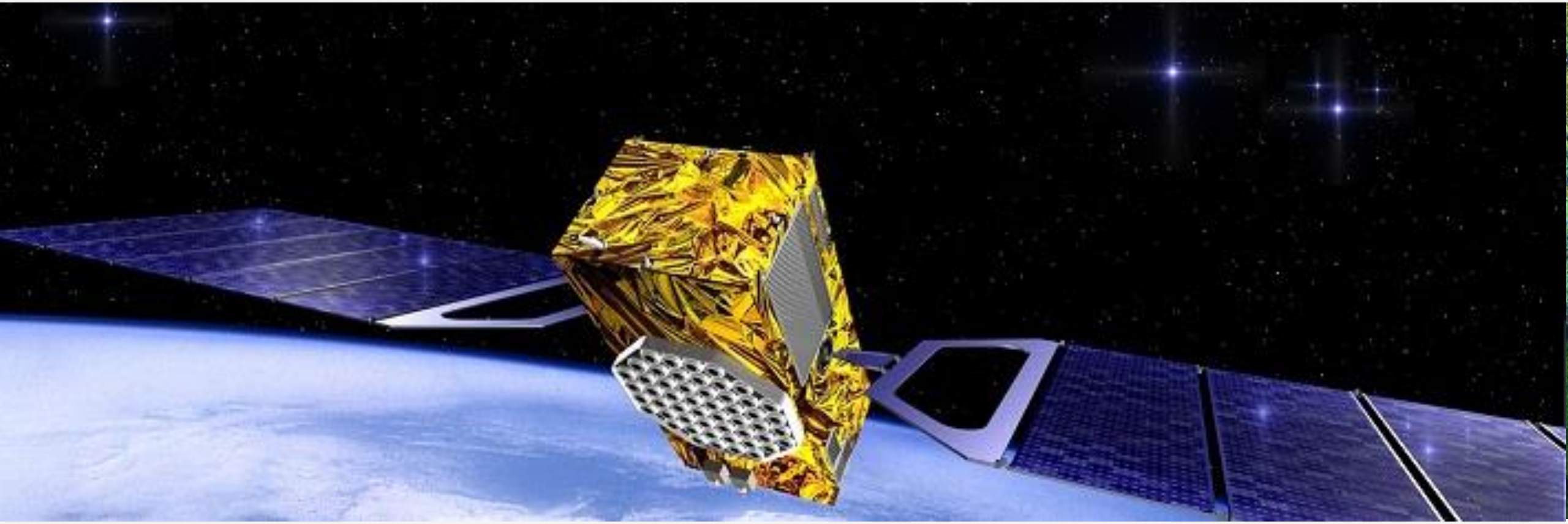
Galileo High Accuracy Service (HAS) performance

Michael Dähnn

Reykjavik, 13.03.2024



Kartverket

Part I

Background

Kartverket

Galileo services

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Galileo services

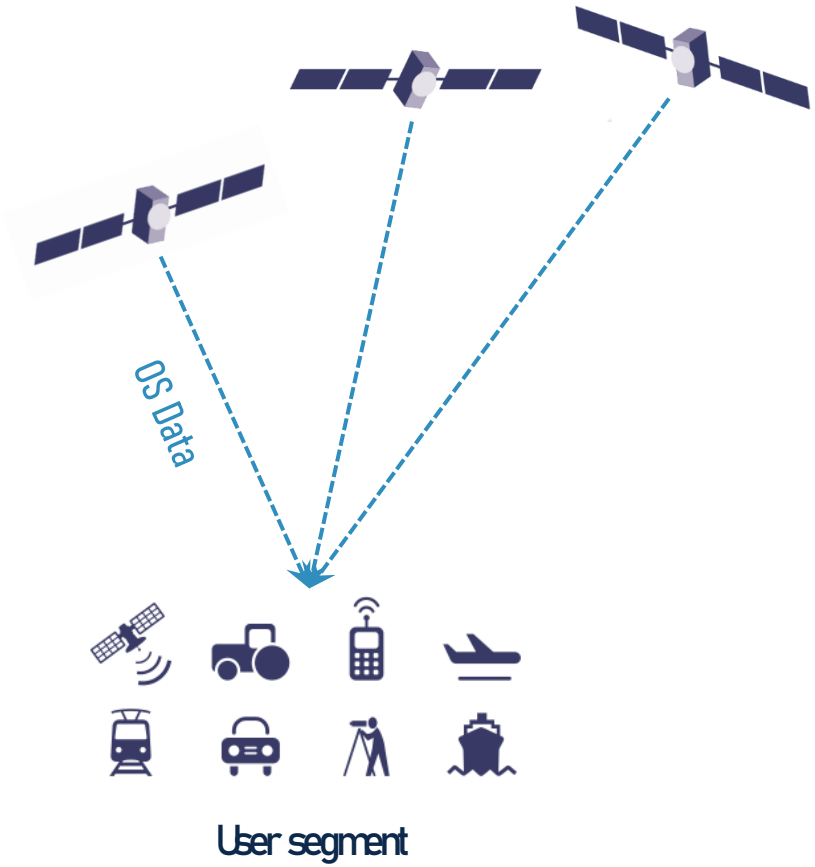
Kartverket

What is Galileo HAS?

- Galileo High Accuracy Service (HAS) is high-precision positioning service
- Established by European Commission
- Decimeter level positioning accuracy target (Horizontal: 20 cm, Vertical: 40 cm)
- Galileo HAS delivers correction data for Galileo Open Service (OS) and GPS Standard Positioning System (SPS)
- A real-time service, which is globally available, free of charge and its data delivery is based on open formats
- Available for an unlimited number of users

Kartverket

Galileo HAS architecture



Source: Based on Galileo HAS Info note.

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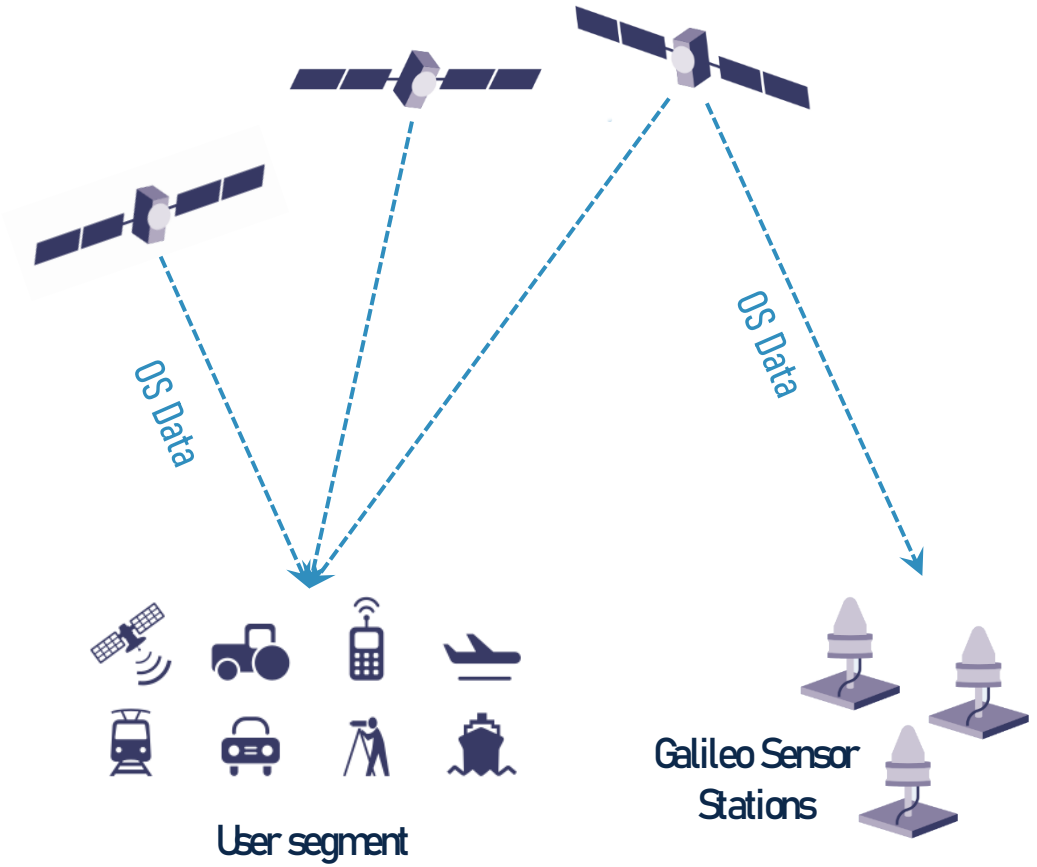

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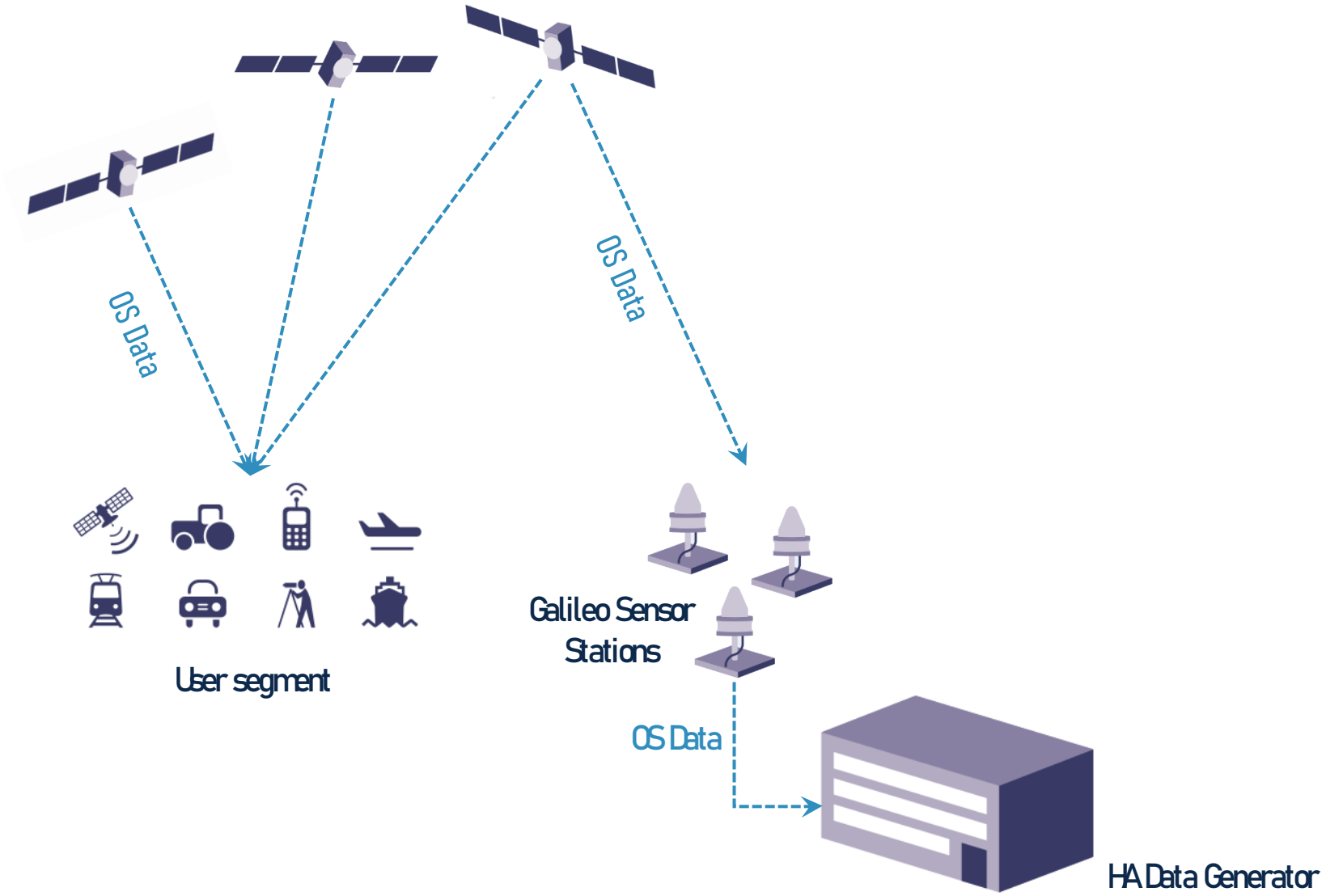

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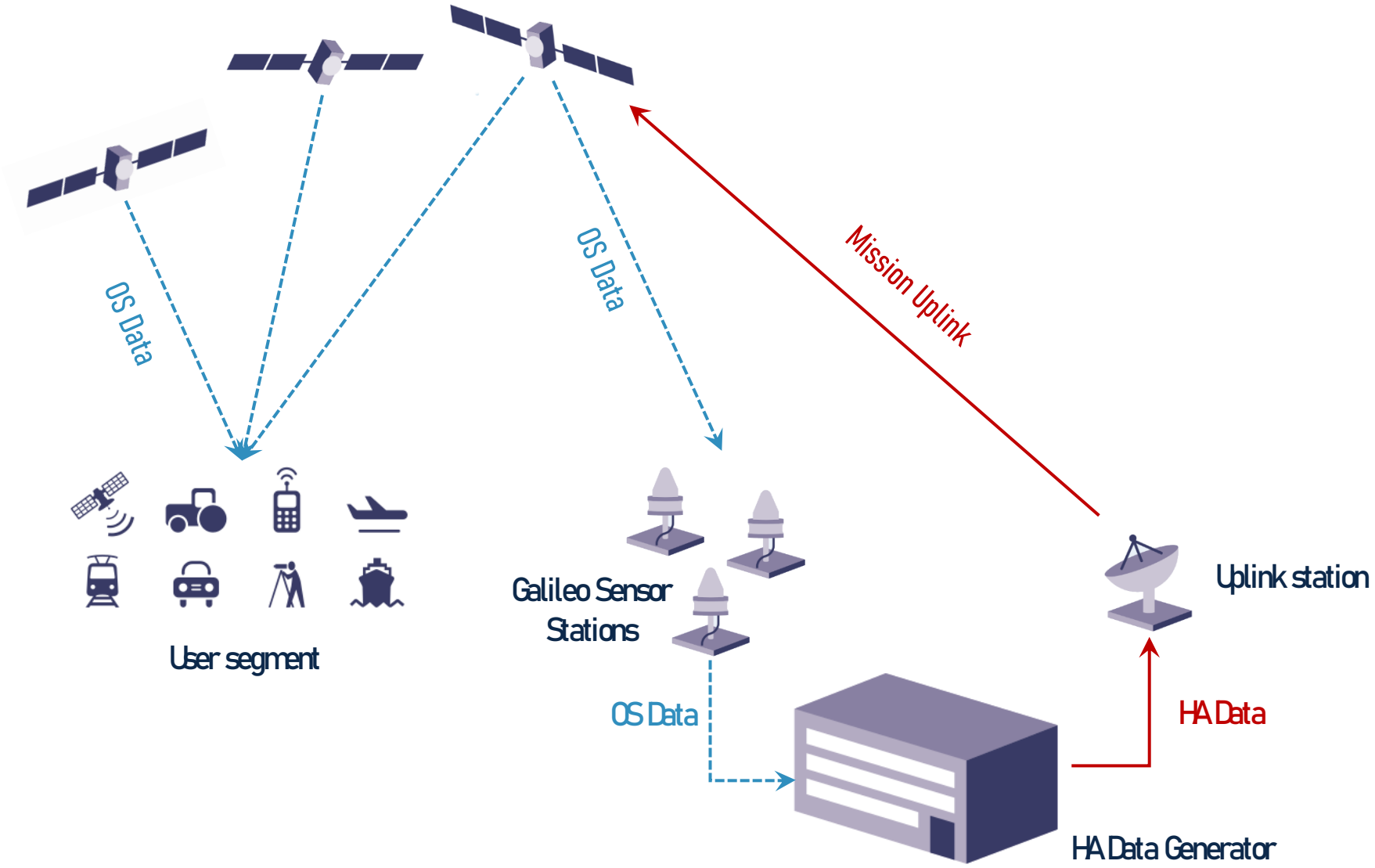

