

DIGITAL SOVEREIGNTY IN POSITIONING, NAVIGATION AND TIMING WITH 5 G BROADCAST

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MBT Meeting, Opatija
22.5.2025

ROHDE & SCHWARZ

Make ideas real



WHAT IS PNT?



Positioning

Where are you now



Navigation

Where you want to go



Timing

What time is now

CRITICAL INFRASTRUCTURE DEPENDS ON ACCURATE PNT SERVICE (GNSS / GPS)

Energy and Power
Grid

Communications

Financial
Transaction

Transportation
(Aviation, Maritime,
Rail, Surface,
Pipeline)

Chemical

First Responder

Critical Defense
Manufacturing

Food and Agriculture

WHAT HAPPENS IN CASE OF GNSS OUTAGE?



PNT services contribute to approximately 10% of the European GDP

[EU](#)

GPS jamming: no more flights to the airport in Estonia for the time being

GPS signals in the eastern Baltic Sea were disrupted for months, but aviation remained unaffected. However, this led to consequences for Tartu, Estonia.

GPS spoofing: civil aviation has problems – currently in South Korea

Fake navigation signals are increasingly being received by aircraft instruments. There were problems at the border with North Korea at the weekend.

GPS Is Easy to Hack, and the U.S. Has No Backup

At risk are airliners, electric grids, stock markets and other systems that rely on GPS to time their operations

[Scientific American](#)

Truck driver has GPS jammer, accidentally jams Newark airport

[CNET](#)

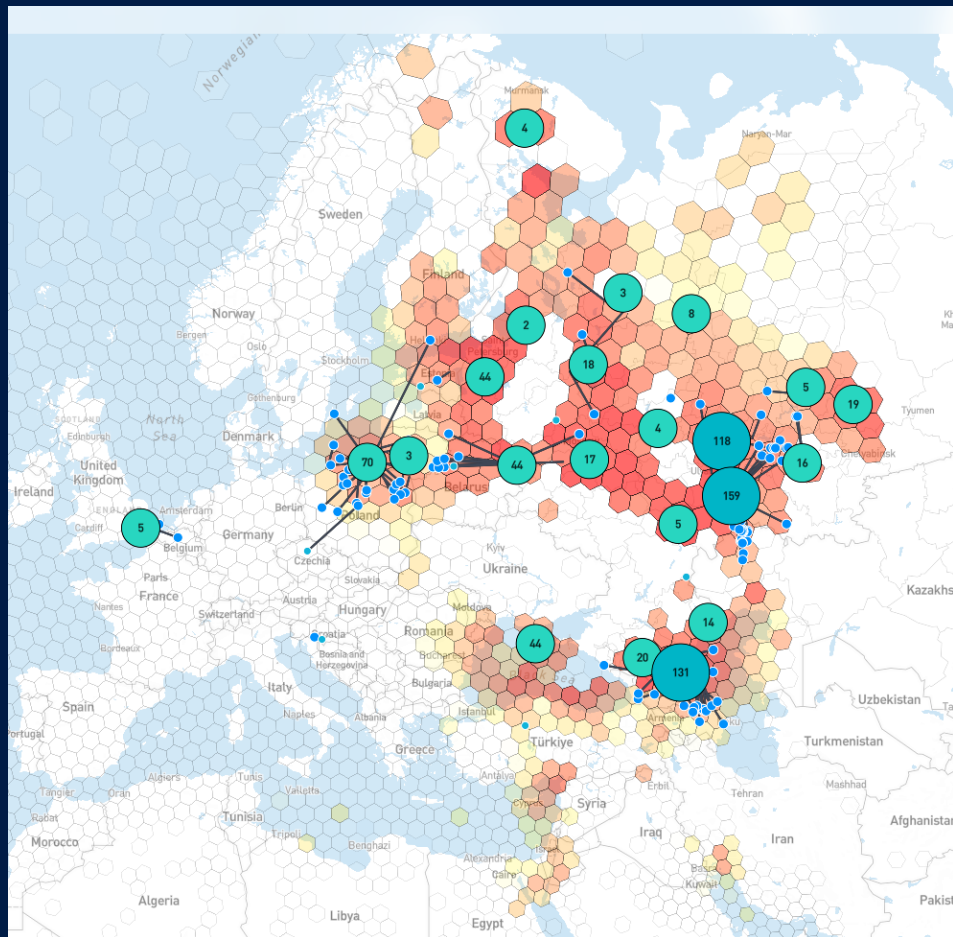
The World Economy Runs on GPS. It Needs a Backup Plan

The small satellite network, which keeps global computer systems from freaking out, is shockingly vulnerable to all kinds of interference.

