



NORDISKA KOMMISSIONEN FÖR GEODESI

Nordic Geodetic Commission

Working Group on Future Positioning Services and Applications
Chairman: Anna B. O. Jensen

WORKING GROUP FUTURE POSITIONING SERVICES AND APPLICATIONS

1st MEETING

Time: May 8, 2019 @ 12:00-17:30 and May 9, 2019 @ 9:00 - 12:00
Place: DTU Space, Building 356, Lyngby, Denmark

Participants: Sweden: Peter Wiklund, Bengt Eurenus, Dan Norin, Samieh Alissa from Lantmäteriet, Bo Jonsson from BNB Consulting (on May 8th)
Norway: Kenneth Bahr and Anders Martin Solberg from Statens Kartverk
Finland: Martti Kirkko-Jaakkola from Finnish Geospatial Research Institute
Denmark: Martin Skjold Grøntved from Agency for Data Supply and Efficiency, Per Knudsen and Anna Jensen from DTU-Space

Notes taken by: Anna Jensen



1. Welcome

Anna opened the meeting and presented the agenda which was approved by the participants



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2. Presentations on current status for GNSS positioning services in each country as well as activities in preparation for the future (if any)

Presentations were provided by:

- Norway (Kenneth and Anders-Martin)
- Finland (Martti)
- Sweden (Peter)
- Denmark (Martin and Anna)

The presentations are attached.

3. Presentation of the working group, its terms of reference

Anna presented the terms of reference for the working group as provided by the NKG General Assembly in 2018. The working group has a four year term with 3½ years left until the next general assembly in 2022. Results should be presented at the end, but also during the term in connection with the bi-annual meetings of the NKG Presidium. Anna is representing the working group in the Presidium.

She suggested to prioritize the work as follows:

- First focus on:
 - First milestone: White paper on future GNSS positioning services in 2019
 - Define a framework for socioeconomic analysis of future GNSS positioning services
 - Urgent because of budgeting and tendering process
- Then, discuss how to prioritize time left:
 - Nordic platform for testing and verifying Galileo and EGNOS services and other GNSS developments
 - Joint project with the car industry to define future demands on the geodetic infrastructure
 - *Research competences on GNSS within the NKG region, identify lacking knowledge, and suggestions for research projects*
 - Define needs for national geodetic infrastructure and services to support future GNSS services
 - Recommendation for future regulation and responsibilities for NMAs in relation to GNSS services

The meeting agreed to follow this suggestion.

4. Framework for socioeconomic analysis

Anna made an introduction to the concept of socioeconomic analyses and suggested the following approach:

- What the working group **shall do**:
 - Definition of the basic scenario
 - GNSS services as of today + expected future GNSS positioning services (i.e. define a future scenario)
 - Things to include in the analysis
 - E.g. private sectors like farming and construction, public sector like cadaster and environmental monitoring, both development of services and users of services etc.
 - Limitations – what to exclude
 - Perhaps military applications?



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- Frame for the output – what do we want the analysis to show?
 - E.g. economic benefits for the farming sector but also economic impact on public health, the environment etc.
- Working group **shall not do**, but leave to the tenderers to suggest or provide:
 - Costs – e.g. the costs of user equipment or developing Galileo
 - Values – e.g. the value of more efficient farming or less accidents or time saved in traffic by use of road pricing
 - Quantification – e.g. number of autonomous cars in our scenario or how to quantify benefits for public health by future GNSS services
- Difficult aspects to consider:
 - Innovation, new applications not yet invented
 - Others?

Kenneth mentioned that Kartverket has initiated work on a socioeconomic analysis on effects of providing GNSS services for free (as opposed to the current payment scheme). This work is on-going.

Martin mentioned that some analyses have already been carried out by SDFE. Reports can be found here (in Danish and/or English):

- Analysis of geospatial data requirements to support the operation of autonomous cars:
https://sdfe.dk/media/2918928/geospatialdata_cavs_final_report.pdf
- Behovet for infrastruktur for positionerings og navigationsdata:
https://sdfe.dk/media/2918878/deloitte_behovet-for-infrastruktur-til-positoneringsdata.pdf
- Denmark's economic vulnerability to a loss of satellite-based PNT:
<https://ufm.dk/publikationer/2019/denmarks-economic-vulnerability-to-a-loss-of-satellite-based-pnt>
- Also the report "Afdækning af værdien af positioneringstjenester i Danmark" which is not available online but is attached to these notes.

