



*Integrating high-accuracy synchronization into your  
financial operations*



Francisco Girela @ STAC Summit 2018

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## White Rabbit technology

**White Rabbit (WR)** is a technology born at CERN which achieves sub-nanosecond accuracy in Ethernet based networks. It allows easy deployments of scalable and reliable networks with high accuracy synchronization requirements.



**Easy to integrate**  
within existing infrastructures  
(Ethernet, PTPv2).



**Scalable**  
to long distances & high number  
of nodes. It supports tree topologies  
and daisy-chain configurations



**Deterministic and highly accurate**  
This allows saving engineering and  
equipment costs to achieve a global  
target time budget.



**Dependable**  
It reduces vulnerabilities to  
spoofing or GPS jamming. Up to 100  
km links without on site calibration.



**Cost-effective**  
It compensates dynamically link  
asymmetries and temperature  
changes. Easy to deploy, pre-  
calibration.



**Facilitates new services**  
Positioning, High Frequency Trading,  
Time as a Service

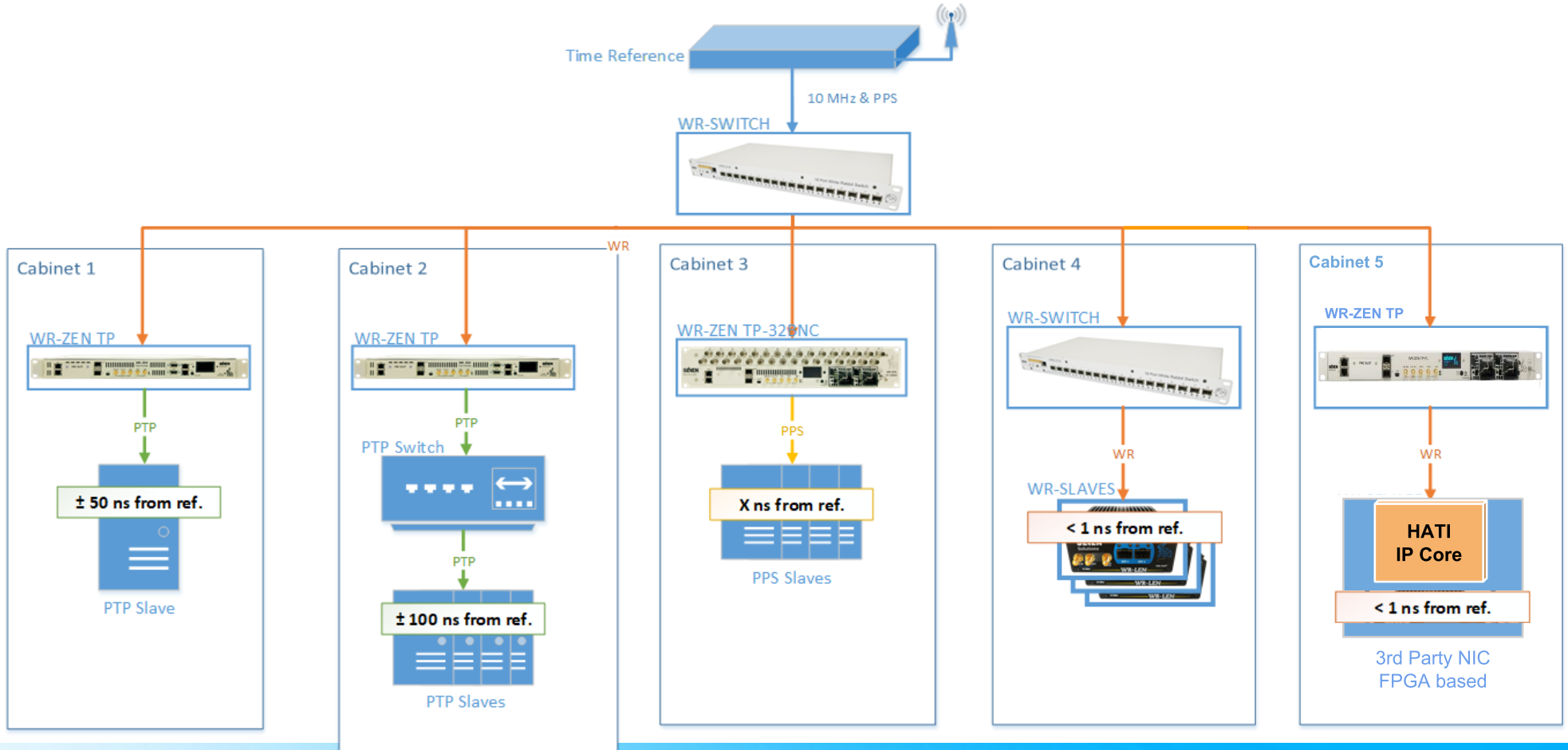
# Intra-datacenter time transfer and synchronization



