White Rabbit Status and Prospects

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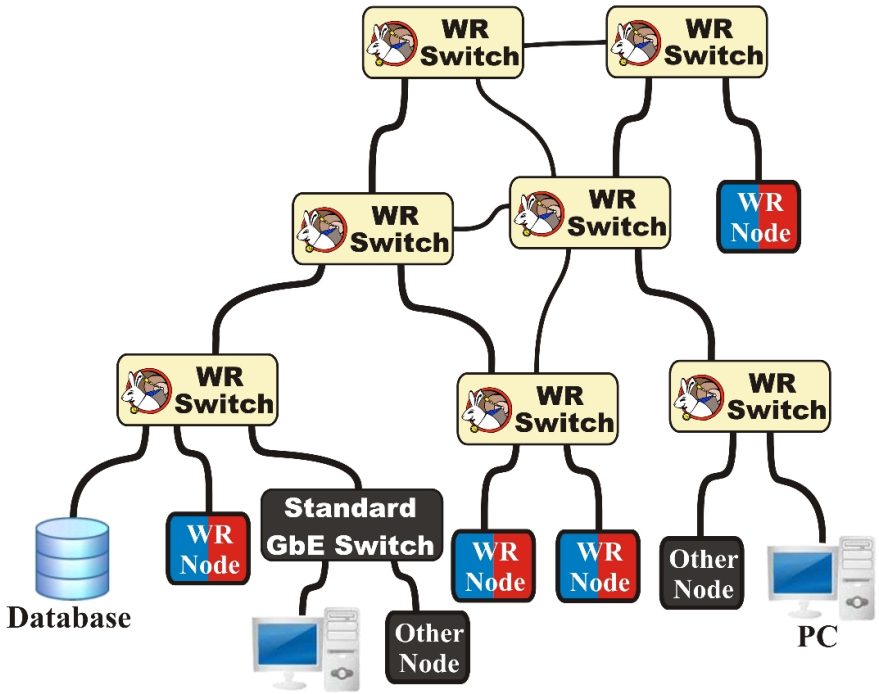
ICALEPCS
San Francisco, 10 October 2013

Outline

White Rabbit: an *extension* of Ethernet

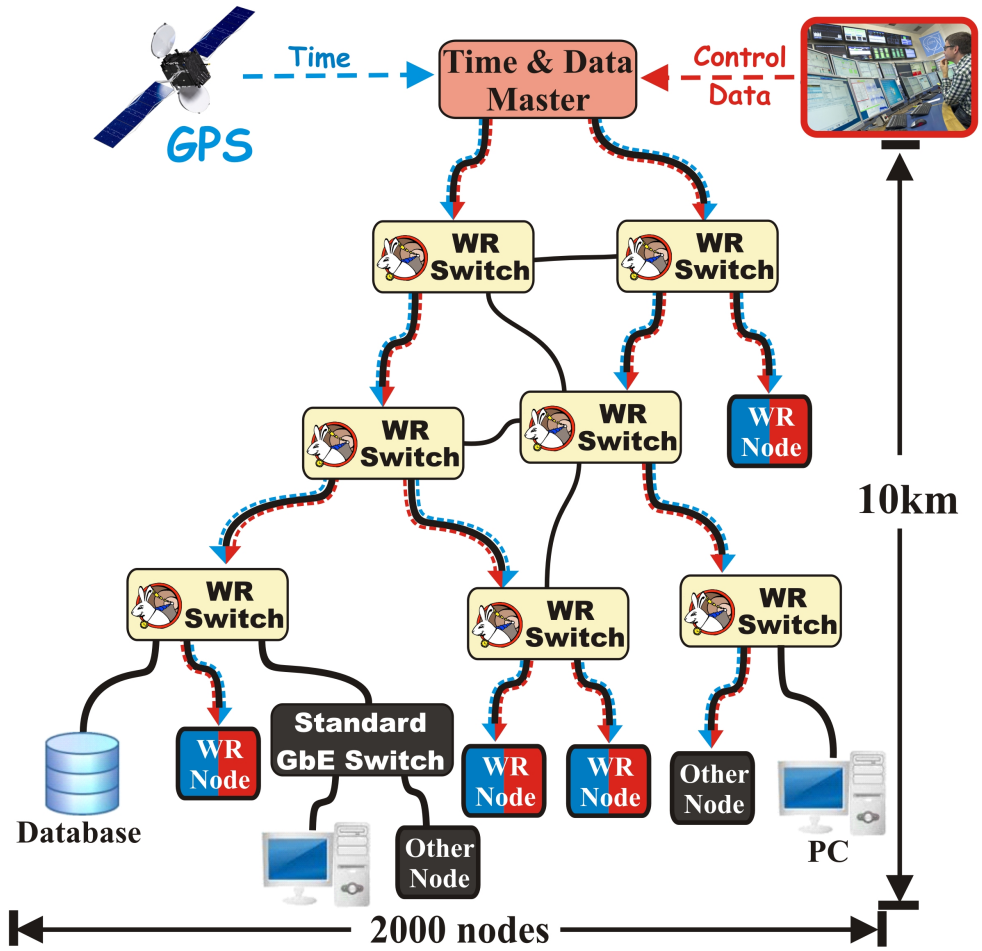
- Bandwidth: 1 Gbps
- Single fiber medium
- Up to 10 km links
- WR Switch: 18 ports
- Allows non-WR Devices
- Ethernet features (VLAN) & protocols (SNMP)



