WhiteRabbbit for

Array Trigger and Time Distribution

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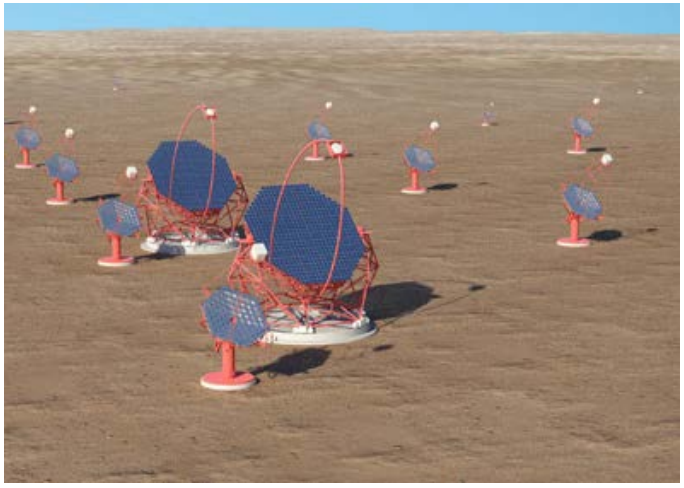
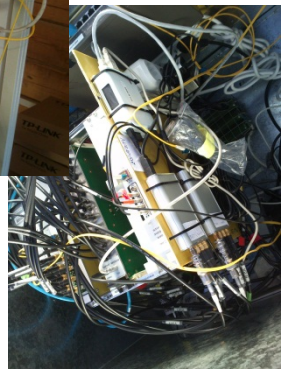
- DESY / HUBerlin -

ACTL/ArrayTrig PhoneConf, 24.44.2014





Executive summary: WR for CTA (1)

> **White Rabbit (WR) = a solution for**

"Array Time and Trigger Distribution" (ATTD)

(1) Clock-Distribution to Camera

- **Clock distribution from ACTL-Center to all cameras by WR-ethernet :**

  - Clock Phase and relative times at every camera and at any moment are actively kept stable to <0.2ns !

  (eg. for precision calibration signals; any other clock solution has multi-ns drifts)

(2) Event Time-Stamping at Cameras

- **Camera trigger time stamping with 1ns precision**

  - sends digital event times to ACTL for Array Triggering via ethernet

  - can also interface directly to Camera to send the time-stamps

Executive summary: WR for CTA (2)

> **Why White Rabbit ?**

(and not a custom system ?)

- **WR - advantages**

  - Open source and open hardware project (CERN: LHC; FAIR)
  - Big user community + longterm support
  - Commercial support (>4 European companies)
  - WR = new ethernet standard
  - Low cost; flexibility by Mezzanine/

  (for detailed discussions, see earlier CTA-talks)

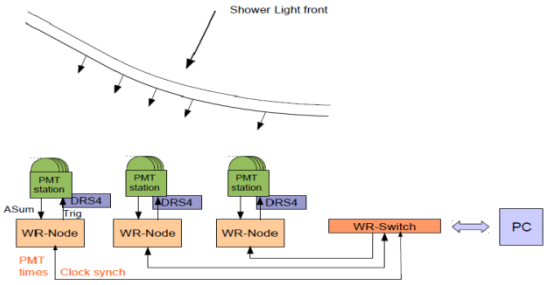
Executive summary: WR for CTA (2)

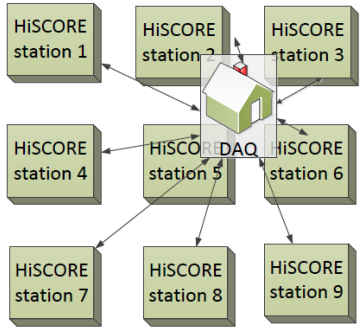
- **Status: WR is a "ready to apply" framework with sub-nsec precision**
  - **Clock distribution and time-stamping ready today.**

