

# DANGO

## Danish National Galileo Overlay

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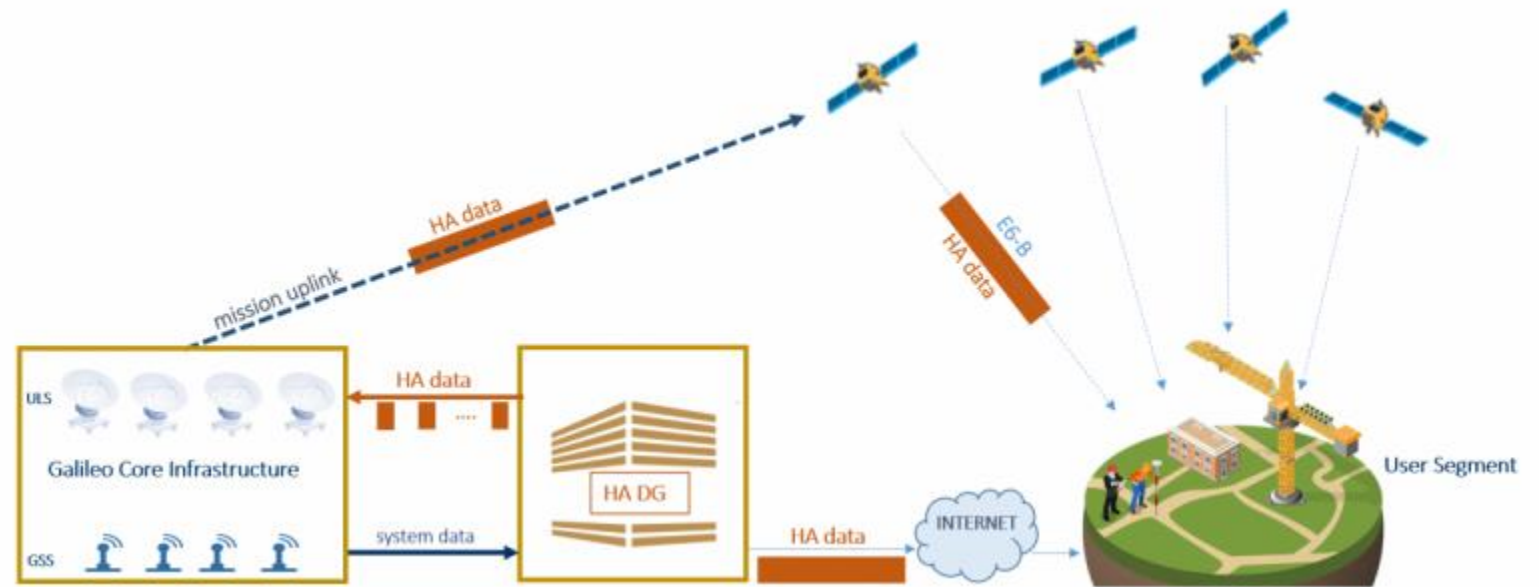


# Galileo High Accuracy Service (HAS)

- Free high accuracy PPP corrections (decimeter level).
- Provided through the Galileo signal E6-B (Signal-In-Space) and through terrestrial means (Internet Data Distribution).
- Galileo HAS uses the GTRF (Galileo Terrestrial Reference Frame).
- Target coordinates are in ETRS89DK, so there is a need for transformations.

	Service Level 1 (SL1)	Service Level 2 (SL2)
Coverage	Global	European Coverage Area (ECA)
Corrections	Orbit, clock, biases (code and phase)	Orbit, clock, biases (code and phase) + atmospheric corrections
Horizontal Accuracy (95%)	<20cm	<20cm
Vertical Accuracy (95%)	<40cm	<40cm
Converge Time	<300s	<100s
Availability	99%	99%
User HelpDesk	24/7	24/7

Target performances for Galileo HAS Service Level 1 (SL1) and Service Level 2 (SL2).



