



When every nanosecond counts

# High accuracy timing synchronization for Quantum communications

*SECPHO Workshop Quantum Technologies in Spain,*

*Madrid, 8 Mayo 2019*



# 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

# 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

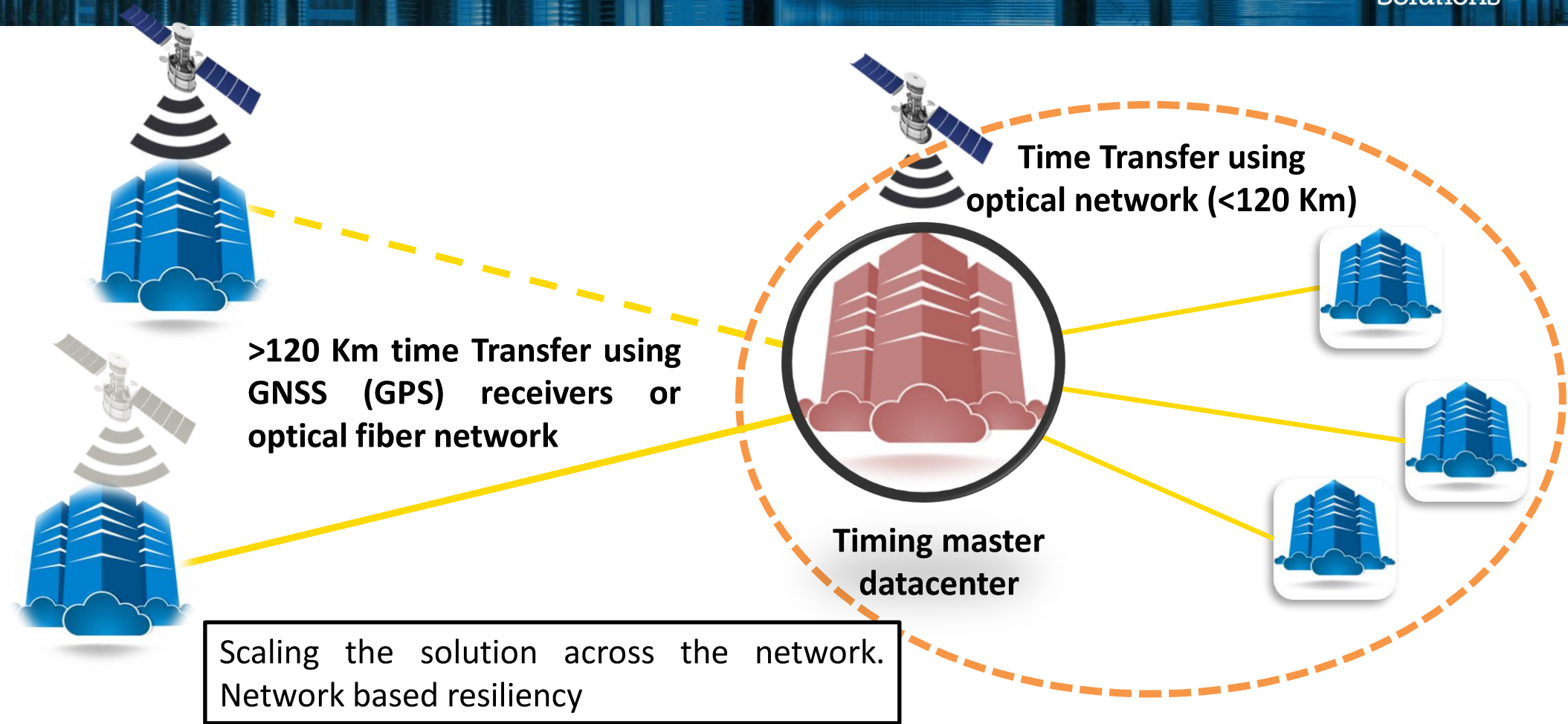
#### Analog Time Fan out

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

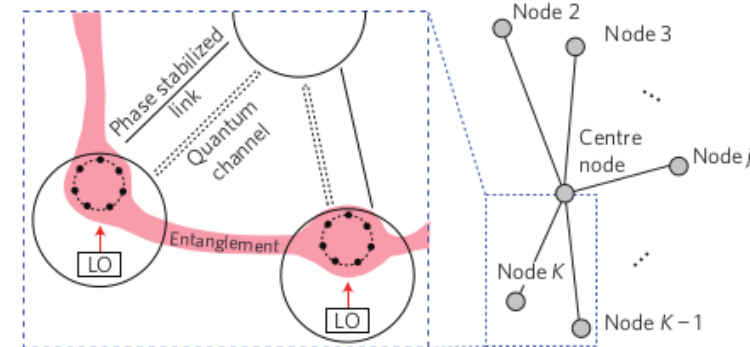


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# Long-distance time transfer in datacenters



- **Timing authentication secured by Quantum technologies:** a Quantum channel provides secure encryption capabilities to implement timing distribution algorithms.
- **Global quantum network of clocks creation:** In addition to locally operating individual clocks, different nodes (like satellites) can employ network-wide entangled states to interrogate their respective local oscillators. The acquired information is sent to a particular node, serving as a centre, where it is used to stabilize a centre-of-mass mode of the different oscillators. This yields an ultra-precise clock signal accessible to all network members.
- **Quantum technology development and verification:** distributed time-tagging → accurate identification of coinciding events of entangled photon pairs. Efficient time window determination.



A quantum network of clocks,  
Komar et al, Nature Physics 2014

- 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 quantum technologies: distributed clocks and time-tagging
  - Synchronization of distant clocks to enable novel quantum architectures (typically ~ 100 ps)
  - Time-tagging (typically ~10 ps)
  - Distributed timed-signals (trigger) generation (typically ~10 ps)



**Thanks for your attention**



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