- **DESY uses WR @HiSCORE in TUNKA**
  - **Extensive laboratory tests (eg. ClimateChamber: -20…+40 C): RMS <0.2ns**
  - **Field tests / Siberia -40…+10C in 2012/13**
  - **HiSCORE data taking since Oct.2013**

    with 9 WR-stations on 0.1km2

    → full CR-shower reconstruction





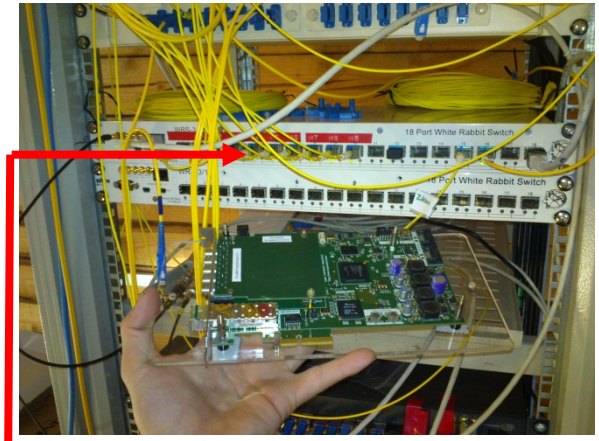
Tunka: 9 WR-stations

  - **precision LED calibration – in progress**

- Under discussion: a White Rabbit setup for MST@prototype

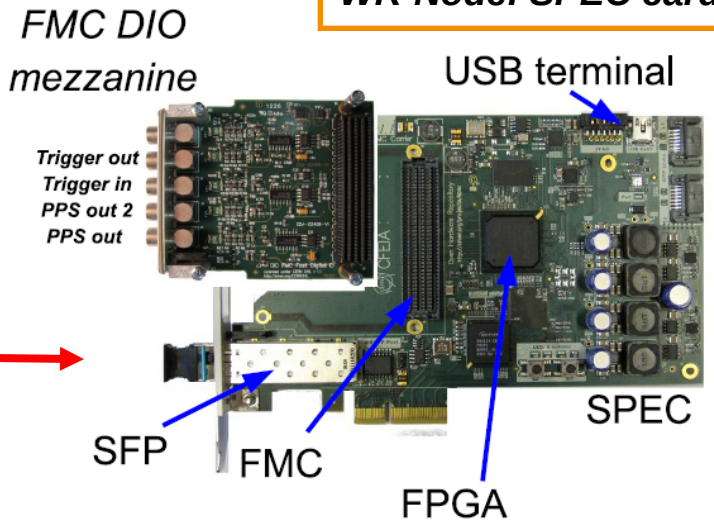
WR - The Basic Elements

WR Master: WR Switch



1Gbit fiber

WR-Node: SPEC card



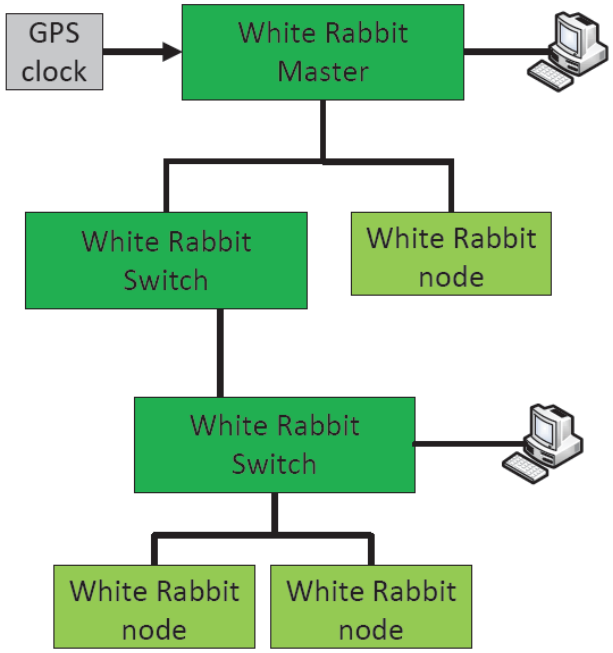
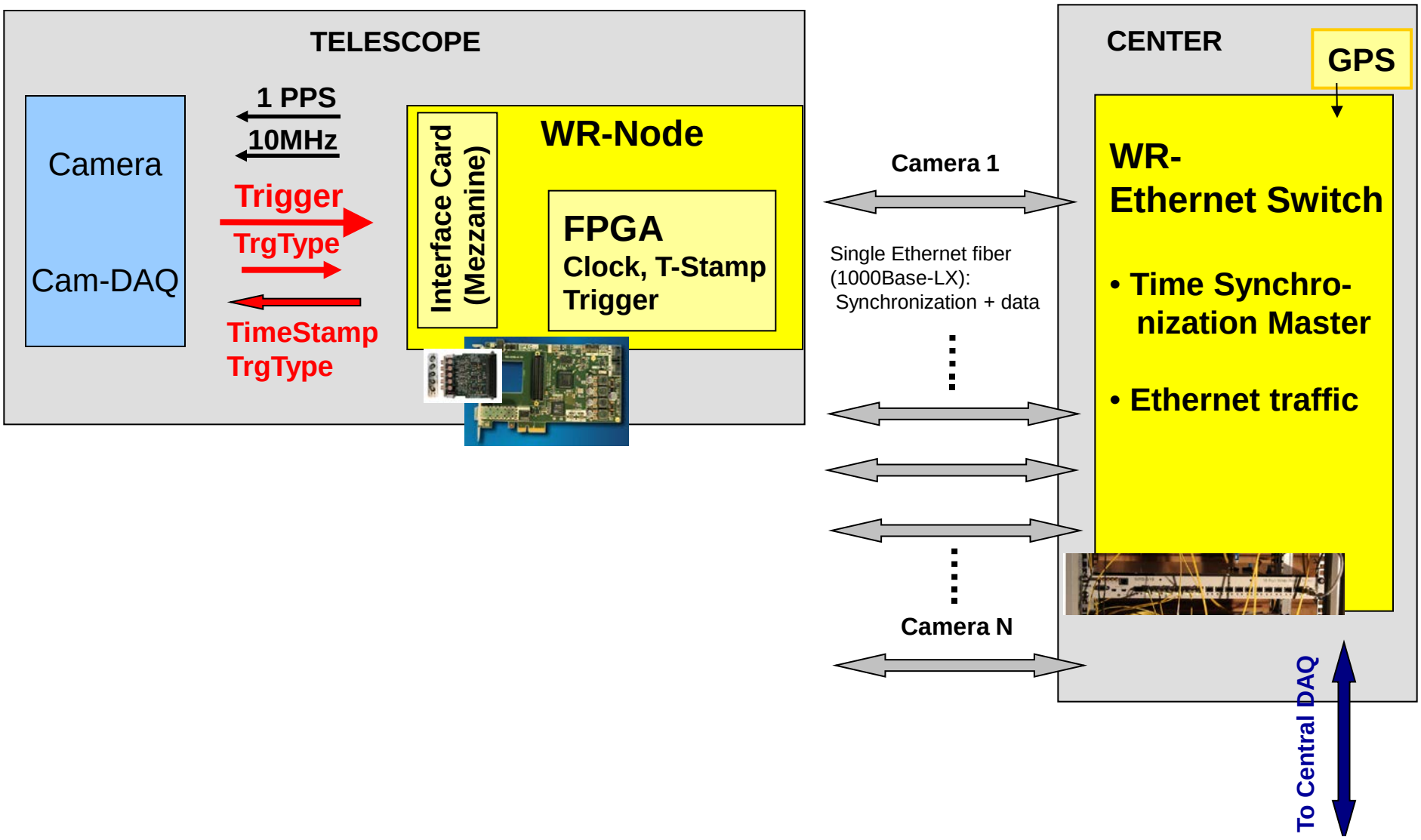