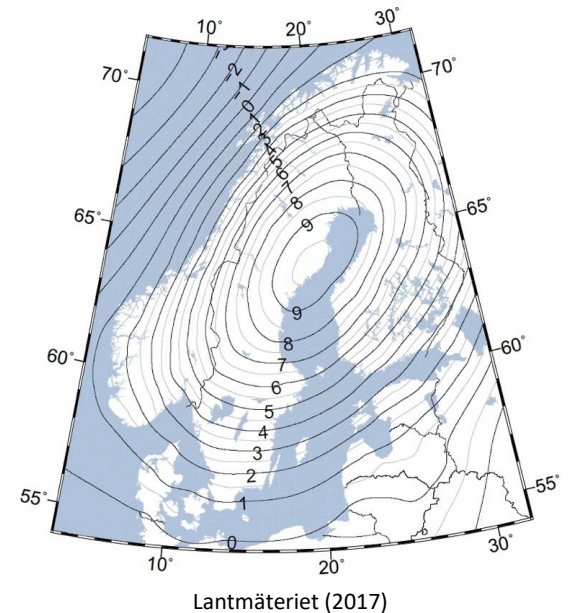
Galileo system elements involved in the generation, provision and exploitation of Galileo HAS.

# DANGO for CRS transformations

- Up-take of Galileo PNT services through national GNSS.
- PPP corrections are estimated in the global geodetic reference frame.
- Service for position transformations from GTRF to the Danish ETRS89(DK).

GTRF19v1(2020.5) => ITRF2014(2020.5) => ITRF92(2020.5) => ETRF92(2020.5) => ETRF92(1994.704)  
 ~ ETRS89(DK)

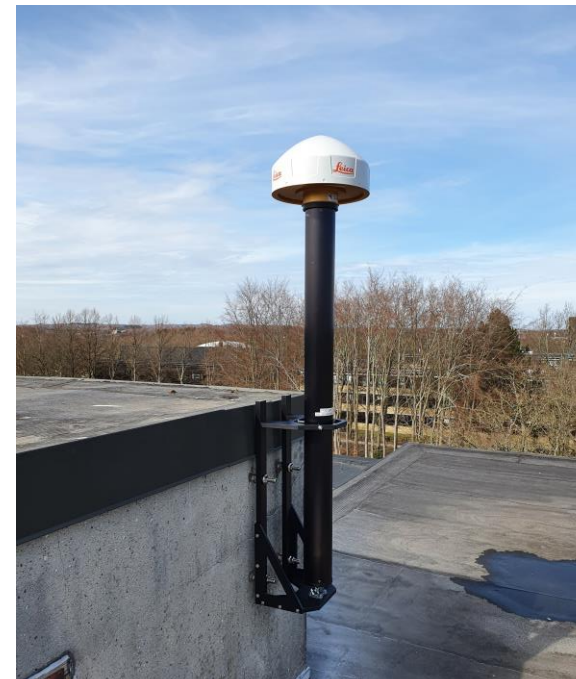
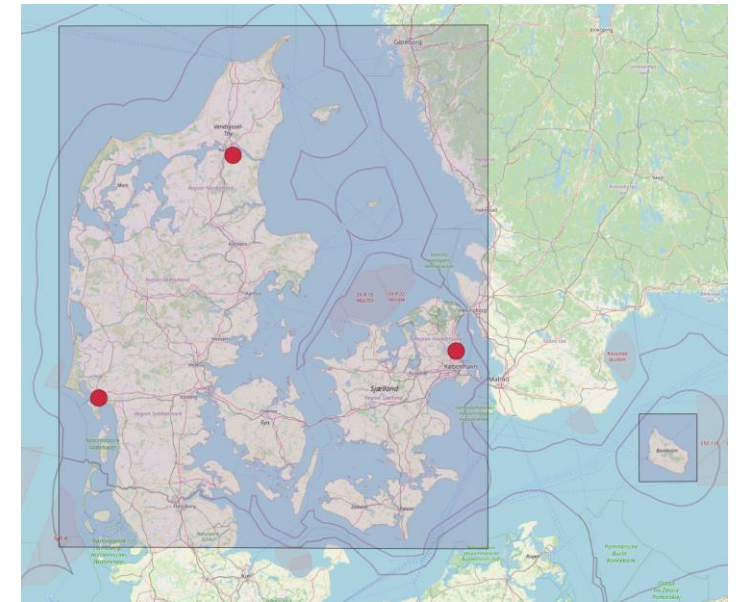
- GTRF is closely alligned to ITRF.
- Chain of transformation that includes the intraplate motion.
- Difference between GTRF and the Danish national system is ~70 cm.
- Expected station movement per year: ~2.5 cm.



# DANGO CORS

Establishment of three permanent CORS in Lyngby, Esbjerg and Aalborg.

- Independent data in ITRS and ETRS89DK.
- Stations are consisting of LeicaAR20 antennas and Septentrio PolaRX5S receivers.
- The data from the stations will be used for derivation of the Helmert transformation parameters.



