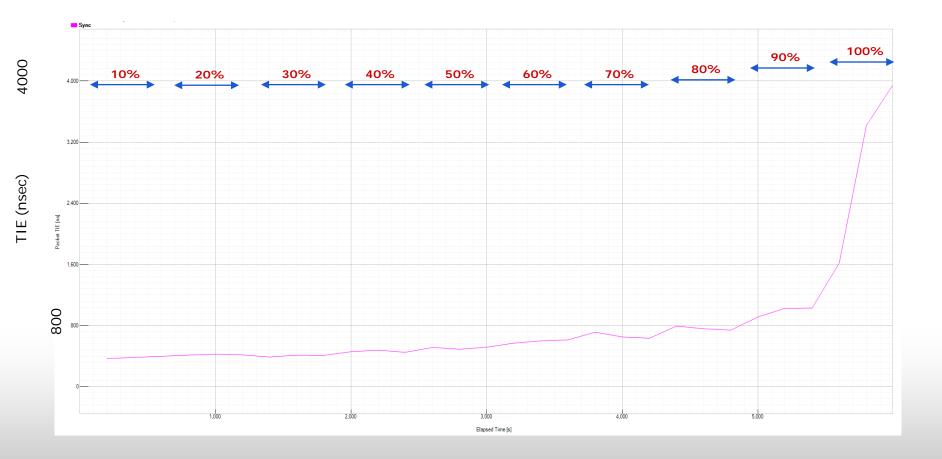


#### Test #4 - Forward Packet TIE (Tester) Sync 80000 100% 90% 80% 40% 50% 10% 30% 60% 70% 20% 60,000 Pa∓elrEns(nsec) 40,000 20,000 0 4,000 2,000 3 000 5,000 Elapsed Time [s]



#### Test #4 - Forward Filtered Packet TIE (Tester)

Window size – 200 sec , band 0.3%





#### Test #4 - Forward & Reverse Filtered Packet TIE (Tester)

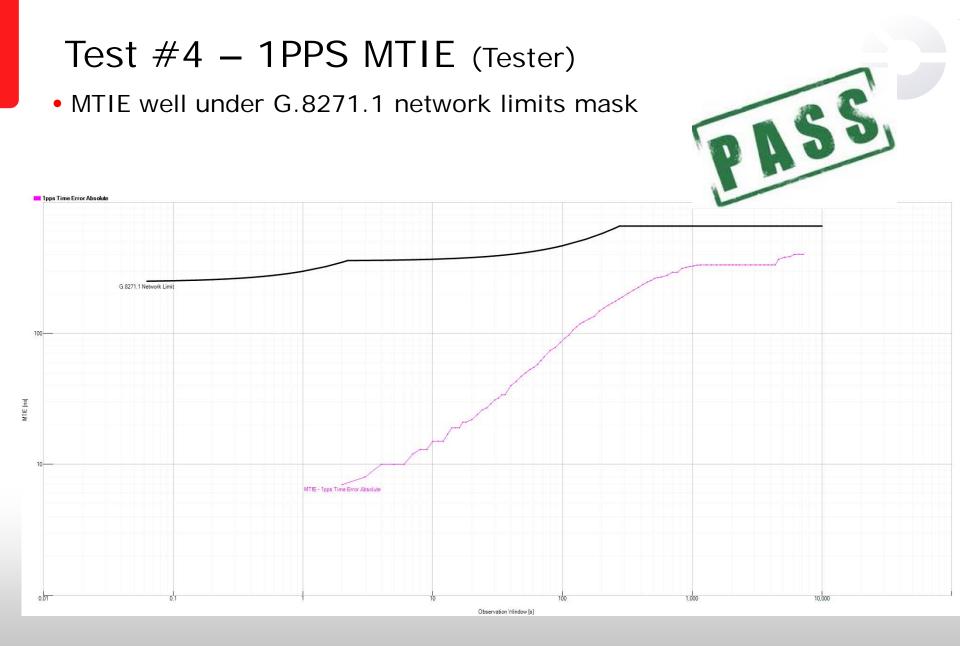
• Window size – 200 sec , 0.3%





# Test #4 – 1PPS TE (Tester) Time Error within +/- 270nsec – well within +/- 1100nsec Inns Time Error Abso 180 Time Error Insl nmm -18 -270 0 Elapsed Time [s]