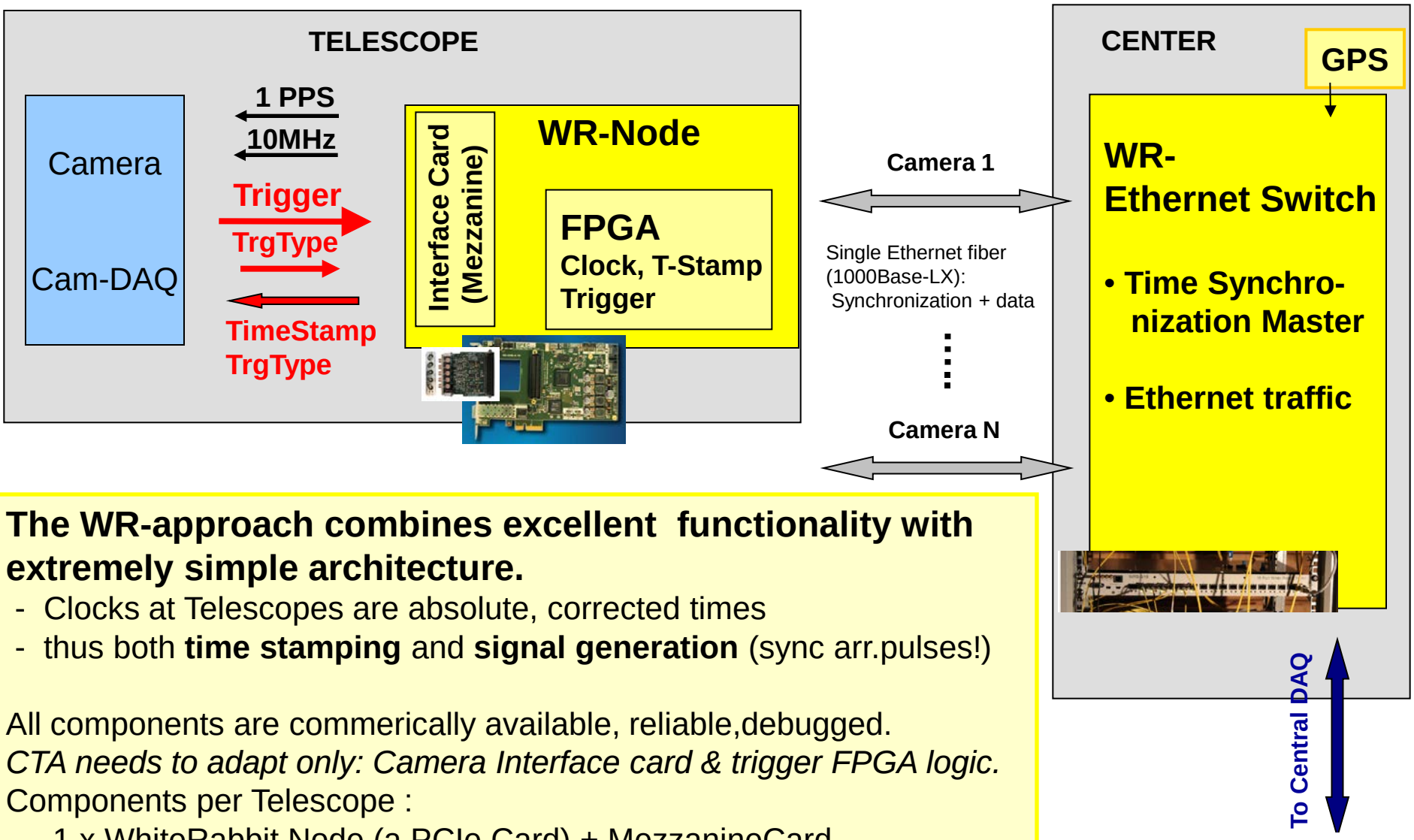
Figure 1: The White Rabbit network

NB: can be used as“normal Eth-Network” for any non-WR components.

White Rabbit at CTA: Baseline architecture



White Rabbit at CTA: Baseline architecture



The WR-approach combines excellent functionality with extremely simple architecture.

- Clocks at Telescopes are absolute, corrected times
- thus both **time stamping** and **signal generation** (sync arr.pulses!)

All components are commerically available, reliable,debugged.
CTA needs to adapt only: Camera Interface card & trigger FPGA logic.
Components per Telescope :

- 1 x WhiteRabbit Node (a PCIe Card) + MezzanineCard
- 1 standard fiber (SM;1390/1510nm)

Per Array : WhiteRabbit Switches (Nb.of.Telescopes / 18).

WR and CTA Cameras

Which Cameras do want / need what functionality ?

> **LST / MST-NCAM: Interface discussion progress**

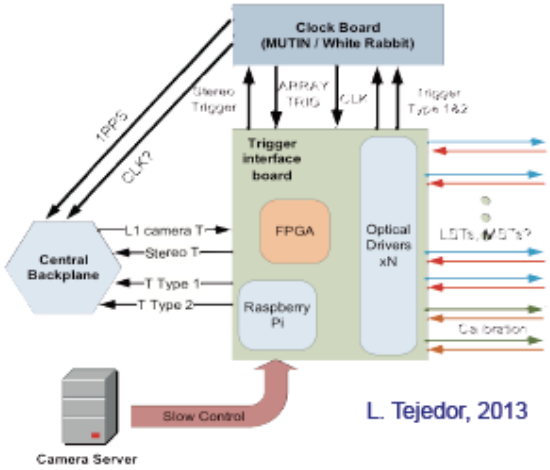
> **FCAM: - Clock needed; interfacing tbd.**

- Trigger-Out seems possible

> **SSTs: WR internally used (planned)**

- Clock ? External Trigger likely possible

> **SCT: - Discussion started.**



Summary

- **WR is ready to go.**

  Fully tested in a long-term field experiment.

