Your Resilient PNT
Mission Partner

Sub-nanosecond synchronization in core networks for an assured PNT system

High accuracy backbone for time as a service

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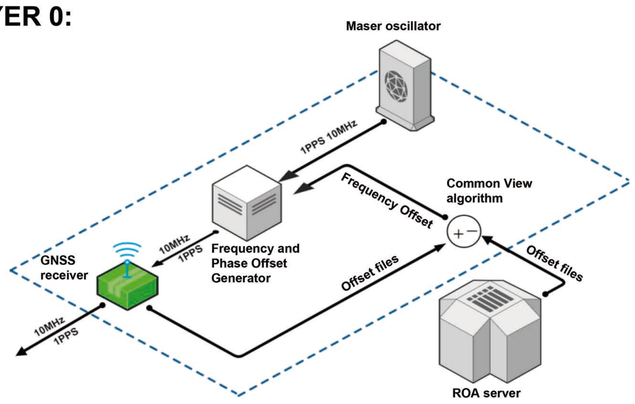
Core networks are an essential component of next generation timing over fiber distribution ensuring alternative Positioning, Navigation, and Timing (PNT) capabilities for satellite-based systems.
These networks need to be engineered considering current and future requirements, guaranteeing their relevance for the next generation of technologies.

Technologies :
- 6G
- Autonomous driving
- Industrial automation
- Smart grid

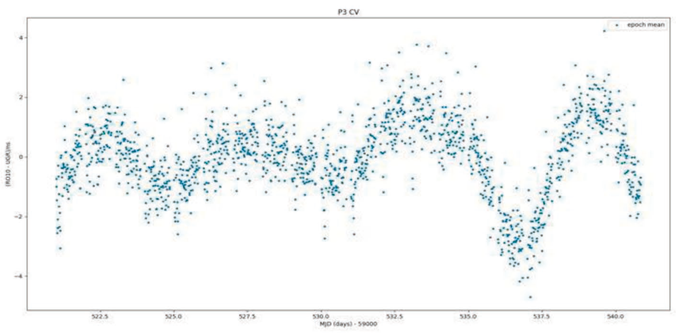
Requirements:
- Traceable
- Rasilient
- Secure
- High Accuracy

A layered, redundant and scalable approach which benefits the most evolved technologies is needed to guarantee a successful deployment that will last for the years to come. The combination of IEEE-1588-2019 High Accuracy profile (or equivalently White Rabbit) and distributed atomic clocks has been demonstrated as the most accurate and reliable mechanism to deploy timing services in sovereign soil that can back up wireless and satellite systems against the increasing number of complex threats.
#Trustable #Resilient #Traceable #Distributed #HighAccuracy

LAYER 0:

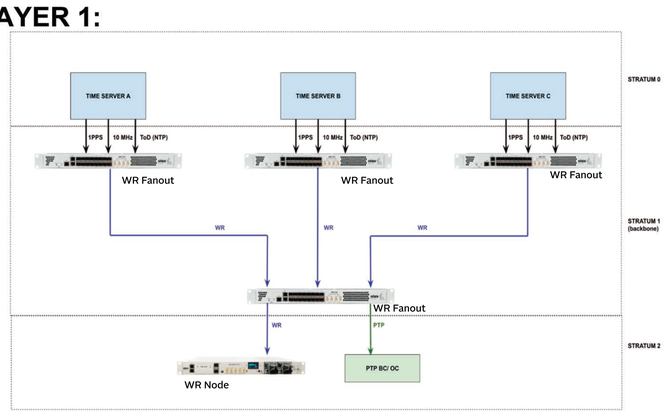


High accuracy traceability between National Metrology Institutes (< 5 ns accuracy) in secure locations.
Resiliency through multiple interconnected locations and extended holdover: < 100 ns after 30 days.