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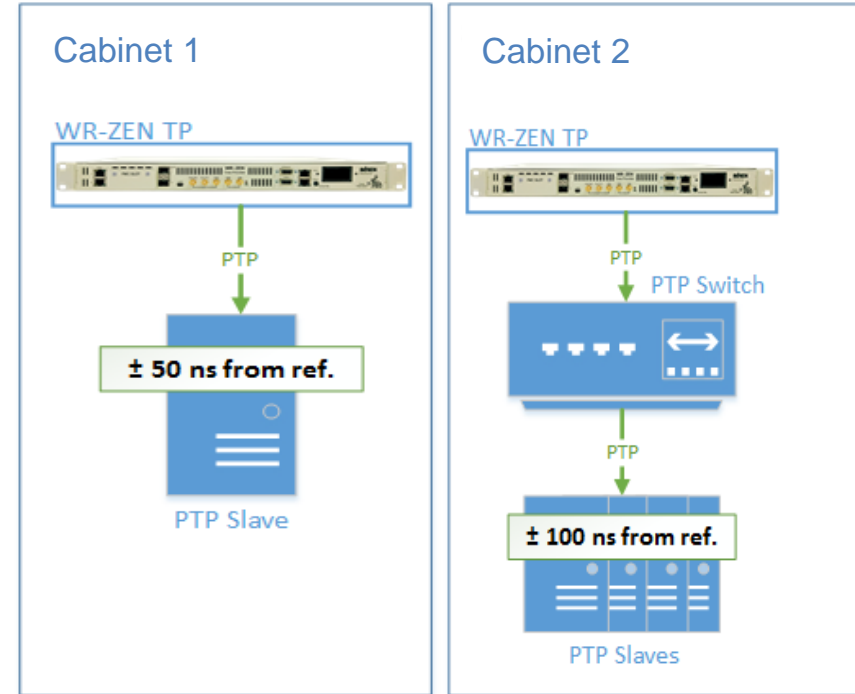
*Leaders in accurate sub-nanosecond time transfer and frequency distribution*

