FINAL RESULTS FROM THE DINPAS PROJECT

NKG WG GNSS & POSITIONING, HELSINKI, 4-5 MARCH 2025

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REMINDER OF THE PROJECT CONCEPT

DINPAS

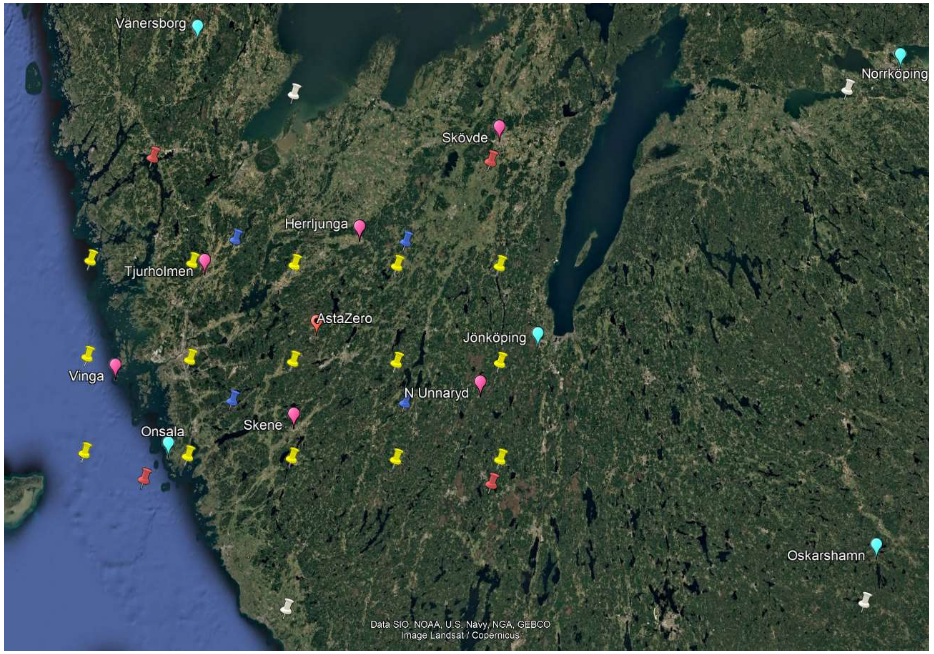
The **DINPAS** project will:

- Implement GNSMART software from Geo++ for generating SSR corrections from a set of reference stations at Lantmäteriet/SWEPOS.
- Analyze design aspects of reference station network for generating SSR corrections and grid design for distribution of corrections.
- Implement GNSS SSR provisioning by converting SSR correction data to the 3GPP Release 16 format in an Ericsson distribution platform prototype and support for 3GPP format in a GNSS receiver by u-blox.
- Evaluate GNSS positioning and timing performance with correction data based on the 3GPP format in relevant autonomous airport related use cases using the reference framework at AstaZero test track.

FINAL TESTS ON ASTA ZERO

DINPAS

- Test of SSR measurements using corrections according to 3GPP Rel. 16 standard including atmospheric corrections using different reference station network and grid settings
- Density of reference stations:
  - 70 km
  - 200 km
- Grid density lat, lon:
  - Dense 0.3°, 0.6°
  - Medium 0.5°, 1.0°
  - Sparse 1.0°, 2.0°
  - Extra sparse 1.6°, 3.2°



- Test scenarios with three receivers using different combinations of SSR and one receiver OSR for 5 min static + 5 min dynamic

LANTMÄTERIET

DINPAS

TEST SETUP

GNSS equipment with 4 receivers connected to the same antenna mounted at the far end of a beam.

The beam is attached at the other end via a rotatable attachment to a fixed point with known coordinates in the middle of a roundabout.

The beam is driven around the roundabout by an electric skateboard.