The meeting then discussed elements of importance for a socioeconomic analysis as follows:

Definition of scenario

Expectations and anticipations:

- Galileo Commercial Service (HAS) operational with 20 cm accuracy
- Next generation Galileo available
- Next generation EGNOS available
- Beidou fully operational
- RTK services with < 2 cm uncertainty available in all Nordic countries
- PPP services with < 5 cm uncertainty within coverage area (south of 65 deg. North)
- Convergence time for PPP (initialization time) at 20-30 seconds (PPP-RTK)
- Wide spread **dual** frequency mass market receivers
- High quality GNSS antennas in cell phones for carrier phase tracking
- High integrity GNSS service is available
- Expect standards and formats available to support the technical development



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- The Galileo authentication services, OSNMA and CAS, (and PRS) are available
- Positioning services (as of today or similar to today's services) are for free in the Nordic countries
- High accuracy timing service is available

- Increased probability of interference
- Increased probability of jamming (even if illegal)
- Increased probability of spoofing (even if illegal)

Other technologies: 5G available in urban areas, complimentary positioning techniques widely available

Dissemination media: NTRIP distribution of PPP-RTK data (i.e. not only via geostationary satellites)

Supporting infrastructure:

- Sufficient power available for signal tracking and processing (e.g. in smartphones, electrical cars)
- High accuracy 3D city models and terrain models
- Validity of geodata (including cadastral) to be discussed, can coordinates be trusted

Legal issues:

- Legal to drive autonomous vehicles
- Legal to use drones within restricted areas given some conditions
- Illegal to own and use jammers and spoofers
- EU Regulations enforcing the use of Galileo (eCall, train control, etc.)

Frame for the output – how do we want to use the analysis, what shall it show?

- Basis for strategies for research, infrastructure initiatives, and financing
- Basis for decision making on geodetic infrastructure
- Broader picture of future role of government institutions (e.g. NMA's)
- Boundary of responsibility for government institutions reg. geodetic infrastructure, geodata etc. (currently these boundaries are different in the Nordic countries)
- Most important private sector players for future innovation (e.g. software companies)
- Basis for ideas for new research topics
- Shall provide financial costs and benefits (quantitative)
- Shall provide ecological (climate, environment, health, etc.) costs and benefits (qualitative)
- Identify areas for possible forerunning of Nordic innovation and industry compared to other countries/regions

Areas of application to include in the analysis:

- Farming (tractor steering, machine control and guidance etc.)
- Construction work (machine guidance etc.)
- Land surveying (cadastral, construction, cable registration etc.)
- Robotics
- Autonomous driving (cars, trucks etc.)
- Drones
- Maritime applications



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- Railway applications
- Location based services (LBS) including augmented reality (AR)
- Air navigation
- Monitoring services (Earth quakes, climate change etc.) – refer to the UN GGRF initiative on the importance of correct positioning
- Surveillance services
- Smart grids (power network)
- Leisure and sports
- Mobility service tracking (people, scooters etc.)
- Smart City applications
- Internet of things (IOT) applications
- Police, border control, coast guard etc.
- Meteorological use of GNSS (weather predictions)

- Location based artificial intelligence (AI) as a tool for various applications

- Seamless indoor-outdoor positioning, a challenge which must be solved

- Backup facilities - check European Radionavigation Plan (ERNP) for input on this

- Consider use of a common Nordic data platform for data available to the public as opposed to national platforms

Areas of application to exclude from the analysis:

- Military and intelligence applications (because of difficult access to information)
- Timing (because it is a different field than geodesy and other competences are needed)

To do next

- Take this list home, consider, discuss with colleagues
- Add key requirements for the different fields of applications (e.g. requirements to accuracy)
- At the next meeting, discuss the list again mainly with respect to priorities in the list

At the NKG Presidium meeting first week of October, Anna will lift the question of how to handle a possible joint tender by (some of) the Nordic mapping agencies

Remember in tender that the analysis is for the Nordic countries – not global (i.e. do not use average global values or global anticipations).

5. Presentation of DTU Space and the TAPAS test platform

Per Lundahl Thomsen, chief consultant at DTU Space, presented the activities of DTU Space - the National Space Institute in Denmark. He also provided a detailed presentation of the TAPAS test platform. The presentation was followed by a number of questions from the meeting participants.



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6. White Paper on future positioning services

Anna made a short presentation on the concept of white papers.

In this case the document is aimed at the Director Generals of the National Mapping Agencies and this should be kept in mind when considering the language and scientific level of the document.

