Future positioning services, geodetic reference frames, and the ISO Geodetic registry

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OUTLINE

- The development of GNSS positioning services and an up-coming mass-market for precise real-time GNSS

- Implications on Geodetic Reference Frames

- The ISO Geodetic Registry (and connection to EPSG and CRS-EU)

On the use of precise positioning services in the near future? – and implications on geodetic infrastructure?

- How will autonomous vehicles ("self driving cars") and a mass market for precise GNSS affect how geographic information (geodata) will be consumed?

- There is a feed back loop where changes/developments in the way geodata are consumed, will provide new expectations/demands on positioning services and geodetic infrastructure!

- A number of external projects and workshops indicate a significant increase in use of positioning services and geodata. We are approaching a "mass market" of connected devices (Internet of Things, IoT) which consumes geodata and precise positionninging services

- Our current professional users (surveyors etc) will still need the best GNSS positioning services and will probably ask for "more and better"

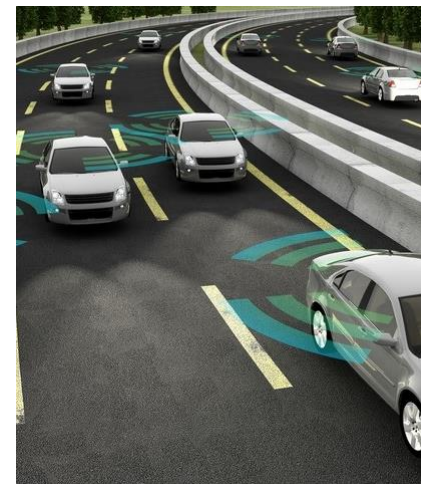- But what will be the needs and solutions for the "mass market"?

(http://www.nordicgeodeticcommission.com/wp-content/uploads/2021/08/NKG-White-Paper-o Future-Positioning-Services-2019_adopted.pdf)
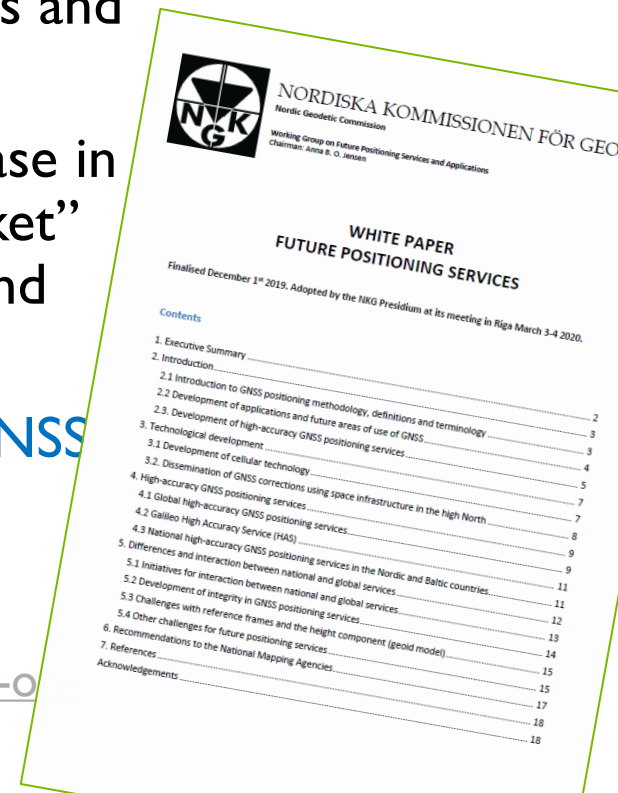
Some development projects in order to better understand the possibilities and needs from mass market applications

NPAD

Network-RTK Positioning for
Automated Driving

NPAD – it is about "scalability" for many users

- Examine the possibility to in an effective way distribute network-RTK corrections to mass market applications and autonomous vehicles

- Network-RTK corrections are packaged and distributed trough a so called "location server" to near by cellphone mast/antenna that distribute the corrections in a standardized format (3GPP – a format for cellphone networks) to all users within the coverage are of the antenna (cellphone network radio base station)

