opnt.
TIME PROVISIONING

CIGRE April 11, 2024

Marco Gorter
CEO / Co-Founder

Optical Positioning, Navigation and Timing.

Clear need for an independent timing system, parallel to GPS

As many government reports have pointed out, and large companies have indicated.

- Accuracy
- Reliability
- Traceability
- Confidence
- Control
- Cost
- Coverage
- Cyber Security
- Resistance to Attack
- GPS Back-up!

Reliable timing is crucial for:

- 4G/5G mobile networks, IoT
- Banking and trading systems (traceable to UTC)
- Power grids
- Datacenters
- Distributed databases
- Edge computing
- The Internet
- Blockchain
- Cyber Security
- Etc.

GPS has become an invisible utility
(US Government Accountability Office)

From: https://www.bloomberg.com/news/features/2018-07-25/the-world-economy-runs-on-gps-it-needs-a-backup-plan

EU tender: Alternative Positioning, Navigation and Timing

Ministers spend £36m to make UK time 'hack-proof'

Executive Order on Strengthening National Resilience through Responsible Use of Positioning, Navigation, and Timing Services

2nd call from Department of Transportation US

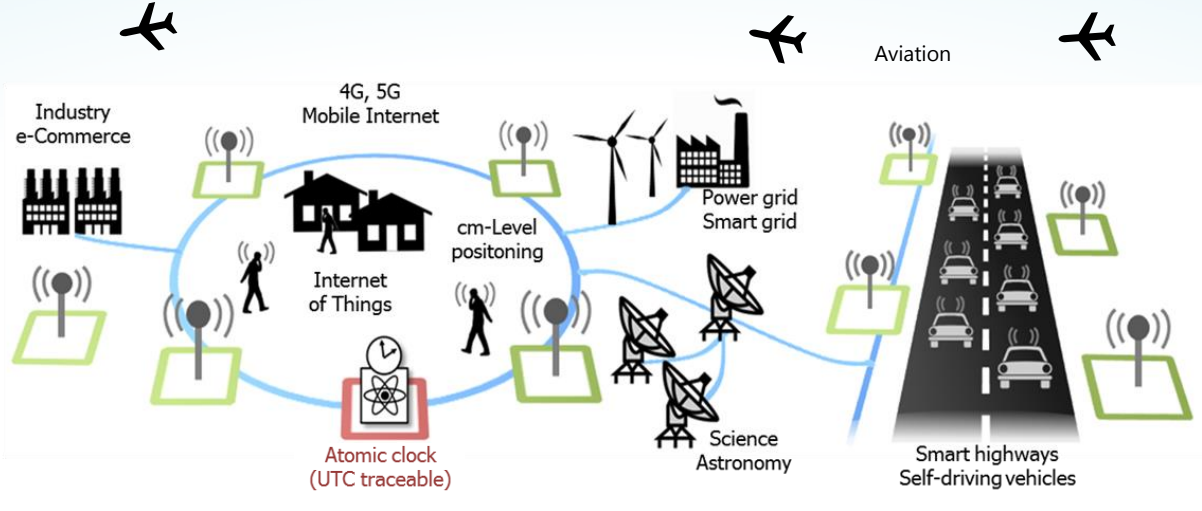
Critical infrastructure heavily relies on GNSS (eg. GPS) only

Terrestrial based timing system (Alt. PNT)

GPS

GPS enabling technology:
precise atomic clocks on each GPS satellite
- it is the precision timing which enables positioning!

opnt. TIME PROVISIONING



Distributed atomic clock signals through the **fiber-optic network**

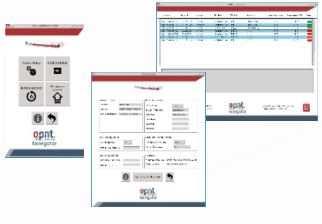
opnt. TIME PROVISIONING

End-to-end solution components (runs on *existing* optical infrastructure)

