OPNT
Optical Positioning, Navigation and Timing

Plenary Session
Based on on results test plan: DEFIS/2020/OP/0007 D210

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OPNT end-to-end solution components
Runs on *existing* optical infrastructure

OPNT Calibrator

- **OPNT Timing Switch**
  - WR + fully backward compatible with PTPv2
  - Redundancy + clock segments

- **OPNT Range Extender**
  - Bi-directional

- **OPNT Optical Multiplexer**

- **OPNT Calibrator and Navigator**
  - Calibration Quality Assurance
  - Network Management and Operation Center

- Software for automated calibrations

- Quality assurance during the calibration process

- Step by step guidance on how to calibrate and automatically capture calibration parameters
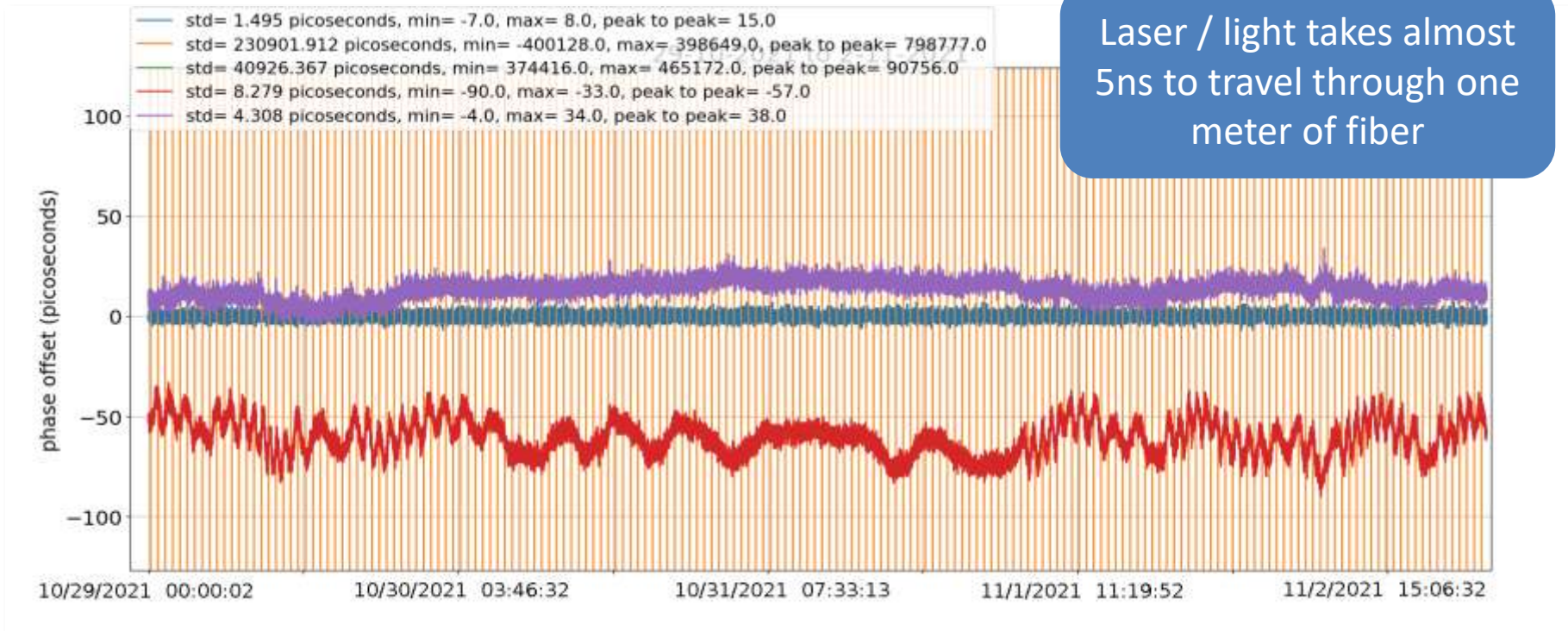
OPNT Navigator