- It has been tested in practice outside Gothenburg, Sweden,
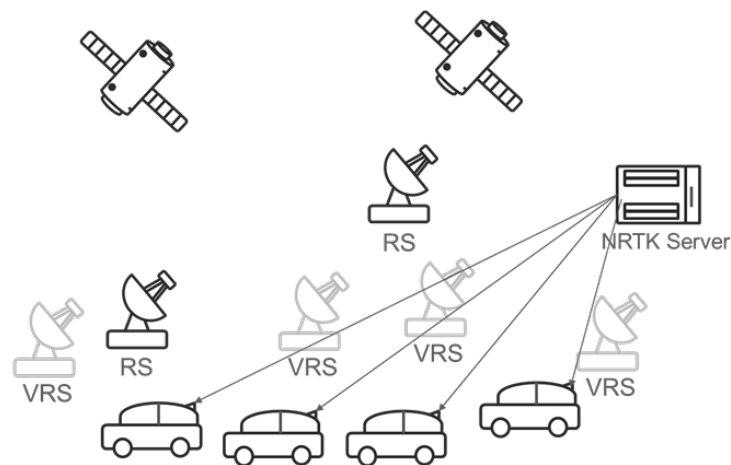
The current NRTK procedures scales badly.
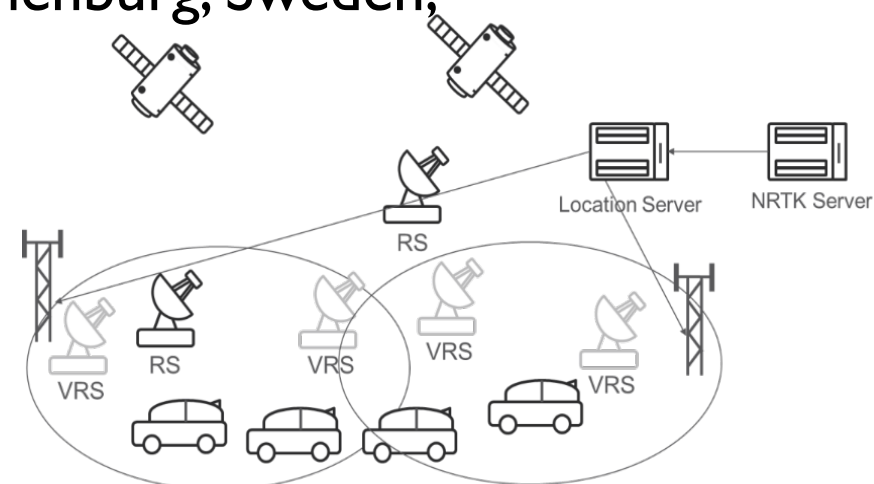
Scalable solution with intermediate processing in a location server and provisioning based on the cellular network.

PNK 4 UTM

Positioning, Navigation, Communication for Unmanned Traffic Management

Focus on un-manned flying vehicles (drones)

Improve the functionality in the mobile networks in order to eventually carry out Traffic Management of Un-manned vehicles (UTM).

Use an existing Text bed for unmanned flying objects outside the town of Västervik.