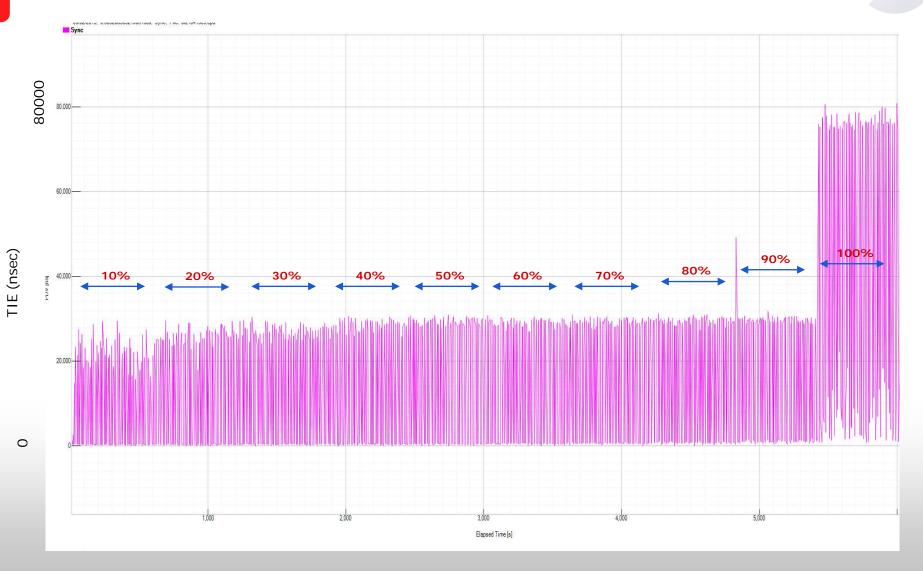


#### Test 5: Traffic model #3

- 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)
  - 10% -minimum size packets (64 octets)
  - 80% maximum size packets (1518 octets)
  - 10% medium size packets (576 octets)



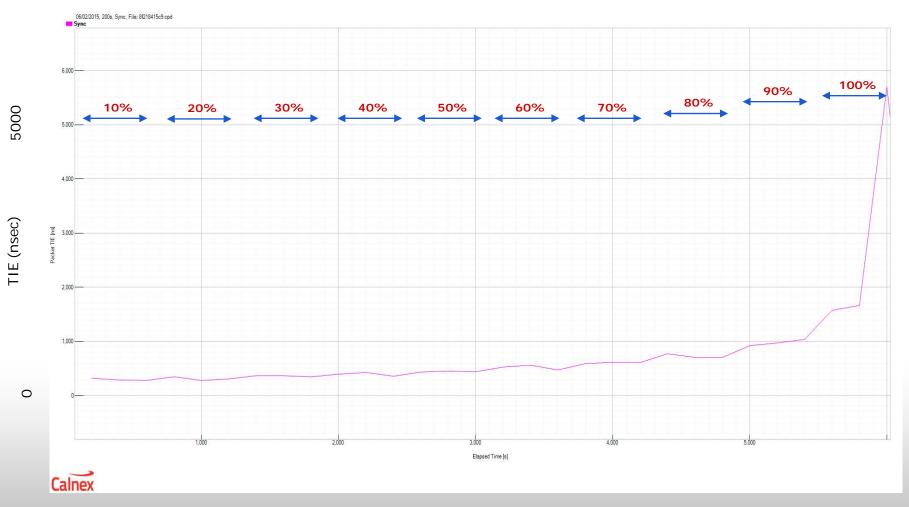
#### Test #5 - Forward Packet TIE (Tester)





#### Test #5 - Forward Filtered Packet TIE (Tester)

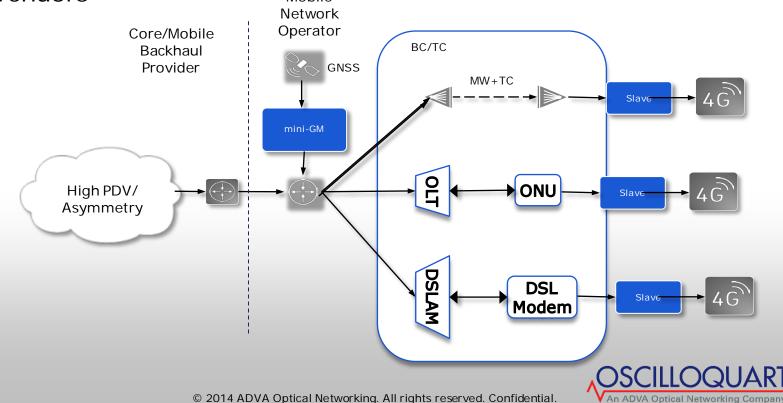
Window size – 200 sec , band 0.3%





### 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
- ITU-T standards not available but proprietary solution are offered by the vendors



#### Phase Delivery over PTP unaware networks

- Phase delivery over PTP unaware Ethernet (L2) network elements is possible with the following network engineering guidelines:
  - Use QoS to priorities PTP packets
  - Avoid speed mismatch (or compensated for known asymmetry generated by the mismatch)
  - Test your access network elements PDV and asymmetry under realistic load scenario
  - Avoid network traffic unitization above 90%
  - If needed, use PTP aware network element for access technologies (MW/WDM/DSLAM/GPON)





## Questions? Thank you!

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