SWEPOS™ and its GNSS-Based Positioning Services

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Key words: GPS, GLONASS, GNSS, reference stations, network RTK

SUMMARY

SWEPOS™, the Swedish network of permanent reference stations for GNSS, is operated by Lantmäteriet (the National Land Survey of Sweden). Today (spring 2008), the network consists of 161 stations that receives signals from both GPS and GLONASS satellites. The stations are connected to a control centre, which in that way has access to GNSS data from all stations in real-time.

A broad spectrum of Swedish organizations makes use of GNSS data from the SWEPOS control centre to make their applications more efficient. The applications are related to both scientific and production work. For scientific work such as studies of crustal motions, meteorology, timing applications, monitoring GNSS and tasks related to reference systems (SWEPOS is for example the basis for the Swedish national reference frame SWEREF 99), post-processing is mainly used. For production work, SWEPOS users can take advantage of five GNSS-based services where three are real-time services:

– Post-processing data through WWW/FTP service
– SWEPOS Automated Processing Service on the SWEPOS web-page
– SWEPOS Network RTK Service
– SWEPOS Network DGNSS Service
– The DGPS service Epos, which is operated by the Swedish company Teracom

Especially the network RTK service is widely used for data capture in many mapping applications, but also in a lot of other areas, e.g. cadastral work and within building and construction work (including machine guidance).

SWEPOS is under constant development and new technical solutions are regularly implemented. A good way to verify the benefits from new solutions in SWEPOS and its services is to let students perform diploma works. Several diploma works have in this way supported the development of SWEPOS. This also makes the introduction of young surveyors into the surveying profession easier. They will at the same time bring new knowledge to the profession and also the capacity to broaden the applications that can be solved by GNSS measurements.

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1. INTRODUCTION

If permanent reference stations that continuously receive signals from GNSS satellites are working together in a network, the use of the stations and the data from them will be more efficient. GNSS (Global Navigation Satellite Systems) has during the past years become an established term for those satellite-based systems that are used for navigation and positioning. SWEPOS™ is a Swedish national network of permanent reference stations for GNSS and the SWEPOS web-page is found on www.swepos.com.

2. THE SWEPOS NETWORK

The SWEPOS network is operated by Lantmäteriet, the National Land Survey of Sweden. Today (spring 2008), the network consists of 161 stations for both GPS and GLONASS operation, see Figure 1-1.

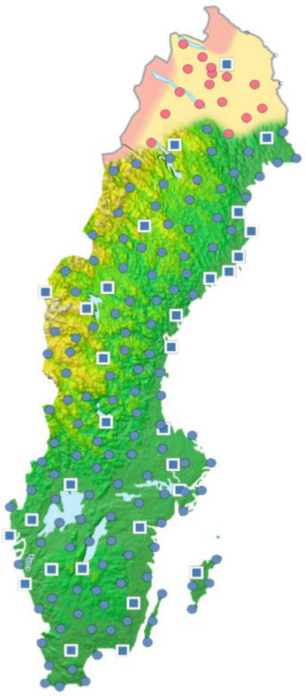

Figure 1-1: The SWEPOS network of permanent reference stations for GNSS consists of 161 stations covering Sweden. Red dots are planned stations.

The development of SWEPOS started in 1991. GNSS data from the stations has all the time been used for both production and scientific work. Even though the main part of the users today is found within production applications, the scientific part of SWEPOS has been important from the beginning. Onsala Space Observatory at Chalmers University of Technology in Gothenburg is an organization studying scientific applications of space-based geodetic techniques. The first years of the SWEPOS operations were performed as a co-operation between Lantmäteriet and Onsala Space Observatory.

In 1998, the SWEPOS network was declared operational for post-processing applications and for real-time positioning with metre accuracy, IOC mode. The development from an experimental network to IOC status was financed by the following Swedish governmental agencies together with Lantmäteriet:

- the National Rail Administration
- the National Road Administration
- the National Maritime Administration
- the Swedish Civil Aviation Administration
- the Swedish Telecommunication Administration
- the Swedish State Railways
- the Swedish Defence

SWEPOS has since 1999 been improved to meet demands on real-time positioning with centimetre accuracy and the development and operation are both since 2000 the responsibility of Lantmäteriet. The development has however been done in co-operation with Onsala Space Observatory and the SWEPOS users.

The purposes of SWEPOS can be summarized with (Jonsson et al., 2006 and Jämtnäs et al., 2008):

- Provide L1 and L2 raw data to post-processing users
- Provide DGNSS and RTK corrections to real-time users
- Act as high-precision control points for Swedish GNSS users
- Provide data for scientific studies such as crustal motion
- Monitor the integrity of the GNSS systems
- Act as the basis for the Swedish national geodetic reference frame SWEREF 99

2.1 The stations in the SWEPOS network

The oldest station in the SWEPOS network is the station at Onsala Space Observatory, which was established already in November 1987. The first station designed to be a SWEPOS station was Mårtsbo, which has been running since December 1991. In August 1993, SWEPOS consisted of 20 reference stations and in 1996 a 21st one (Borås) was added. These 21 stations are all monumented with concrete pillars directly on bedrock, see Figure 2-1. New stations have been added since 1999 and the establishment of the main part of them has been done in a more simplified way. For example, these stations have mainly roof-mounted GNSS antennas, see Figure 2-2. The first 21 stations together with 11 newer stations that mainly have been monumented with concrete pillars are called Class A stations (blue squares in Figure 1-1). The remaining 129 stations belong to Class B and have mainly been established for network RTK purposes (blue dots in Figure 1-1).