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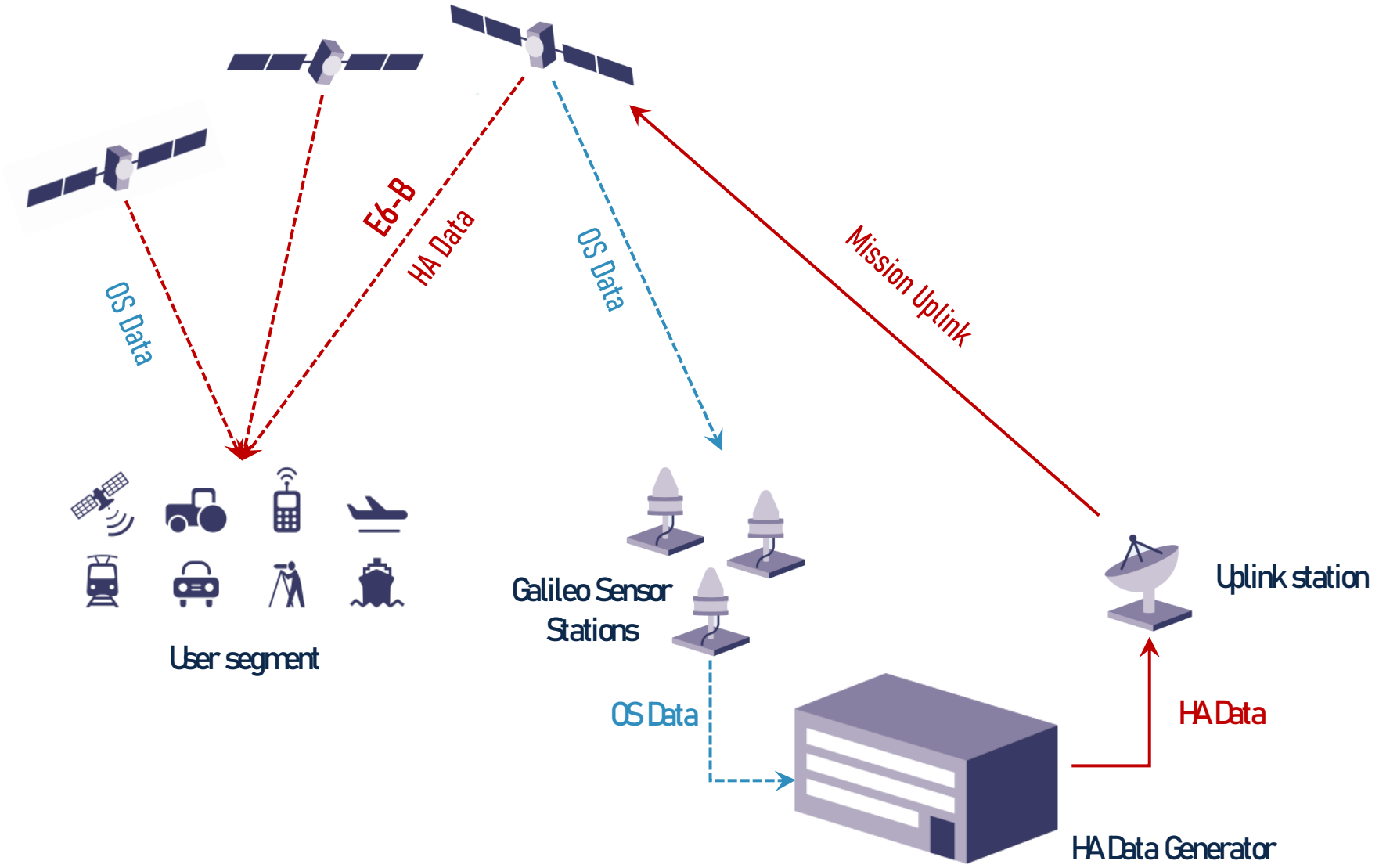

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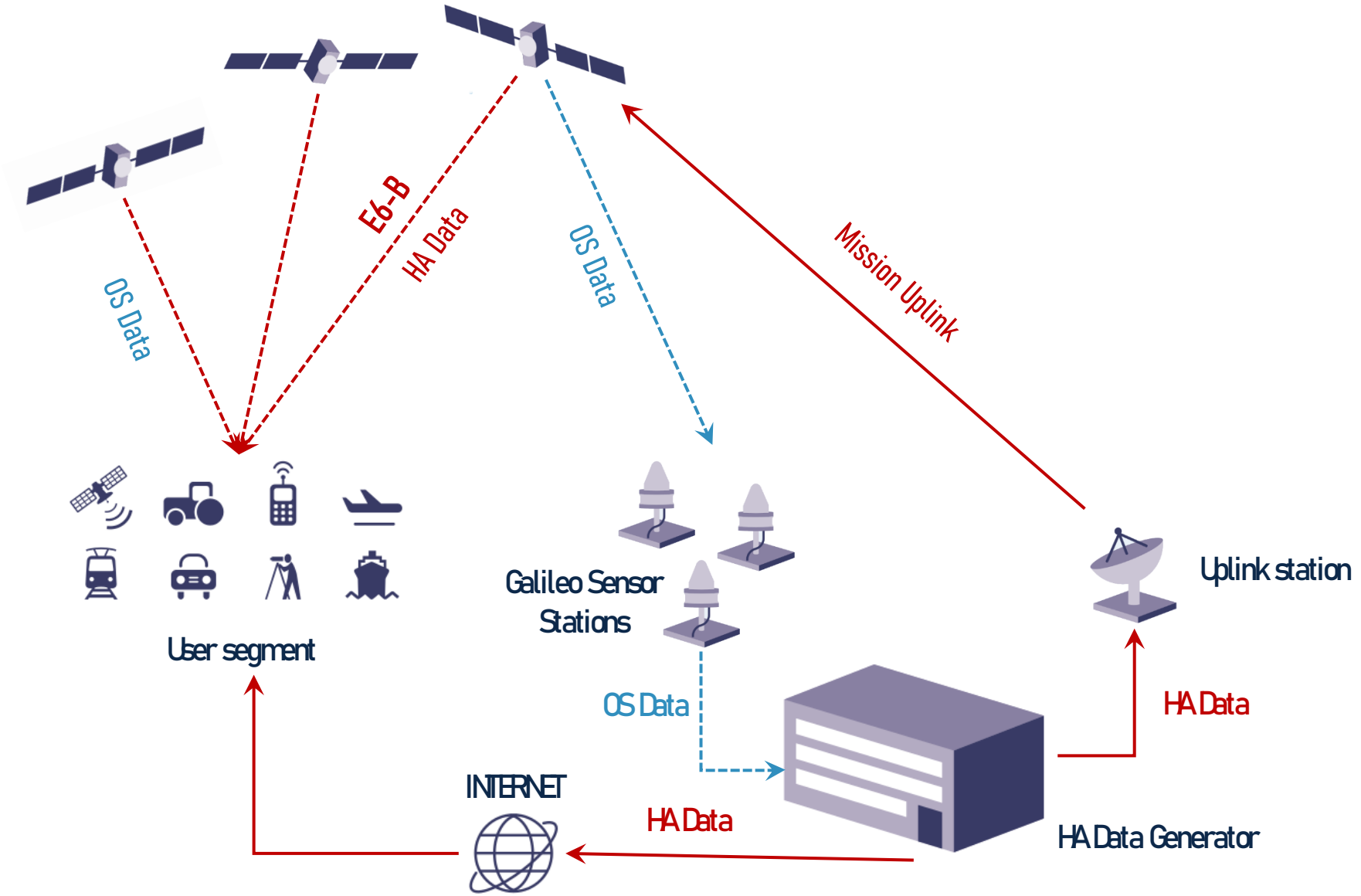

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How works Galileo HAS?

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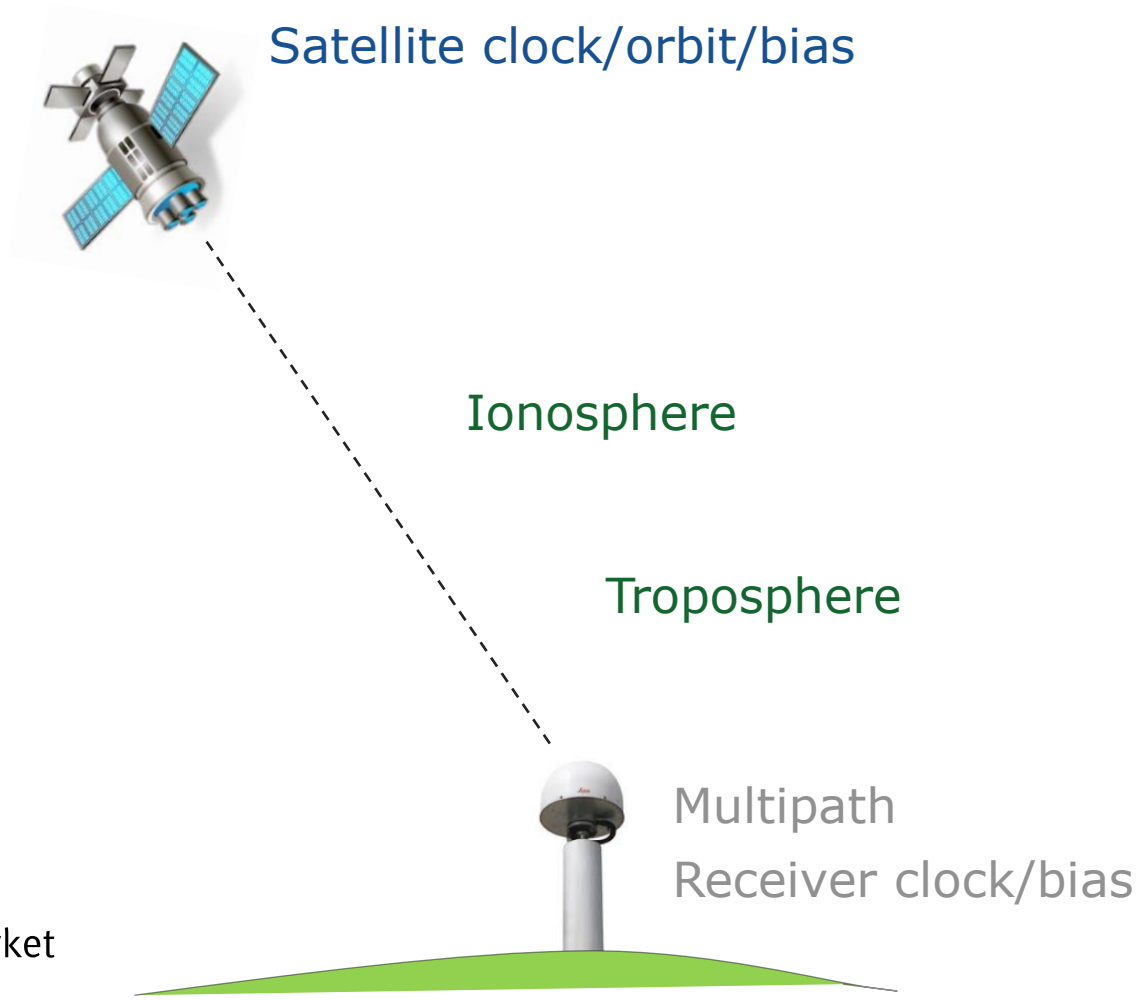


Kartverket

How works Galileo HAS?

Satellite clock/orbit/bias

global

Ionosphere

regional

Troposphere

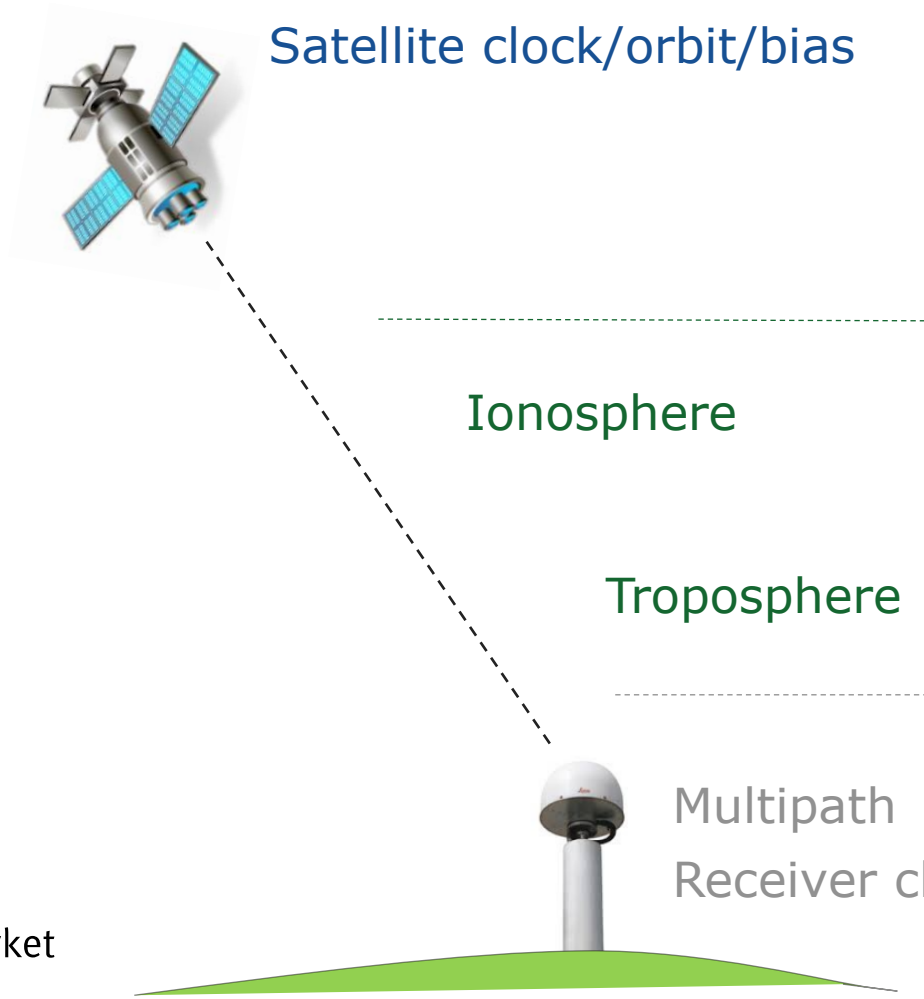
local

Multipath

Receiver clock/bias

Kartverket

How works Galileo HAS?



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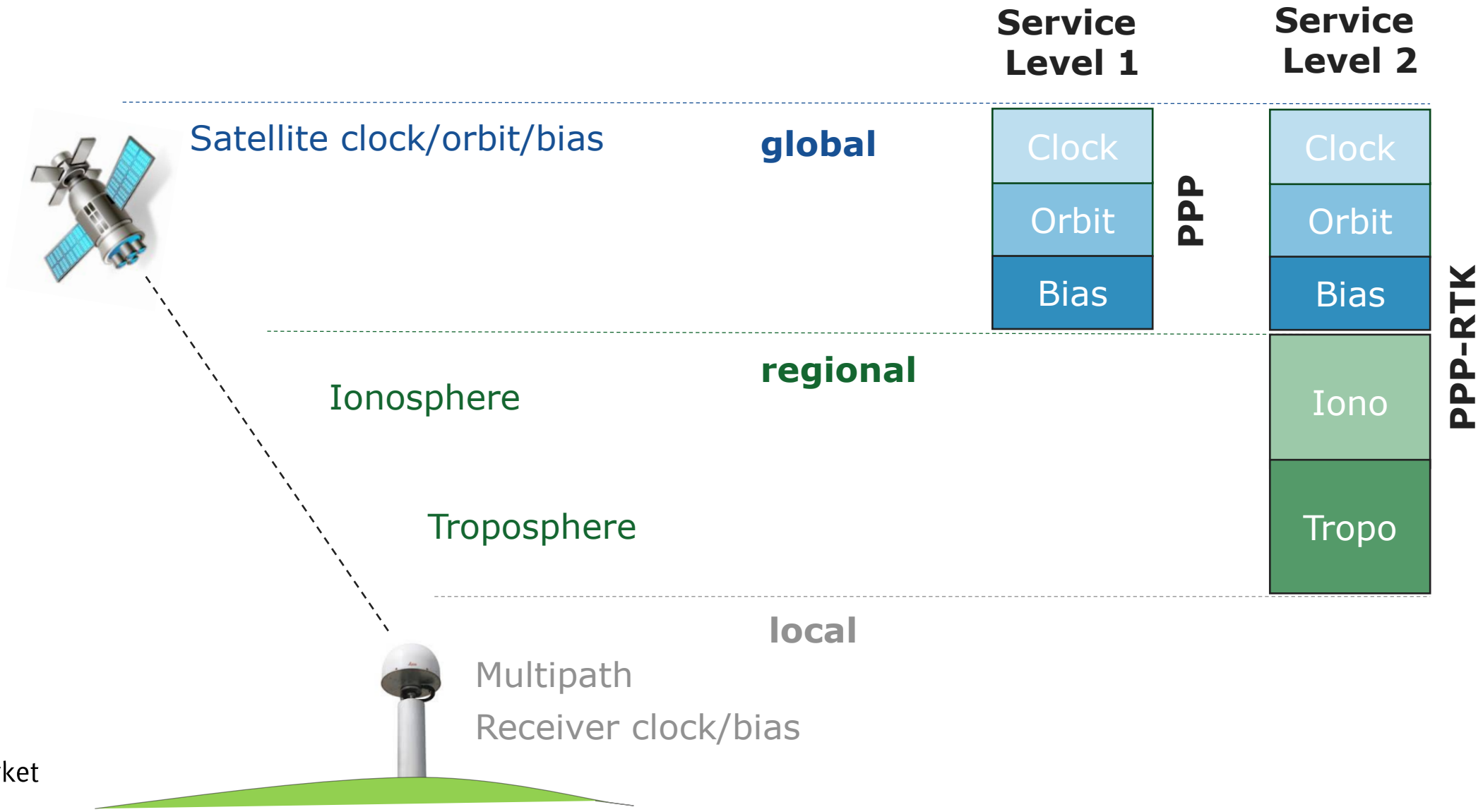