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

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

- **OPNT Optical Multiplexer**

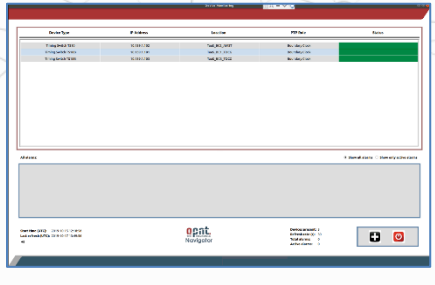


- **OPNT Calibrator and Navigator**
  - Calibration Quality Assurance
  - Network Management and Operation Center

OPNT Calibrator

- 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 (WR)

- WR
  - Developed at CERN
  - Open / market standard

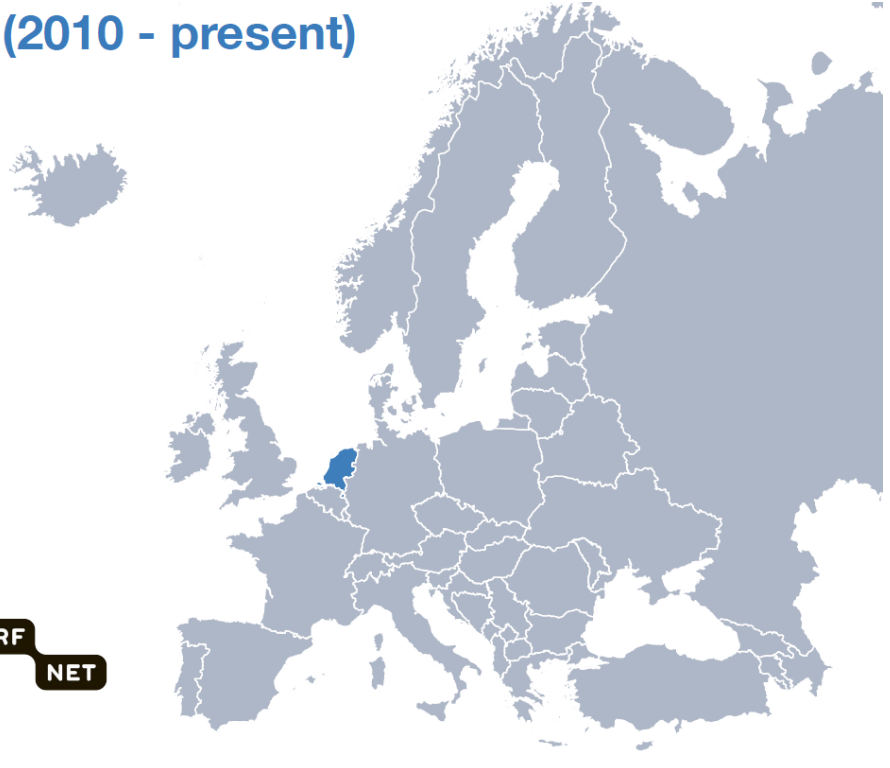
- Sub 100 picosecond accuracy

- White Rabbit uses the Precision Time Protocol.
- A two-way exchange of the Precision Time Protocol synchronization messages allows precise adjustment of clock phase and offset.
- The link delay is known precisely via accurate hardware timestamps and the calculation of delay asymmetry.

White Rabbit | Netherlands WR Hotspot

WR Academic Research Activities in NL (2010 - present)