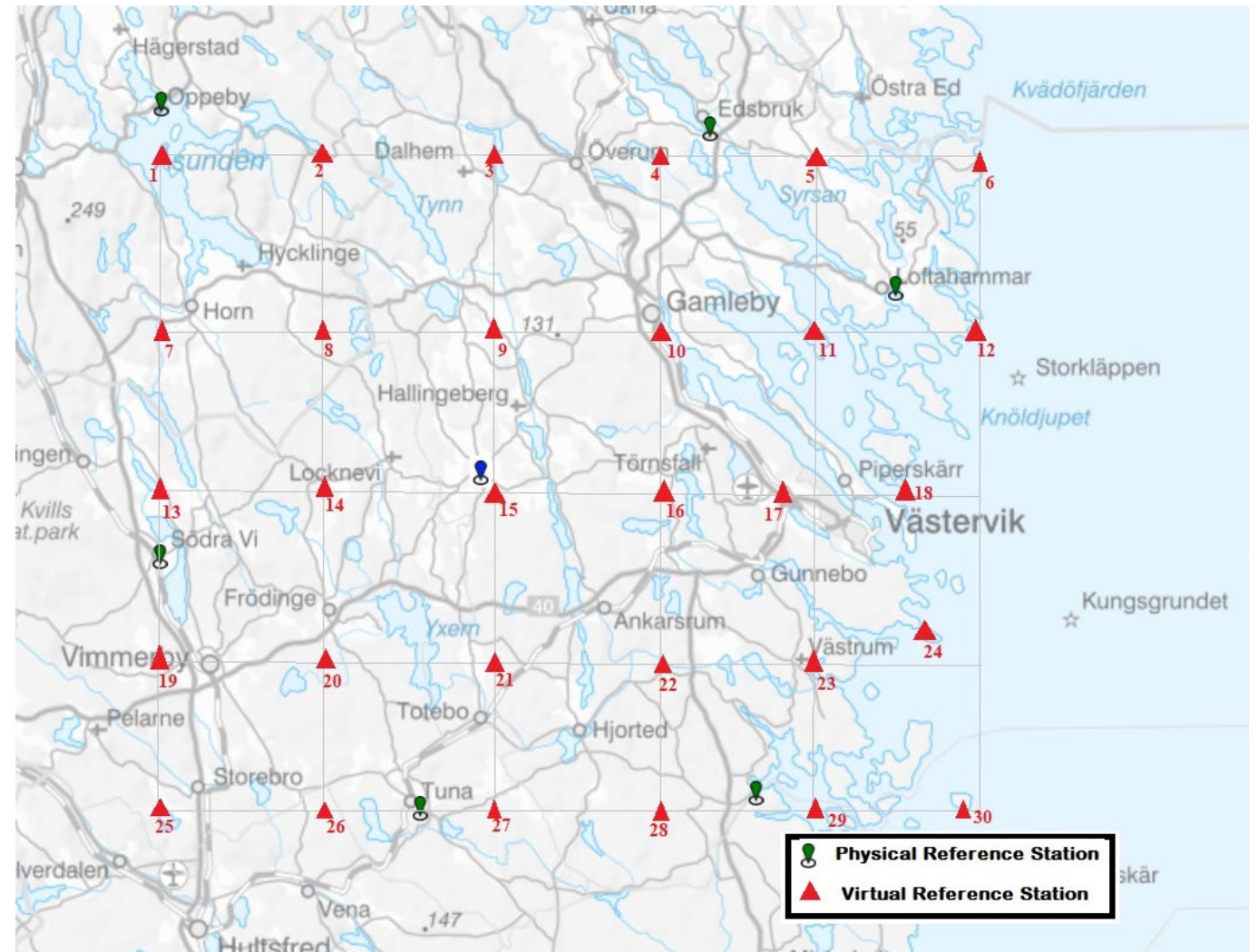Investigate the need for up-grading of mobile communication networks, and distribution of GNSS-data, for safe aviation

Network-RTK corrections from SWEPOS for precise positioning of the drones.

The concept is based on the same technical platform that was developed in the NPAD project

PNK 4 UTM

A grid of virtual reference stations have been established within the project for the distribution of RTK streams.

I the project, distribution is done in the mobile network of Telia (the largest network operator in Sweden)

PNK4UTM Partners

TRAFIKVERKET

Telia

ERICSSON

LANTMÄTERIET

Västerviks Kommun

RISE

T2 DATA

COMBITECH

Drone Center SWEDEN

WABEMA AB

WASP — WALLENBERG AI, AUTONOMOUS SYSTEMS AND SOFTWARE PROGRAM

WASP Research Arena – Public Safety (WARA-PS)

CHALMERS UNIVERSITY OF TECHNOLOGY

KTH VETENSKAP OCH KONST

liu LINKÖPINGS UNIVERSITET

LUNDS UNIVERSITET

UMEÅ UNIVERSITET

PrePare-Ships - a EU-H2020 project

Create solutions for safe navigation "ship to ship" and "ship to land" and establish possibilities for future autonomous marine transport through the use of Galileo and EGNSS.

Test and develops also precision GNSS further out at sea.

Prepare Ships
Increased Safety and Efficiency in Shipping

The Prepare Ships project integrates a new precise positioning system based on the features of Galileo and EGNSS signals.
It enables merchant ships to plan and execute safe ship passages of other vessels in challenging fairways by advanced decision support.