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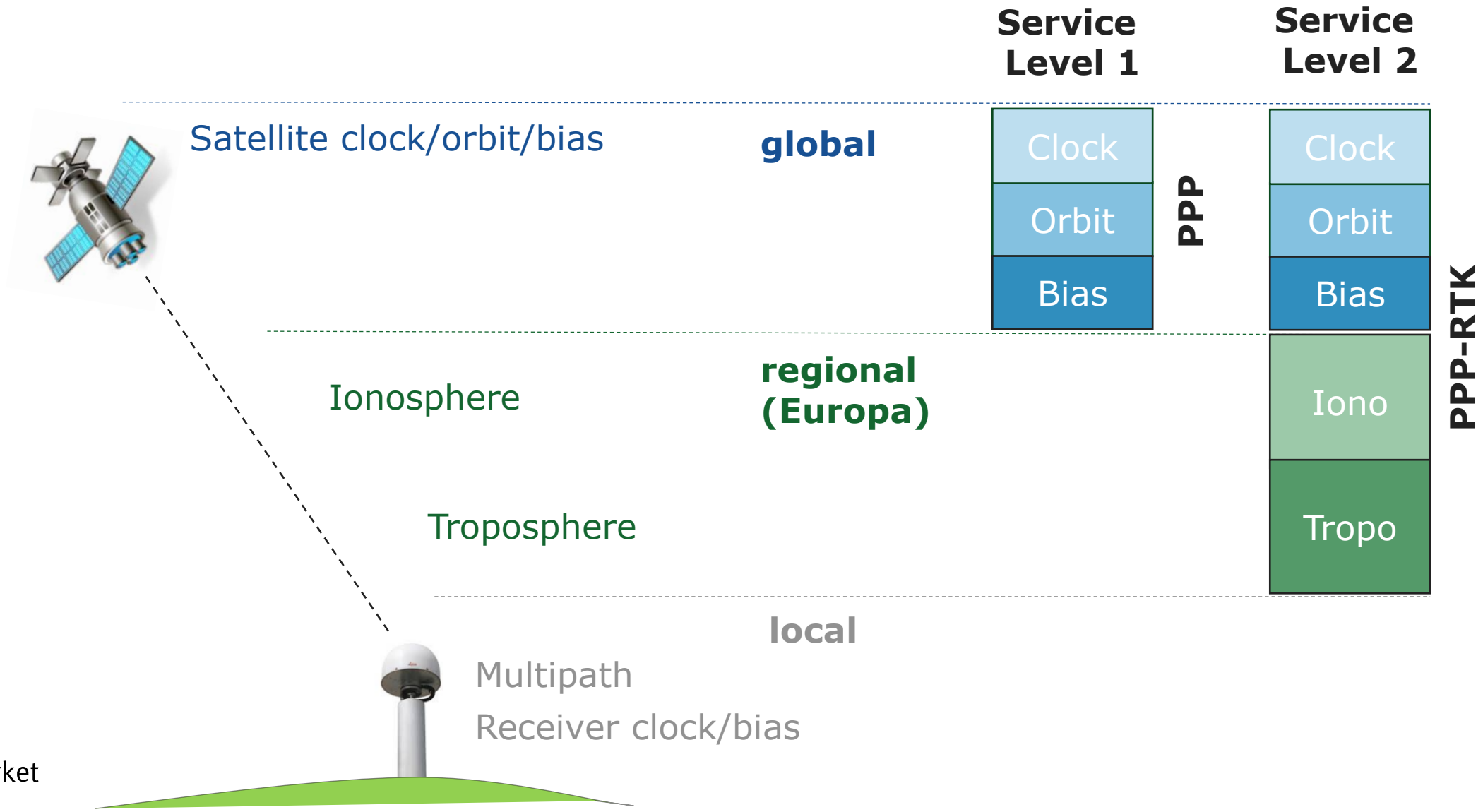

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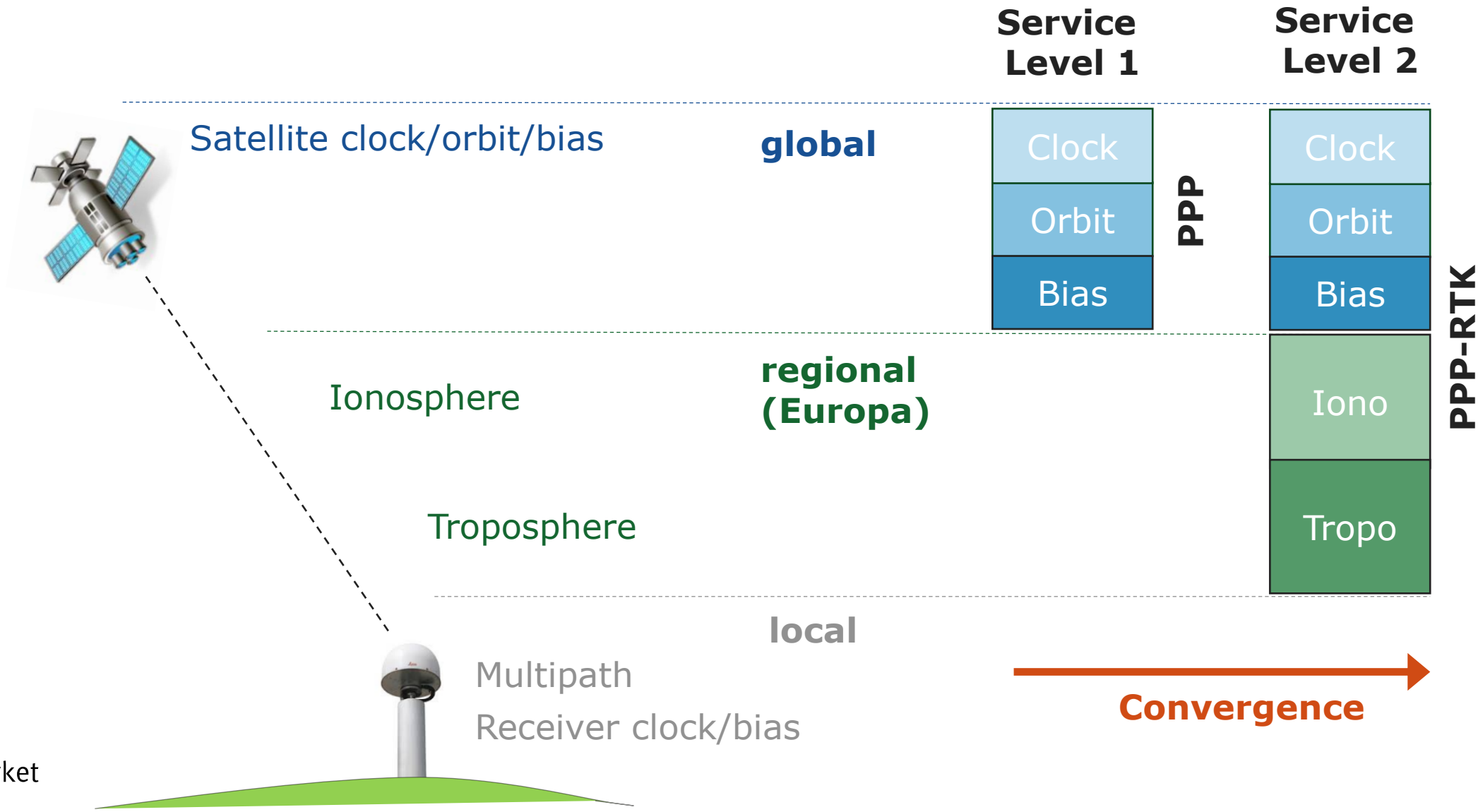

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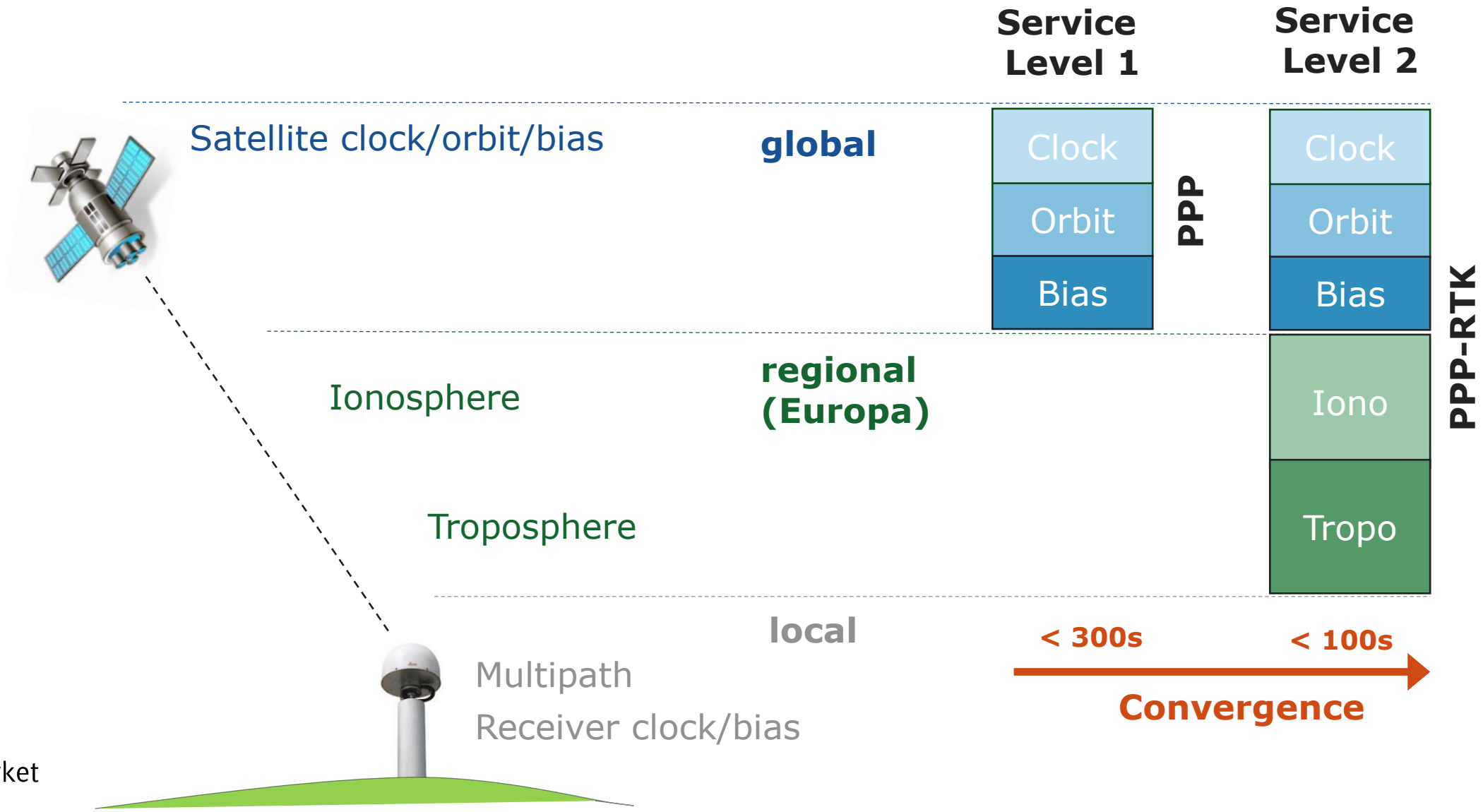

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User of Galileo HAS

Source: Galileo HAS Info note.

Kartverket

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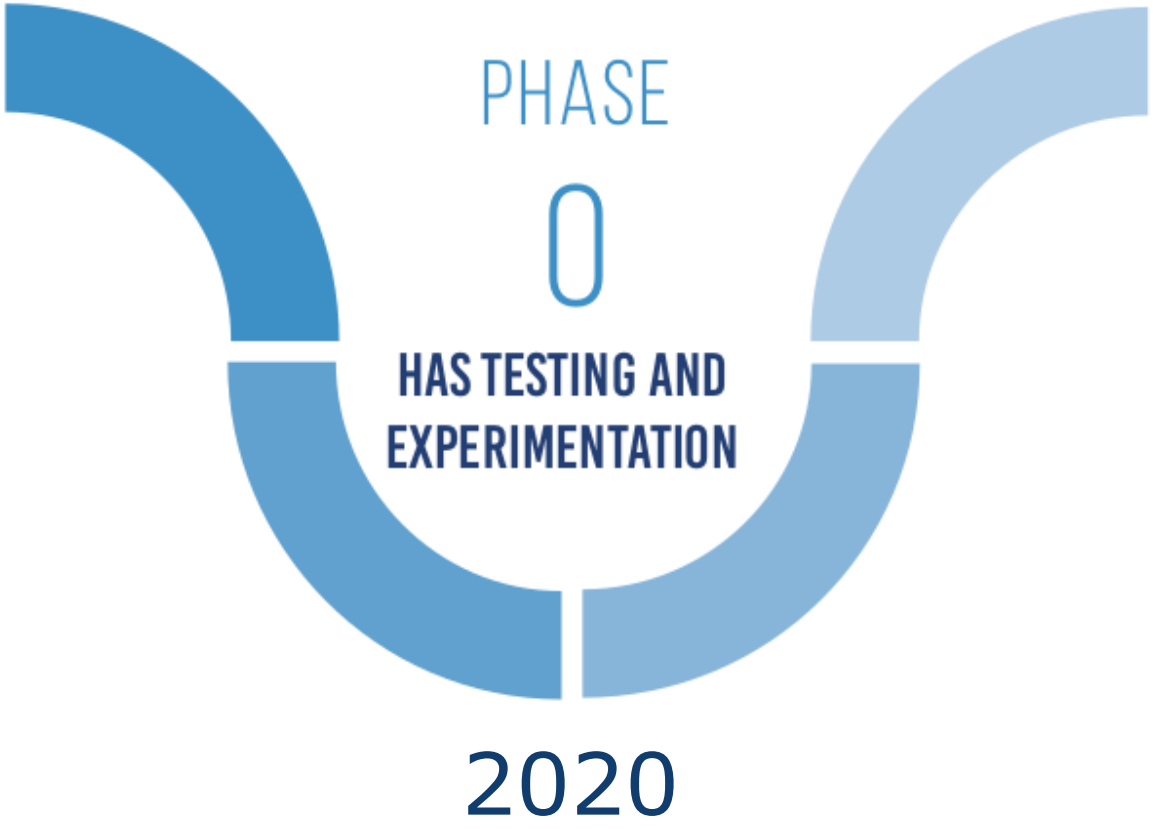
Galileo HAS roadmap



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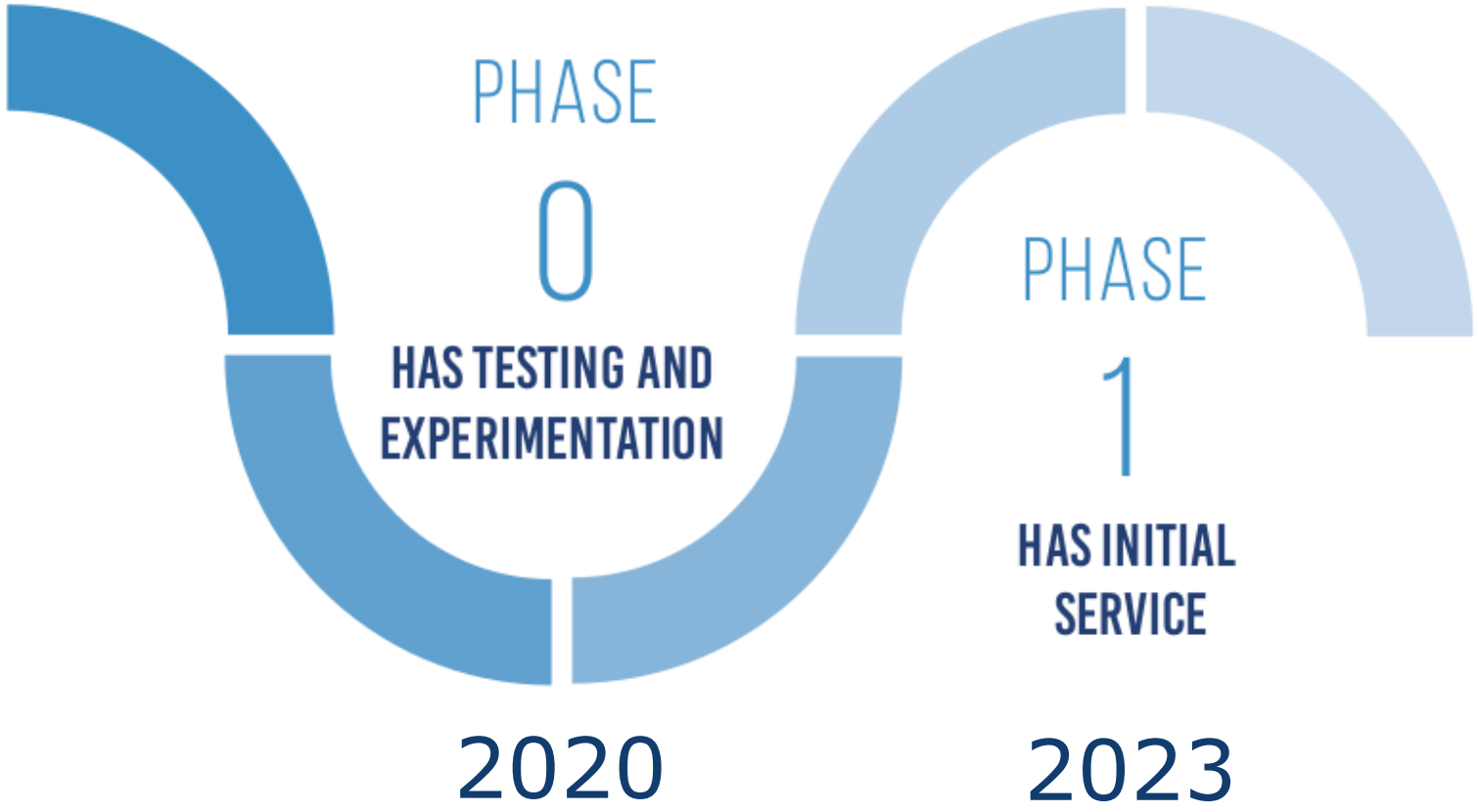

Service Level 1

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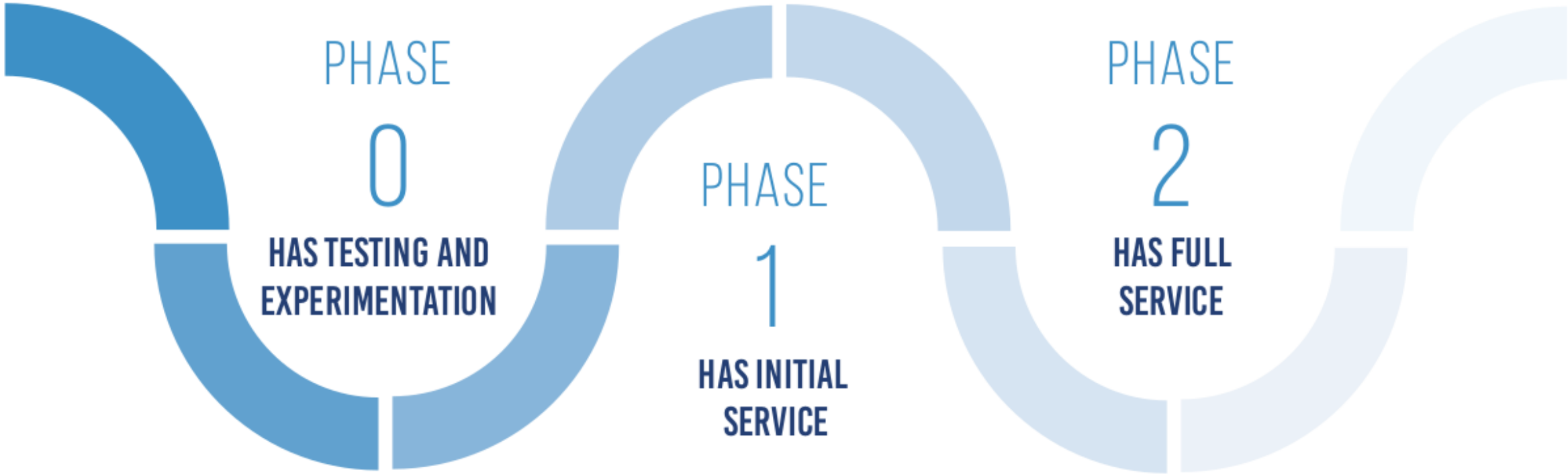
Galileo HAS roadmap



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Source: Based on Galileo HAS Info note.