# Intra-datacenter Time Transfer and Synchronization

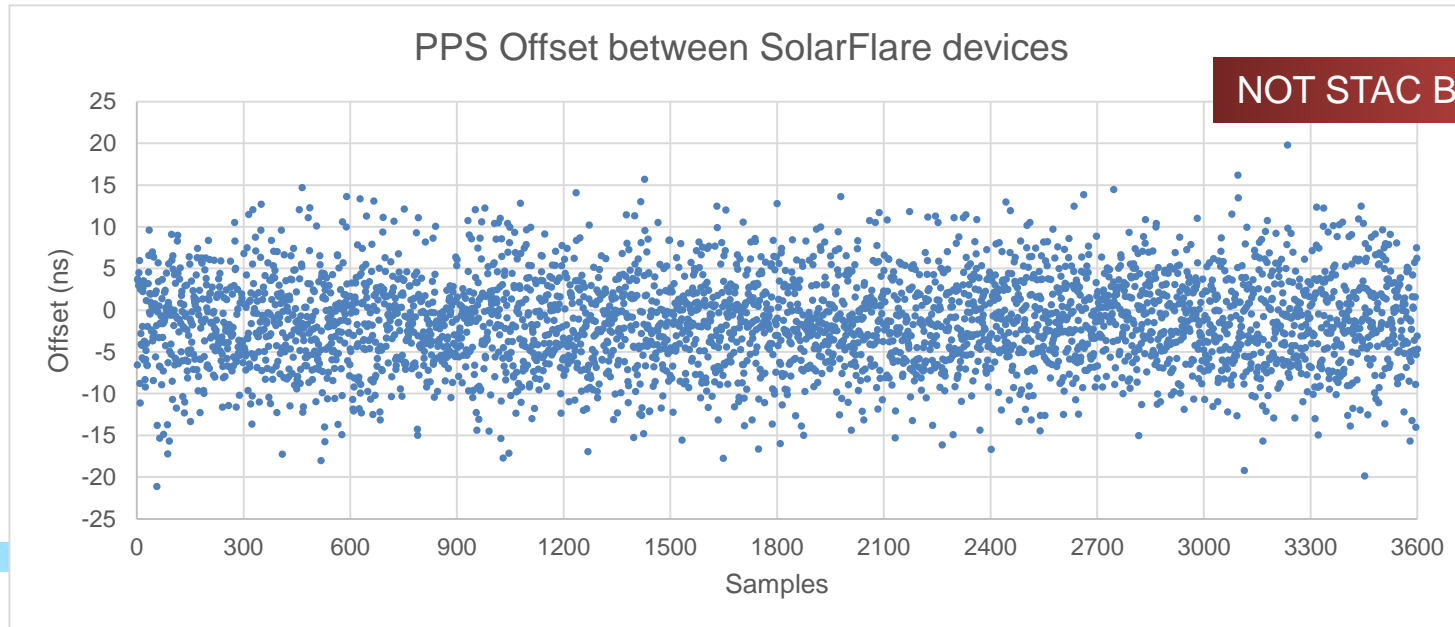
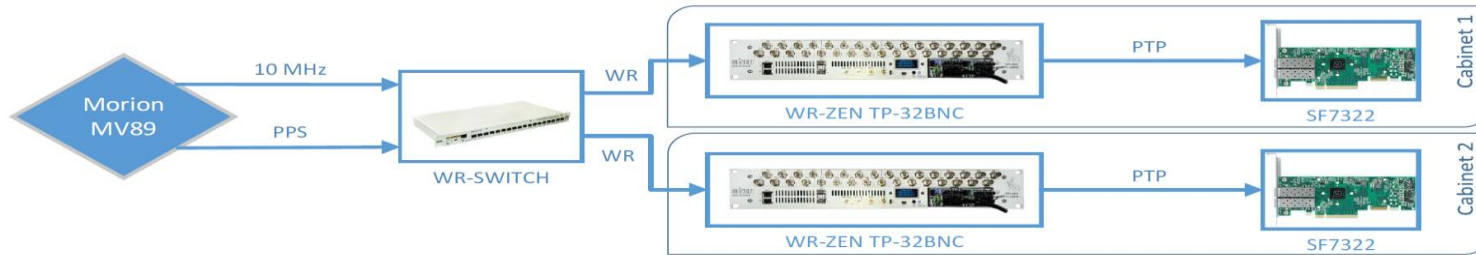