White Rabbit: an *extension* of Ethernet

Two separate services (enhancements to Ethernet) provided by WR:

1. Synchronization:
   - accuracy better than 1 ns
   - precision in the tens of ps
2. Deterministic, reliable and low-latency Control Data delivery



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White Rabbit application examples

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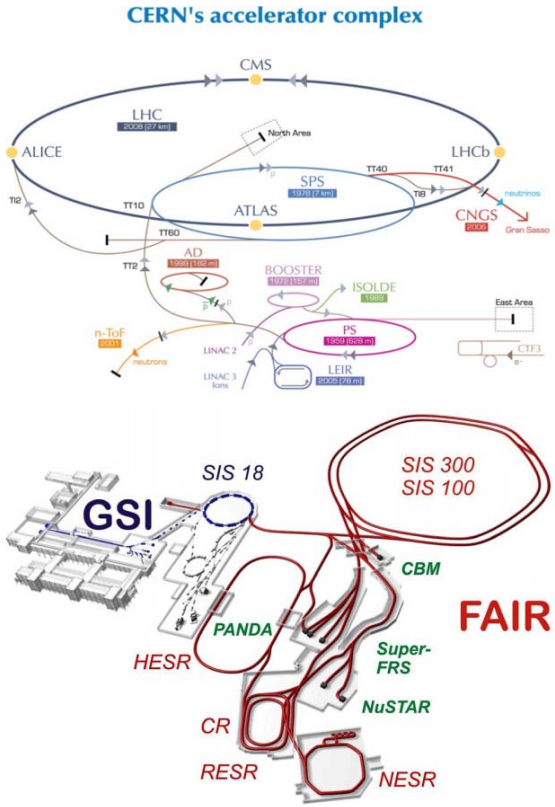
  - **CERN and GSI**



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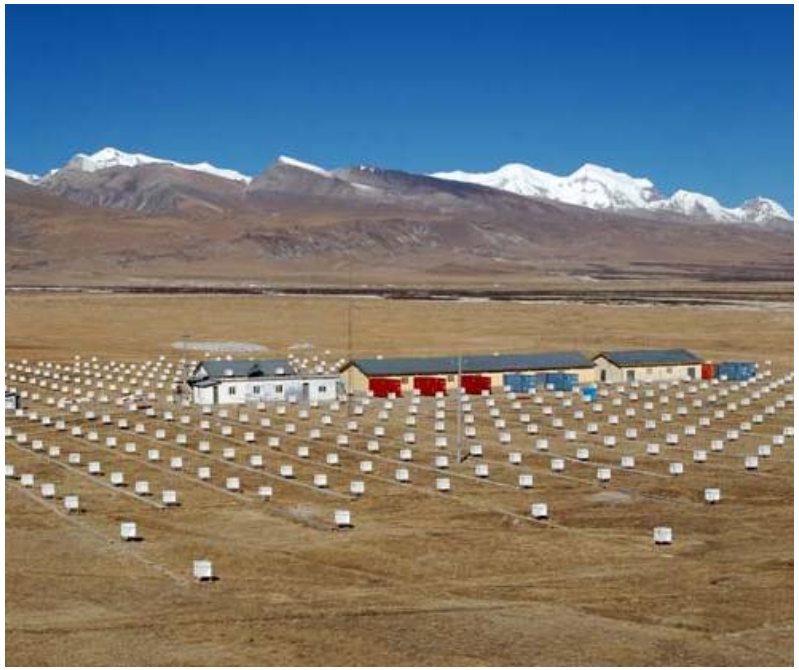