Part II

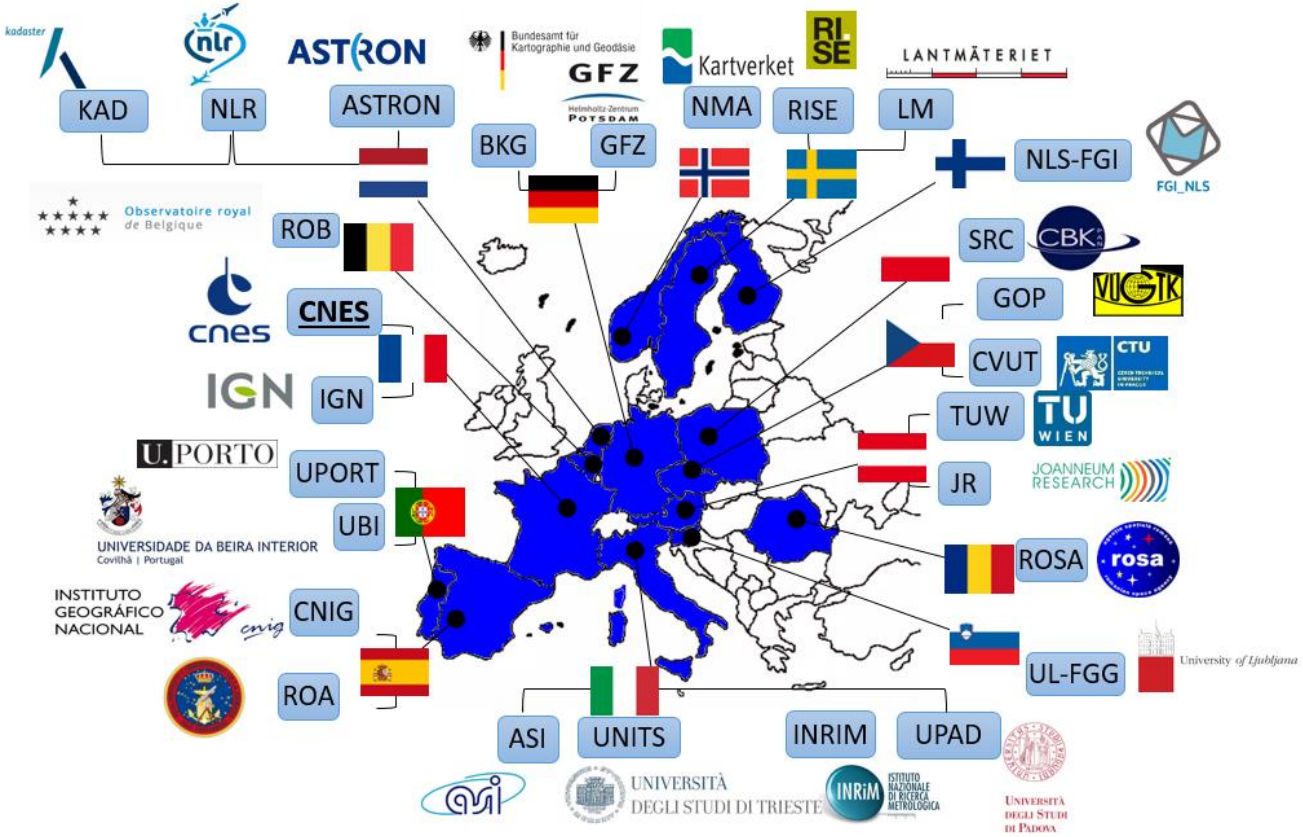
Monitoring of Galileo HAS

Kartverket

GEMOP project

Galileo and EGNOS Monitoring Of Performances by Member States

- Project participants: 27 organizations of 15 European countries
- Support for the Galileo Reference Centre (GRC) in Netherland
- Monitoring of Galileo and EGNOS service performance
- NMA is involved in several working package:
  - OS navigation performance (WPG3.1)
  - HAS performance (WPG3.2)
  - Nequick model performance (WPG3.4)
  - Galileo SLR evaluation (WPG5.2)
  - EGNOS OS & SoL performance (WPE3.1)



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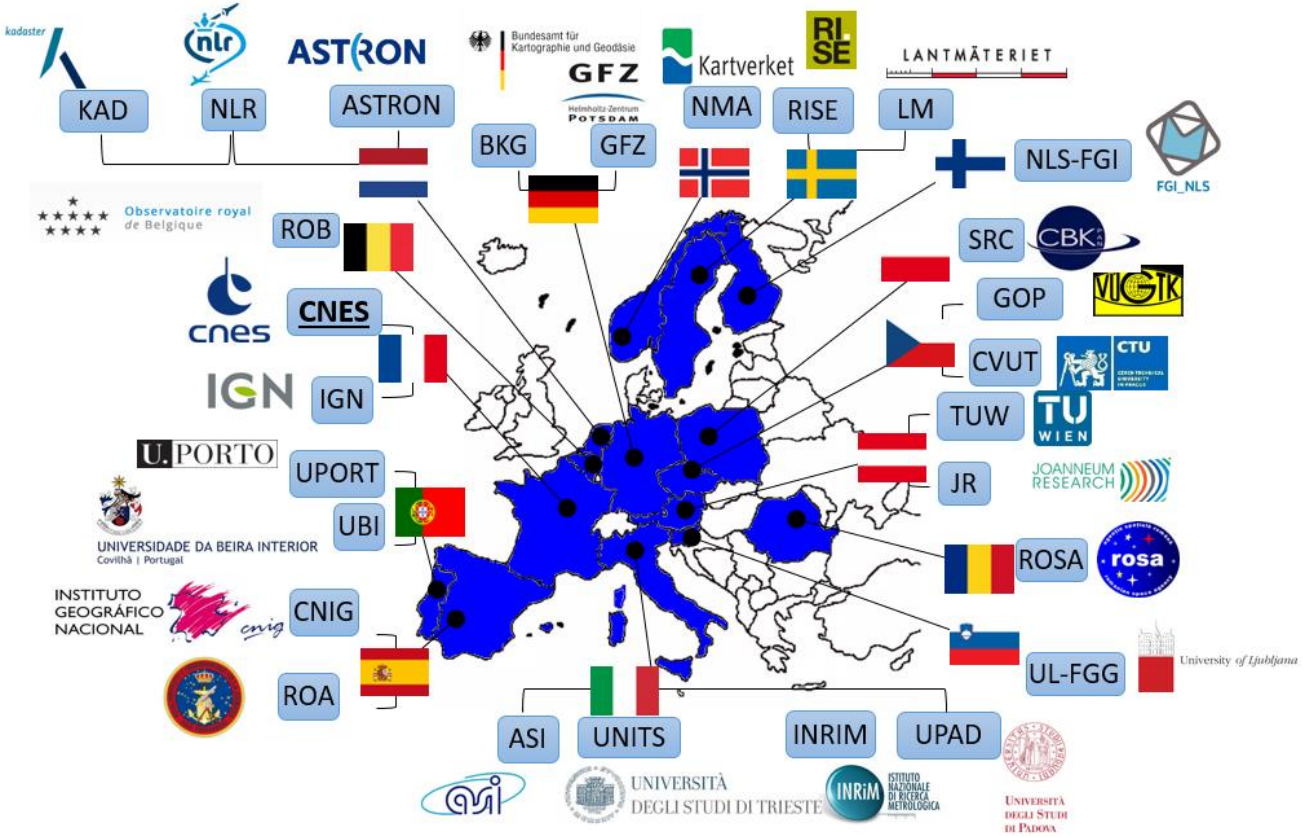

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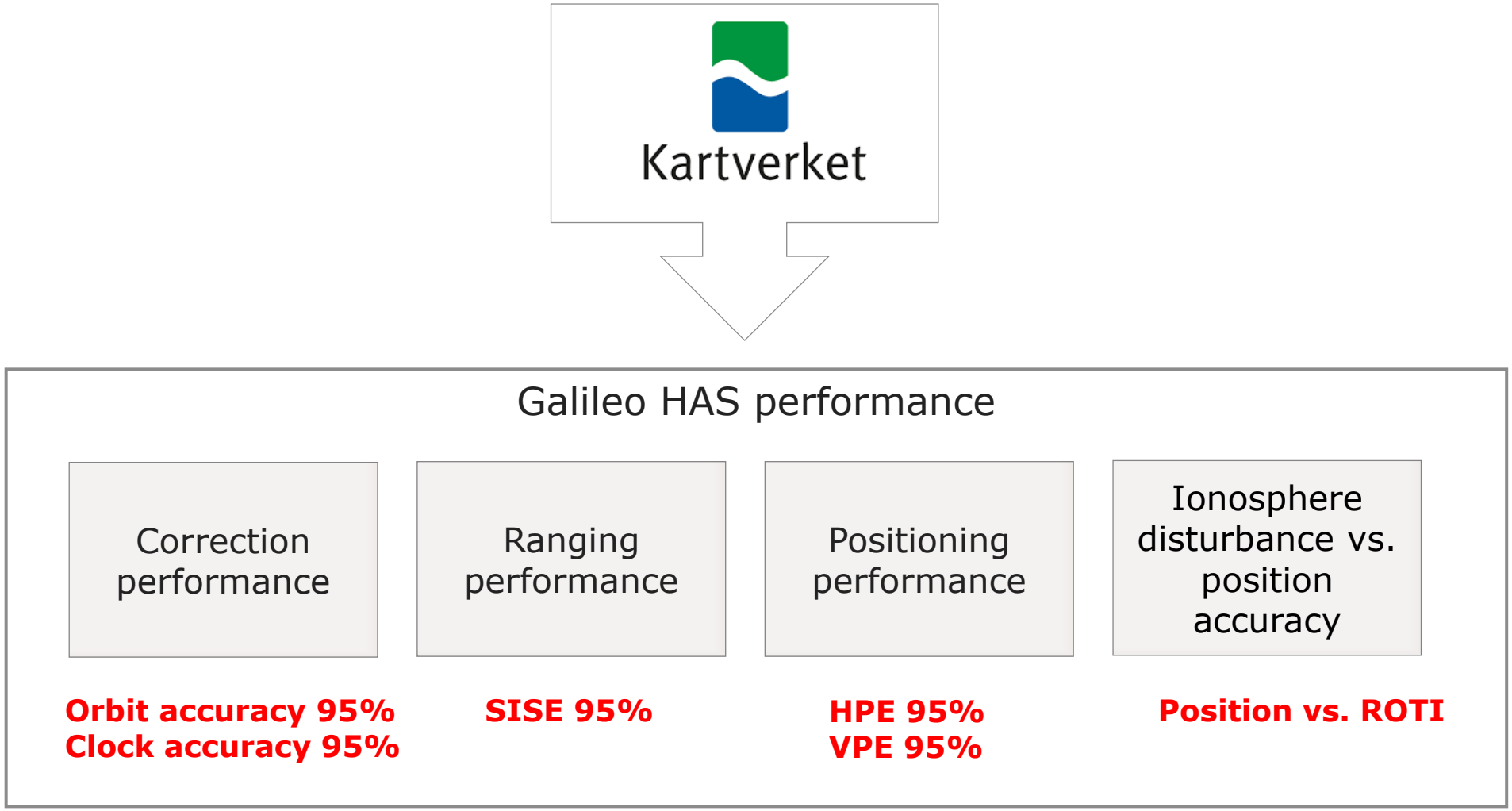
Monitoring of Galileo HAS



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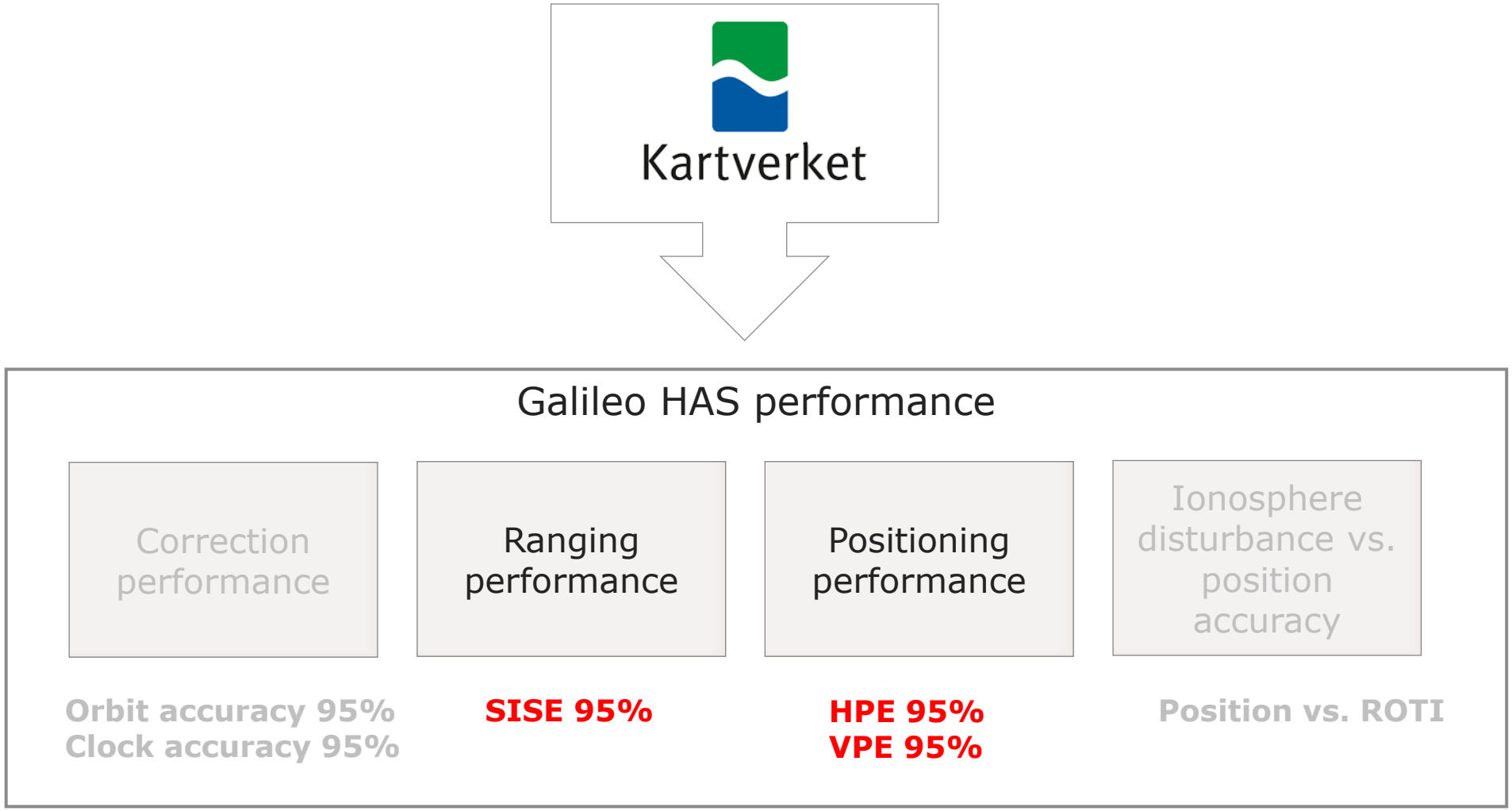

How do we get the HAS messages?