## Intra-datacenter time distribution

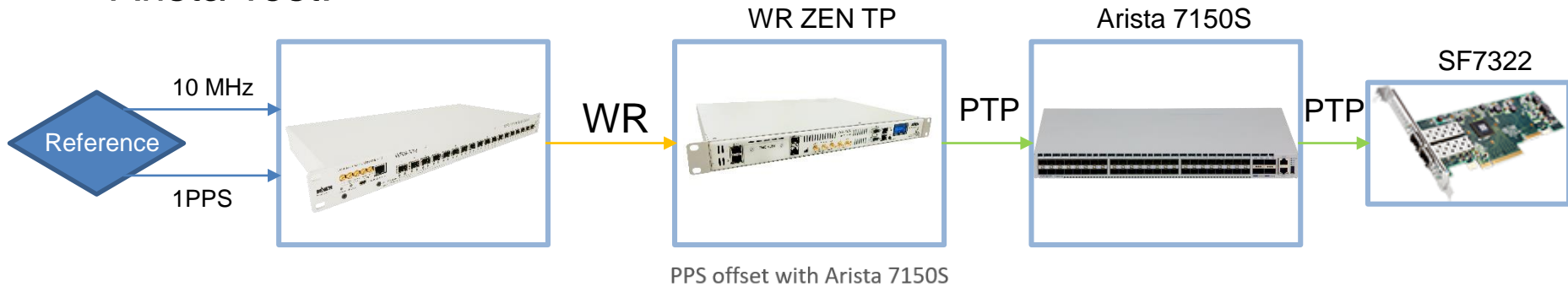
- PTP interoperability using WR-ZEN TP devices.
- Setup 1: Direct connection to PTP Slave ( $\pm 50$  ns accuracy)
- Setup 2: Multiple PTP slave connection using a PTP switch ( $\pm 100$  ns accuracy)
- Tested devices: Solarflare, Metamako, Oregano, Endace, Napatech.