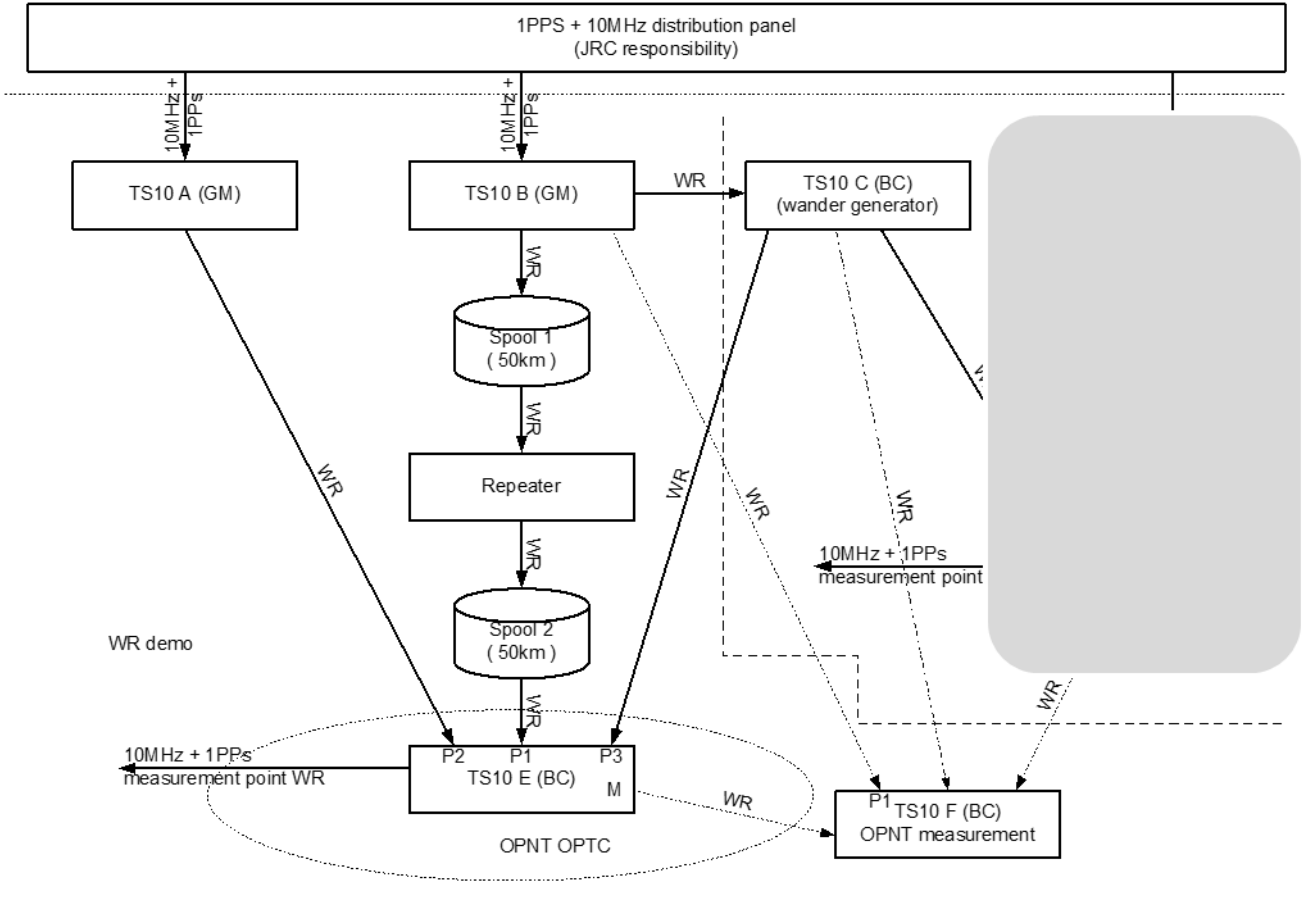
- **Nikhef high-energy physics institute**
  - Introduced famous WR bitslide mechanism
  - WR for submarine KM3NeT neutrino telescope
  - Absolute delay calibration techniques
- **VU University (incl. WR spin-off OPNT)**
  - Long-haul, low-noise implementations of WR
  - WR over WDM installed / live fiber-optic networks
  - WR for optical metrology / data acquisition infrastructure LaserLaB VU
- **TU Delft**
  - (SuperGPS)
- **VSL Delft (NMI)**
  - Nanosecond UTC dissemination over long-haul WR links
- **SURFnet (NREN)**
  - Long-haul WDM WR for academic research (particle physics, radio astronomy)
- **ASTRON/JIVE**
  - WR for radio astronomy (VLBI, LOFAR and SKA)



