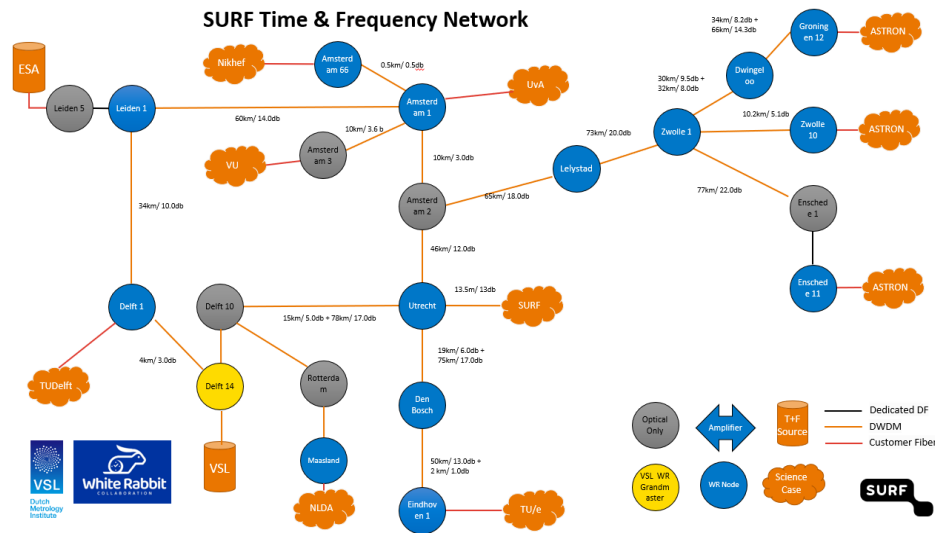
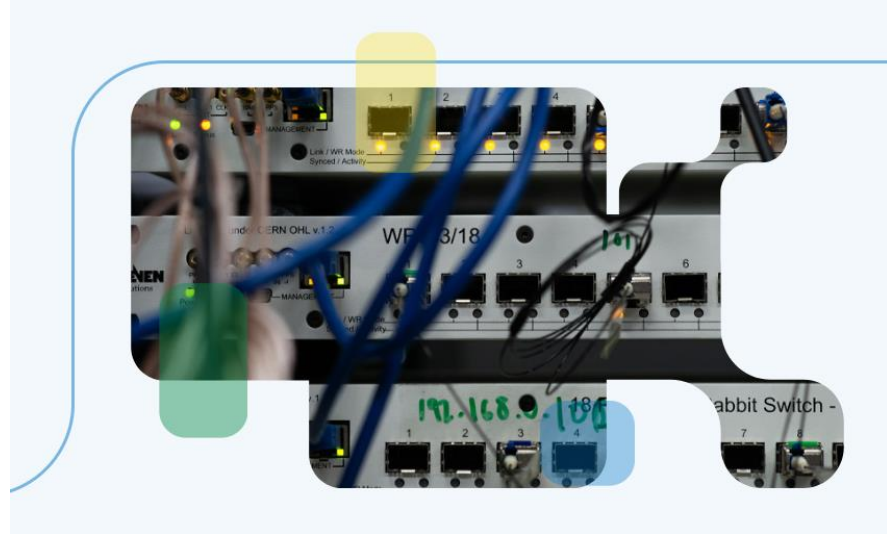


SURF Time and Frequency Transfer

Robin Janssen

Product Manager Network Connectivity

GÉANT BoF - Long-Haul White Rabbit



Agenda

1. Introduction

2. Our service

3. Use cases

4. Lessons learned

5. Next steps

SURF

The Dutch National Research and Education Network

Cooperative

125 member institutions and ~2 million users in research and education across the Netherlands.

Sectors

Universities, universities of applied sciences, MBO colleges, research institutes and UMCs.

Network

11,000 km of fiber nationally and internationally. 800 Gbit/s backbone in 2026. Connected to GÉANT, NetherLight and AMS-IX.



The team



Sander Klemann

Product Manager

Lead for Time and Frequency at SURF.
Drove product development.



Paul Klop

Technical Product Manager

Built the technical foundation.
Deep expertise in WR and optical networking.