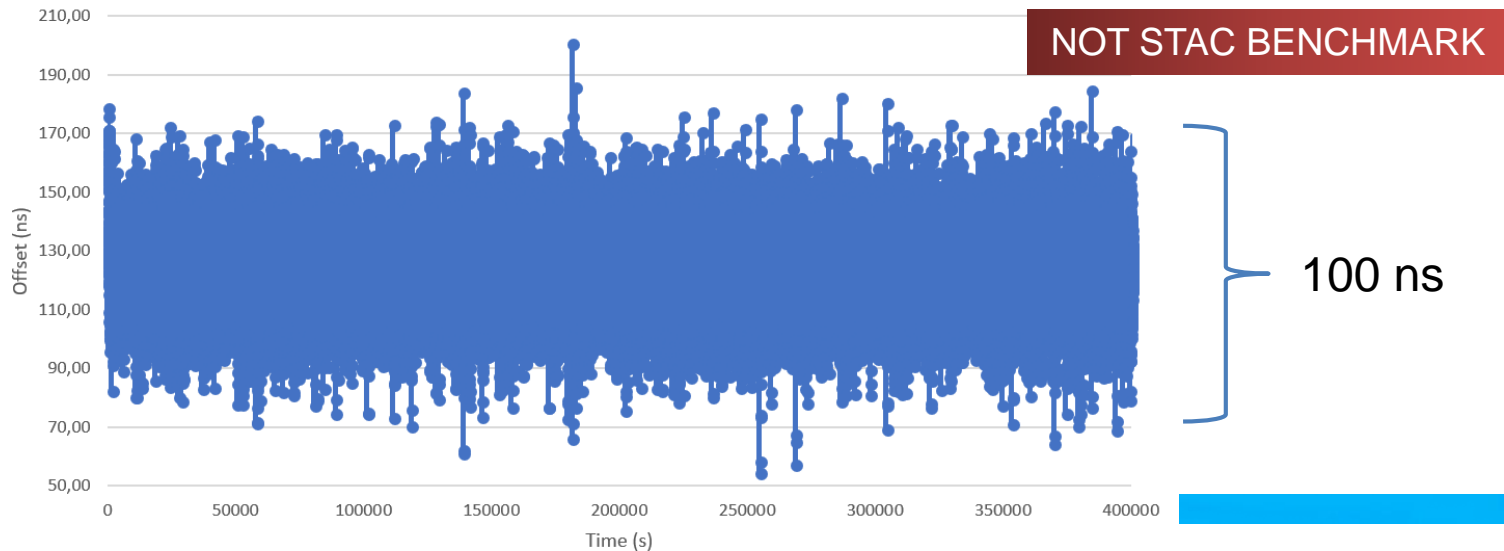
## Solarflare (SF7322) Test



## Arista Test:



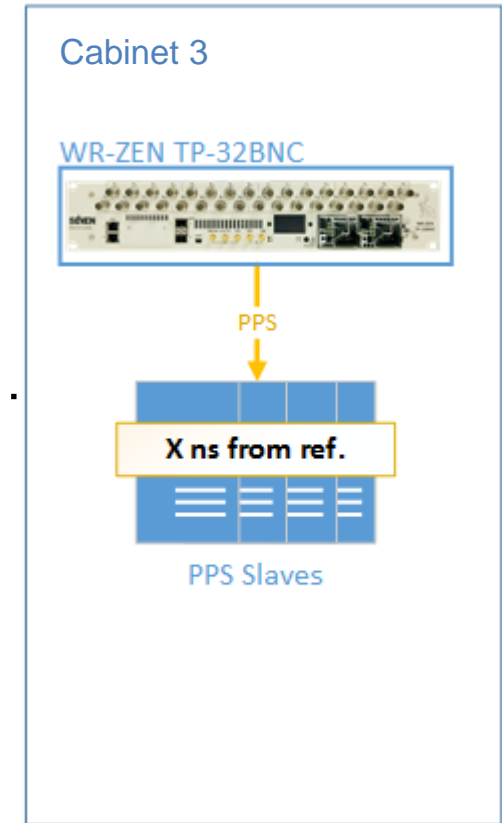
PPS offset with Arista 7150S





## Intra-datacenter PPS Distribution:

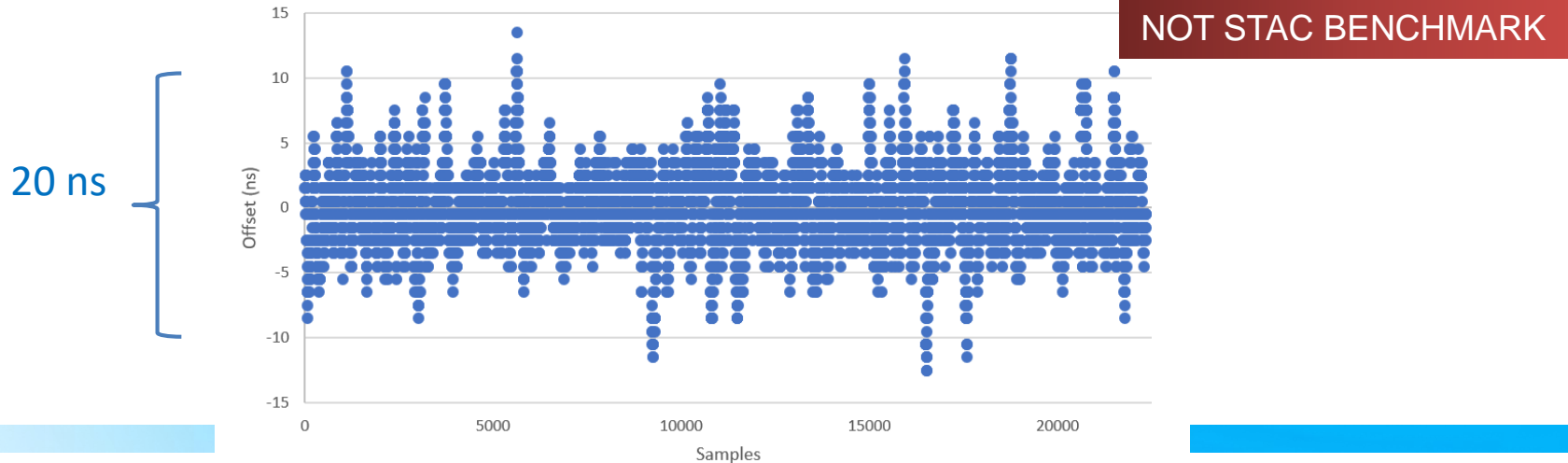
- Setup 3: Up to 32 PPS slaves connection or 16 PPS & 10 MHz slaves connection.
- Tested devices: Solarflare, Metamako, Meinberg...