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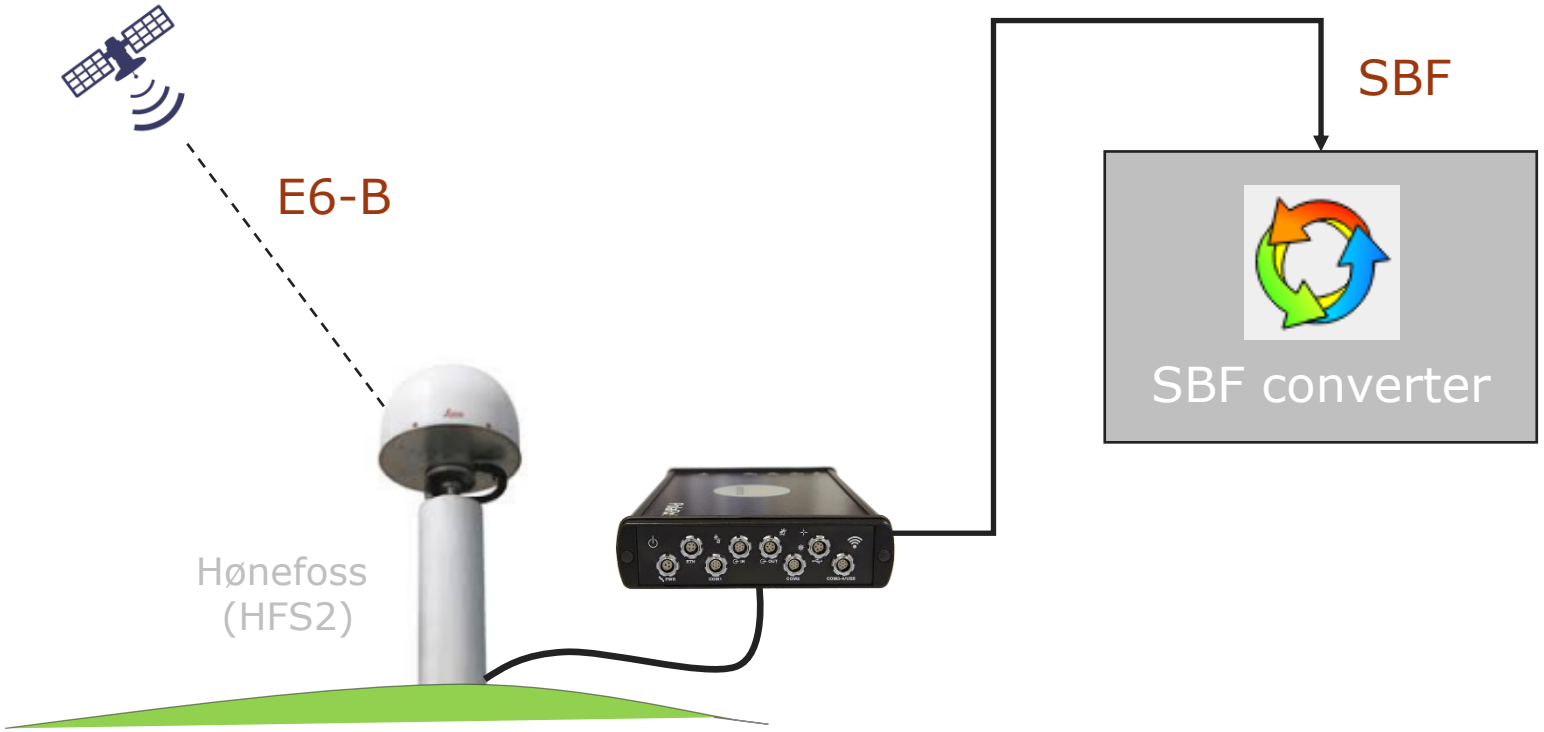

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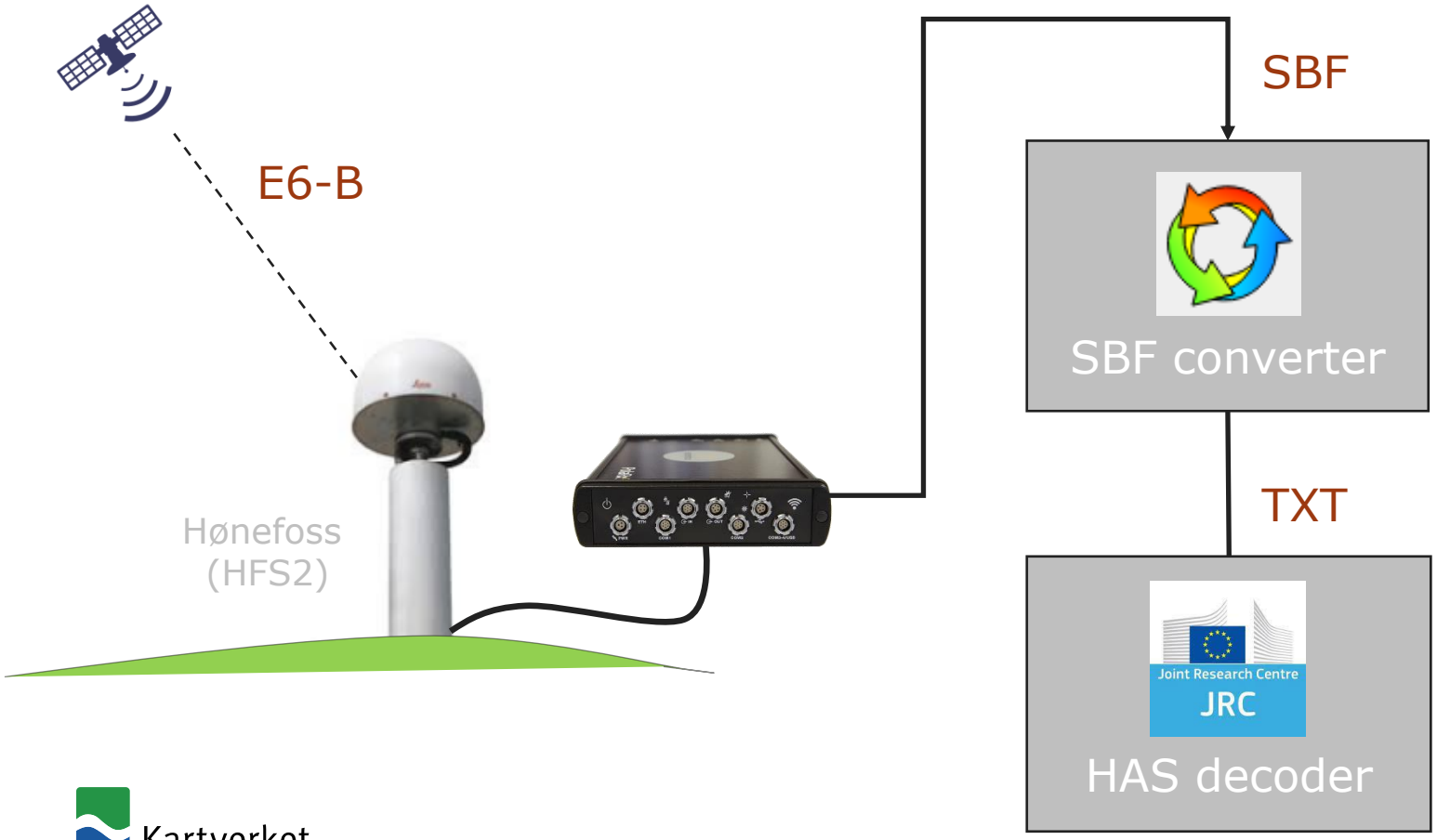

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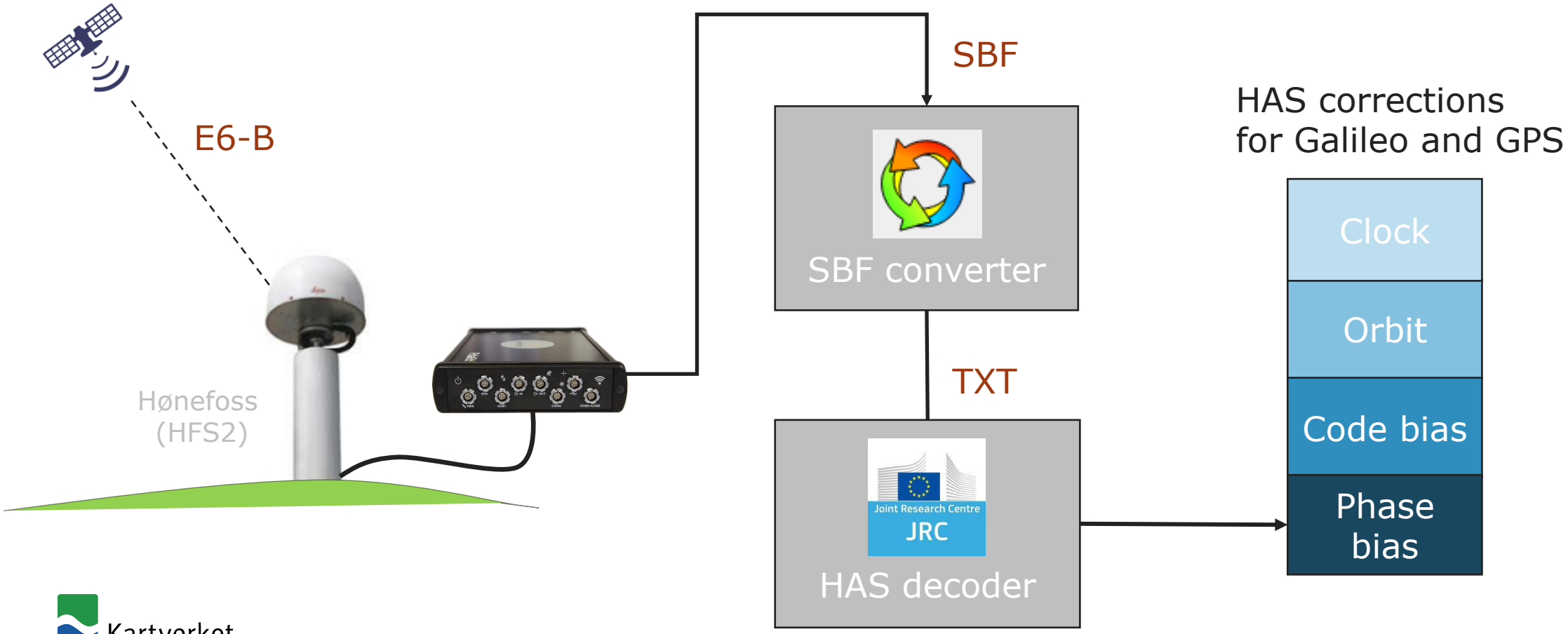

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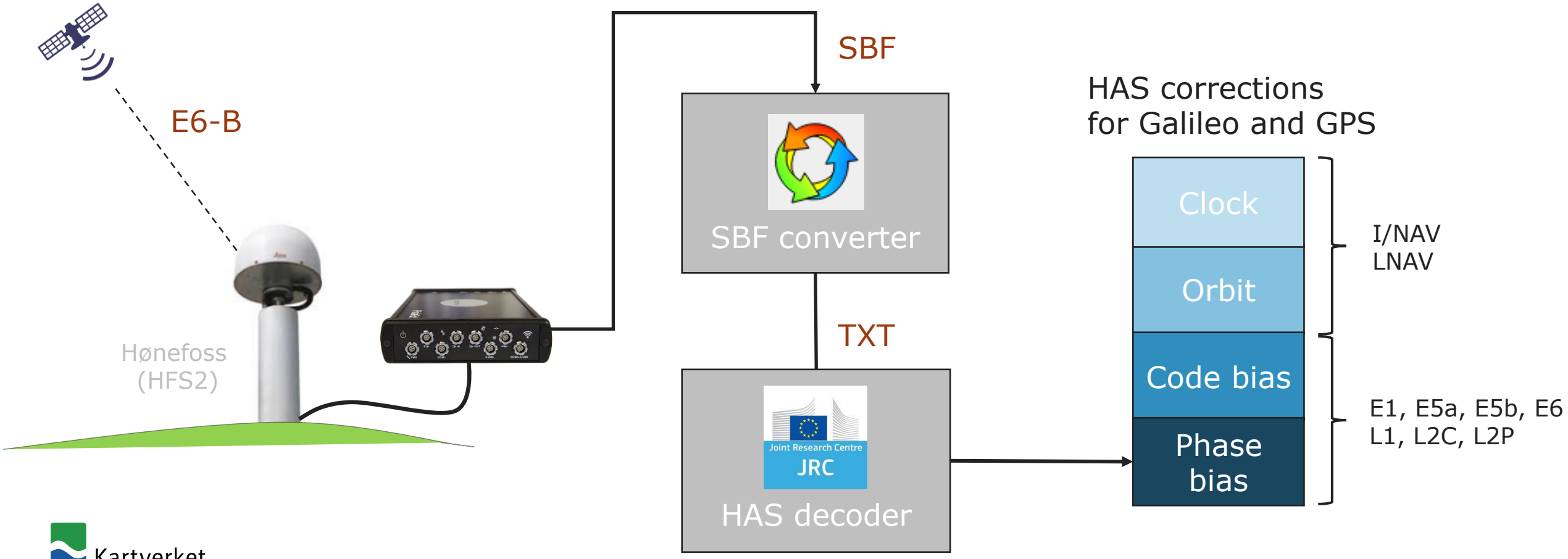

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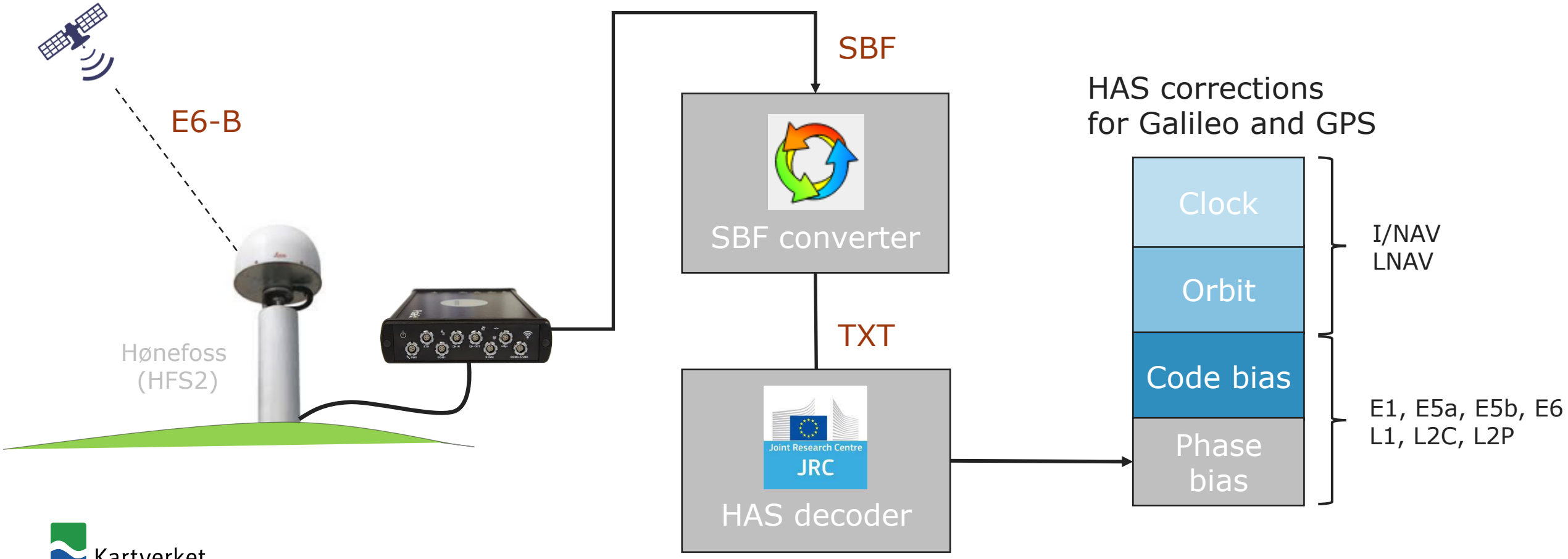