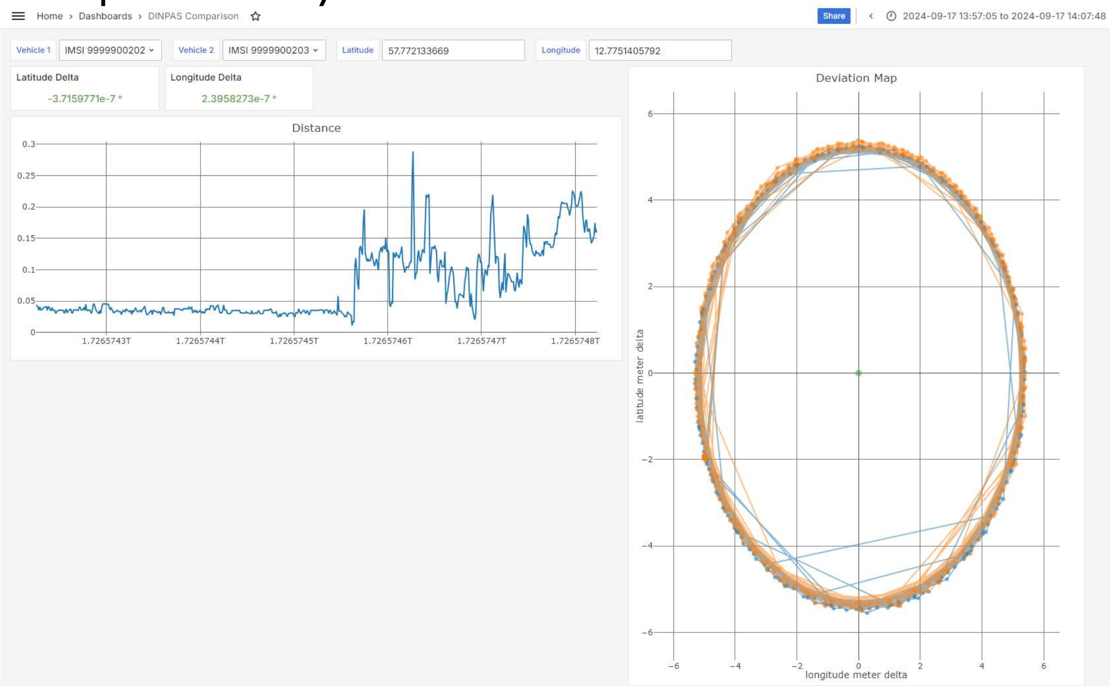
At the fixed point in the roundabout, a total station is located, simultaneously with the GNSS measurements, measuring the distance to the prism under the antenna at the far end of the beam.

The total station's distance is compared with the calculated GNSS vector distance to the fixed point to evaluate the quality of the GNSS position.

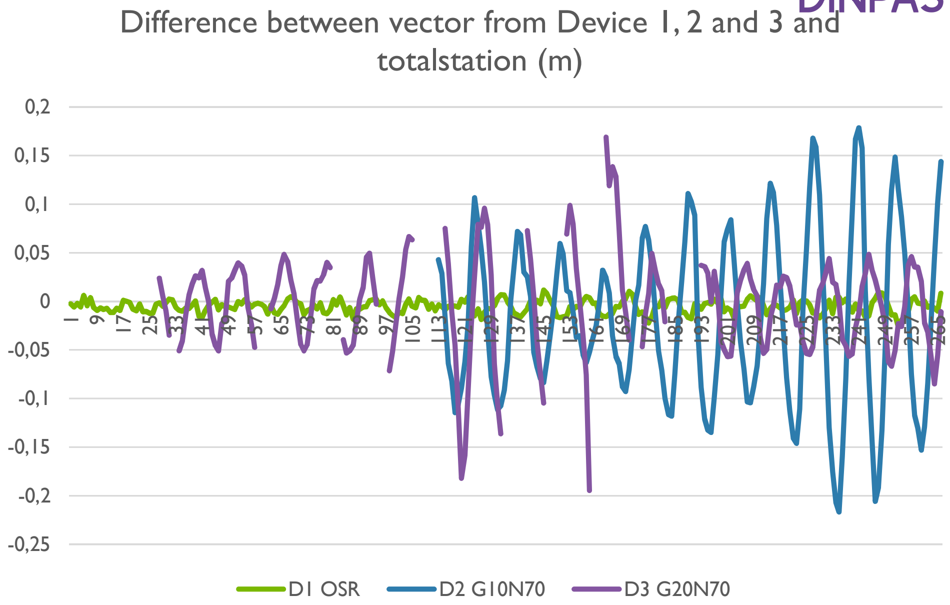
VIDEO OF THE SKATEBOARD IN ACTION

EXAMPLE OF RESULTS

Unfortunately very few fixed solutions during this test campaign and not so much data to draw conclusions from. High ionospheric activity?



Difference between Device 2 (orange, G10N70) and Device 3 (blue, G20N70) during Test #1.