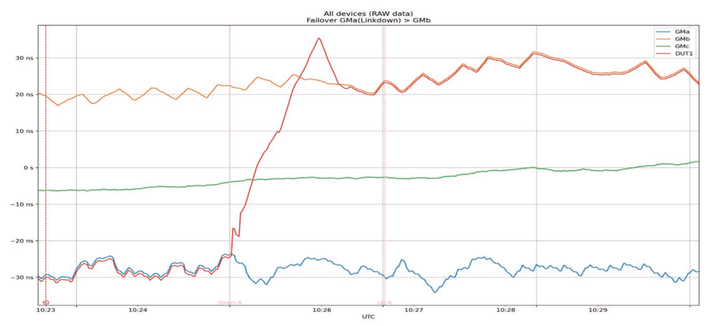


Single nanosecond long-term traceability

LAYER 1:

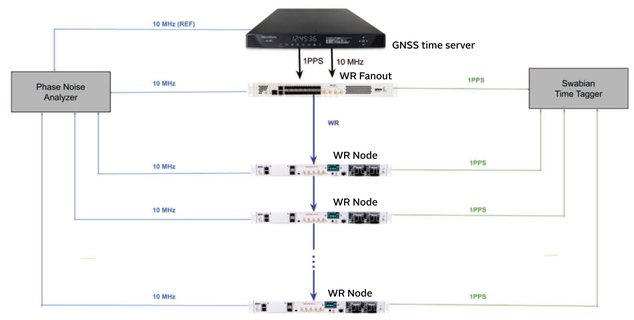


Multi-protocol timing comparisons between different sources for distributed monitoring using survey nodes.
Redundant feeds with multi-source seamless failover with no downtime periods.

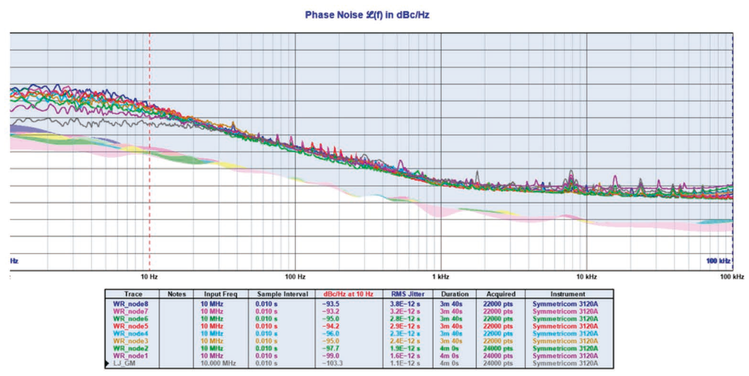


Multi-source seamless failover

LAYER X:



Scalable and interoperable high accuracy timing networks compatible with existing optical fiber infrastructures.
Secure nodes with standard management, authentication and cyphering tools which align with industry standards.