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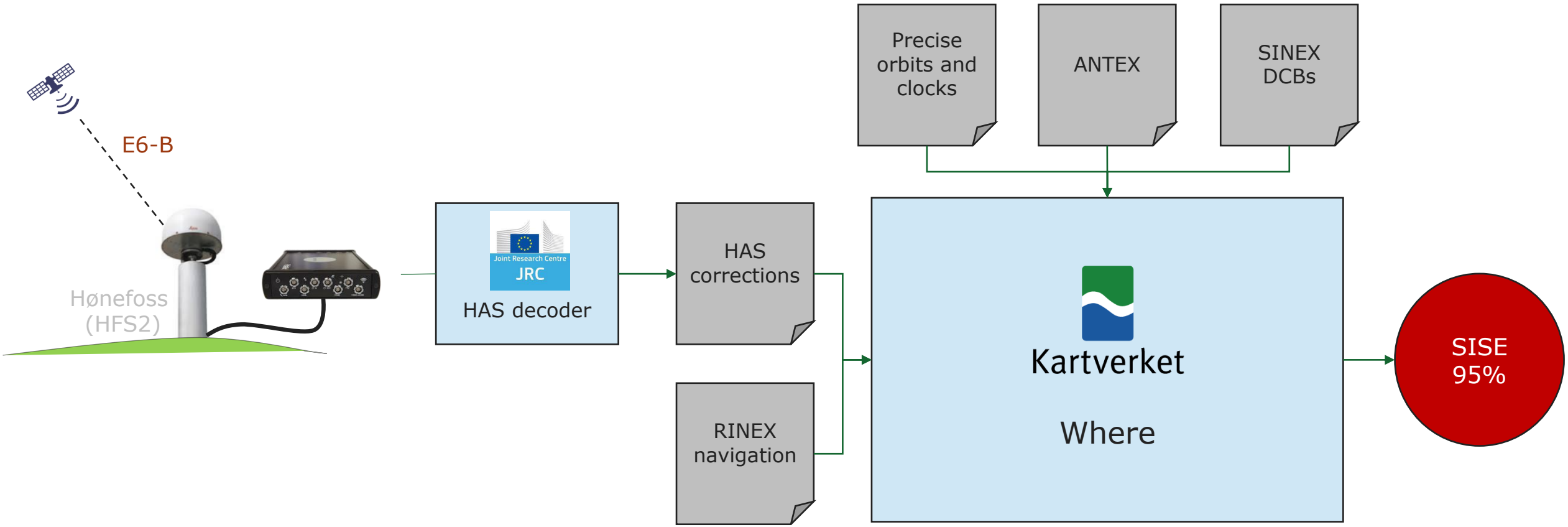
Galileo HAS ranging performance



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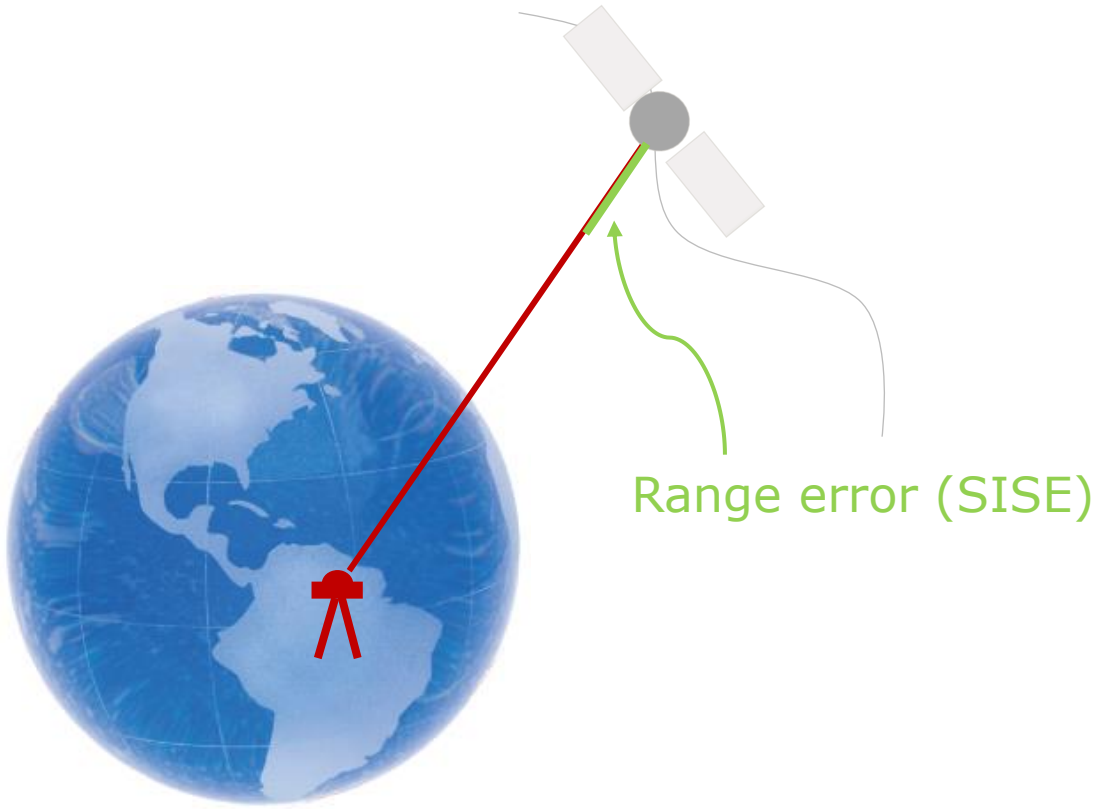
How can the Galileo HAS orbit- and clock performance be determined?



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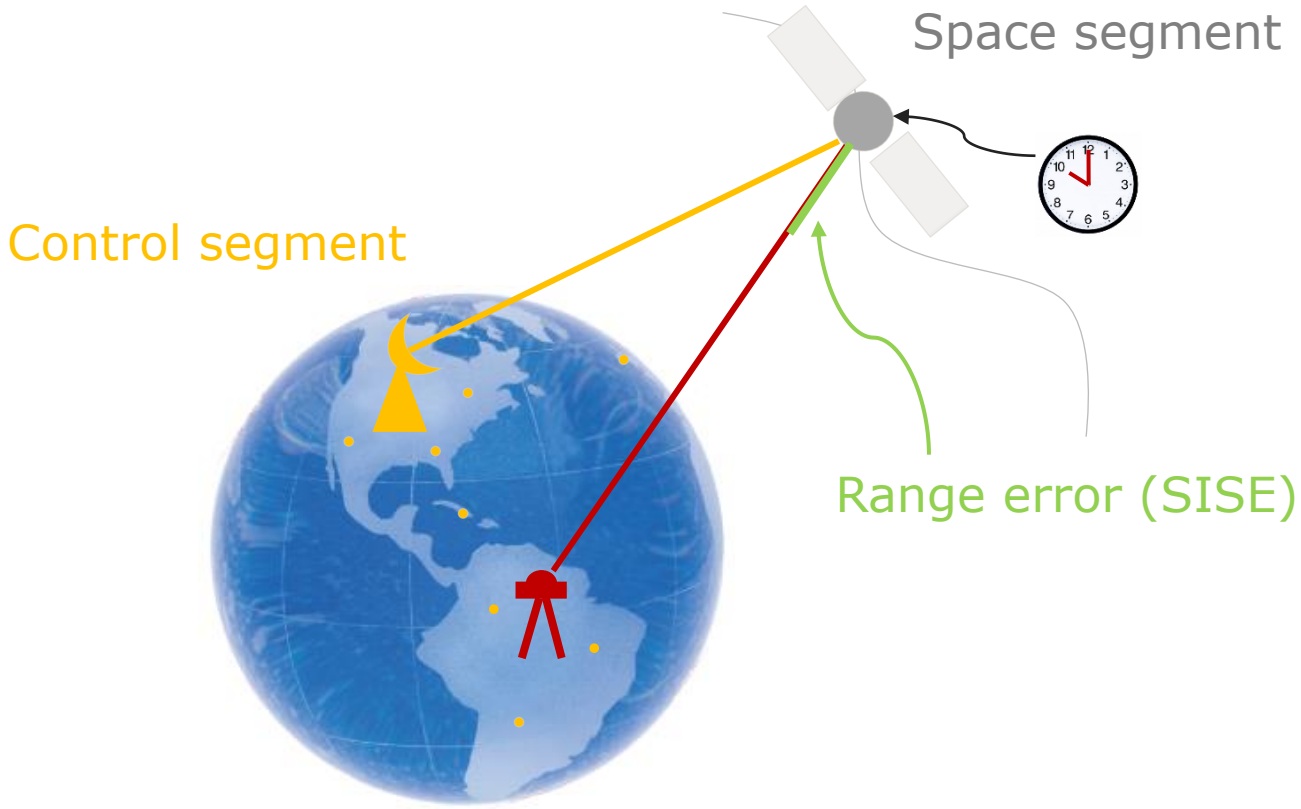

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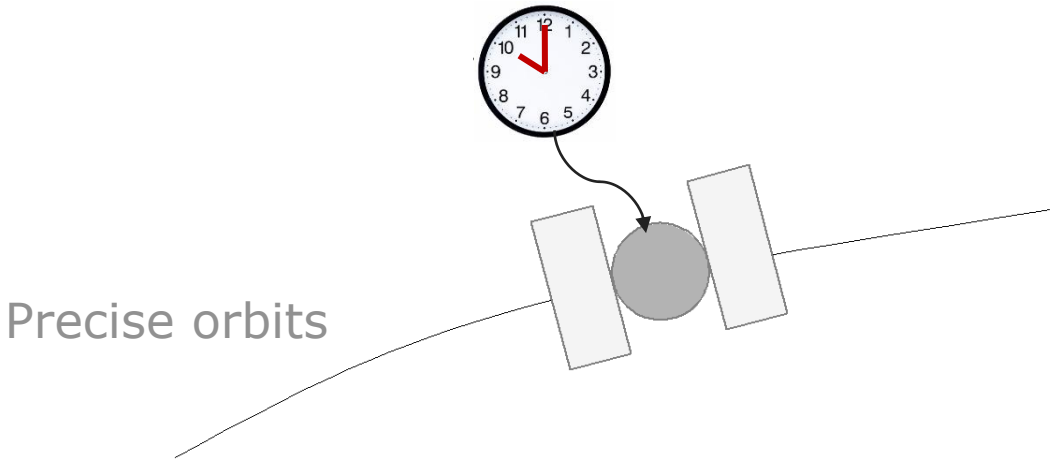
Signal-in-space ranging error (SISE)



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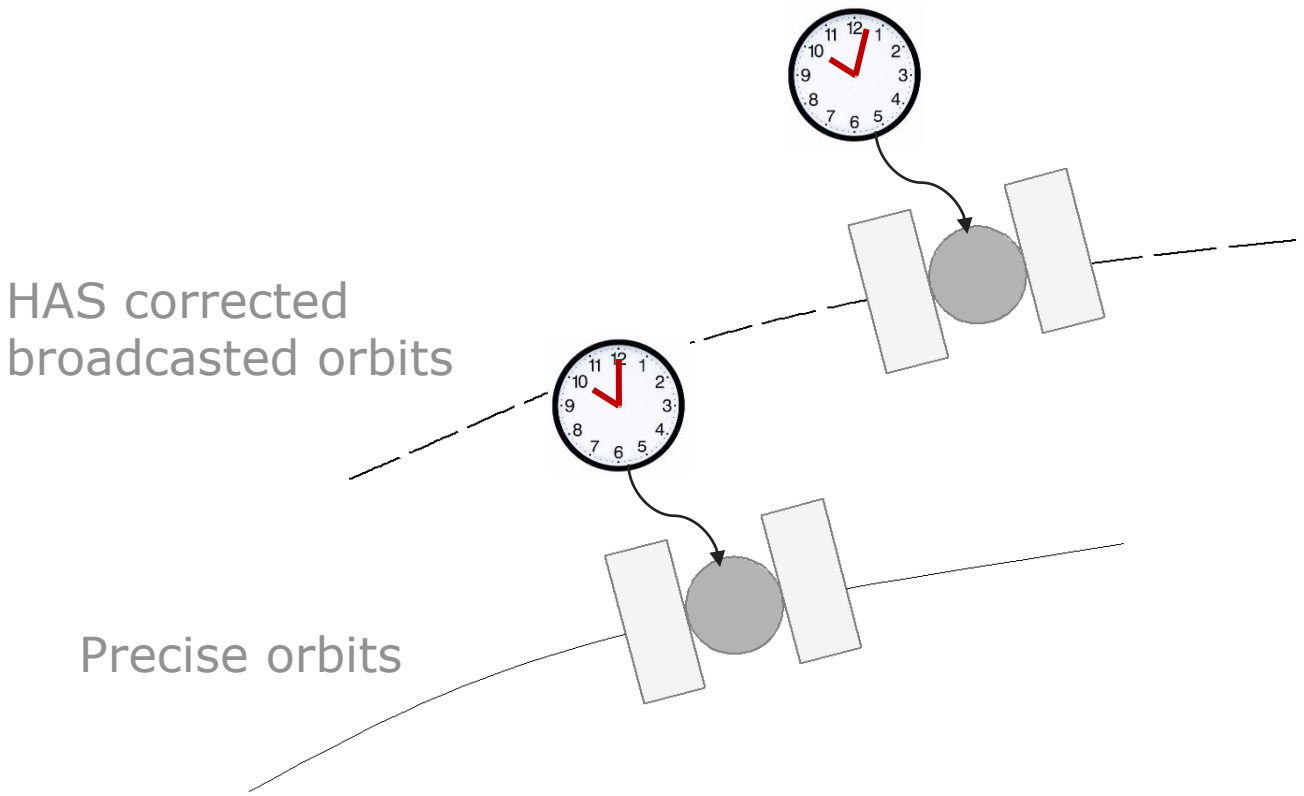

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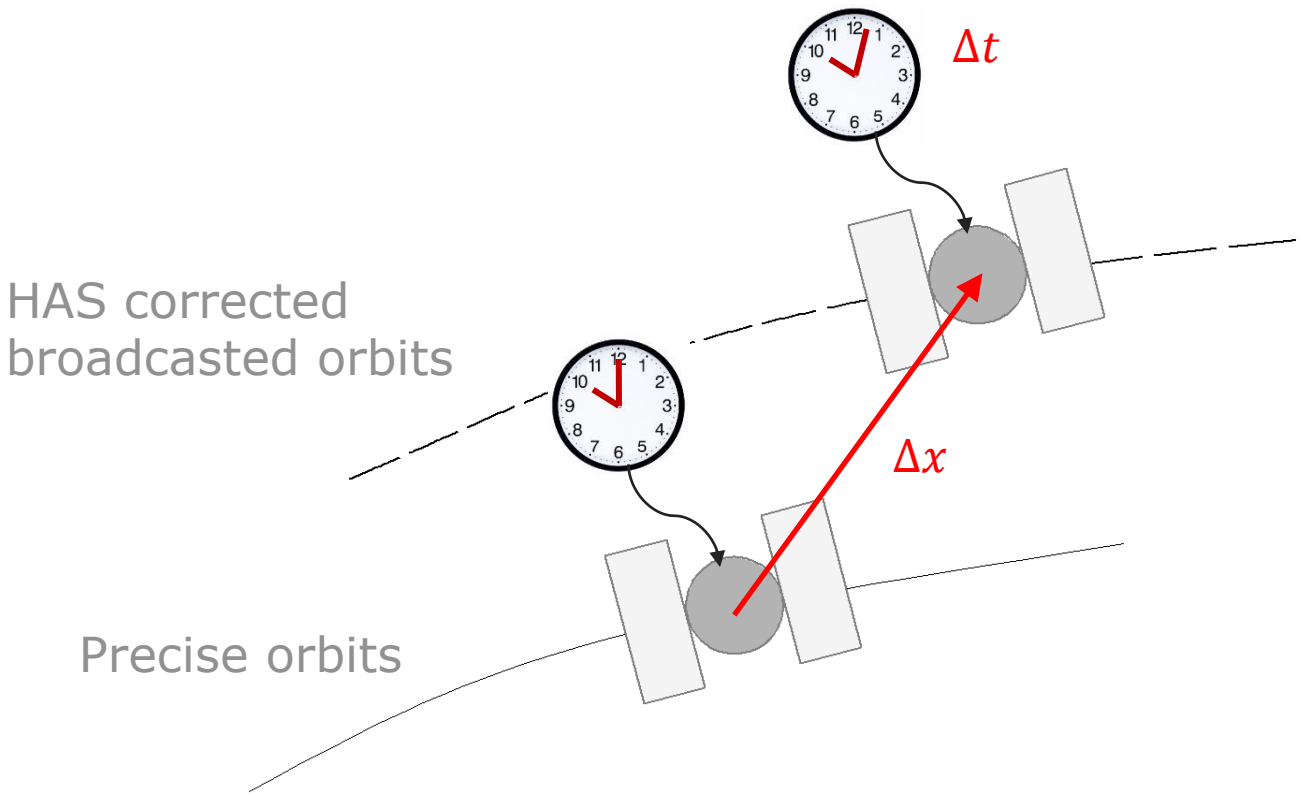