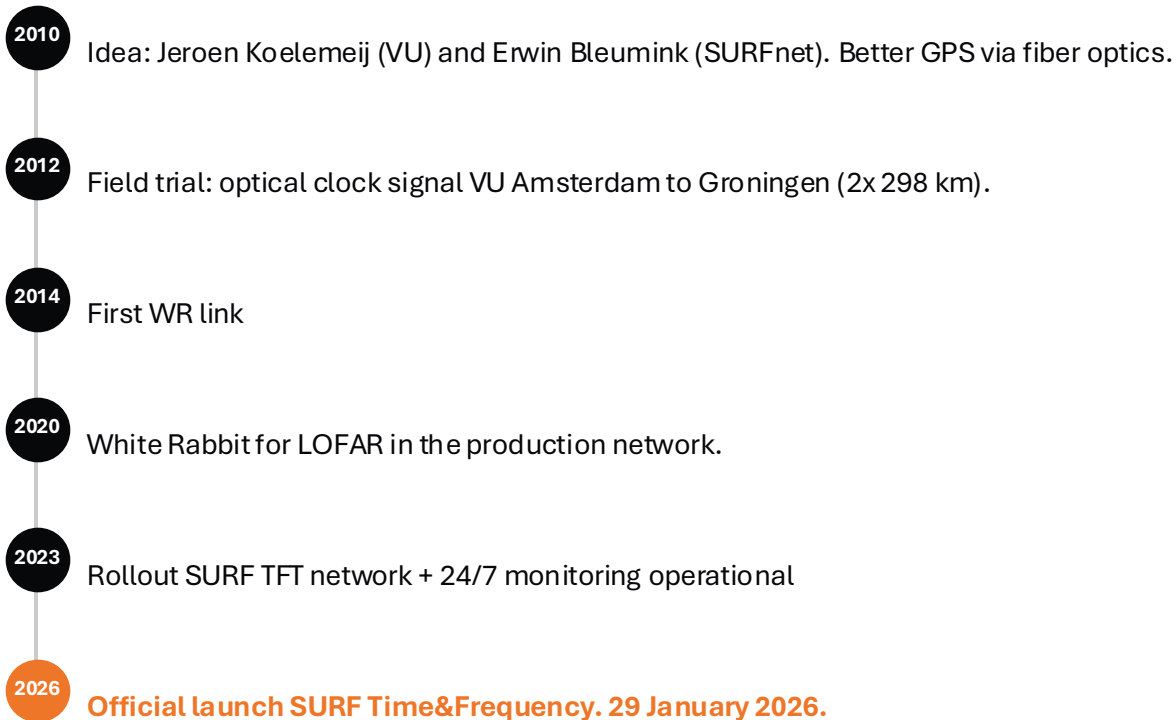


Robin Janssen

Product Manager

Jep, that's me! New to the team.
Experienced (non-network) PM.

A journey through time





Our service

SURF distributes VSL's atomic clock signal over fiber, so research institutions don't need one of their own

Our service

What we deliver

Frequency reference (10 MHz)

A stable reference signal. Scientists use it to calibrate their instruments.

Precision timing (< 1 ns)

Knowing exactly what time it is, to the nanosecond.

How we do it

White Rabbit over shared DWDM

Through our network

18 switches, 15 cities, 950 km



Use cases

Most users need only the frequency reference. TU Delft is the only user that also uses precision timing.

LOFAR / ASTRON

Dwingeloo

Radio telescope synchronisation. Stable time reference across distributed antenna arrays.

Nikhef

Amsterdam

White Rabbit protocol research.

VU Amsterdam

Amsterdam

Precision measurements of the properties of elementary particles such as atoms and molecules.

TU Delft

Delft

Super GPS2 project. The only current user requiring full sub-nanosecond timing precision.

TU/e

Eindhoven

Quantum lab. Frequency reference for quantum computing and sensing experiments.

UvA

Amsterdam

Research instrumentation and iqClock research. Frequency reference for physics and astronomy experiments.

Use case: SuperGPS - TU Delft

The problem with GPS

GPS signals are weak and bounce off buildings in cities, making accurate positioning unreliable exactly where we need it most.

The solution: SURF TFT

Instead of satellites, SuperGPS uses the SURF fiber-optic network with the atomic clock signal from VSL. SURF installed the equipment that distributed VSL's time signal to radio transmitters along the road.

Result: 10 cm accuracy

6 transmitters on lampposts, one car with a receiver. Accurate to 10 cm. Published in Nature, November 2022.

'SuperGPS' project

(collaboration with Delft University of Technology, VSL Delft, and private partners)