  (also: Laboratory test with Mutin scheduled)

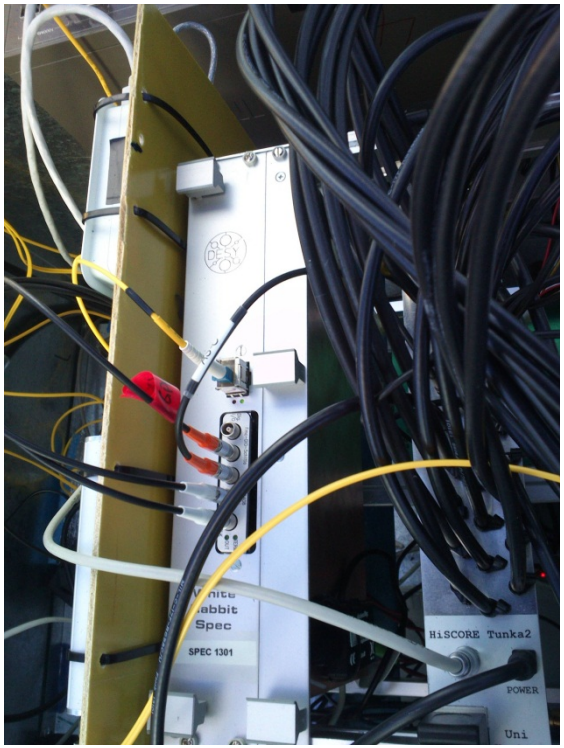
- **Next Steps:**

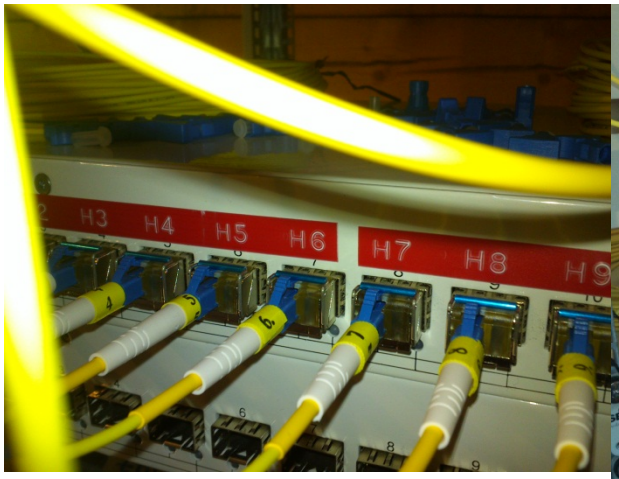
  - define functionality per camera

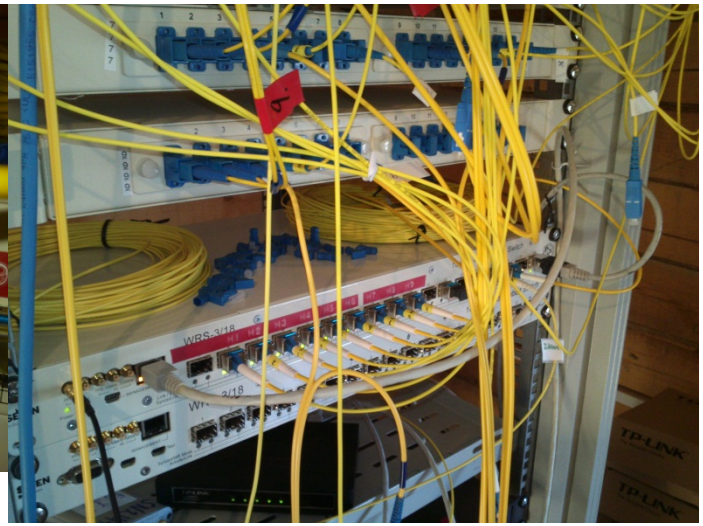
  - define higher-level Camera interfaces for LST, MST, SST, …

Thank you && Backup slides …

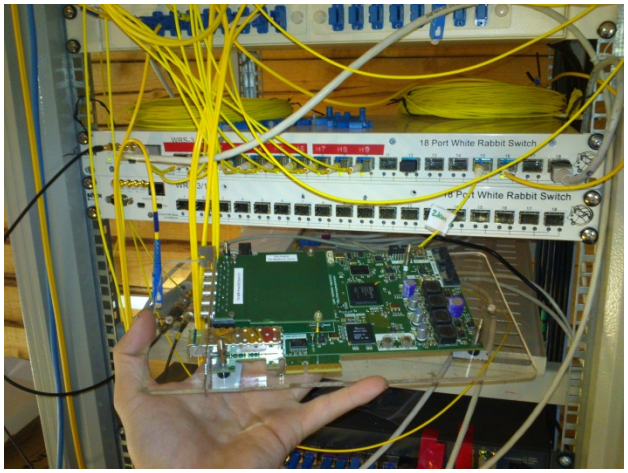
Station Tunka-2013 DAQ-Center







WR – Node (SPEC) card in Station



WR-Switch in DAQ Center