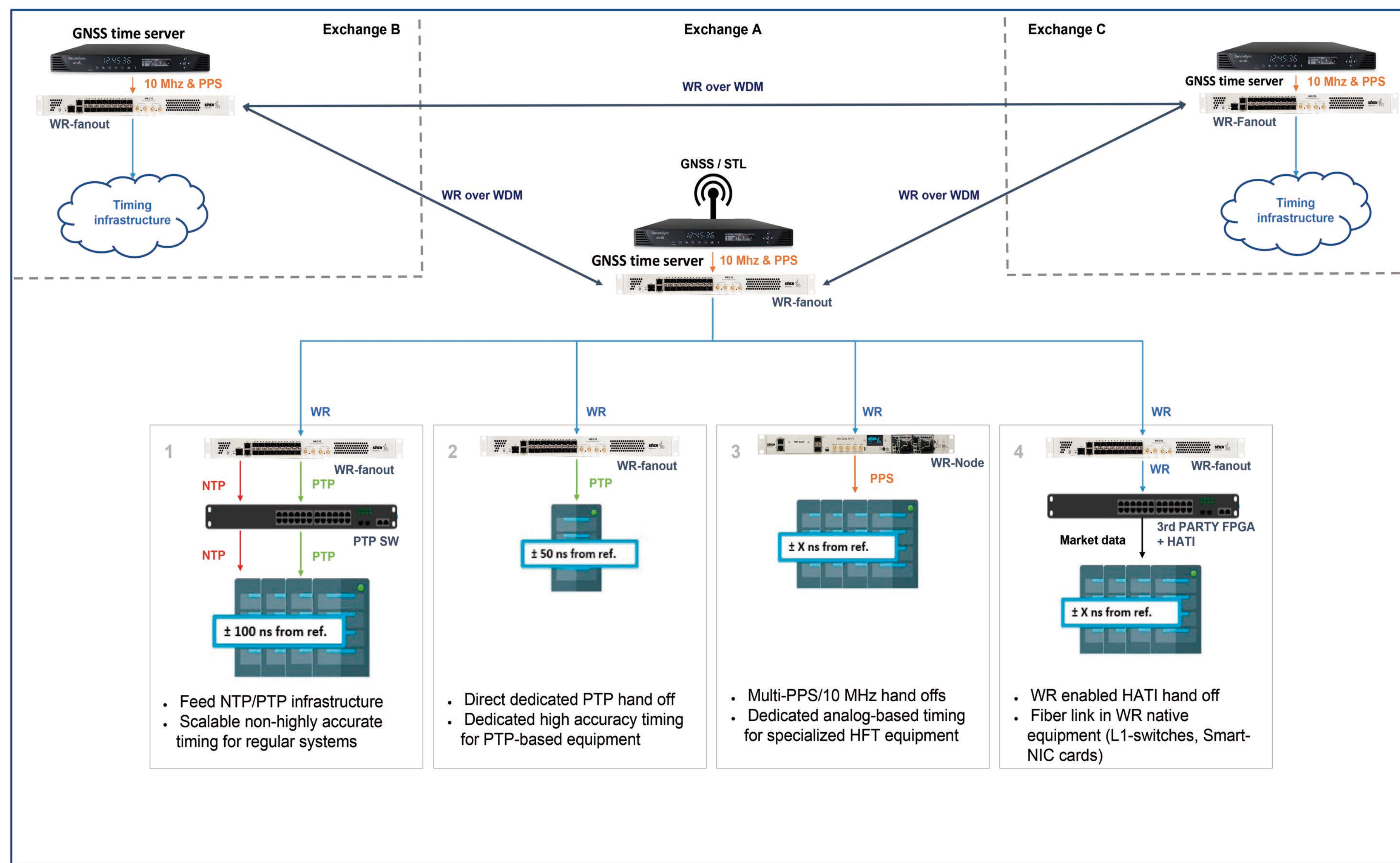# Timing in finance: Measuring in picoseconds
Inter-datacenter time distribution and Intra-datacenter interoperability

Francisco Girela - Americas WR Tech Responsible - francisco.girela@orolia.com

Finance use cases:

1. Deployed by trading firms both to improve accuracy and precision within and between co-located trading locations. White Rabbit leverages the latest technology to improve electronic trading decisions, data science, back testing and real time latency monitoring.