The white paper should be ready in 2019.

With respect to the content of the white paper, the following items were discussed by the meeting:

- Focus on dynamic, not static applications (focus on moving users)
- Omit timing applications
- Focus on the Nordic countries
- Consider EU initiatives (regulations etc.)
- Focus on region specific challenges in the Nordic area (e.g. ionosphere, snow, ice, remote areas, low elevation angle for geostationary satellites for dissemination etc.)
- Consider that the Nordic countries are highly digitized societies
- Include global services that are used in the Nordic area

Use of the white paper

Keep in mind that perhaps the white paper will steer activities of our organizations in the coming years.

Suggested content of the white paper

The meeting discussed the following content to be provided in the white paper:

- Introduction to the level of development in the Nordic countries
 - 3G, 4G, digitalization, uptake of new technologies (e.g. smart phones, tablets etc.), free and open data sources, positive attitude towards new technology
- Reference to World Economic Forum white paper on IoT, autonomy etc.
- Development of GNSS systems – GPS, GLONASS, Galileo, Beidou
 - Keep this very short
- Development of non-Nordic services available in the Nordic countries, public
 - For instance IRNSS (Indian), SDCM (Russian), EGNOS, Galileo HAS and safety of life service etc.
 - Dissemination of data in the high North (e.g. Norway and Greenland), new communication satellites etc.
- Development of non-Nordic services, available in the Nordic countries, private (i.e. closed, proprietary services)
 - For instance Fugro, Trimble, SAPCORDA etc.
- Development of GNSS positioning services in the Nordic countries
 - Integration/interaction between national and global services
 - Identify gaps between these two types of services (national vs. regional / global)
 - How to provide PPP-RTK to everyone (non-proprietary), stand on existing projects and testing e.g. within FinnRef and TAPAS
 - Seamless transfer between networks / service providers / VRS
 - Development of high integrity services
 - Challenges with the height component (geoid)
 - Challenges with reference frames (national vs. global)



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- Development of applications and areas of use in the Nordic countries – farming, construction, autonomous mobility, LBS etc. – discuss this in relation to each service above

Discuss with the maritime organizations about their plans for navigation infrastructure

Use GSA reports as references, i.e. the GSA Market Report, User Technology Report, and User Requirement Report Series (output from the GSA user consultation platform, e.g. road, maritime etc.)

- Reports from the GSA are available through this web site:
<https://www.gsa.europa.eu/market/gnss-market>

To do next:

- Clear the suggested list of content with the NKG Presidium before we start any writing (Anna)
- Look for existing text that can be re-used in the White Paper (all)
- Assign writing tasks for what is missing, after clearance from the Presidium (all)
- Use Google docs as platform for the writing (Anna)
- Keep the document to maximum five pages

7. Plan for future work of the working group

The meeting discussed suggestions for agenda items at the next meeting:

- Budget in relation to the socio-economic analysis – check on similar work already done and what may be available
- Presentations on existing activities regarding platforms for testing Galileo and EGNOS from each country (all)
- Presentations on ongoing projects with the car industry (all)
- Presentation on need for integrity service (by Lantmäteriet)
- Discuss how the cooperation with the car industry can be carried out. Perhaps need for dialogue because we must explain what is meant with geodetic infrastructure. Is funding needed/available for this?
- Consider not only car industry, but also the GNSS service providers aiming at the car industry (e.g. Sapcorda, Trimble etc.)
- Consider joint Nordic research projects to solve problems experienced by the car industry
- Consider seminar / workshop with car industry on need for geodetic infrastructure
- Consider broadening the concept – not only cars but also drones (because they have different requirements), machine steering (farming and construction work), and/or robotics in general
- Consider state of the art on SLAM and related research (other sensors than GNSS and sensor fusion)

Before the next meeting Anna will make an agenda considering some of these items as well as the socioeconomic analysis and the white paper.

8. Any other business

Dan asked about participants from the Baltic countries.



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Anna replied that they have been invited to participate through the NKG Presidium. Before next meeting of the working group, she will make direct contact with colleagues in the Baltic countries to ask if they want to participate.

9. Next meetings

- 2nd meeting:
Will be in Denmark (either Aarhus or Copenhagen) during September 2019. Martin will find meeting room and provide suggestions for meeting dates as soon as possible
- 3rd meeting:
Will be in Iceland, during calendar week 11 which is March 9-13, 2020. This will be in connection with an NKG Science Week, more information will follow later.