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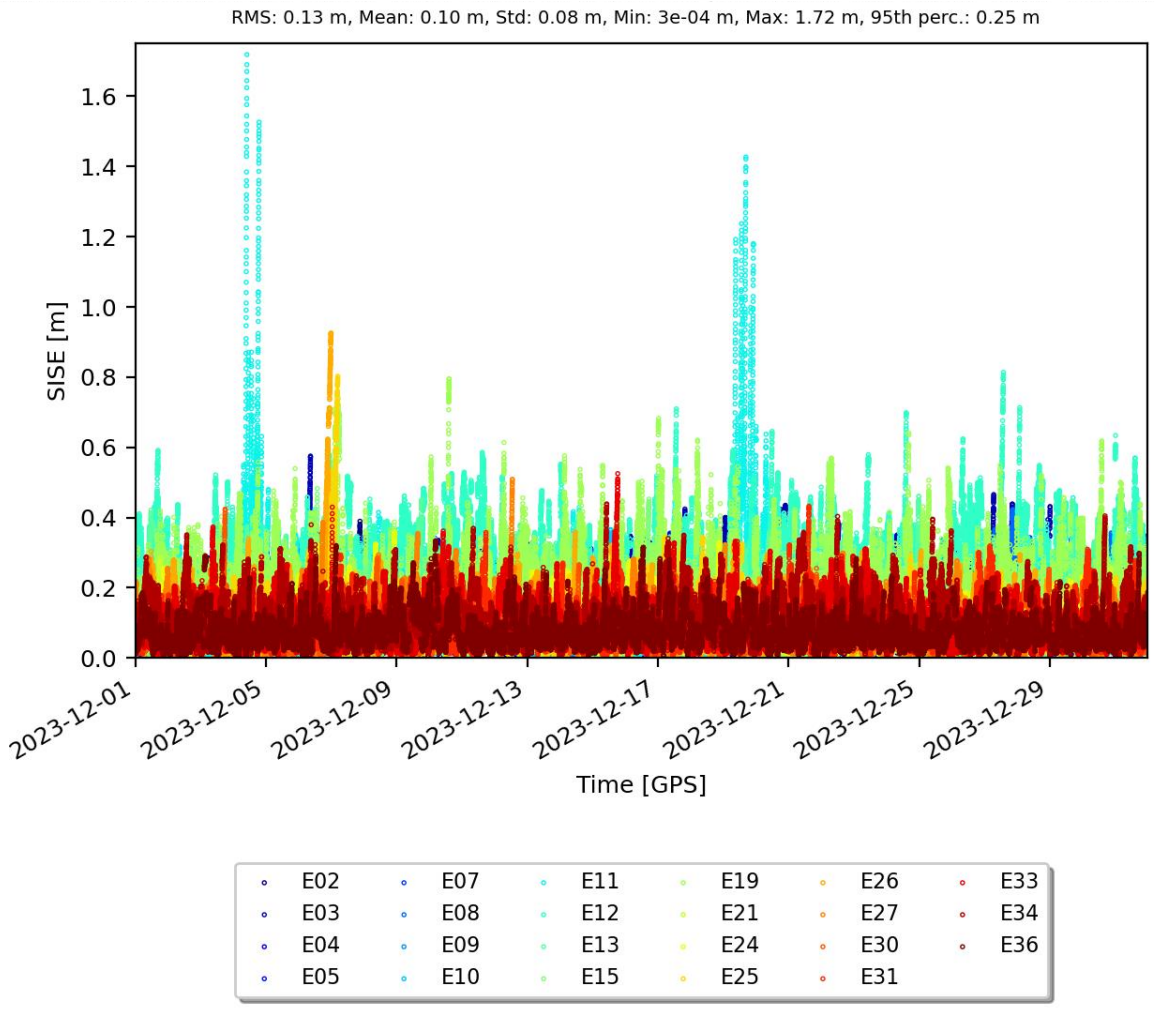
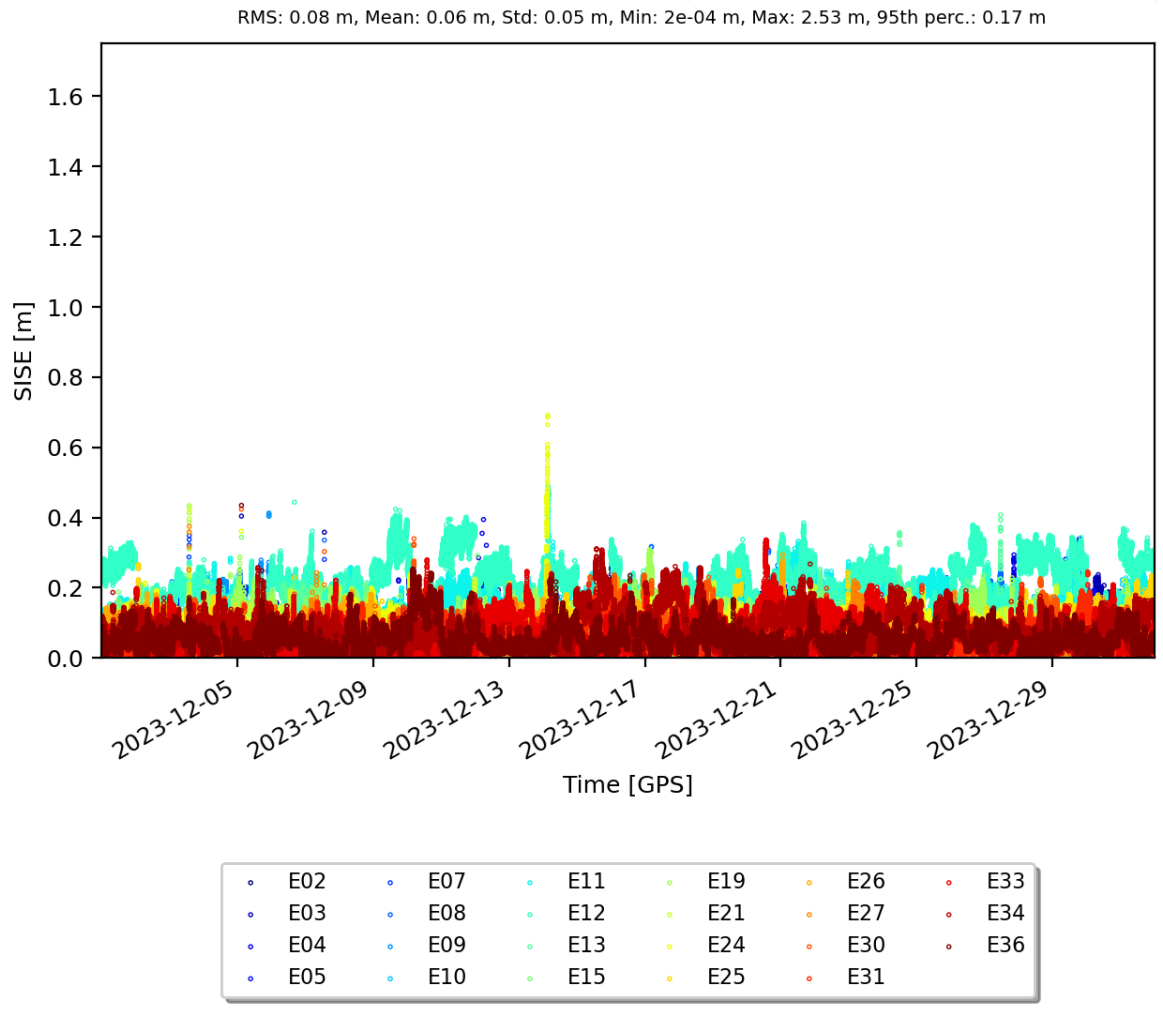
What is the performance of Galileo HAS orbit and clock data?

Solution: **OS**-CNES-INAV-E1E5b, Step: 60 s

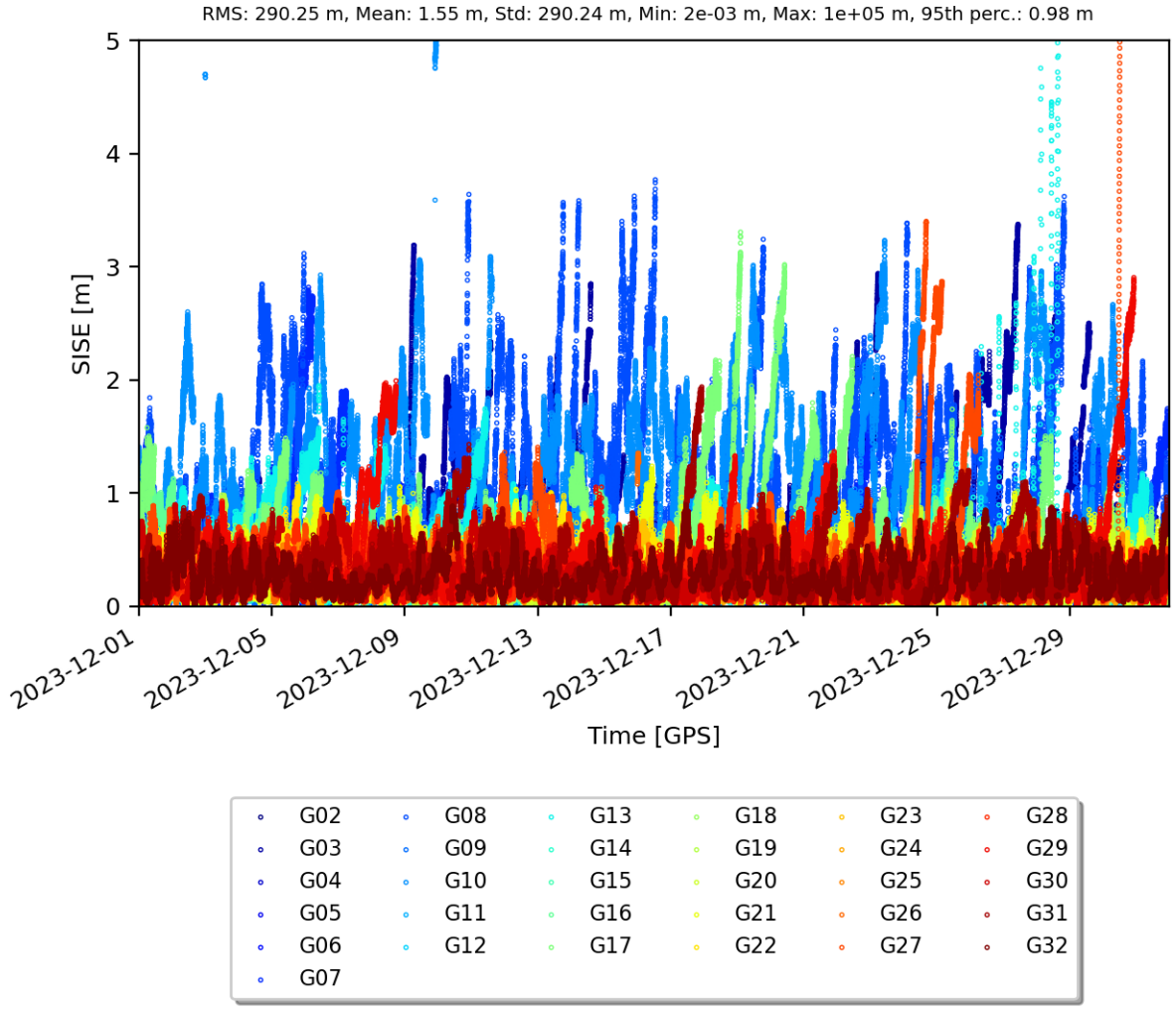


Solution: **HAS**-CNES-INAV-E1E5b, Step: 30 s

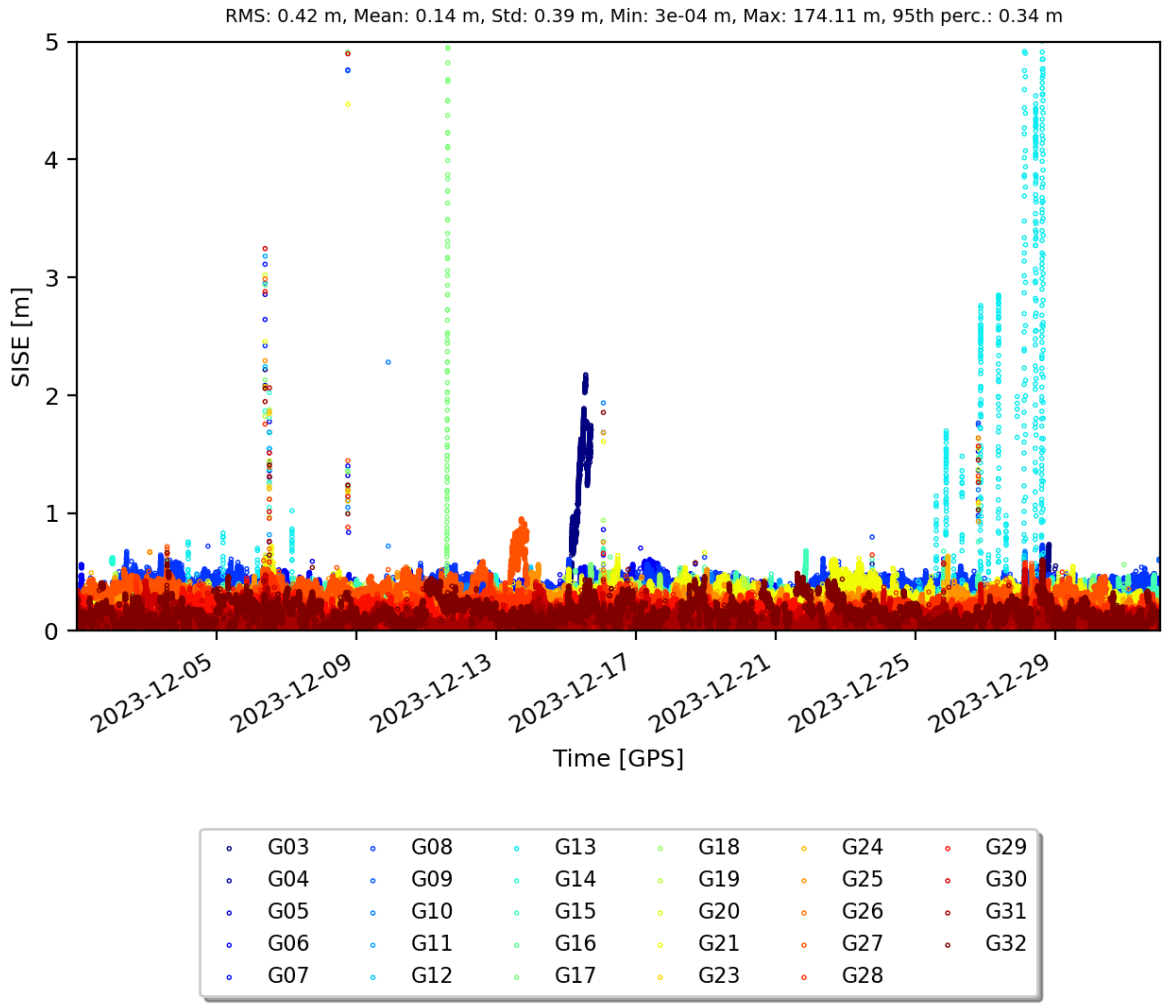


What is the performance of Galileo HAS orbit and clock data?

Solution: **OS**-CNES-LNAV-L1L2, Step: 60 s



Solution: **HAS**-CNES-LNAV-L1L2, Step: 30 s



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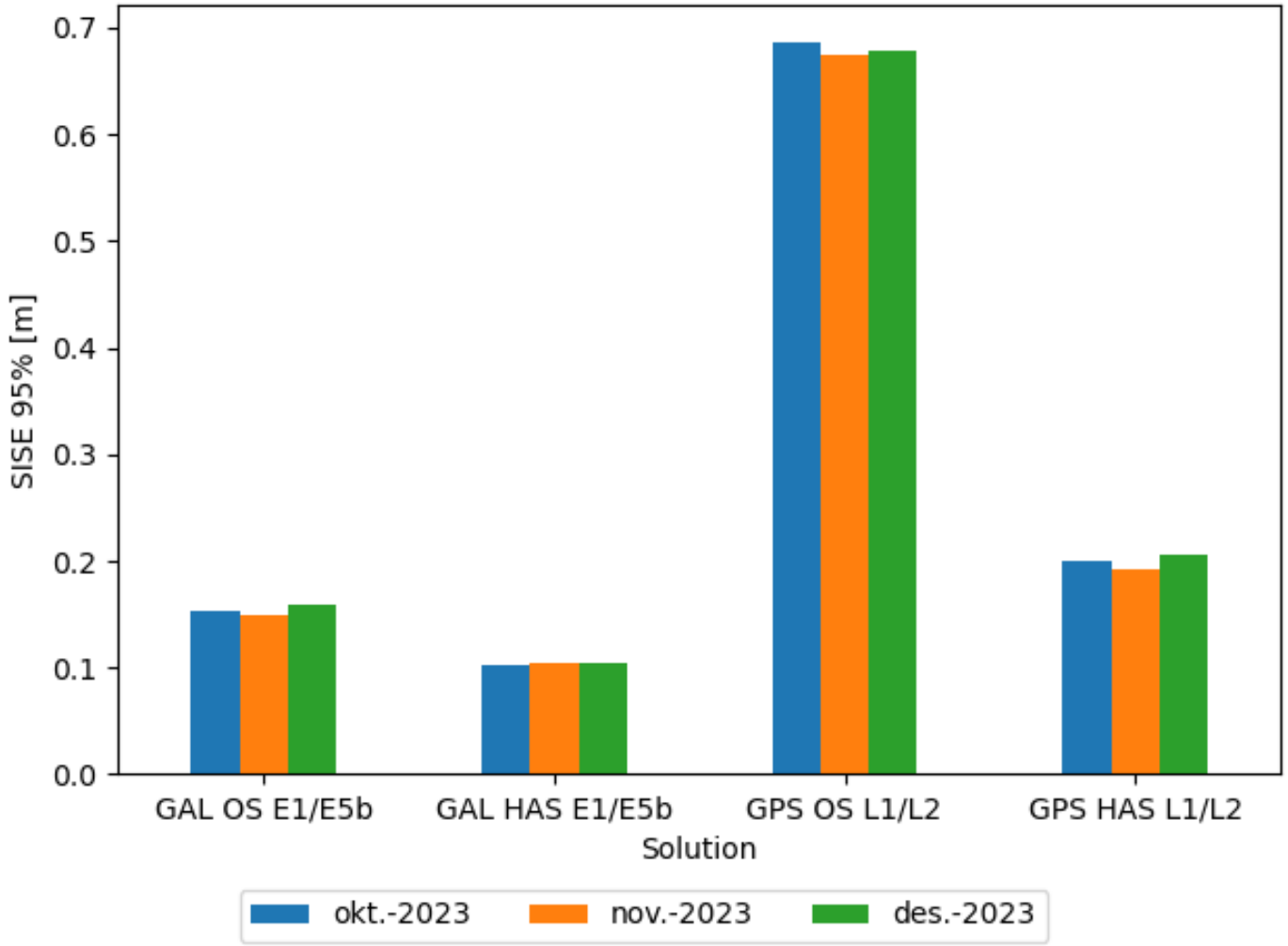