Source: VU University, TU Delft, Astron, Nikhef || Confidential

European Commission Alt. PNT demo

White Rabbit Time & Frequency Test Setup @ JRC ISPRA

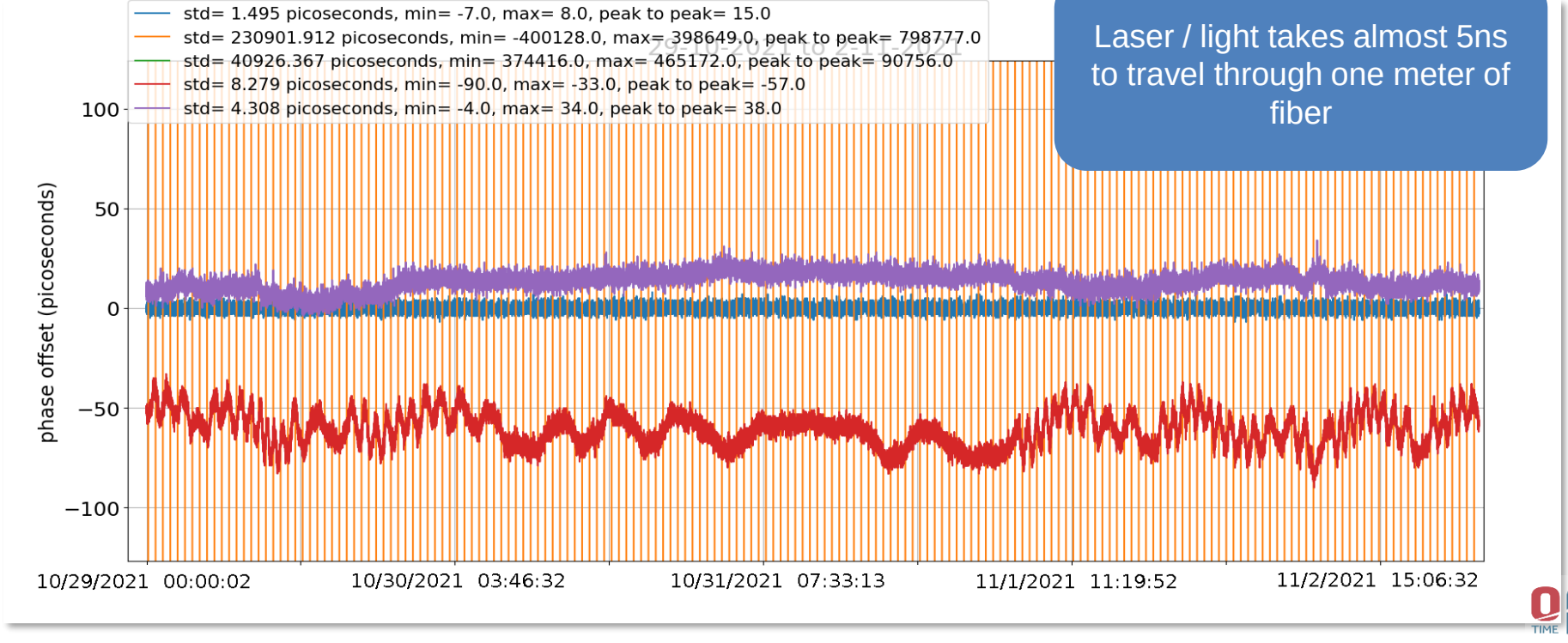


Legend

- TS10 A
- TS10 B
- TS10 C
- TS10 D
- TS10 E

White Rabbit Time & Frequency Transfer 1