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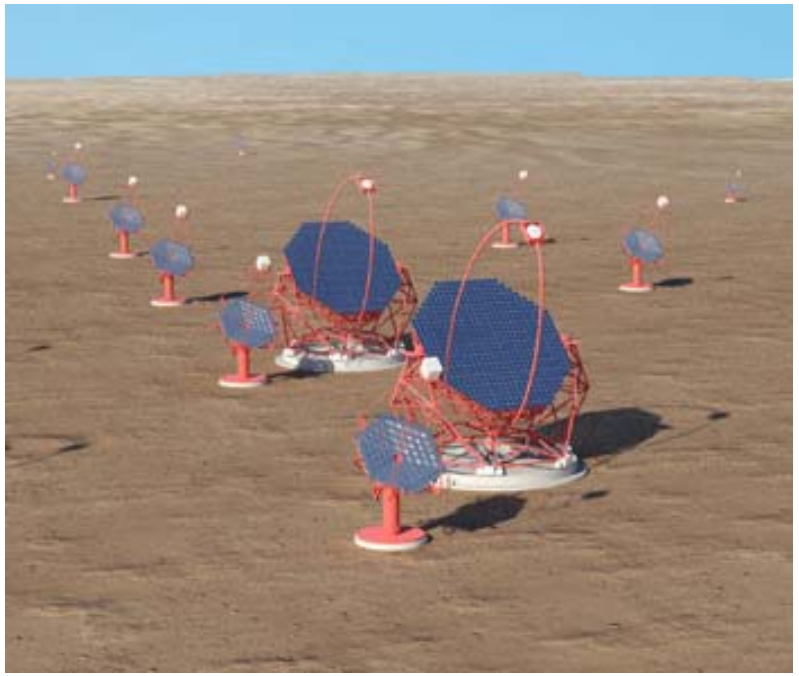
- Under evaluation:
  - **Cherenkov Telescope Array**



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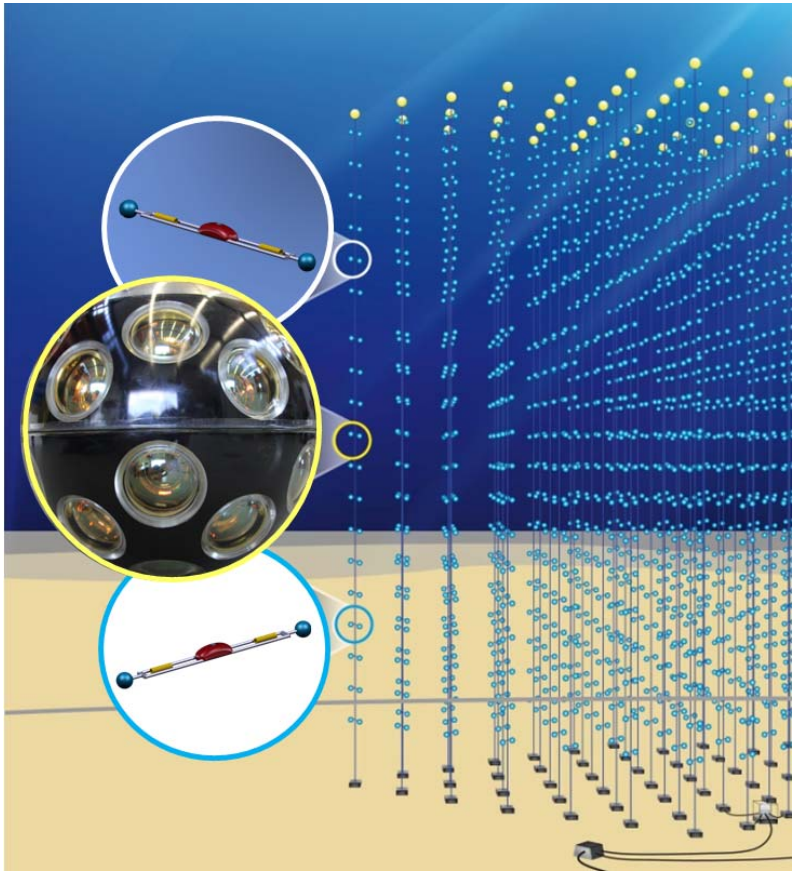
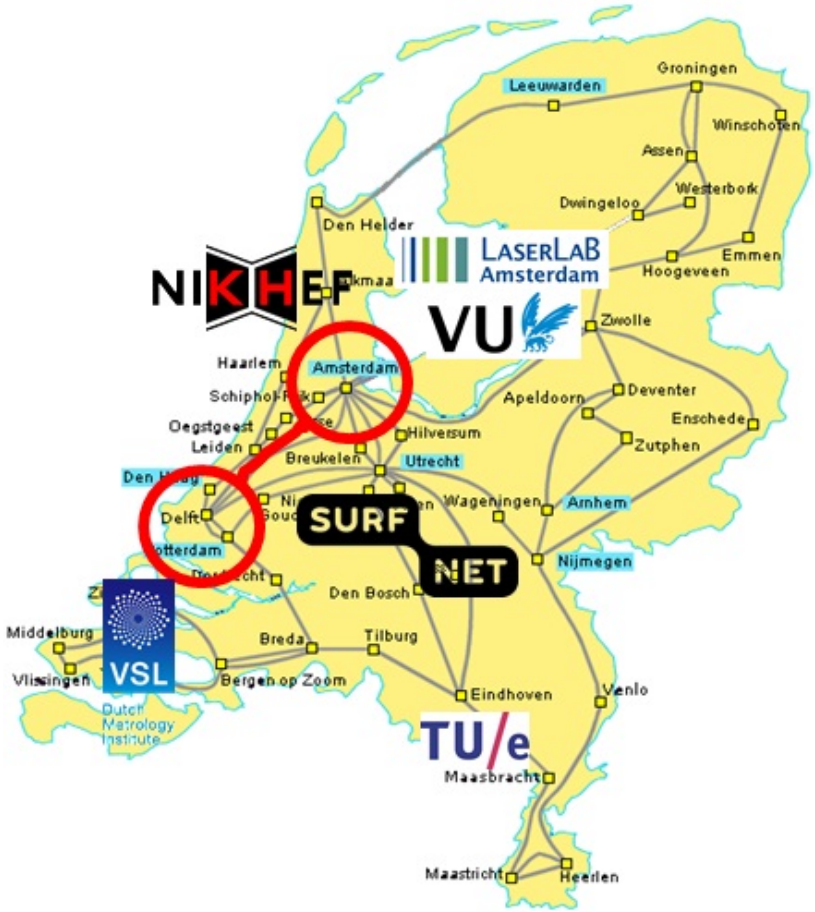
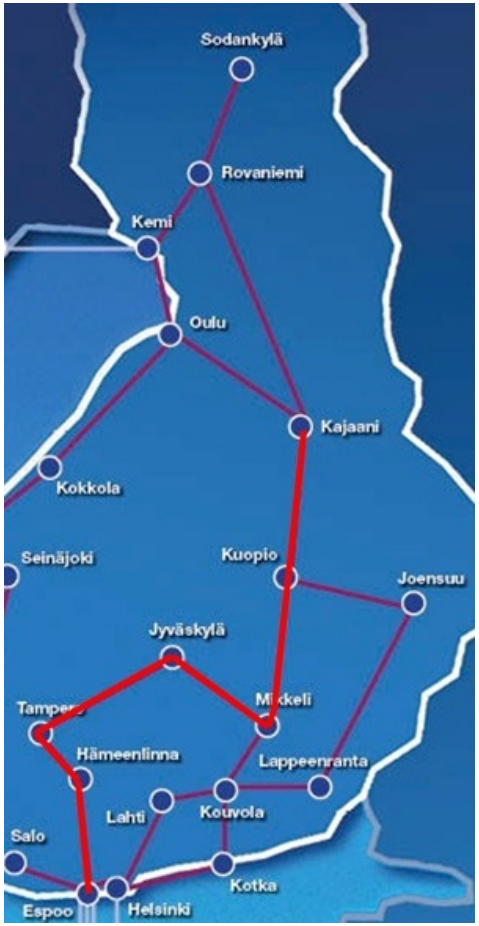
  - **European deep-sea research infrastructure (KM3NET)**
  - Long distance Time Transfer