2. Deployed by exchanges initially to improve accuracy and precision to and within their matching networks. White Rabbit also introduces significant benefits including better transparency to exchange participants, high resolution time-stamping for network latency monitoring and the ability to monetize time distribution as a service to market participants.

3. Deployed by service providers to improve monitoring capability, including accuracy and precision within their infrastructures, White Rabbit is also being used by service providers to democratize high-resolution Timing as a Service to their client communities.

- Feed NTP/PTP infrastructure
- Scalable non-highly accurate timing for regular systems

- Direct dedicated PTP hand off
- Dedicated high accuracy timing for PTP-based equipment

- Multi-PPS/10 MHz hand offs
- Dedicated analog-based timing for specialized HFT equipment

- WR enabled HATI hand off
- Fiber link in WR native equipment (L1-switches, Smart-NIC cards)

Native White Rabbit:

The HATI (High Accuracy Timing IP) is an FPGA core designed for exchange and trading applications to provide sub-nanosecond synchronization accuracy by using 1 Gbps optical fiber links.

The core is based on precise internal clock corrections to achieve sub-nanosecond synchronization accuracy without requiring external clocking circuitry. It can be deployed in FPGA-based network devices like Layer 1 switches, Smart-NIC cards and custom FPGA design boards.

1. Sub-nanosecond time accuracy over optical fibers until the actual time consumer.
2. Minimal analog timing distribution based on coaxial cables reducing the calibration effort.
3. Easily integrable in datacenters and metro areas with an increasing ecosystem of White Rabbit native network devices.
4. Tested and proven for integrations with Arista, Cisco and LDA Technologies.

Integrability takeaway:

White Rabbit time synchronization is not intended to replace the whole timing infrastructure, but to complement it creating a high accuracy timing backbone or parallel network which are interoperable with legacy technologies such as PTP or PPS and ensure the best accuracy for the most exigent applications in the network.

Failover takeaway:

Addendum to Segal's law: "A man with a watch *or two equal watches* knows what time it is. A man with two *different* watches is never sure"
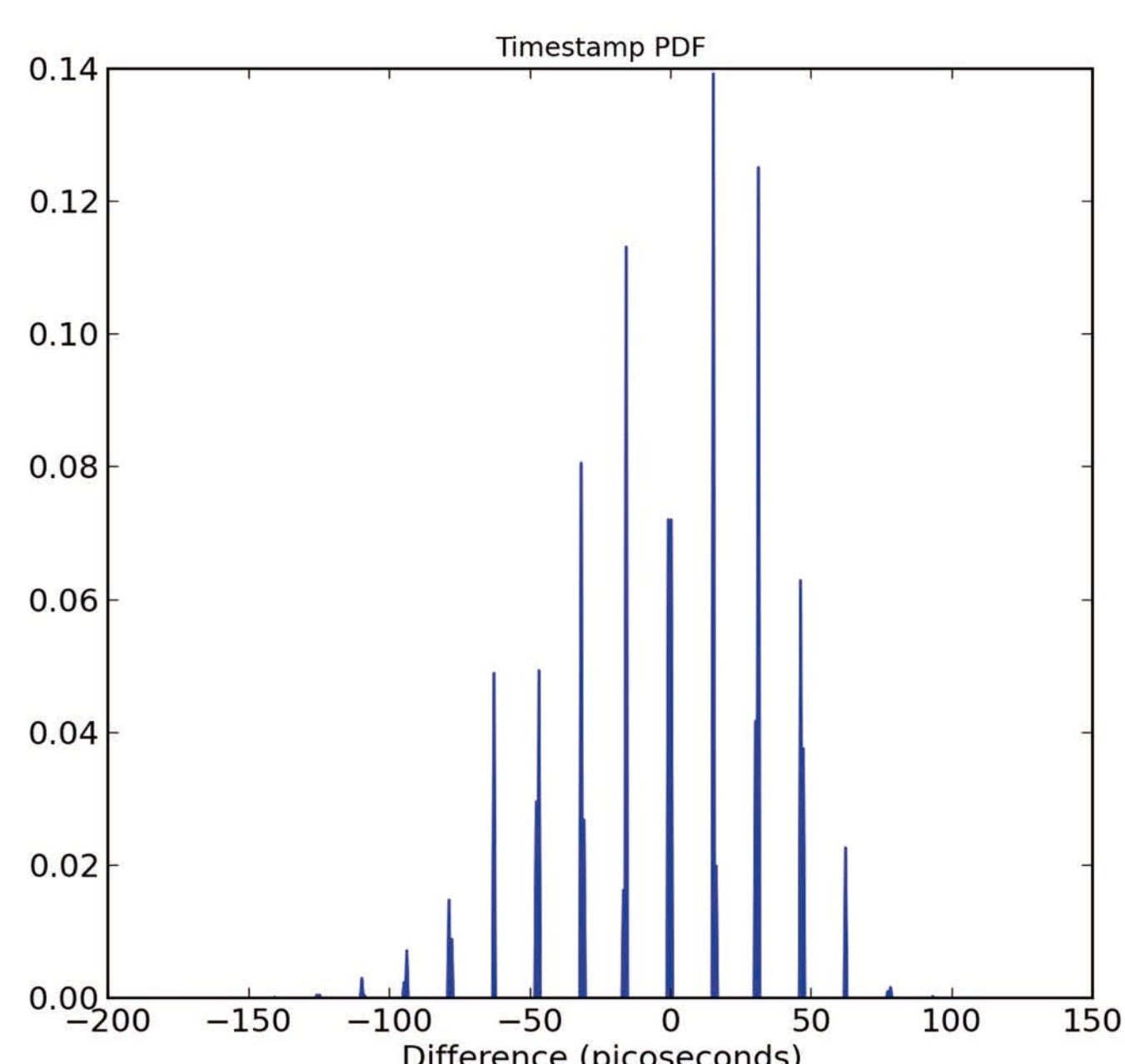
Distributed time references in remote locations, alternative LEO timing via STL or Traceable TaaS via Hoptroff guarantee having different "watches".

