

Time transfer and frequency dissemination technologies for space applications

SECPHO workshop Tecnologías ópticas y fotónicas para aplicaciones espaciales, Madrid, 7 Mayo 2019

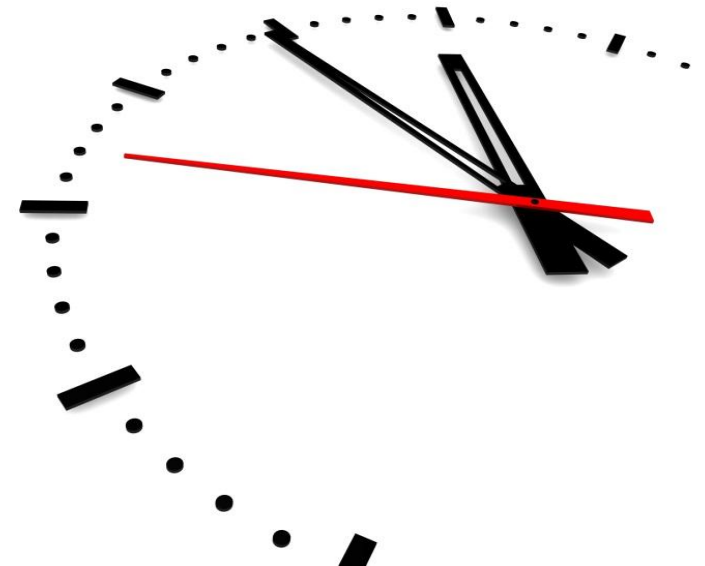


Seven Solutions S.L. is a privately held leading company in accurate sub-nanosecond time transfer and frequency distribution for reliable industrial and scientific applications.

Experts in timing and synchronization

Leaders on **White Rabbit technology (WR)** in close collaboration with **CERN**.

Success on adapting WR to multiple research and industrial infrastructures including avionics, radar, telecommunications, homeland security, defense and Fintech.



Solution ecosystem

Time references

DOWR & ZENs

Time reference receiver

- ✓ Calibrated time receiver
- ✓ High accuracy time transfer
- ✓ Traceable to UTC reference
- ✓ Built-in Fail over
- ✓ Best network switchover



Enablers (partnerships)

OEM modules & IP cores

Software & services



- ✓ Support
- ✓ Auditing . Remote Monitoring
- ✓ Calibration of metro & Long-haul links
- ✓ Turn-key QoS & SLA

**Ecosystem for
TaaS providers and
timing consumers**



Distribution devices

Z16

Time Fan out

- ✓ High accuracy time transfer
- ✓ High accuracy Fan Out



ZEN TP32

Analog Time Fan out

- ✓ High accuracy local time transfer
- ✓ High accuracy analog Fan Out



Confidential, do not distribute

Our unique solution: White-Rabbit Ultra-accurate time transfer

SEVEN
Solutions

Born at CERN, Next PTP-2019 standard
Establishing and validated ecosystem



Easy to integrate into existing telecom networks
(Ethernet, PTPv2)