NL: Time Distribution over 120 km with amplifiers



FI: Time Distribution over 900 km with amplifiers



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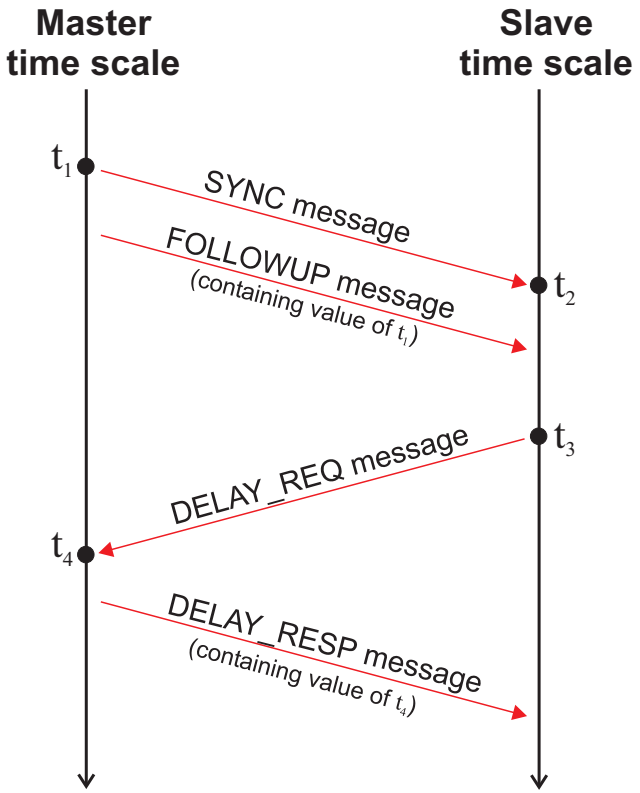
Precision Time Protocol (IEEE 1588)