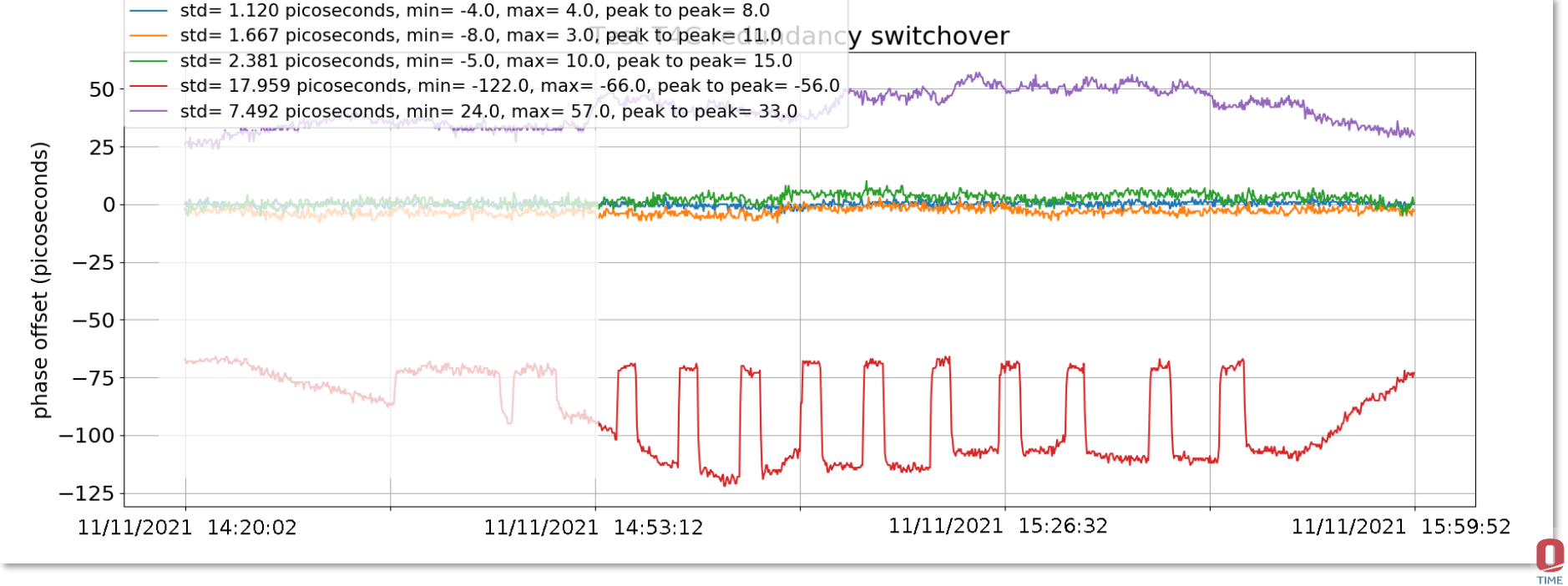
- 100km link with repeater in between (2x 50km) measured during approx. 72 hours
- Time stability: 57ps peak-to-peak / 8.3ps std. dev. (red graph)



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

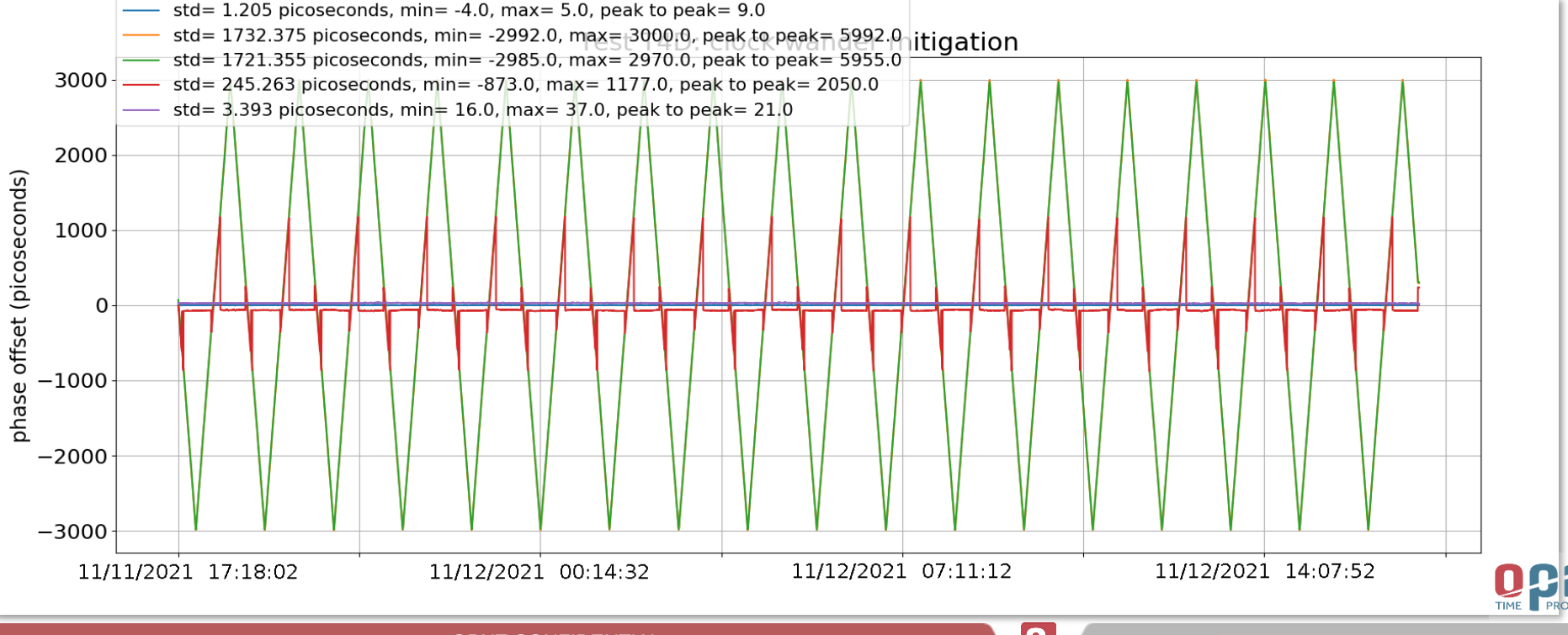
White Rabbit Time & Frequency Transfer 2