Scalable
to long distances



Dependable
No GPS vulnerabilities.
Performance is not affected by data traffic



Cost-effective
Easy to deploy, self-calibration

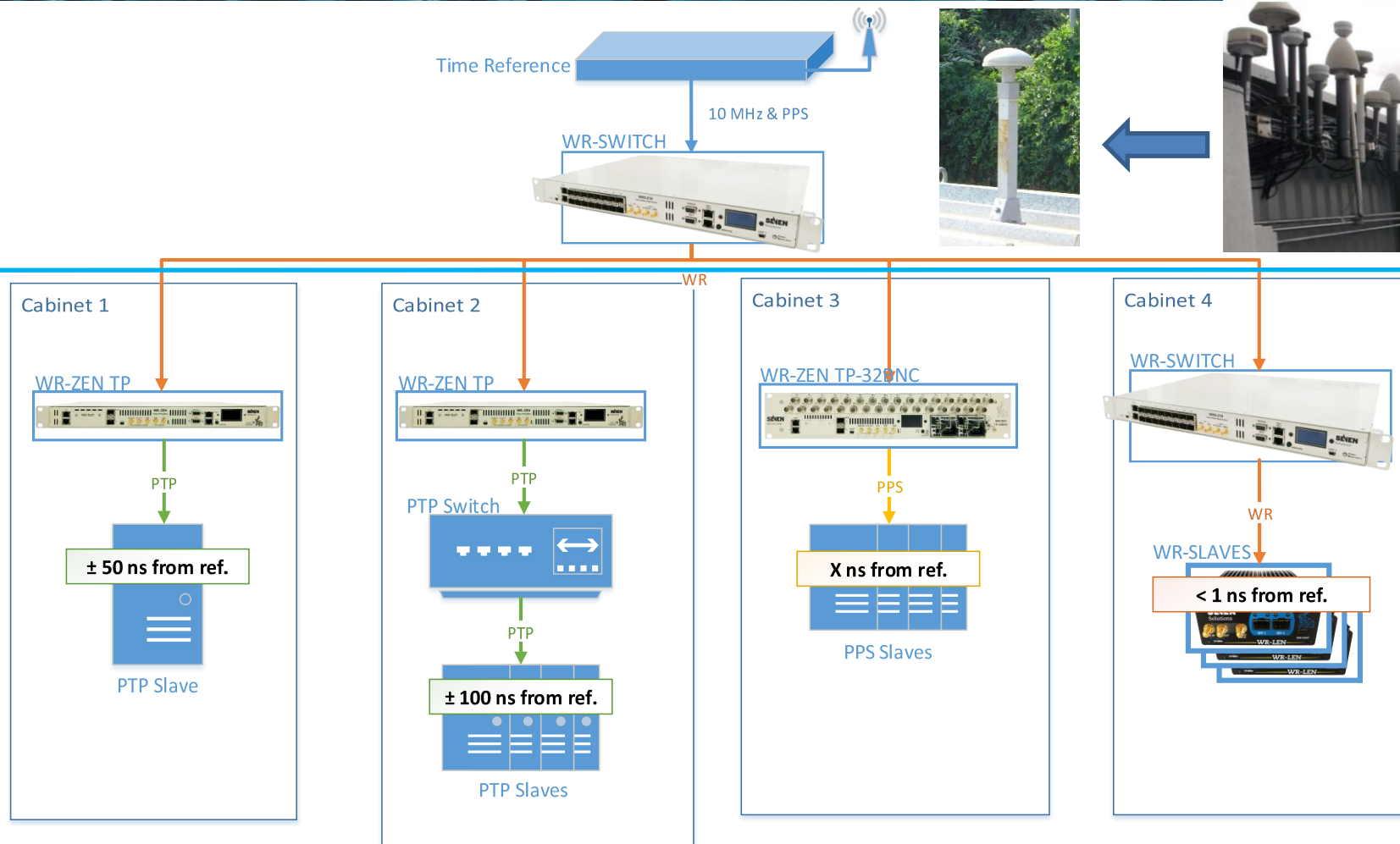


Highly accurate
Subns performance.