- Navigator
  - Network Management Service
  - Network Operation Center
- Scan for devices on the network
  - Scan the network and get an overview of the OPNT TaaS network and devices found.
  - Monitor the network and keep track of the status.
- Operate devices with ease
  - Operating a device with OPNT Navigator gives an overview and easy access to the functions.
  - Can be integrated into 3rd party NMS.
- Alarm monitoring and email notifications
  - Receive and process alarms generated by devices
  - Generate email notifications based on received alarms
  - Generate alarm log file and device daily log files

# White Rabbit Time & Frequency Test Setup @ JRC ISPRA

White Rabbit Time & Frequency Transfer 1

- 100km link with repeater in between (2x 50km) measured during approx. 72 hours
- Time stability: 57ps peak-to-peak / 8.3ps std. dev. (red graph)

Legend:
- std= 1.495 picoseconds, min= -7.0, max= 8.0, peak to peak= 15.0
- std= 230901.912 picoseconds, min= -400128.0, max= 398649.0, peak to peak= 798777.0
- std= 40926.367 picoseconds, min= 374416.0, max= 465172.0, peak to peak= 90756.0
- std= 8.279 picoseconds, min= -90.0, max= -33.0, peak to peak= -57.0
- std= 4.308 picoseconds, min= -4.0, max= 34.0, peak to peak= 38.0