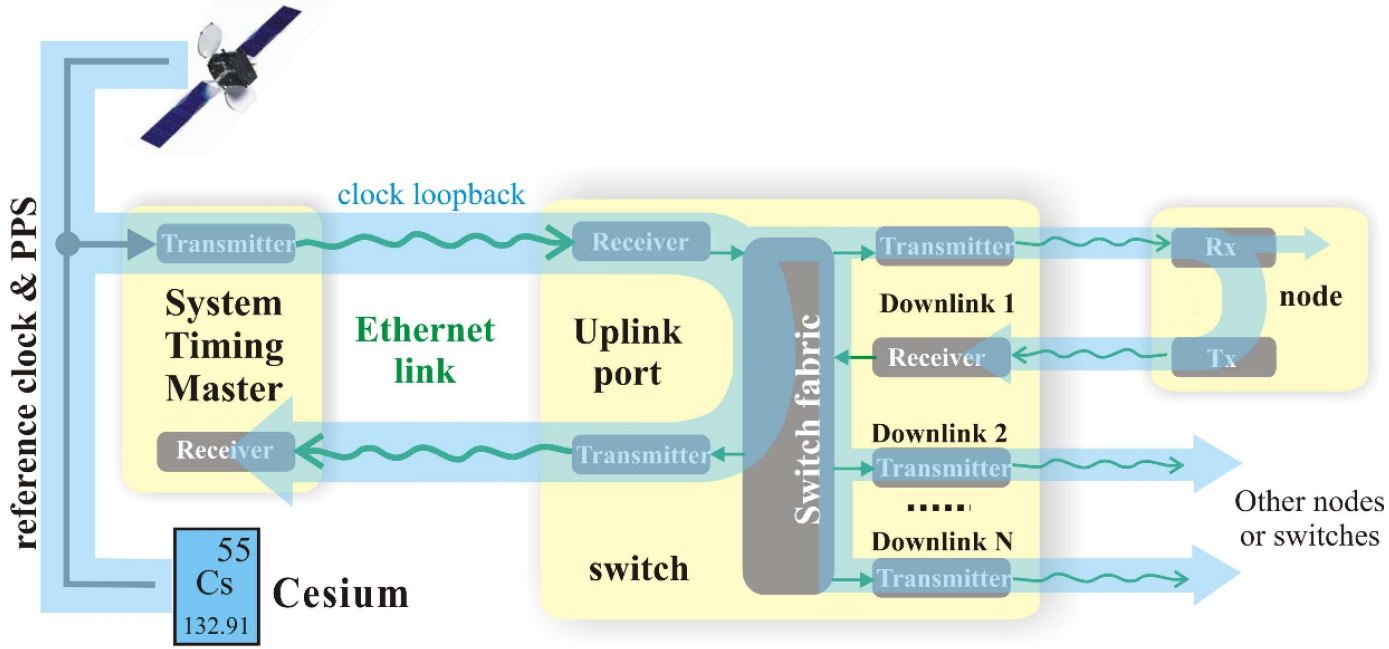


- Frame-based synchronization protocol.
- Synchronizes local clock with the master clock.
- Link delay evaluated by measuring and exchanging frames with tx/rx timestamps.