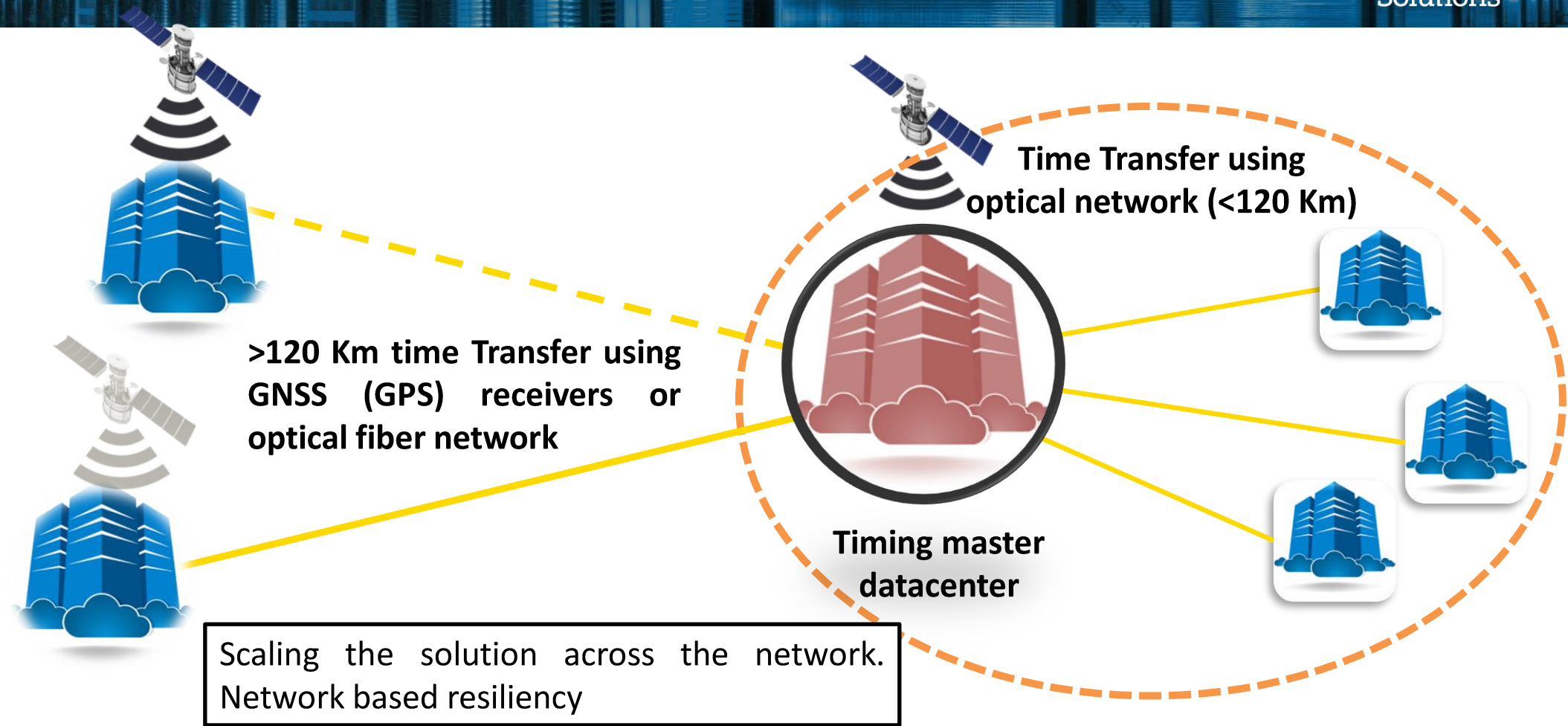


New applications
Mobile-based cm-range indoor/outdoor positioning as GPS alternative
Support Blockchain scalability

TaaS in Datacenters



Inter-datacenter time transfer



Distributed – low jitter frequency dissemination

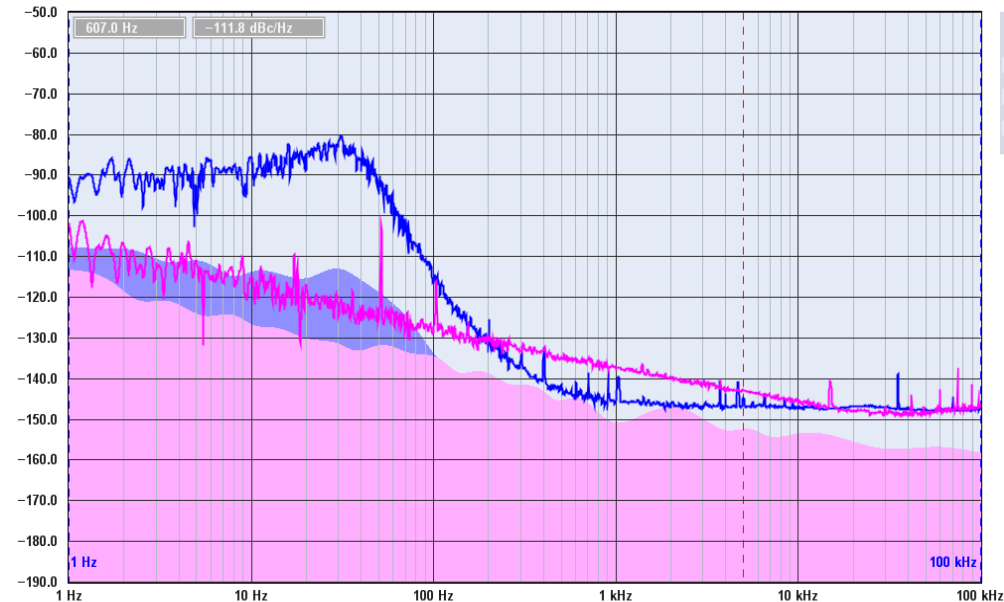
Distributed Radar, HEP and space applications