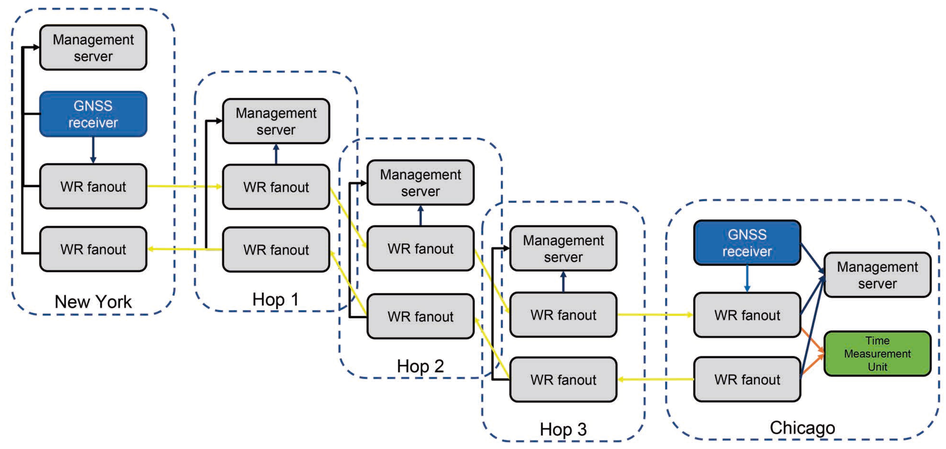


Trace	Notes	Input Freq	Sample Interval	dBc/Hz at 10 Hz	RMS Jitter	Duration	Acquired	Instrument
WR_node8		10 MHz	0.010 s	-93.5	3.8E-12 s	3m 40s	22000 pts	Symmetricom 3120A
WR_node7		10 MHz	0.010 s	-93.2	3.2E-12 s	3m 40s	22000 pts	Symmetricom 3120A
WR_node6		10 MHz	0.010 s	-95.0	2.8E-12 s	3m 40s	22000 pts	Symmetricom 3120A
WR_node5		10 MHz	0.010 s	-94.2	2.9E-12 s	3m 40s	22000 pts	Symmetricom 3120A
WR_node4		10 MHz	0.010 s	-96.0	2.3E-12 s	3m 40s	22000 pts	Symmetricom 3120A
WR_node3		10 MHz	0.010 s	-95.0	2.4E-12 s	3m 40s	22000 pts	Symmetricom 3120A
WR_node2		10 MHz	0.010 s	-97.7	1.9E-12 s	4m 0s	24000 pts	Symmetricom 3120A
WR_node1		10 MHz	0.010 s	-99.0	1.6E-12 s	4m 0s	24000 pts	Symmetricom 3120A
L.J_GM		10.000 MHz	0.010 s	-103.3	1.1E-12 s	4m 0s	24000 pts	Symmetricom 3120A

Frequency distribution over 10 WR hops

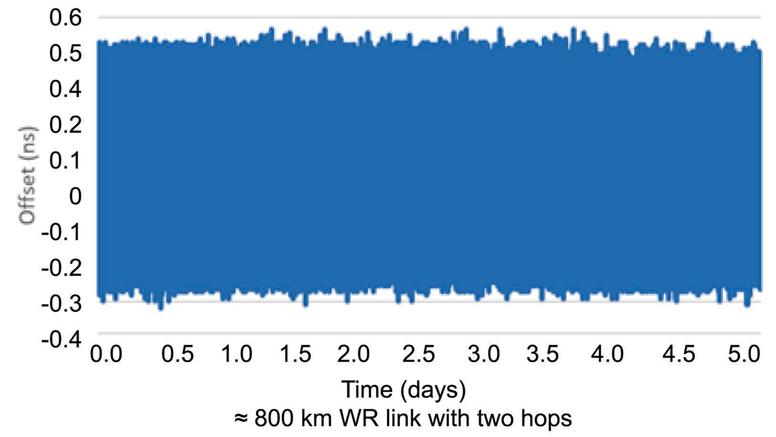
Use case

White Rabbit link with an approximate distance of 1,350 km (840 miles) which was deployed in collaboration with a High Frequency Trading firm, a leading financial company, to connect Chicago and New Jersey trading locations. This link is formed by six long-distance White Rabbit hops using a WR fanout and a WR node device connected by a combination of DWDM and SyncE-compliant transponders over a public telecommunication fiber network.

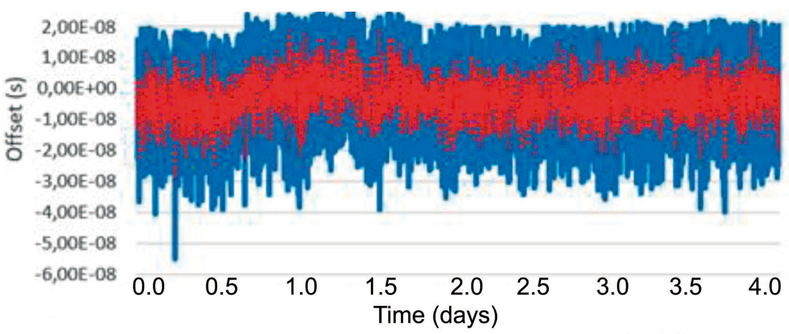


Sub-nanosecond precision on an 800 km loopback after network-based calibration:
Mean offset = 112 ps | Standard deviation = 39 ps | Peak-to-peak difference = 880 ps.
Gaussian distribution with no daily trends shown because of temperature or humidity.

Nanosecond-level precision on a 1350 km link after GNSS-based calibration:
Mean offset = 2.98 ns | Standard deviation = 10.4 ns | Peak-to-peak difference = 83.3 ns.
Gaussian distribution with no daily trends shown because of temperature or humidity.
This does not only represent the real White Rabbit link error but the GNSS time server errors (<15 ns RMS jitter) to accurately measure the link accuracy.



≈ 800 km WR link with two hops



≈ 1350 km WR link with six hops against GNSS

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