## MetaMako tests (PPS sync)

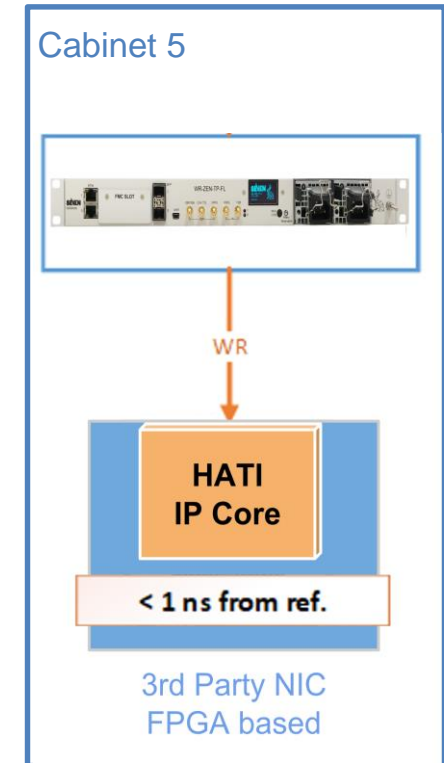


Metamako Synchronization offset using PPS



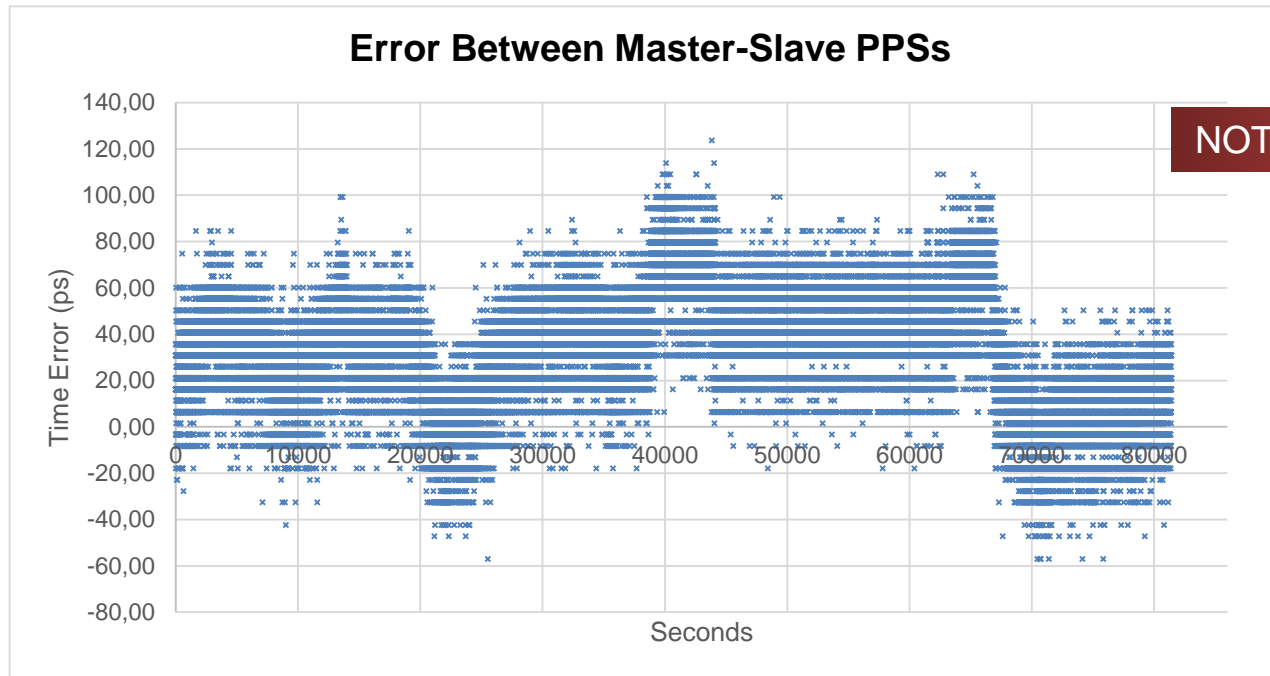
## White Rabbit PTP HATI

- WR-PTP time using FPGA IP Core
- Enables 3rd NICs to be WR compliant
- Tens of WR Slaves synced in Sub-nanosecond range