For distributed RF nodes located on large areas

- Phase synchronization sub-10 ps
- Frequency jitter better than 400 fs (1-1MHz)
- Fully digital, Ethernet-based technology
- Timing and data are distributed on the same network



Phase Noise $\mathcal{L}(f)$ in dBc/Hz

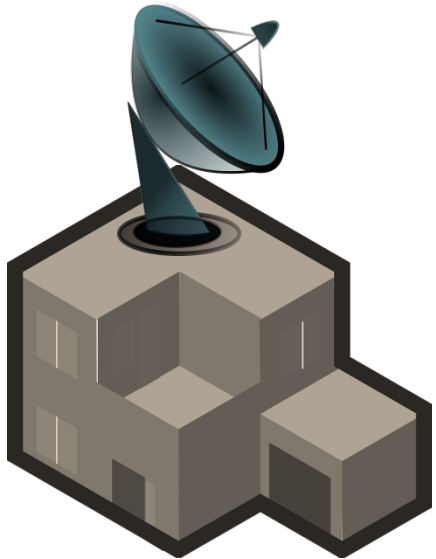
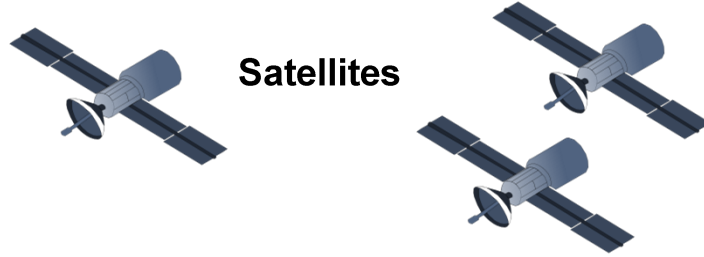


Ground Control Segement: Synchronization for distributed monitoring stations

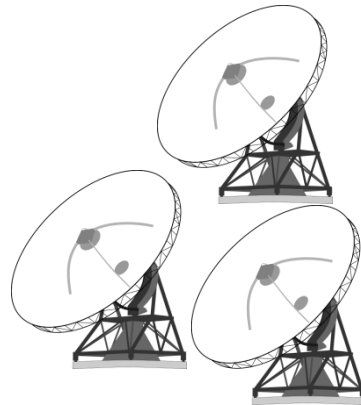
- **Monitoring stations:** tracking and ranging → satellite Ranging is in fact reverse GPS. It is formed by multiple ground stations, each containing complete RF chains, to range (locate) a satellite.
- **Proposal:** Distributed synchronized antennas (hundred of Km in the ~100 ps range) to increase satellite location accuracy.



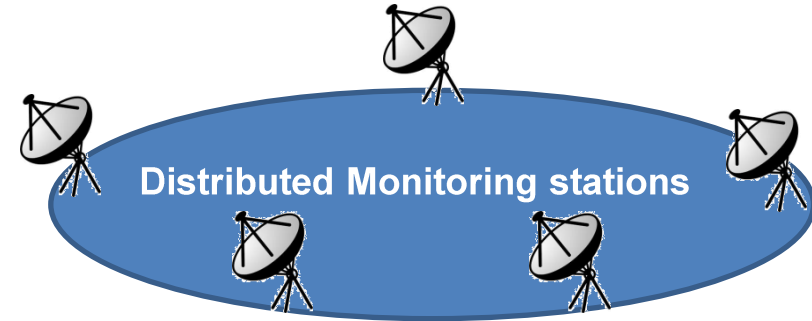
Ground Control Segement: Synchronization for distributed monitoring stations



Master control station



Ground stations



Satellite ranging from distributed antennas (located more than 100Km away) and very highly synchronized

- Seven Solutions is a company leader on high accuracy timing solutions based on Ethernet and optical fibers links
- Distributed timing over telecom networks (WDM) with accuracy better than 1 ns and ultra low jitter frequency dissemination (phase-noise better than 1ps) over hundred of Km.
 - 1G/10G Ethernet data traffic can be distributed on the same link without performance degradation. Deployment similar to data networks.
- Key solutions for space ground segment: distributed antennas synchronization and frequency dissemination for:
 - RF systems.
 - Satellite ranging for monitoring stations



Thanks for your attention



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Leaders in accurate sub-nanosecond time transfer and frequency distribution