- EGNSS and RTK resilience positioning
- Real-time dynamic predictor based on machine learning
- Ship-to-ship / ship-to-shore communication (VDES)
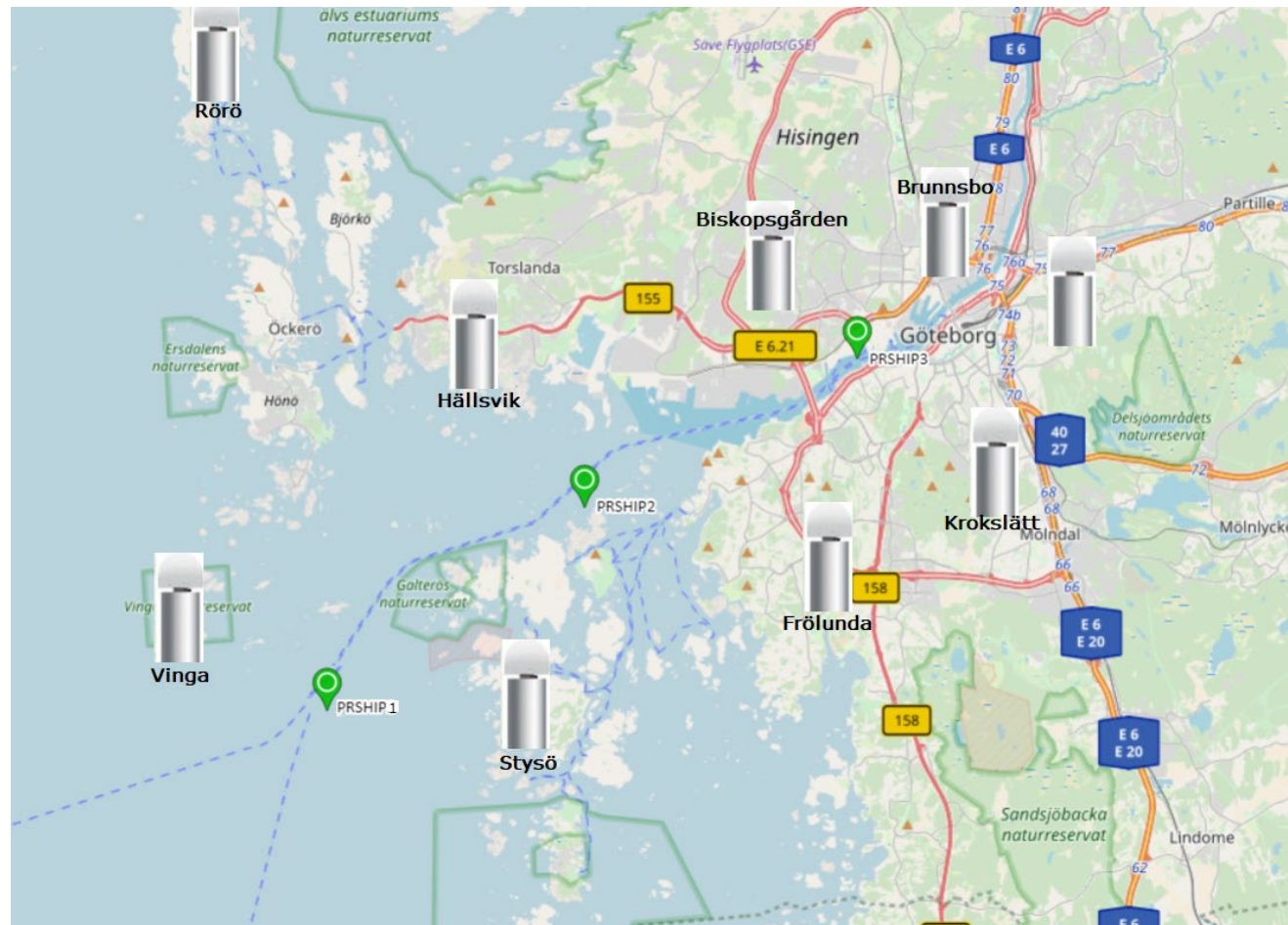- Geo-fencing and "go" areas