Layer 1 Syntonization

Common clock for the entire network

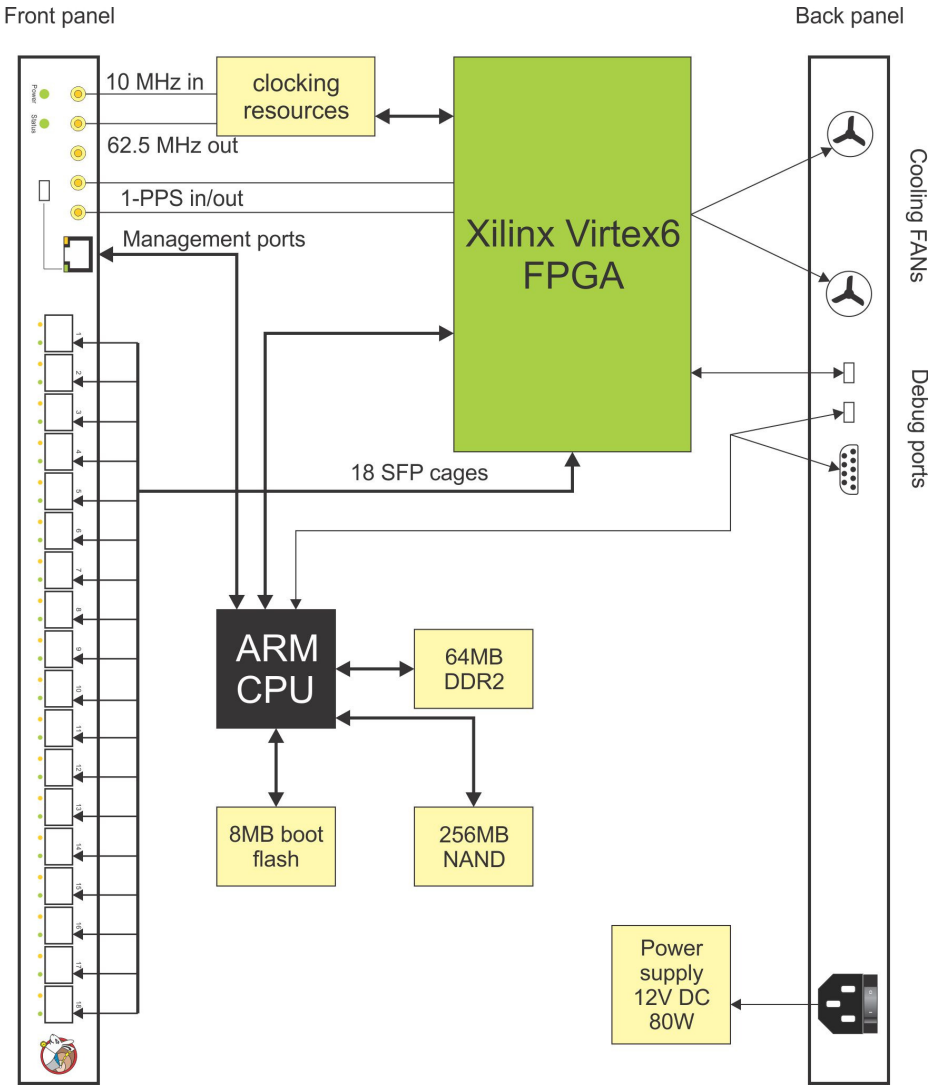
- All network devices use the same physical layer clock.
- Clock is encoded in the Ethernet carrier and recovered by the receiver chip.
- Phase detection allows sub-ns delay measurement.



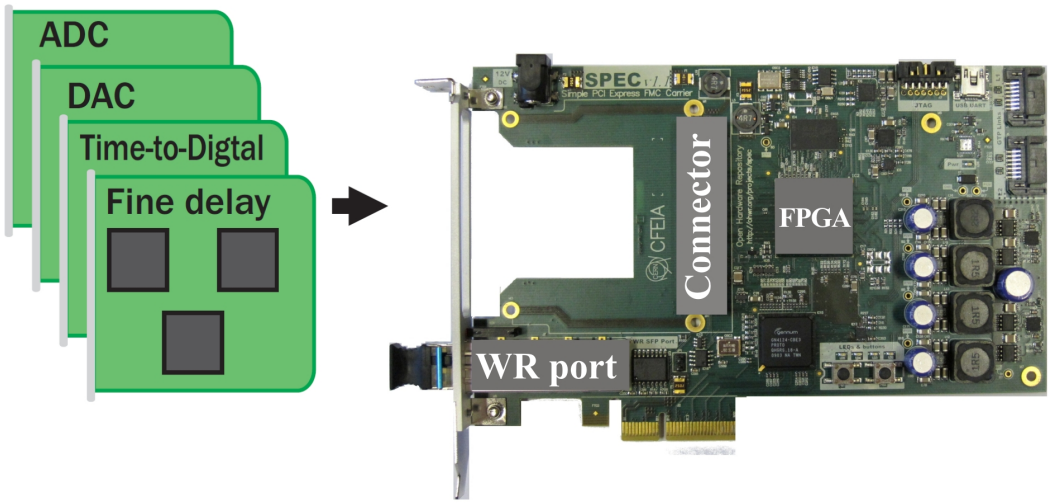
White Rabbit Switch

- Central element of WR network
- Original design optimized for timing, designed from scratch
- 18 1000BASE-BX10 ports
- Open design (H/W and S/W)
- Commercially available