[Bloomberg](#)

SPAMMING & SPOOFING THREAT TO AIR TRAFFIC

<https://spoofing.skai-data-services.com/>



OTHER TECHNOLOGY FOR GNSS BACKUP

Space Based Systems (MEO&LEO Satellites)

- ✓ Strong signal
- ✓ Operational frequency have limited penetration in urban areas and indoor
- ✓ High Total Cost Ownership

Terrestrial Beaconing Systems

- ✓ Like eLoran, rely on purpose-built ground-based infrastructure
- ✓ Very High TCO for wide scale
- ✓ Limited bandwidth

Time Over-Fiber

- ✓ Most precise methods for PNT delivery
- ✓ Very High Installation costs
- ✓ Vulnerable to natural disaster

Local Terrestrial Systems

- ✓ Emerging purpose built local PNT systems are promising
- ✓ Challenging costs and infrastructure
- ✓ Hard to scale

Cellular and Wireless Signals

- ✓ MNO can deliver PNT
- ✓ High TCO to deploy, especially in urban areas
- ✓ Low robustness

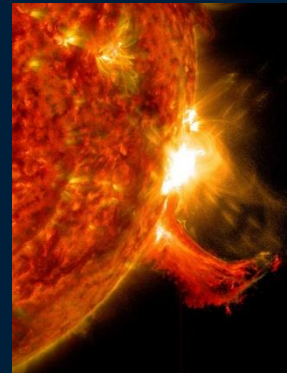


WHAT SHOULD A GNSS BACKUP SYSTEM LOOK LIKE?

- ▶ High signal power
- ▶ Low exposure to solar storms & space debris
- ▶ A **dissimilar** backup system is desirable
 - Other frequency range (not L-band)
 - Other transmitter location (not MEO orbit)
- ▶ Cost effective to deploy and maintain
- ▶ Performance?
 - EU: technology demos requested that can achieve:
 - < 100m (95%)
 - < 1 μ s UTC time sync (3-sigma)



A low-cost jammer
Source: some online shop



Solar eruption
Source: NASA/SDO/ Wiessinger

LET'S LOOK AT PNT WITH 5G-BROADCAST

What is the Position Navigation and Timing (PNT) in 5G-BC?



A system and method of estimating time and position at a receiver using 5G Broadcast broadcast signals



Compliant with the 3GPP standard

Uses the file download feature



Independent and stand-alone

→ GPS, Internet or cellular connectivity not required

WHAT?