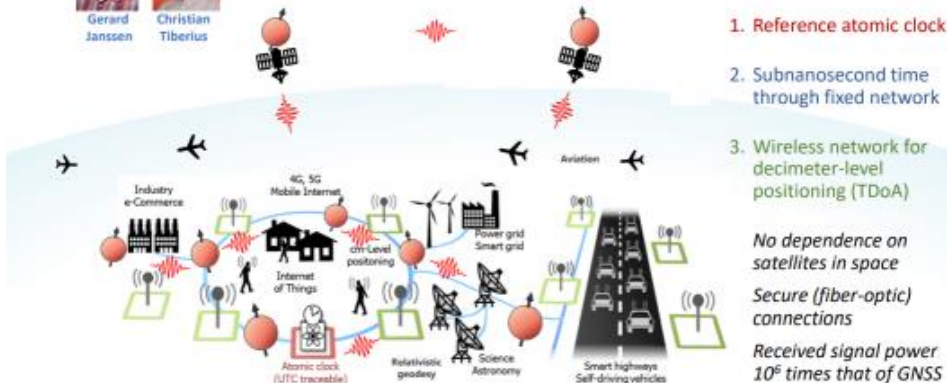
Gerard Janssen



Christian Tiberius

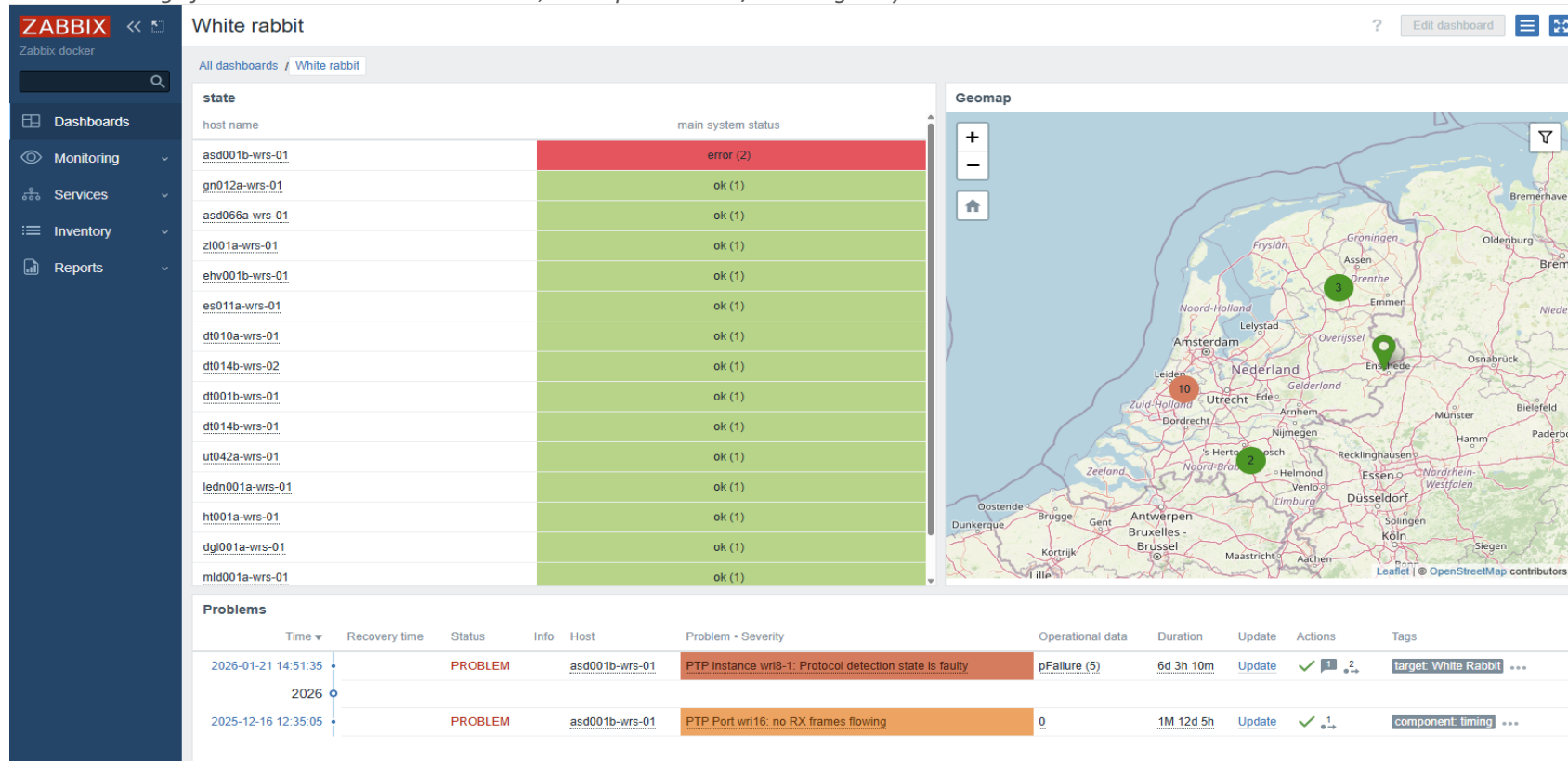
Back-up system for PNT through GNSS

Could also support quantum networks and distributed quantum computing



Monitoring and dashboard

Live monitoring of all WR connections. Green = OK, Red = problem. 24/7 managed by SURF.



Lessons learned

Calibration after fiber repairs: still manual

A specialist is needed each time.

No dedicated monitoring for White Rabbit (yet)

Standard network tools don't understand WR.

Onboarding takes more time than expected

Users aren't familiar with the service.

Next steps

Connecting to the European C-TFN

SURF as a node in the planned European Core TFN.

Expanding to more locations

Growing from 15 cities toward broader national coverage.

PTP on the roadmap

Next step after WR stabilization. Also a NIS2 recommendation.

What we need from this community

Automated recalibration tooling. Cross border standards.

Thank you

Robin Janssen

Product Manager Network Connectivity

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