Simplified block diagram of WR switch



WR Node: SPEC board

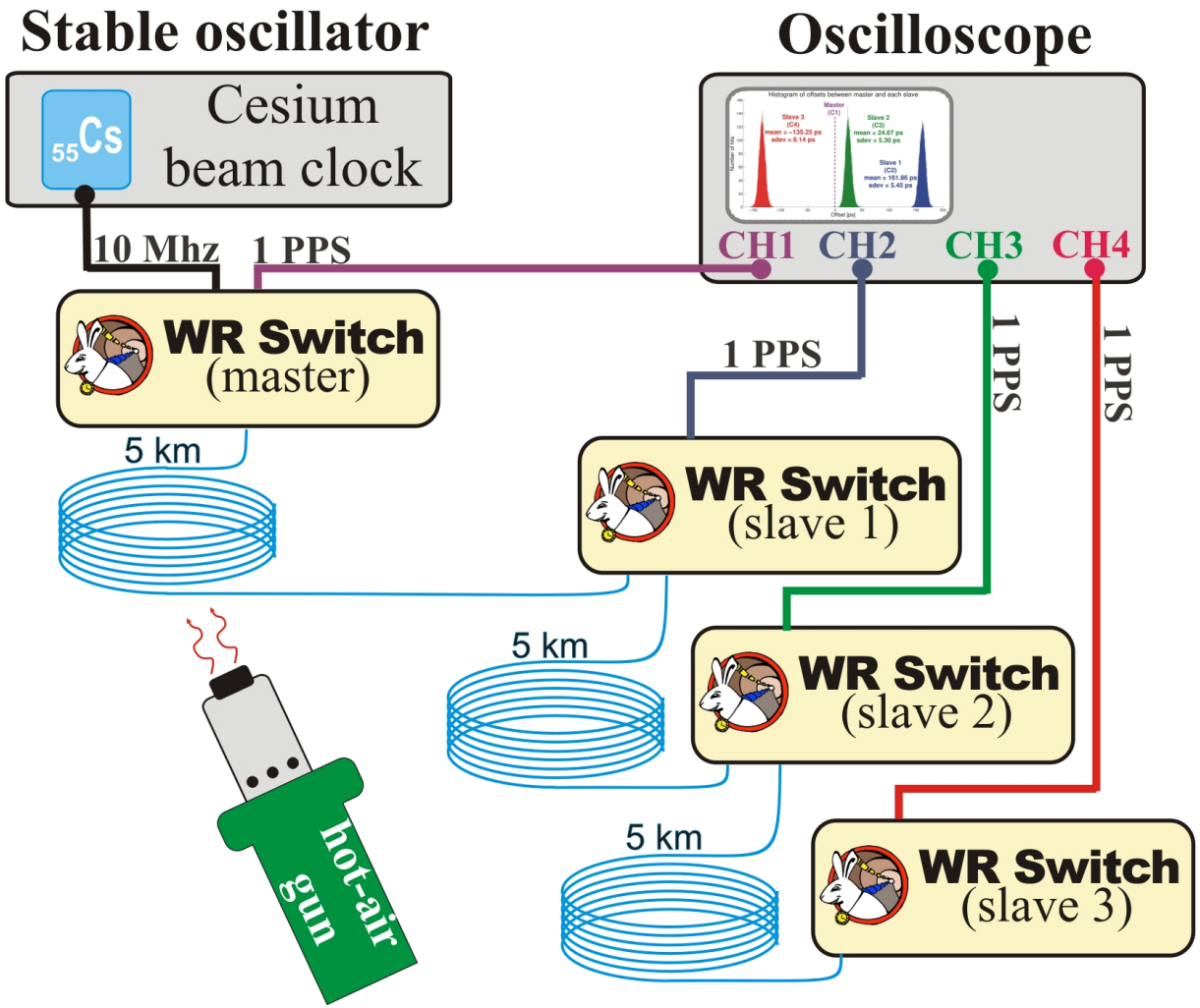


FMC-based Hardware Kit

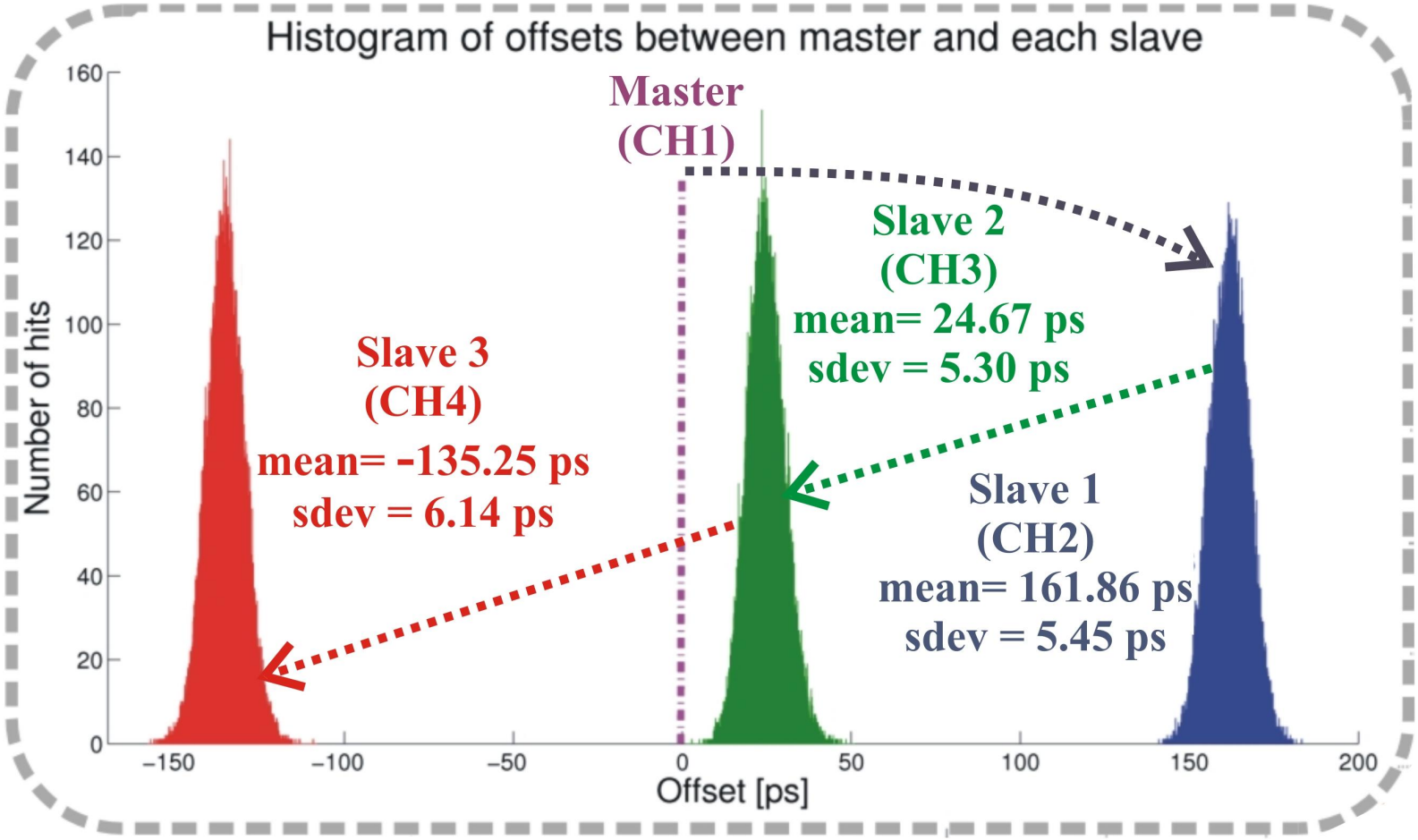
- All carrier cards are equipped with a White Rabbit port.
- Mezzanines can use the accurate clock and TAI (synchronous sampling clock, trigger time tag, ...).

Outline

WR time transfer performance: test setup



WR time transfer performance: test results



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Low latency

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Suitable for time-based control and data acquisition