prepare-ships.eu

Some densification of the SWEPOS RTK network

In order to facilitate precise tests, the SWEPOS station network has been densified with additional stations in the archipelago of Gothenburg
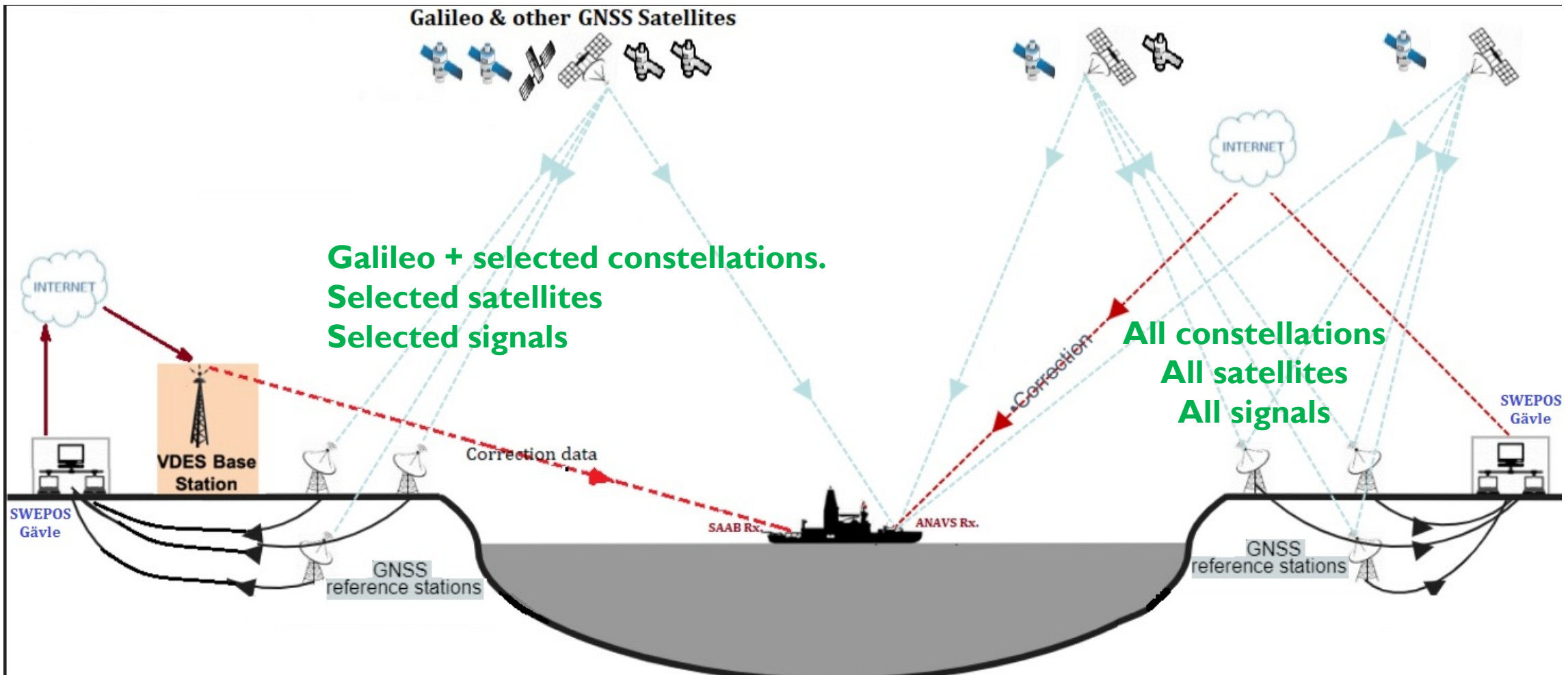