# Intra-datacenter Time Transfer and Synchronization – HATI IP Core Test

Max-Min (ps)	180,66
Mean (ps)	32,54
Dev. Std. (ps)	23,15952618



*Test over 80 km of fiber during 24 hours.*



**When every nanosecond counts**

*Inter-datacenter time transfer and  
synchronization*



# Inter-datacenter Time Transfer and Synchronization



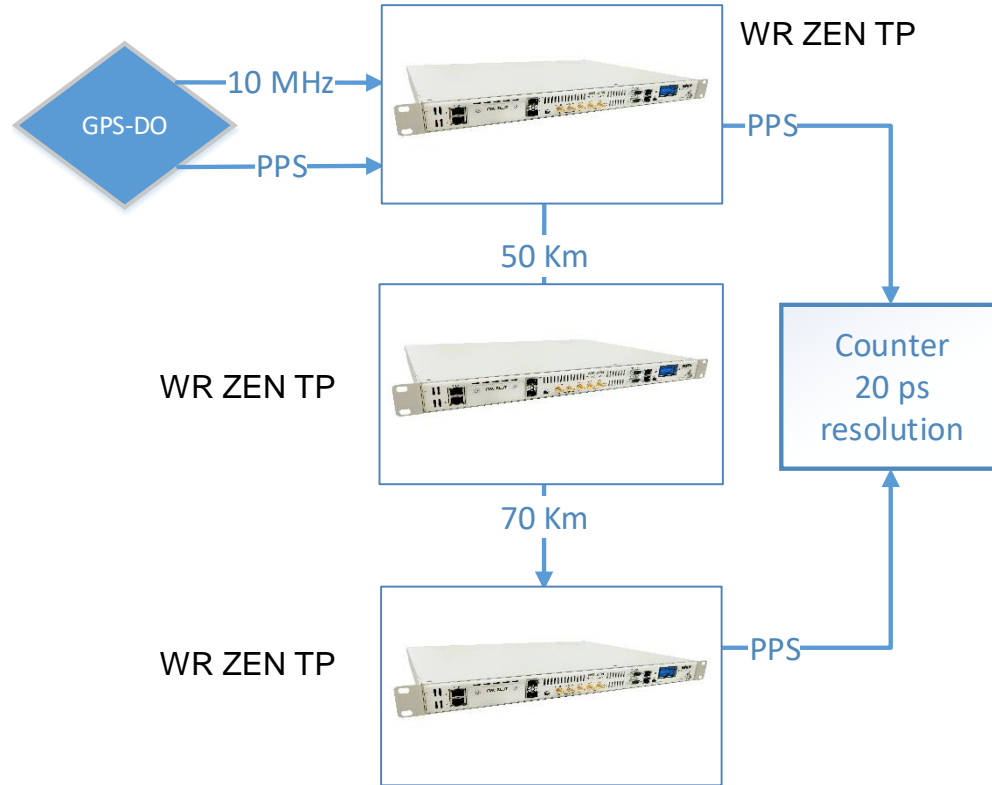
Datacenter A

< 120 Km



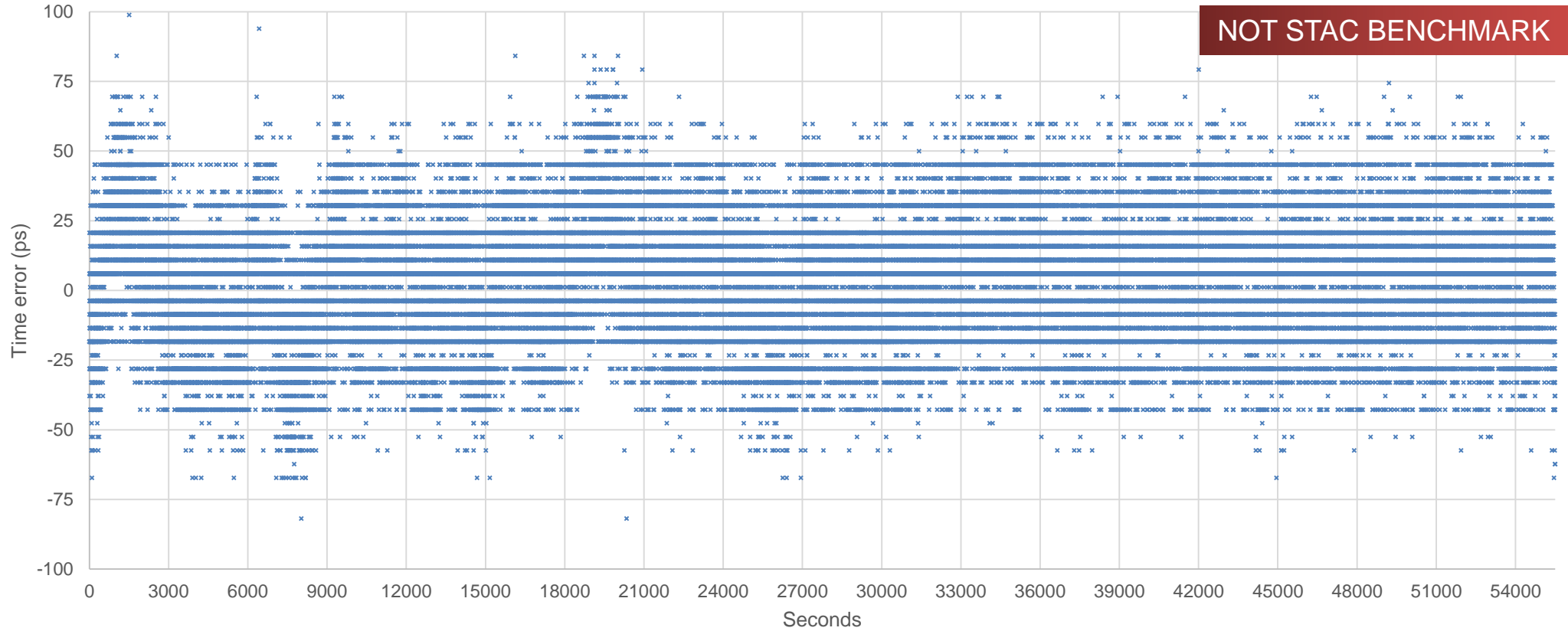
Datacenter B





- Lab test
- 18 hours measure

## Time Error on 120 Km, 2 hops





- More than 8 years leading accurate sub-nanosecond time transfer and frequency distribution for reliable industrial and scientific applications.
- We can help you:
  - Designing your nanosecond timing network
  - Providing WR equipment
  - Integrating HATI IP Core in your HDL gateware
  - Monitoring and auditing your timing networks
  - Commissioning a WR network and supporting you in production
- We're a Spanish company based in Granada, Frankfurt and Chicago



H2020 SME Instrument

Thank you!