# DANGO dissemination system

- Originally, open standards like NTRIP and RTCM were planned to be used for dissemination of the Helmert parameters for transformations from ITRS to ETRS89(DK).
- RTCM messages:
  - 1021 – Helmert / Abridged Molodenski Transformation Parameters
  - 1023 – Residuals, Ellipsoidal Grid Representation
  - However, these are not found in actual use.



**1021**

**Helmert / Abridged Molodenski Transformation Parameters**

A classical Helmert 7-parameter coordinate transformation message. Not often found in actual use.

**1023**

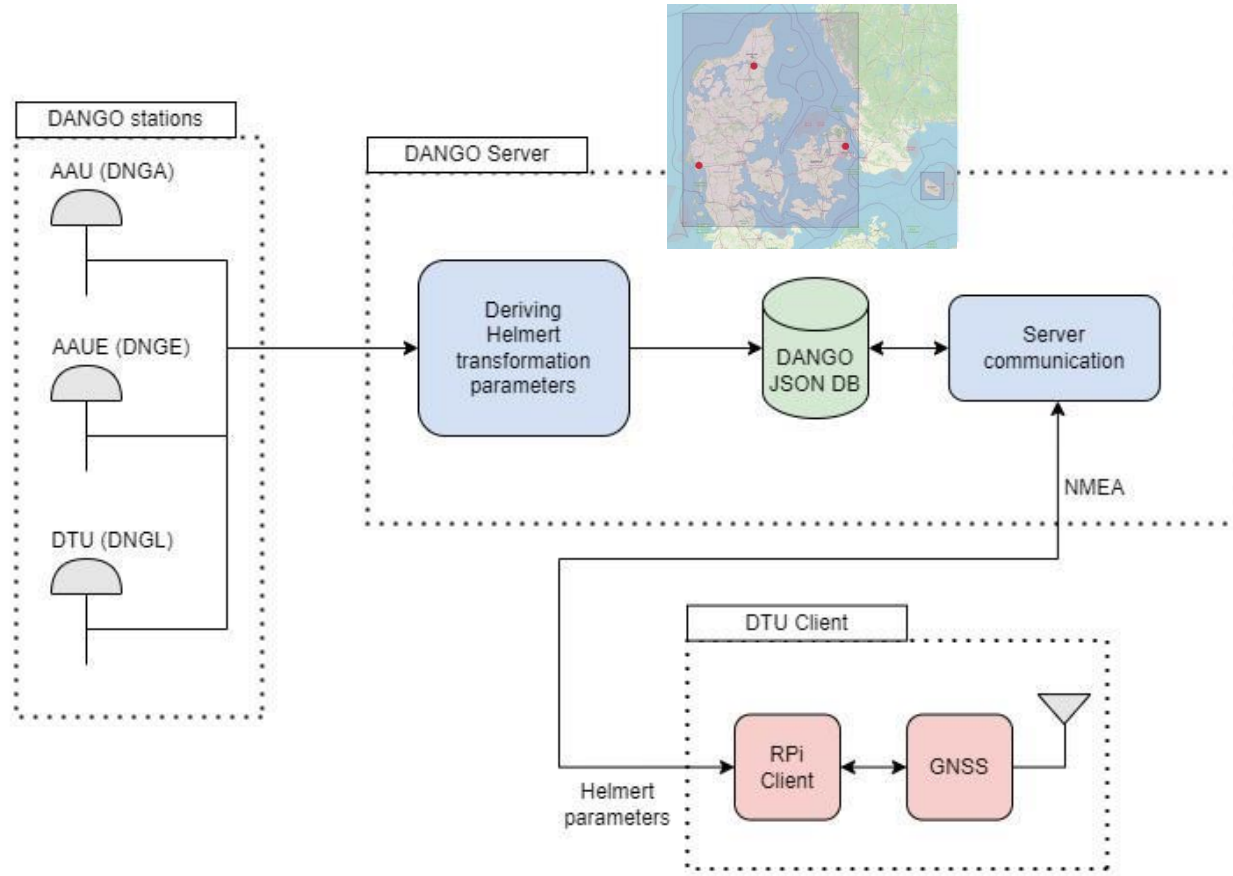
**Residuals, Ellipsoidal Grid Representation**

A coordinate transformation message. Not often found in actual use.

- According to SNIP, these messages are not implemented for receivers.
- Therefore, a de-risked strategy for disseminating parameters was proposed: TCP/IP system.



# TCP/IP dissemination prototype



## Future DANGO goals

- Static and kinematic in-situ tests.
- Disseminating geoid heights together with Helmert parameters.
- Subregion definitions.

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