Vinga

Distribution of RTK corrections through VDES

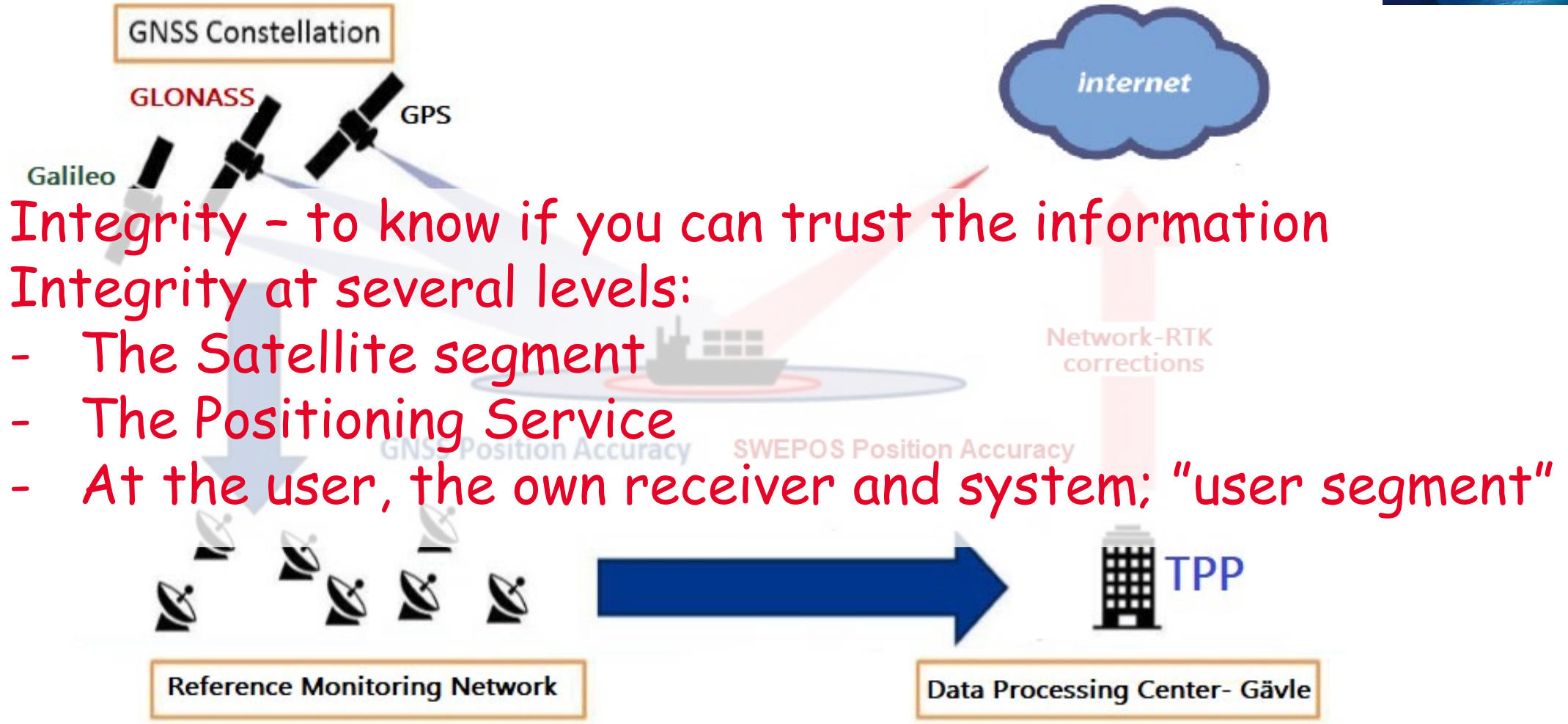Software development for the optimization of RTK in VDES
(VDES – communication link with better range at sea, but reduced data capacity)

INTEGRITY – NEXT PART IN THE PROJECT

Integrity – to know if you can trust the information

Integrity at several levels:

- The Satellite segment

- The Positioning Service

- At the user, the own receiver and system; "user segment"

DINPAS *Digital Infrastruktur för Noggrann Positionering av Autonoma System*

A continuation of the NPAD-project

Purpose: To meet the demand on precise and reliable positioning in focus area "autonomous airport, with scalablility for a large number of mobile units in order to promote next generation industrial digital solutions

"PPP"-service (Precise Point Positioning) based on SWEPOS, distribution in mobile network "for many" and implemented in user unit (u-Blox)
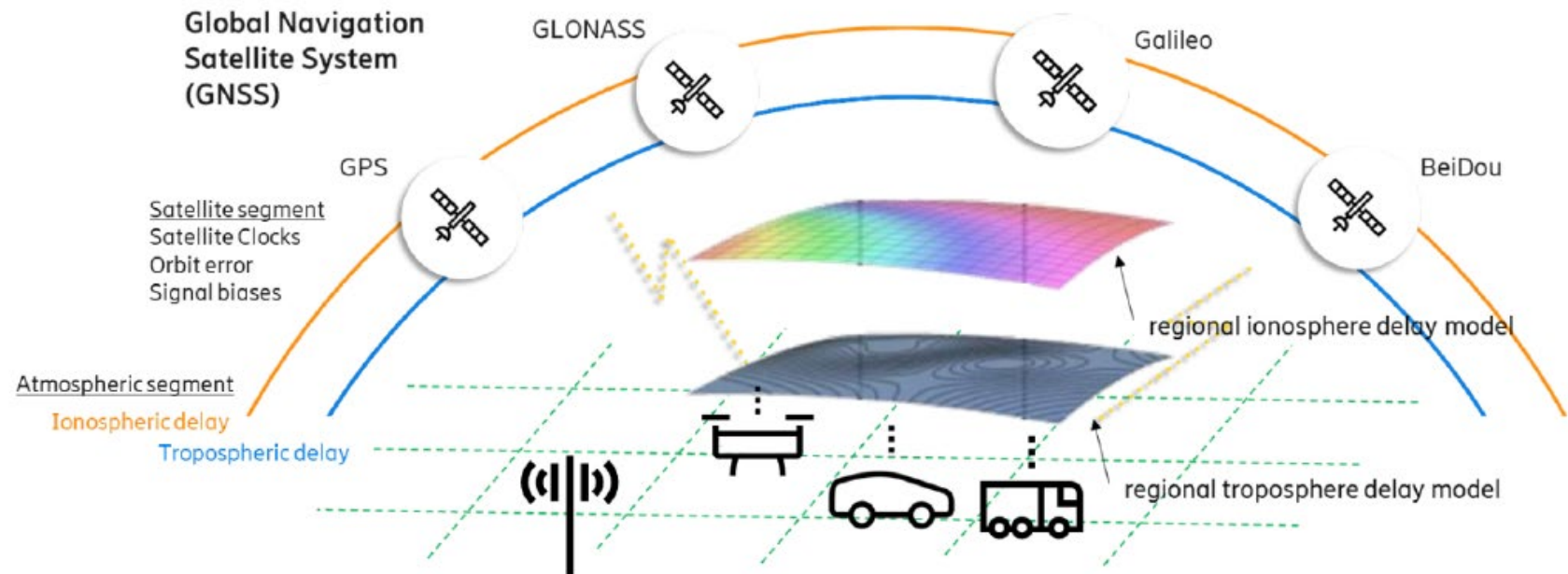
SPECIFIC CHALLENGE
– example sea traffic, but similar example on land and in the air