Difference between mean vale of total station measurements to prism and the computed GNSS vector for all GNSS fixed solutions with Device 1 (OSR), Device 2 (G10N70) and Device 3 (G20N70) during Test #1.

GENERAL CONCLUSIONS FROM THE PROJECT (1)

For the different network and grid settings:

- Good results with fixed solution during certain periods for all tested grid and network configurations.
- For measurements during the same time, denser grid and network tend to give better results.
- Results varies a lot between different test periods, so difficult to draw sharp conclusions.
- The time to obtain fixed solution varies a lot between different test periods, so difficult to draw sharp conclusions.
- Total station for evaluating a GNSS trajectory works well in post-processing, but the clock and time synchronization limits the evaluation of dynamic positioning at a specific location and time along the trajectory.

GENERAL CONCLUSIONS FROM THE PROJECT (2)

The DINPAS solution has the potential for <1 dm standard uncertainty and RMS for both plane and height coordinates under favorable receiver conditions.

However…

- The fix solutions occasionally have systematic deviations from known coordinates at the decimeter – several meter level.
- Fix solutions are not maintained but are lost or not reached for significant parts of the time. Manual restart of the device is often required after a lost fix solution.
- Two identical devices with identical input data can give completely different solutions.
- The devices have big problems getting a fix solution in complex environments, such as interrupted line of sight to the satellite or high ionosphere activity.
- The standard uncertainty seems to grow in dynamic compared to static mode, but the evaluation methods of dynamic measurements needs to be developed.
- The LTE communication that delivers corrections via mobile networks can be a limiting factor when flying at higher altitudes (>100 m?)

RESULTS FROM STUDENT THESIS TESTING GALILEO HAS

NKG WG GNSS & POSITIONING, HELSINKI, 4-5 MARCH 2025

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WORKING APPROACH

Goals for Galileo HAS service at Service Level 2:

- Accuracy in plane of < 2 dm and height < 4 dm (95% confidence level)
- Convergence time of < 100 seconds.
- During spring 2024 only Galileo HAS Service Level 1 available which means no phase biases

Test setup:

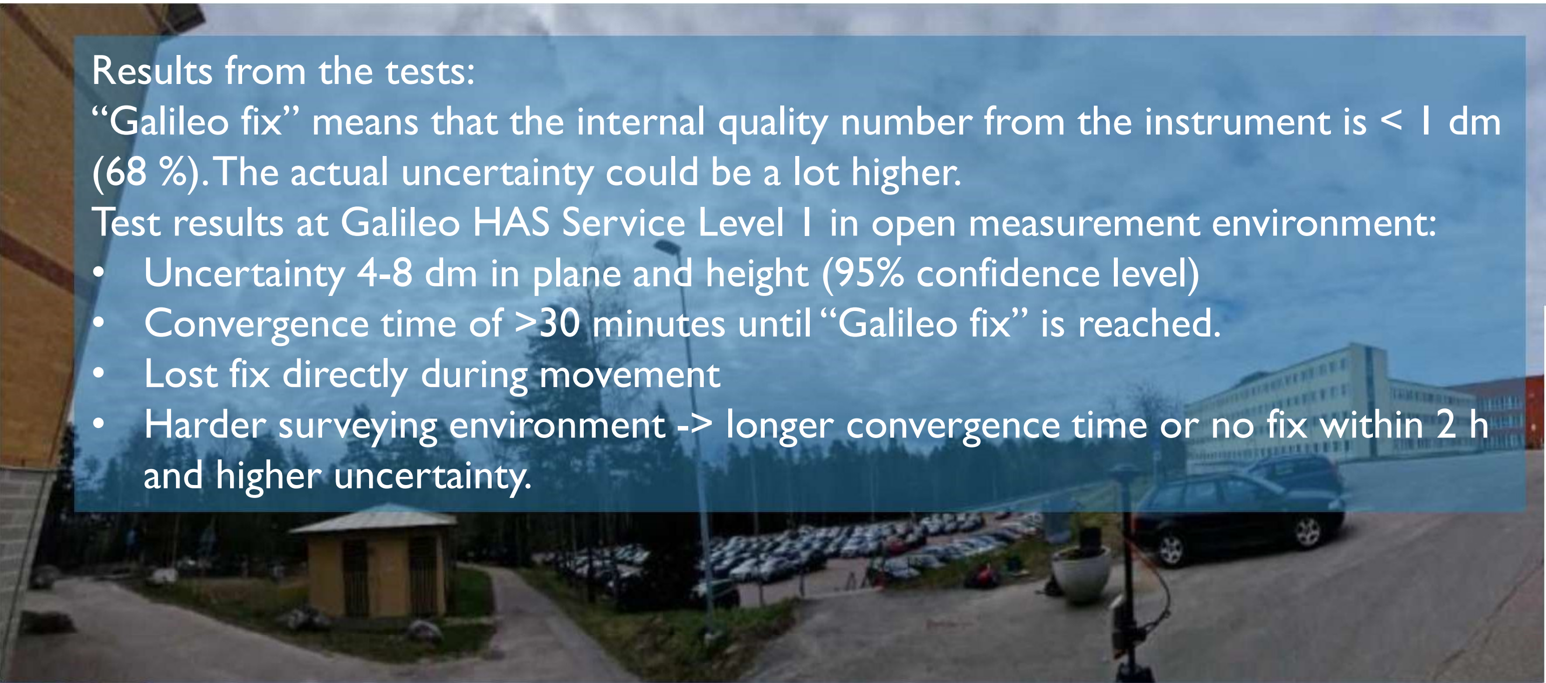
- Arrow Gold+ receiver
- Repeated static 2 h measurements in different urban surveying environment
- Detail measurements after static measurements in nearby area