#Trustable #Resilient #Traceable #Distributed #HighAccuracy #Interoperable
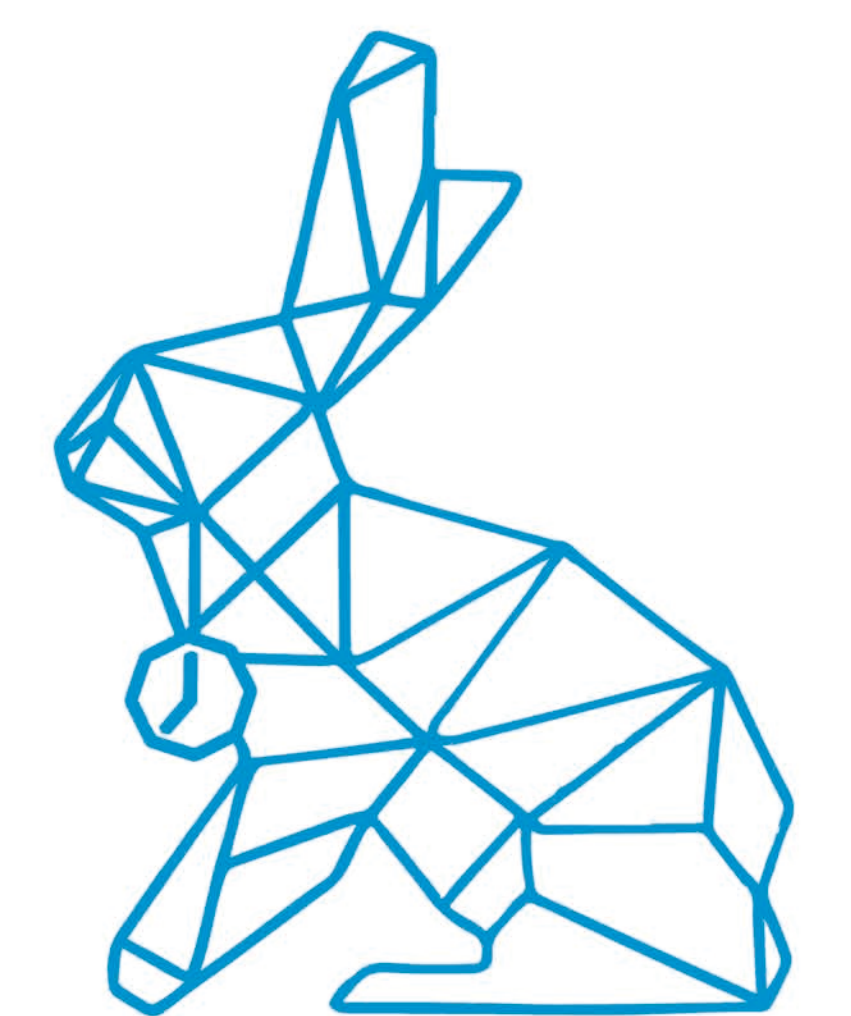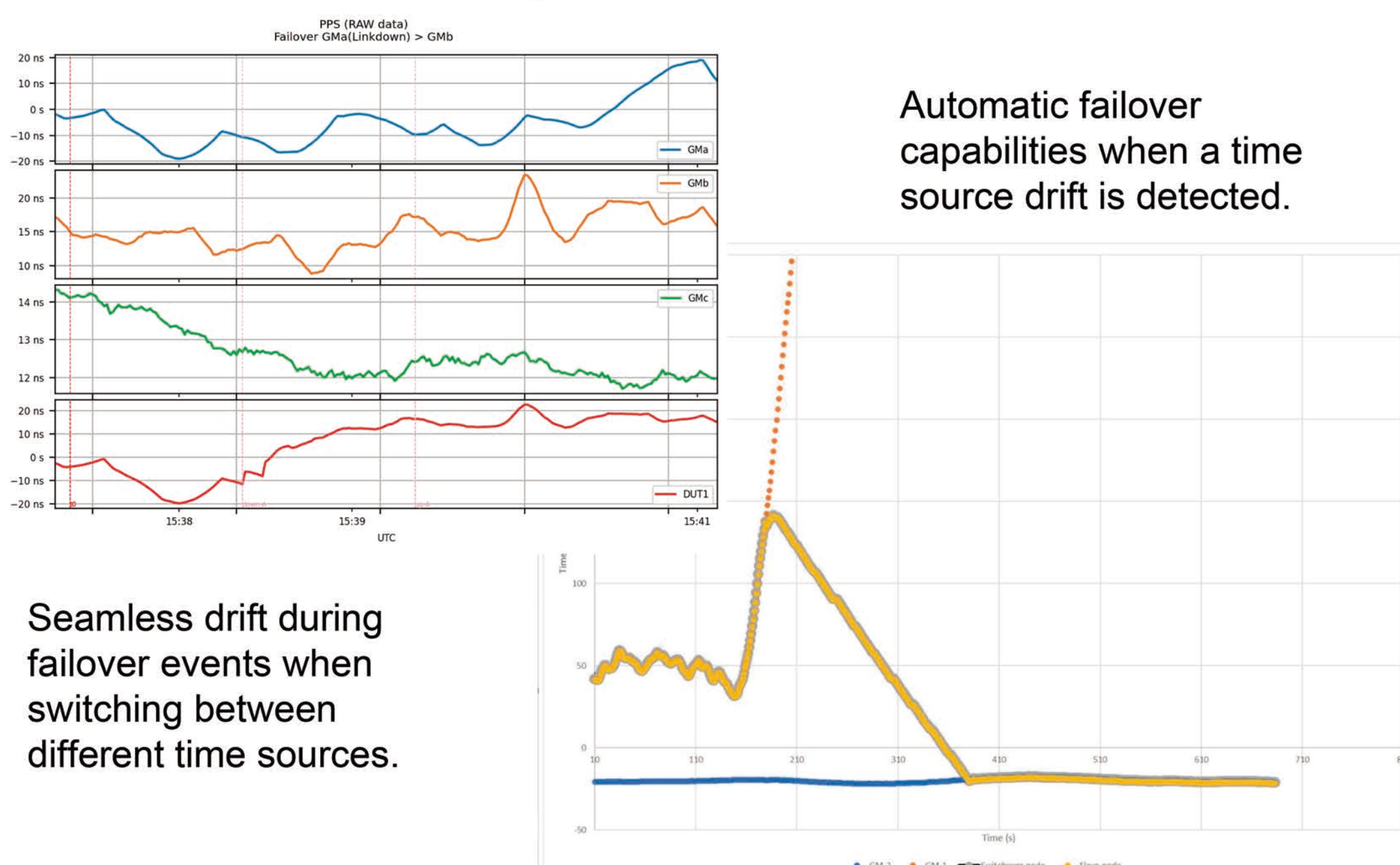
3rd party L1-switch RESULTS
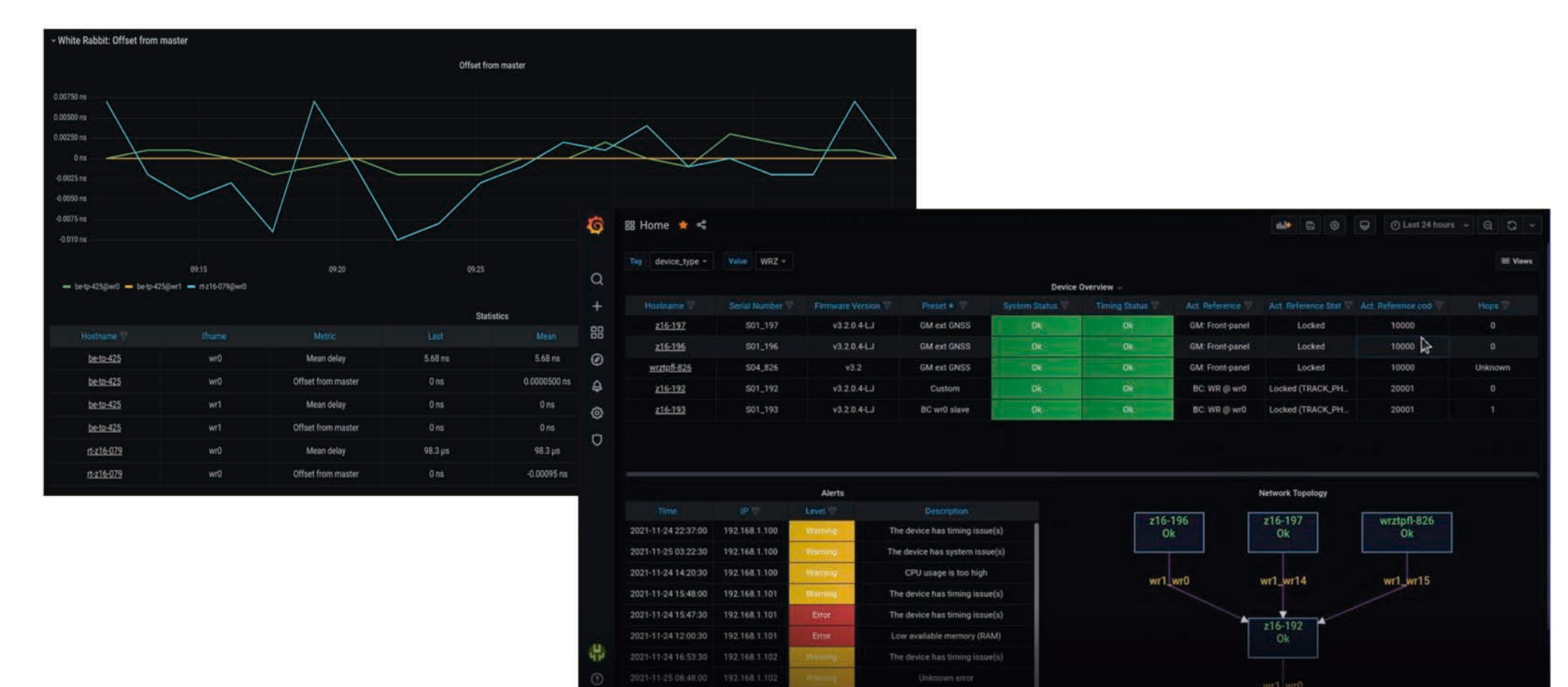**Timestamping using native White Rabbit time synchronization**

Max-Min (ps)	235
Mean (ps)	-63.84
Std. Dev. (ps)	36.39

FAILOVER RESULTS
Minimal affection during failover events

Automatic failover capabilities when a time source drift is detected.

Seamless drift during failover events when switching between different time sources.

MONITORING & MANAGEMENT TOOLS
Similar to other network devices

- Integration with third-party tools (Grafana, InfluxDB, Kibana, etc.)
- SNMP, Rsyslog, email alerts for monitoring
- Utilization of LLDP as reverse PTP protocol
- Authentication and security tools