Laser / light takes almost 5ns to travel through one meter of fiber

White Rabbit Time & **Frequency** Transfer 2

- Redundant links in hot-standby with seamless switchover from simulated failed link (100km link) to a working link (orange graph).
- From sample 400: 2 minutes disconnect, 5 minutes connect repeated 10 times to simulate link interruption. Largest peak is 56ps (red graph).
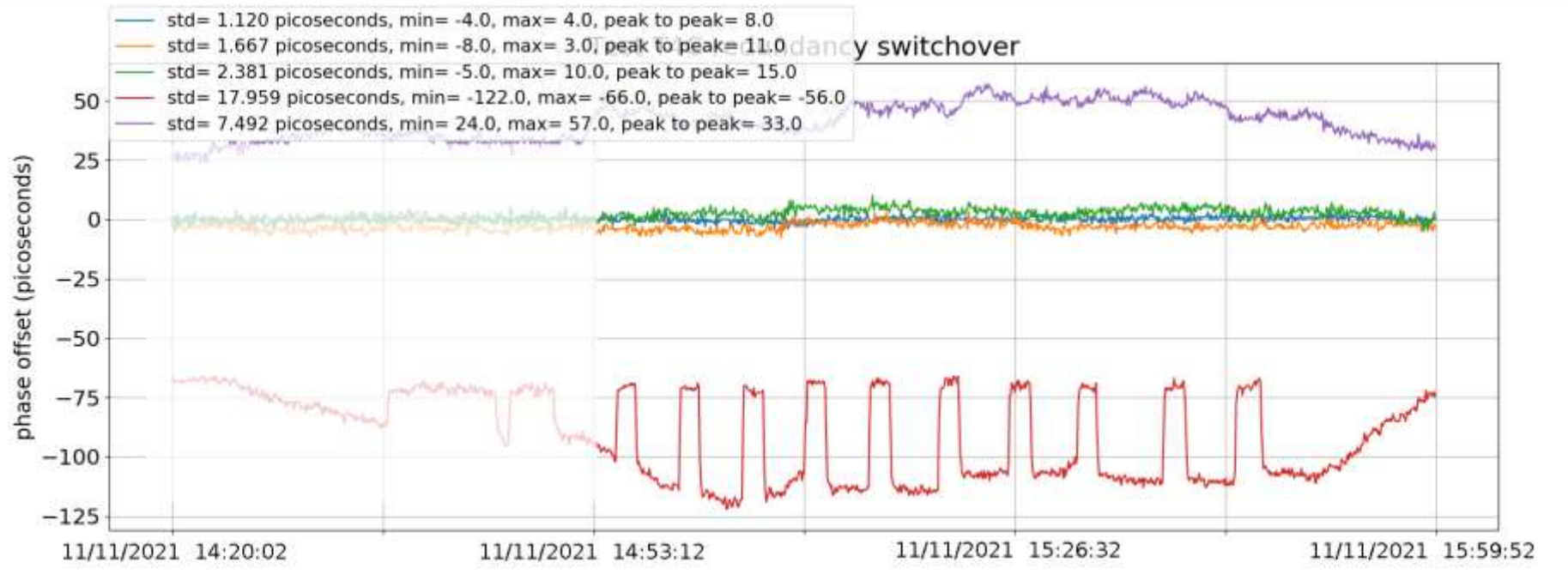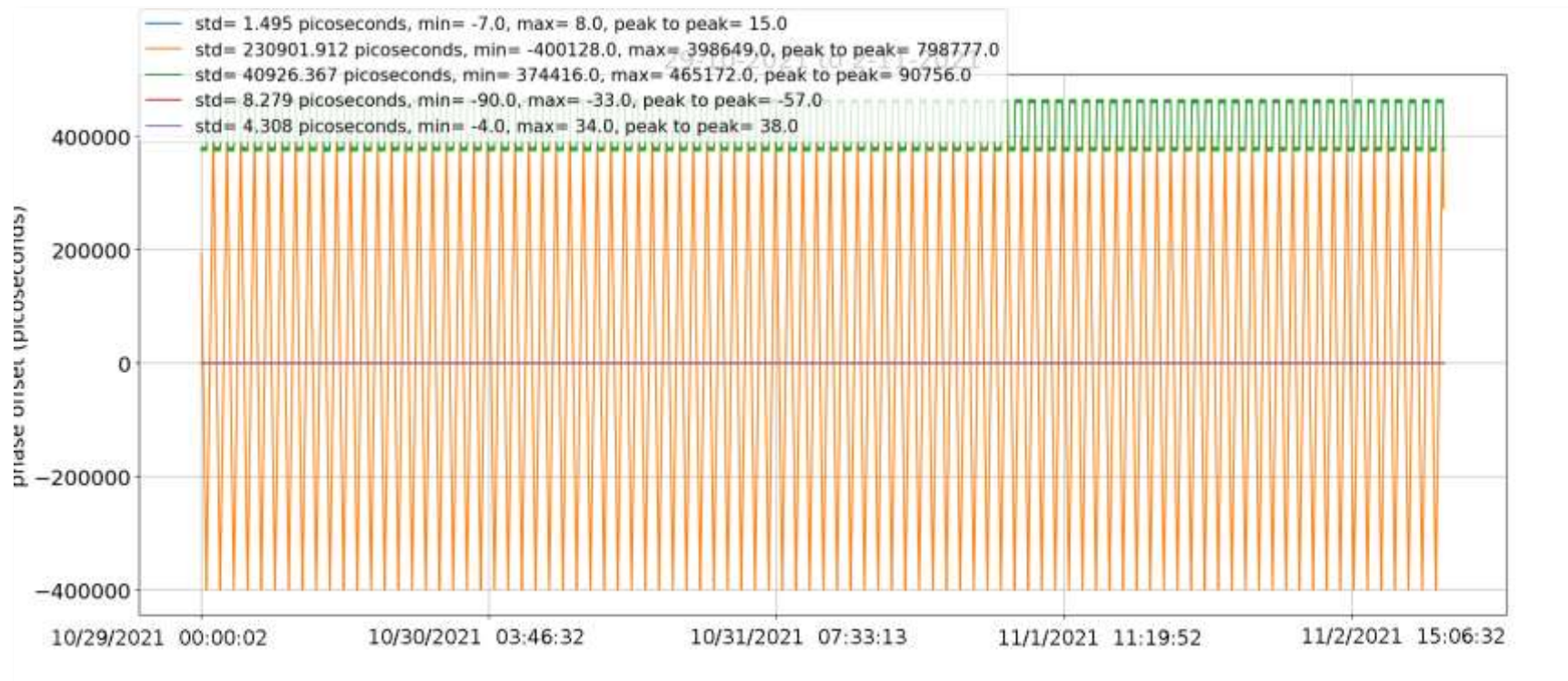
White Rabbit Time & Frequency Transfer 3