Results from the tests:

"Galileo fix" means that the internal quality number from the instrument is < 1 dm (68 %). The actual uncertainty could be a lot higher.

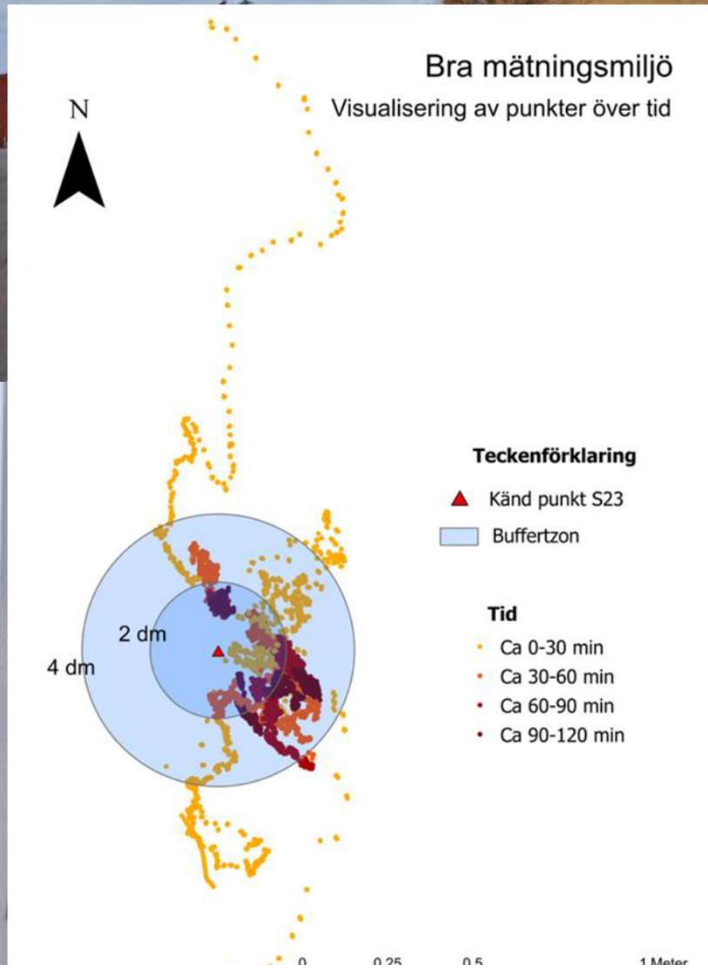
Test results at Galileo HAS Service Level 1 in open measurement environment:

- Uncertainty 4-8 dm in plane and height (95% confidence level)
- Convergence time of >30 minutes until "Galileo fix" is reached.
- Lost fix directly during movement
- Harder surveying environment -> longer convergence time or no fix within 2 h and higher uncertainty.



Conclusions:

- Galileo HAS at Service Level 1 (with this receiver) is not useful for production measurements due to long convergence time and lost fix when start moving.
- New tests would be desirable when Service Level 2 is launched.
- Results agrees with the results presented from other test of Galileo HAS using this receiver in NKG Science Week last year.



TACK! VI FINNS PÅ…

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