- At navigation at sea the ship use global positioning service that provide position in global reference frame

- Closer to the coast and for precision navigation in narrow waterways and approaching harbor and pier, the ship could use a regional positioning service with better performance (e.g. SWEPOS Network RTK or similar) that provide ger position and vertical position in reginal reference frame (national realizations of ETRS89 and EVRS) that agree in detail to the sea charts

- The challenge is then to automatic and seamless handle the transition from navigating at "open sea" to precise navigation in waterways and harbor.

Standardization issues
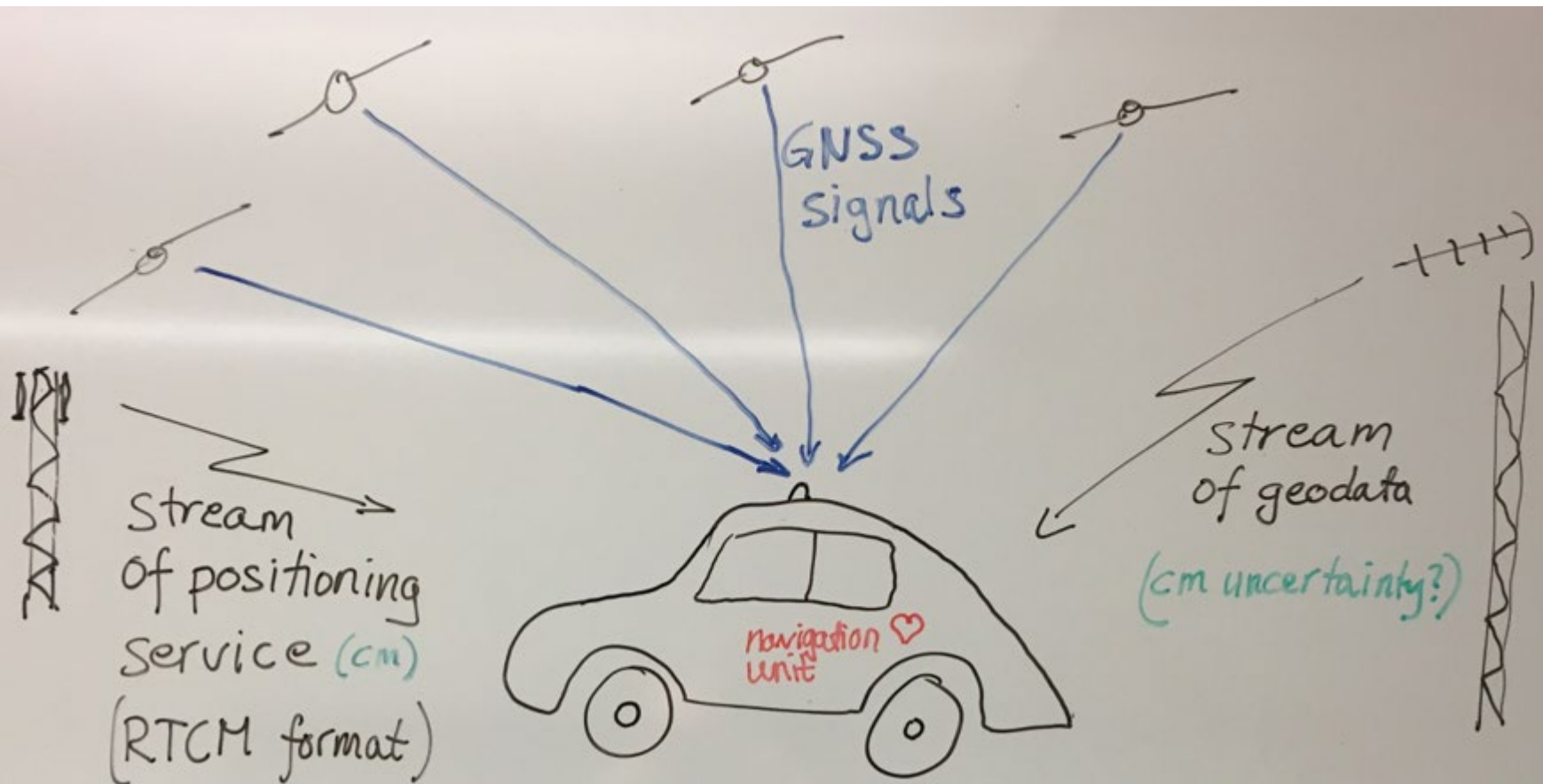
The navigation unit needs to be able to verify that geodata and positioning service use the same reference frames!