- Changeover when primary time source (green graph) drifts and exceeds a predefined threshold
- Time accuracy provided by the system stays within 2.1ns (red graph)
- Run time: approx. 14 hours
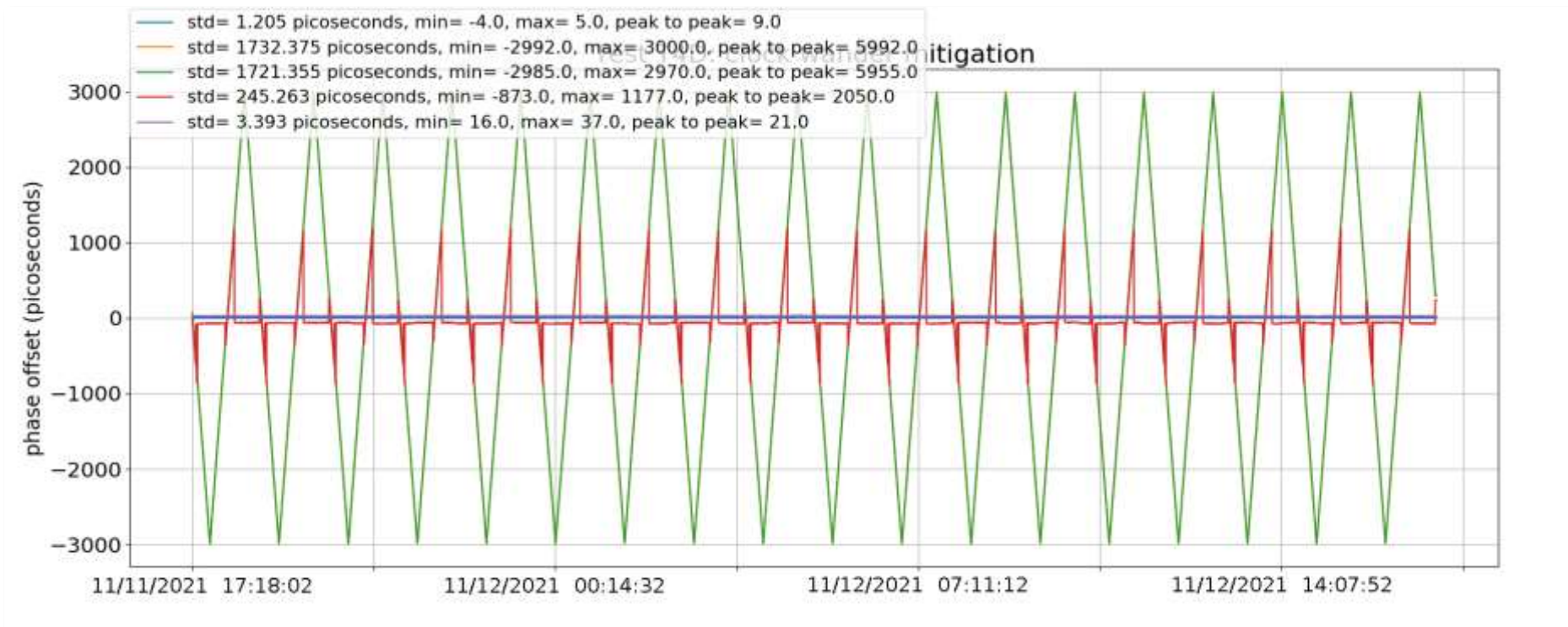
Wireless time synchronization

- Corrected 'target' stays within 91ns (TS10 D, green graph) while time source has a simulated drift of 799ns (TS10 C, orange graph)
- Run time: approx. 72 hours

Conclusion

OPNT has demonstrated the ability to:

- Transfer time & frequency over long distances with better than 1 nanosecond accuracy using the White Rabbit protocol

- Offer seamless switchover between time sources in case of failure

- Detect a time source going out of specification and switchover to a valid time source

- Monitor and Correct devices with a drifting time source with better than +/-200 nanosecond accuracy by monitoring radio signals.

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