PNT Capability

- ▶ One TV tower can provide accurate time at a known position

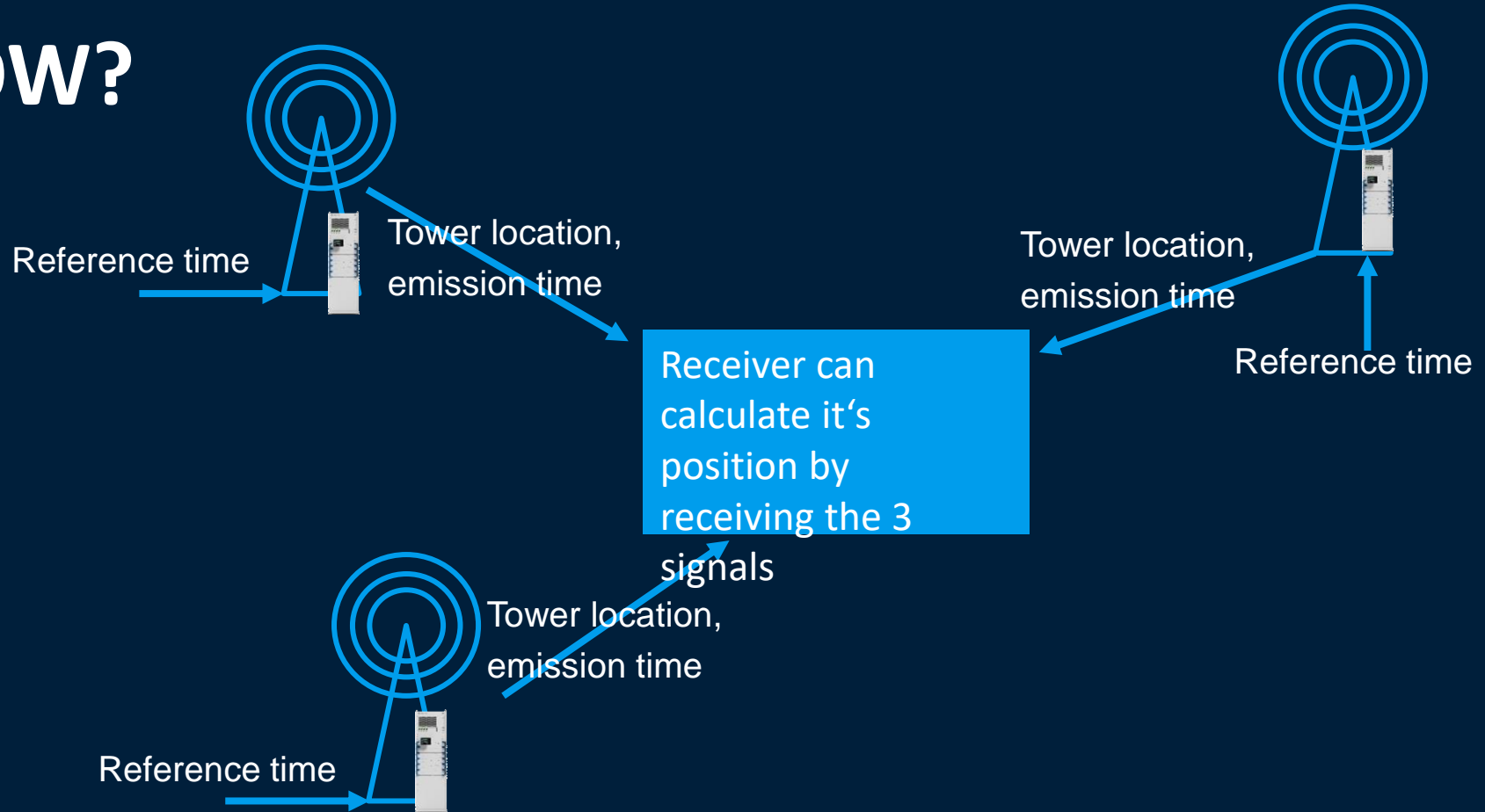
100 ns, 95 % of the time

- ▶ Three TV towers can provide both time and position estimation

100 m average accuracy expected



HOW?



5G BROADCAST PNT AS A SOLUTION

- ▶ Can meet timing requirements of Critical infrastructure
- ▶ Broadcast Network already built
- ▶ Based on global 3GPP standard
- ▶ Nationwide coverage in place but to be extended
- ▶ Works in receive only mode (no uplink)
- ▶ Resilient in case of disaster
- ▶ Spoofing and Jamming resistant



R&S 5G BROADCAST FOR PNT

- ▶ Use existing TV broadcasting infrastructure for timing and navigation

- ▶ UHF band (~470-698 MHz)
- ▶ typ. ~10-100 kW ERP



- ▶ Use of worldwide 5G Broadcast standard

- ▶ UTC timestamp and positioning features available
- ▶ Easy integration in 5G chipsets for mass-market receivers
- ▶ Minimal overhead for navigation and timing, majority remains for broadcasting



- ▶ Minor upgrade for existing R&S TV transmitters



5G BROADCAST: PNT TEST

The screenshot shows the ESA NAVISP website. At the top, it says 'EUROPEAN SPACE AGENCY' and 'DELEGATIONS SIGN IN'. The main header features the 'navisp' logo with the tagline 'ESA ENGAGEMENT WITH PNT SECTORS: THE NAVISP PROGRAMME, A KEY ENABLER FOR INNOVATION AND COMPETITIVENESS' and the ESA logo. A navigation bar includes links for HOME, THE PROGRAMME, OPPORTUNITIES, PROJECTS, ACTORS INVOLVED, EVENTS, and MORE. Below the navigation bar is a row of flags representing various countries. The main content area displays a project titled 'RESILIENT PNT BASED ON 5G BROADCAST' with a thumbnail image of a radio tower on a hill. The project details are as follows:

- Status:** On Going
- Activity Code:** NAVISP-EL2-112
- Start date:** 01/10/2022
- Duration:** 14 Months