Therefore, we need reference frame information in the data streams.

And we need standards that supports this!

ISO GEODETIC REGISTRY

- AND OTHER REGISTRIES ON GEODETIC REFERENCE FRAMES

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THE ISO GEODETIC REGISTRY

- The ISO implementation of the standards
  - ISO 19111 (Geographic information – Referencing by coordinates) and
  - ISO 19127 (Geographic information – Geodetic register
  - ..and some more..
- ISO Geodetic Registry (ISOGR) (https://geodetic.isotc211.org)

*"The main purpose is to serve as the primary source for **authoritative** data on coordinate reference systems and transformations that can be used not only by end users but also other registries, including the ubiquitous EPSG Geodetic Parameter Dataset and Registry."*

"The concept of an ISO Geodetic Register (ISOGR) goes back many years, and the International Association of Geodesy (iag-aig.org) (IAG) has been active in supporting this by nominating the convenors for the Control Body of the ISO Geodetic Register." (i.e. Mike Craymer)

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BENEFITS OF ACKNOWLEDGED GEODETIC RF

- We (EUREF) evaluate national realizations/densifications of ETRS89

- For geographical information (e.g. GIS) applications, identifiers and description of the reference frame (or the "Coordinate Reference System" – CRS) together with transformations are important

- While "CRS" describe "coordinates" (numbers), Geodetic Reference Frames have not really defined how to express this (X,Y,Z) or (lat, long, h)

- We have identified the benefit of having the Reference Frame included in real time GNSS streams, and for this the **Identifiers** are needed

- The implementation of INSPIRE request known identifier for the geodetic reference frame (EPSG codes are used) while testing/accepting services for geodata

SEVERAL REGISTRIES ON "CRS"

- The ISO GR ISO Geodetic Registry (ISOGR) (isotc211.org)

- The IOGP (International Association of Oil & Gas Producers) EPSG register (https://epsg.org/home.html)

- "Our own" CRS-EU *"Information and Service System for European Coordinate Reference Systems"* (http://www.crs-geo.eu/)

- The widely used PROJ transformation tool may also be mentioned in this context (See Tutorial from the meeting in Tallinn)

Benefits of the ISO Geodetic Registry

- Authoritative information on geodetic reference frames
- The responsible for the reference frame (Coordinate Reference System) provide the information or acknowledge the information (*we have control of the information*)
- Description/definition of the CRS
- And transformation (to ITRF) or link to a publication

- The value of ISO may be important!
- And we have got request from the ISO Geodetic registry Control Body to promote national realizations of ETRS89 to be included/uploaded into the ISO GR

What happens next?

- I think it would be beneficial to include more national realizations of ETRS89 into the ISO GR,

- *(national realizations of EVRS is also important,but may be next step – we have currently the European Unified Height Reference on-going)*

- Therefore, I propose to write a letter to **national** contact persons, describing the ISO GR, and ask for providing the information on national ETRS89 realization

- The letter is in preparation and will be sent from chairman/convenor of the ISO GR Control Body (Mike Cramer) and chairman of EUREF (Martin Lidberg)

THANKS FOR YOUR INTEREST!

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