- 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).



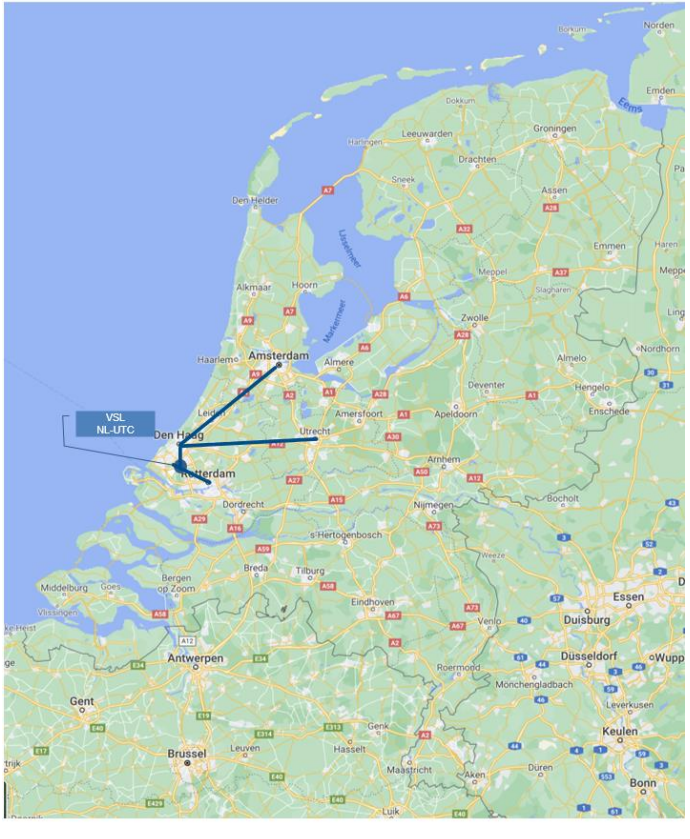
White Rabbit Time & Frequency Transfer 3