The project description states: 'Global Navigation Satellite Systems, like Galileo and GPS are the backbone for position and timing in many industries today. An extended service outage of 5 days, which might be invoked by (intentional and unintentional) man-made or natural effects could cause multi-billion losses for the economy, e.g. by blocking port operations, disrupting telecommunication networks or stopping financial transactions. Several administrations, i.e. the European Union, the United Kingdom, South Korea and the United States identified this threat and are actively searching for backup solutions. In this project Rohde & Schwarz develops a demonstrator of a GNSS-backup system based on using the existing terrestrial TV/Radio transmitters by improving the synchronization between transmitters, adding special positioning reference signals, the UTC time and the transmitter locations to the signals of the 5G broadcast transmission. These transmitted signals need no longer be considered a "signal-of-opportunity", but become fully functional navigation signals.'

PRIME CONTRACTOR

- Name:** Rohde & Schwarz GmbH & Co. KG
- Country:** Germany
- Website:** <https://www.rohde-schwarz.com/>

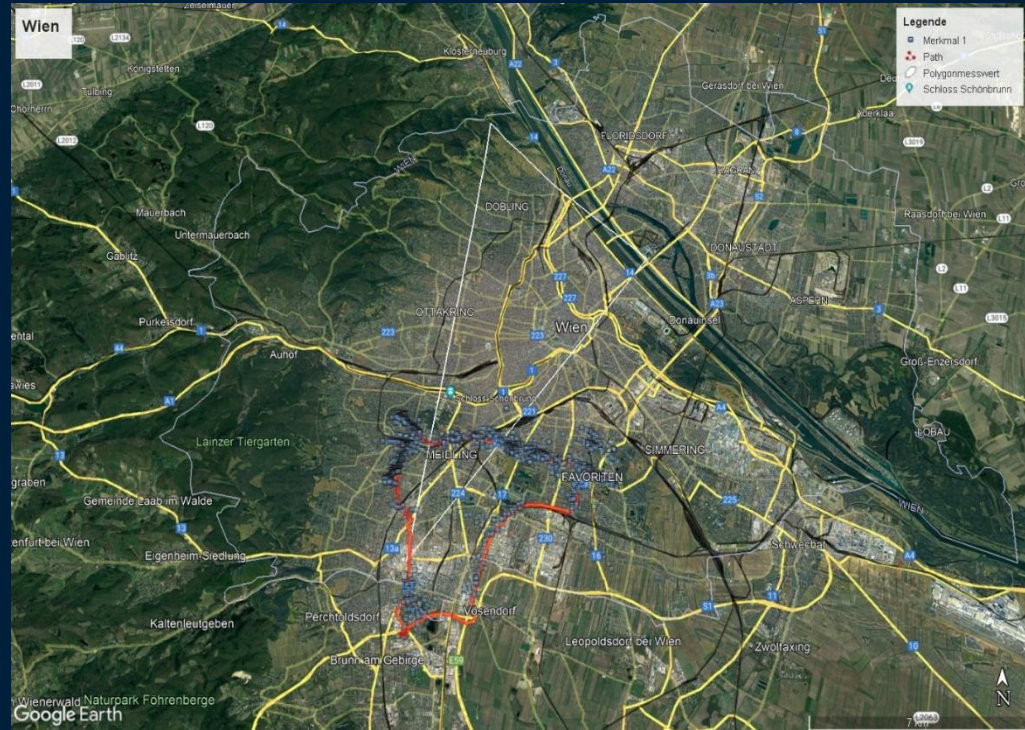
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FIELD TESTS – VIENNA TEST BED



3 HPHT SITES FROM ORS IN VIENNA:

- ✓ TX1: KAHLENBERG, 40 KW ERP
- ✓ TX2: DC TOWER, 10 KW ERP
- ✓ TX3: LIESING, 10 KW ERP
- ✓ UHF BAND 666 MHZ
- ✓ 5 MHZ BANDWIDTH



5G BROADCAST AS PNT: BENEFITS



Enhance & complement GNSS as back-up in case of Jamming/spoofing conditions



PNT to be provided independently of network conditions



SIM-Free reception of real-time positioning information (i.e. Cars, Trucks, Buses, etc)



Free-to-Air and Receive-Only-Mode allow more flexibility



High reliable and robust system: cost effective with National coverage



Leveraging UHF band for terrestrial broadcasting of Public Services



Very low TCO vs other similar solutions

Rohde & Schwarz

Experts of 5G technology
Experts of Broadcasting technology