Combining a low upper bound in latency and a good common notion of time.

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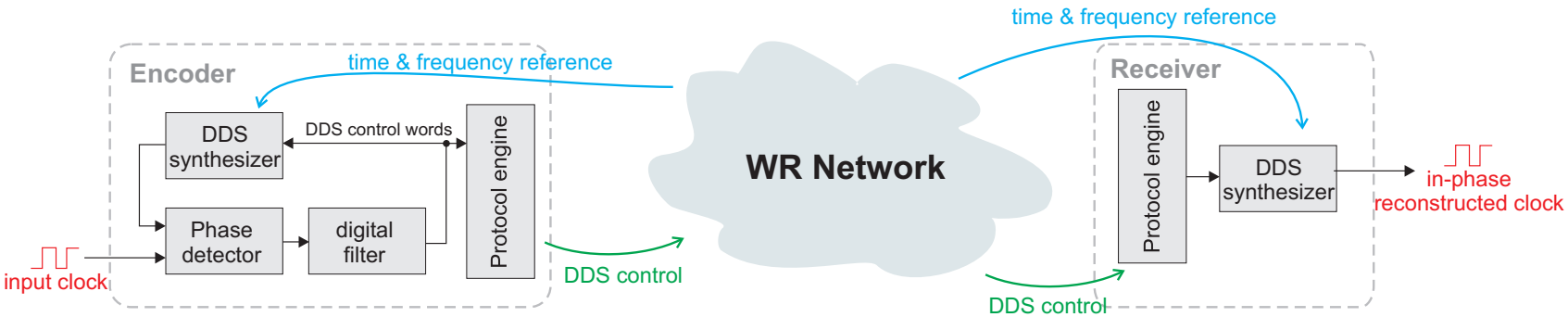
Robustness

Based on redundant information and fast switch-over between redundant switches.

Ethernet Clock distribution a.k.a. Distributed DDS



Distributed Direct Digital Synthesis

- Replaces dozens of cables with a single fiber.
- Works over big distances without degrading signal quality.
- Can provide various clocks (RF of many rings and linacs) with a single, standard link.

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For more information see
http://www.ohwr.org/projects/white-rabbit/wiki