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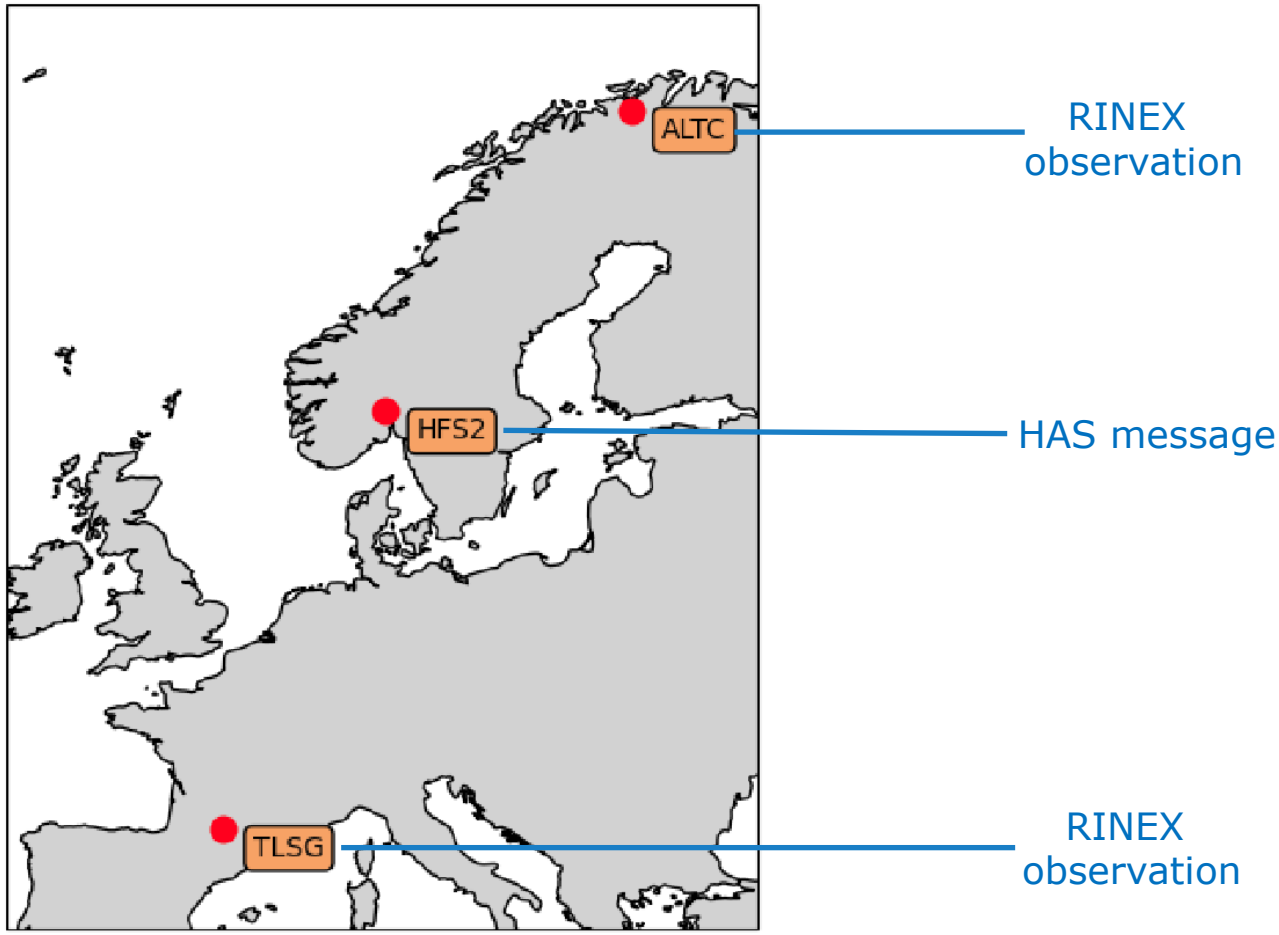
Galileo HAS positioning performance



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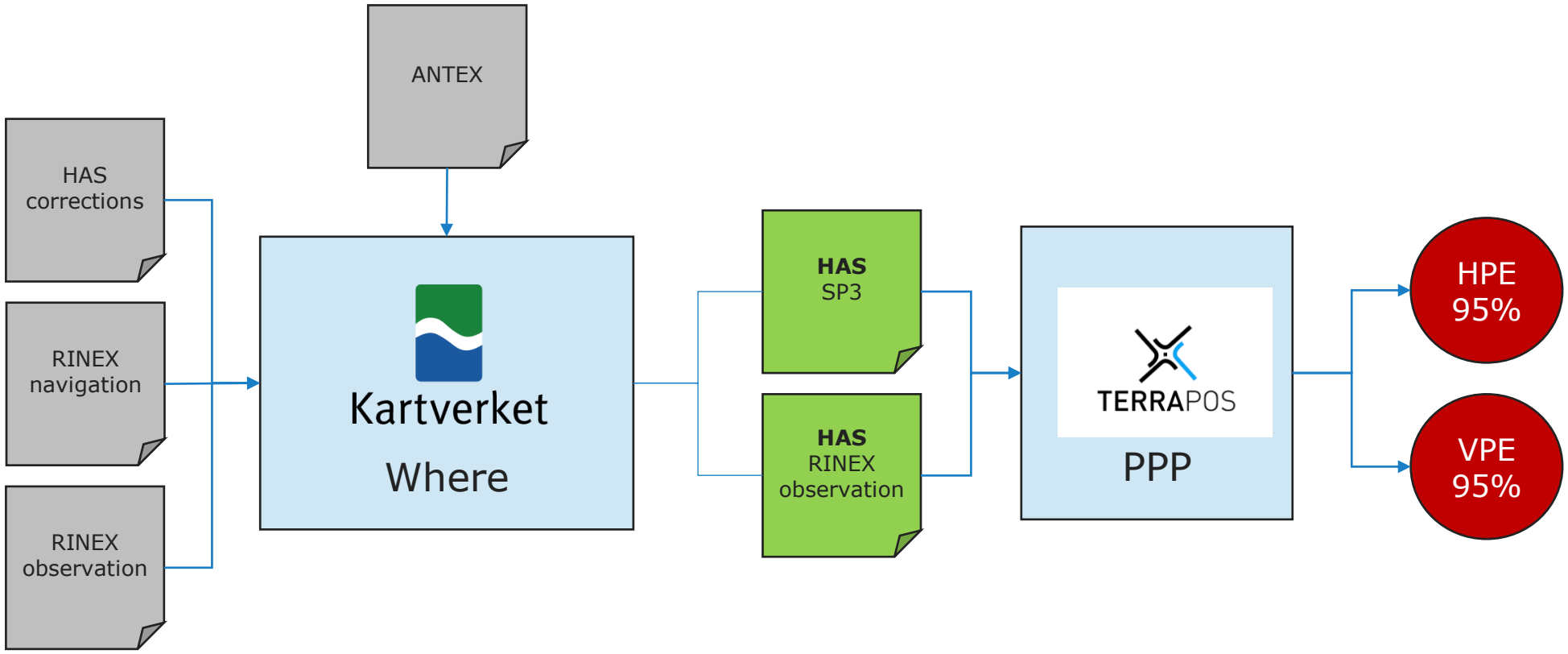

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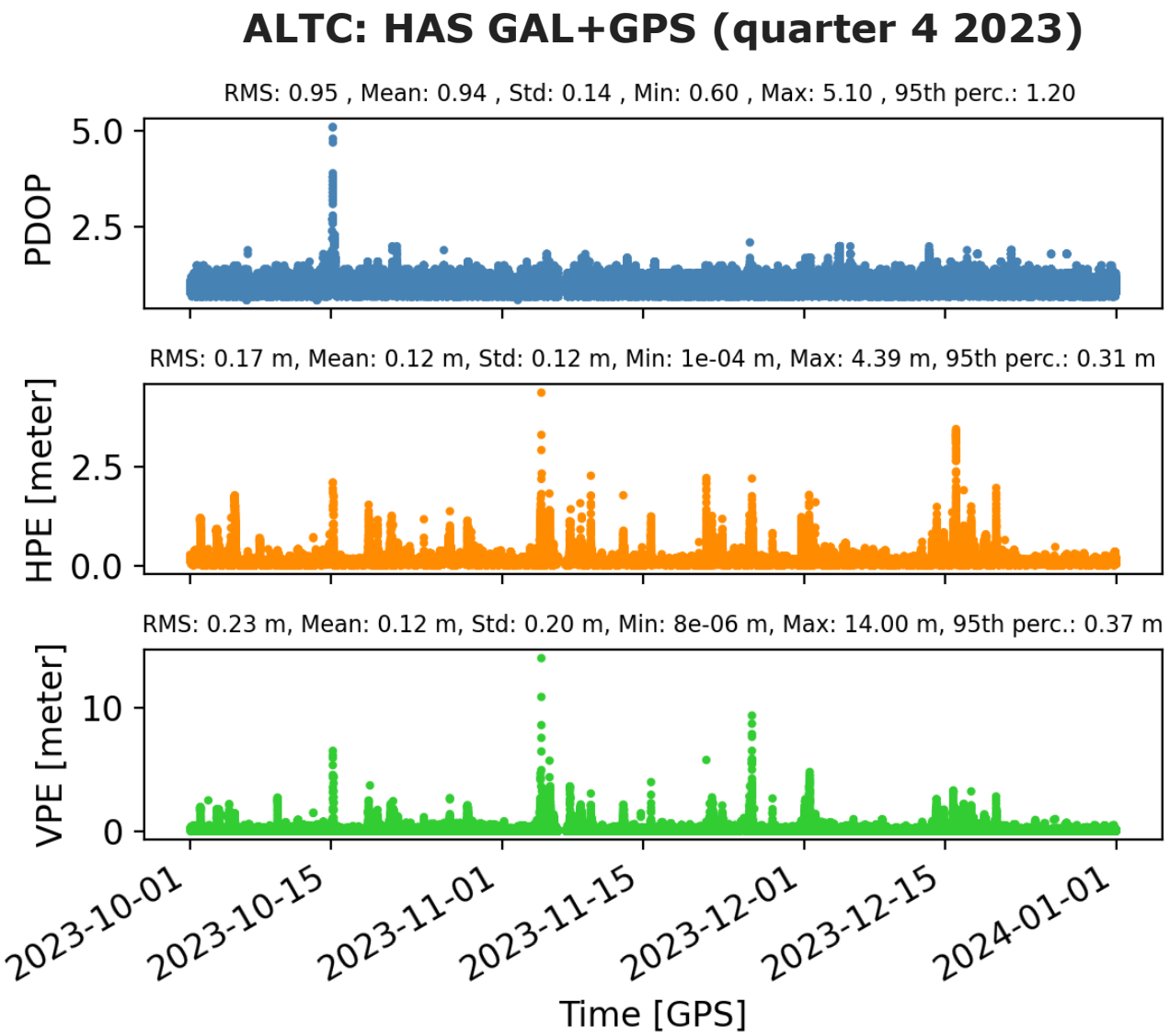

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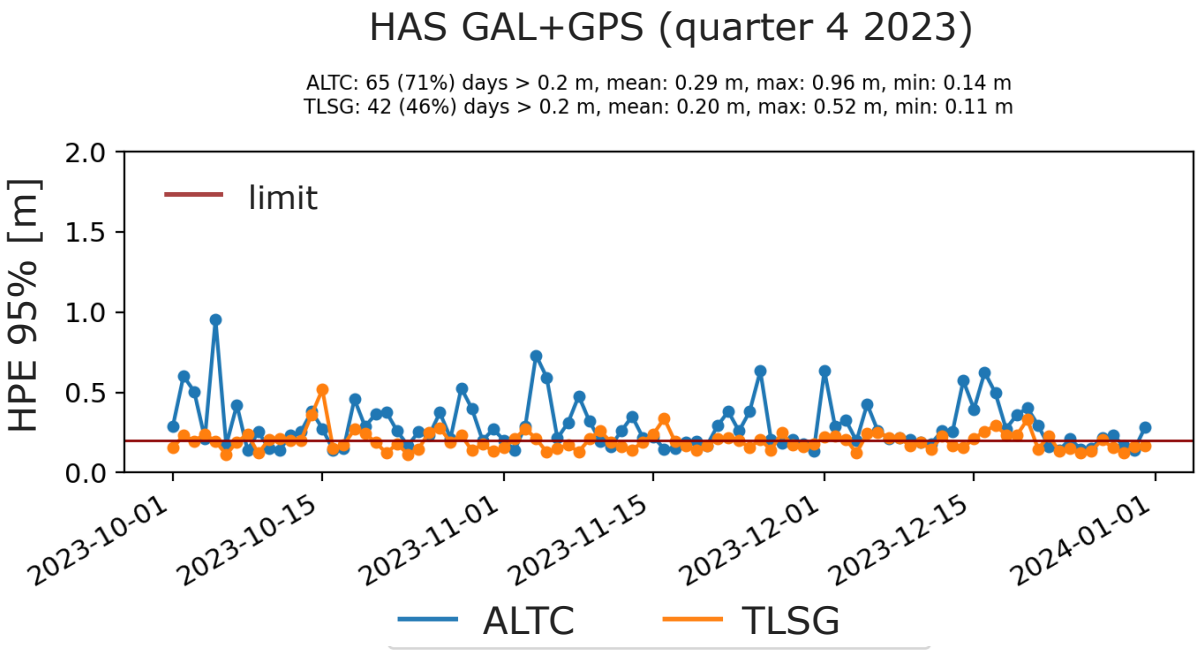

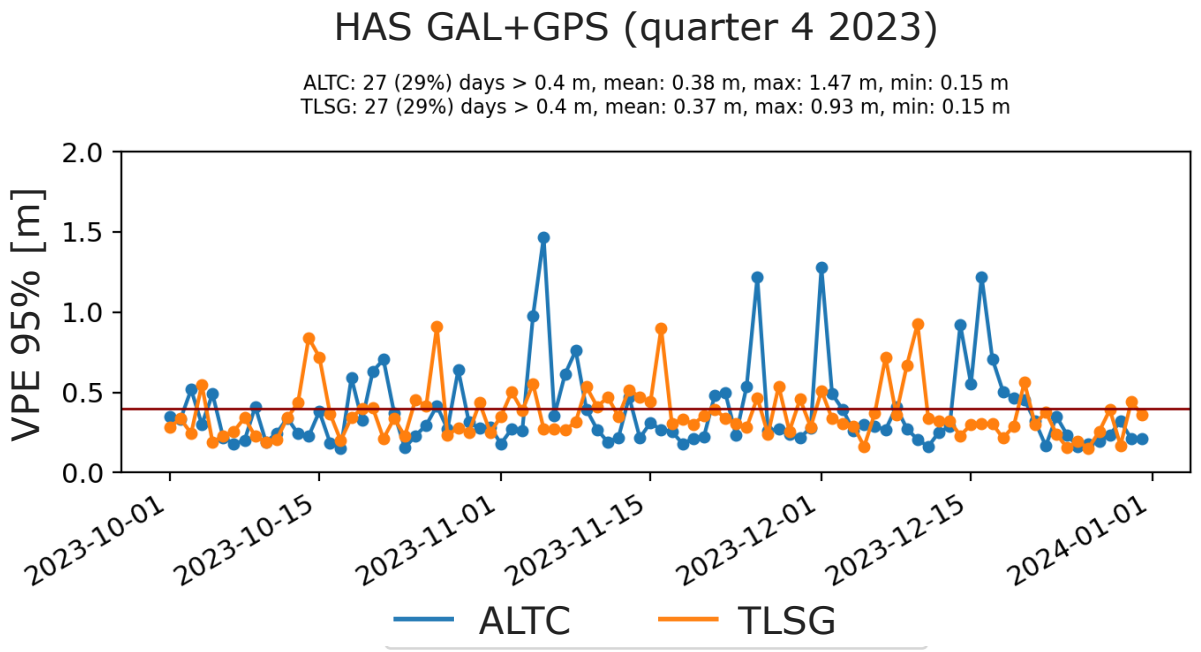

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Summary

- Galileo High Accuracy Service (HAS) is a global and free of charge positioning service with decimeter accuracy
- Galileo HAS Initial Service is available since 24th January 2023
- Galileo HAS Full Operational Service is expected > 2024
- HAS performance for quarter 4 2023:
  - SISE 95%: < 11 cm (GAL), < 20 cm (GPS)
  - Mean HPE 95% (GAL+GPS): 25 cm
  - Mean VPE 95% (GAL+GPS): 38 cm

Kartverket

Outlook

- NMA will proceed with Galileo HAS performance monitoring via GEMOP project
- One of the NMA geodesy division strategy targets is the “Accurate and reliable positioning for all people”, which means:
  - → Inhabitants should have easy access to accurate and reliable positioning
  - → Through Research & Development cooperations will we find solutions which make a user-based data collection possible with 10 cm position accuracy

Kartverket

Outlook

- NMA has established a team working with "Accurate and reliable positioning for all people"
  - Purchase a Galileo HAS **"ready-to-use"** receiver and look at the positioning performance
  - Following receivers provides/or will provide Galileo HAS solutions:
    - → EOS Arrow Gold+
    - → **ANavS Arox or MS-RTK**
    - → Leica GS07 DS
    - → Trimble R580 (expected with a later firmware update)

Kartverket

Questions?

Contact information

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