- 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



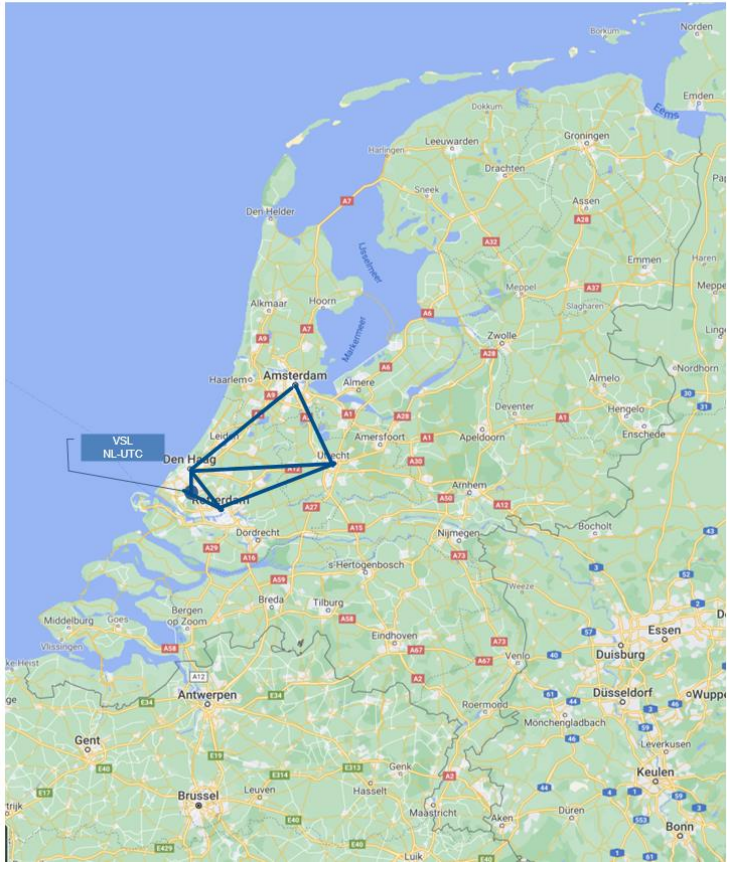
Example implementation the Netherlands

National Level Phase 1a: UTC Traceable Time to Metro's



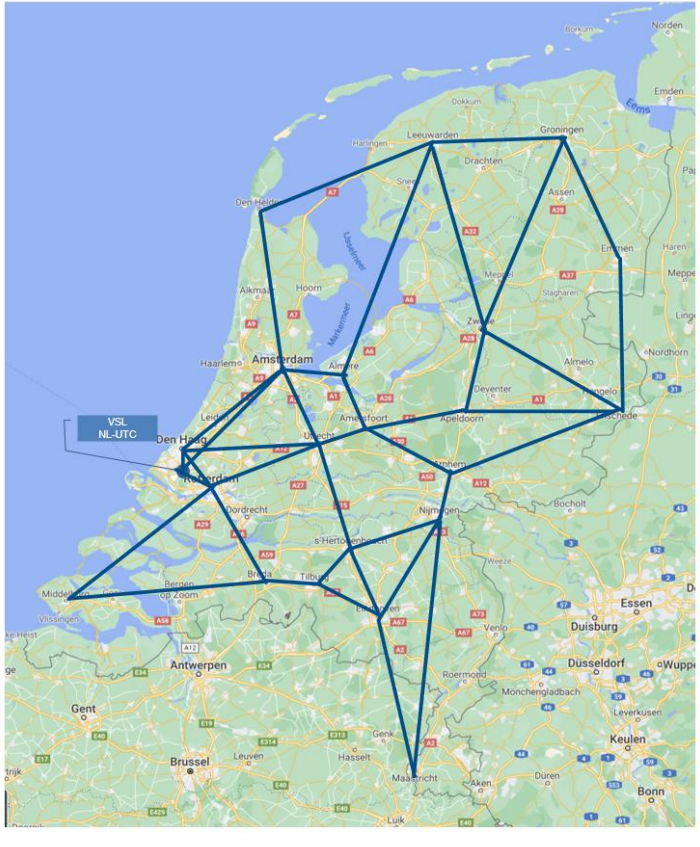
- Phase 1a:
  - Connect main metro's to NMI / NTI for legal UTC time
- Star shaped Network

National Level Phase 1b: Redundant connections to Metro's



- Phase 1a:
  - Connect main metro's to NMI / NTI for legal UTC time
- Phase 1b:
  - Introduce Redundancy / Meshed Network

National Level Phase 1c: National Timing Backbone



- Phase 1a:
  - Connect main metro's to NMI / NTI for legal UTC time
- Phase 1b:
  - Introduce Redundancy / Meshed Network
- Phase 1c:
  - Timing Backbone to all metro's (large cities)

Contact Information

OPNT B.V.

De Boelelaan 1081
1081 HV Amsterdam
The Netherlands

Marco Gorter

m.gorter@opnt.nl

WWW.OPNT.NL

LinkedIn Follow us

info@opnt.nl