Figure 2-1: Östersund is one of the 21 first SWEPOS stations belonging to Class A.

All 161 SWEPOS stations are equipped with dual-frequency GNSS receivers, which track both GPS and GLONASS signals. Data is collected every second and a 5 degrees elevation mask is used. The GNSS antenna at every station is a choke-ring antenna of Dorne Margolin design mounted under a radome. The radomes are made of clear acrylic.

Figure 2-2: Söderboda is a SWEPOS station with a roof-mounted GNSS antenna mainly established for network RTK purposes belonging to Class B.

The pillars which are used for the antenna monumentation on the main part of the Class A stations are three metres high, see Figure 2-1. Due to the winter conditions in Sweden, these pillars are insulated and heated electrically to a constant temperature of about 15^{o} C. This will reduce the deformations of the pillars due to thermal expansion. Small high-precision geodetic networks marked with steel bolts in bedrock are also established around each pillar. These networks make it possible to check the stability of the pillars using terrestrial geodetic methods (Lidberg & Lilje, 2007). A complete network computation of all SWEPOS stations is done on a daily basis with the Bernese GPS Software, in order to monitor the stability of the Class B stations.

2.2 The data flow in the SWEPOS network

The stations in the SWEPOS network are connected to a control centre located at the head quarters of Lantmäteriet in Gävle via leased TCP/IP connections, which are monitored at all times. The SWEPOS control centre therefore has real-time access to 1 Hz raw GNSS data from all the 161 stations, which is quality checked before further distribution to the different services and end users.

A broad spectrum of Swedish organizations makes use of GNSS data from the SWEPOS control centre to increase productivity and efficiency in their respective applications. The applications are related to both scientific and production work. Scientific applications are described in Chapter 3. For production work, SWEPOS users can take advantage of five different GNSS-based services, which are described in Chapter 4.

3. SCIENTIFIC APPLICATIONS

Research institutes are using SWEPOS data for studies of crustal motions (Lidberg, 2007 and Lidberg et al., 2007) and for estimation of the water vapour content in the atmosphere. SWEPOS data is also used for timing applications and for monitoring GNSS. Post-processing is mainly used for the scientific work.

Lantmäteriet is using SWEPOS data for tasks related to reference systems. SWEPOS is the basis for the Swedish national reference frame SWEREF 99, which is a realisation of the adopted European three-dimensional reference system ETRS 89. SWEREF 99 was certified (accepted) by the IAG Sub commission for Europe (EUREF) in June 2000 and is defined by the original 21 SWEPOS Class A stations. SWEPOS data is also used to monitor the stability of the Swedish reference systems, e.g. the influence of the land-uplift process.

3.1 IGS and EUREF

Lantmäteriet and Onsala Space Observatory have been active in international projects for many years. One example is EUREF, where the European countries have collaborated in building up a network of permanent GNSS stations as well as in computing national realisations of ETRS 89.

The SWEPOS stations Visby, Onsala, Borås, Mårtsbo, Vilhelmina, Skellefteå and Kiruna are included in the European network of permanent reference stations, EPN. Data is delivered every hour to the data centre at BKG (Federal Agency for Cartography and Geodesy) in Germany. Data in the EPN network is processed at a number of analysis centres in Europe and the results from these computations are combined to one solution per week, which is available at the EUREF web-site. The data from the Nordic block of EUREF sites is processed at the Nordic Geodetic Commission (NKG) processing centre at Lantmäteriet in collaboration with Onsala Space Observatory.

The SWEPOS stations Visby, Onsala, Borås, Mårtsbo and Kiruna are also included in the network for the International GNSS Service (IGS). All Swedish EPN stations, except Vilhelmina, are also participating in two pilot projects for real-time distribution of GNSS data over the Internet, EUREF-IP and IGS-RTPP.

4. SWEPOS SERVICES FOR PRODUCTION APPLICATIONS

Five different GNSS-based services from SWEPOS, where three are real-time services, can be used for production work:

– Post-processing data through WWW/FTP
– SWEPOS Automated Processing Service on the SWEPOS web-page
– SWEPOS Network RTK Service
– SWEPOS Network DGNSS Service
– The DGPS service Epos, which is operated by the Swedish company Teracom

4.1 Data for post-processing

GNSS data for post-processing from all SWEPOS stations is found on a server at the SWEPOS control centre through WWW/FTP. The data is prepared by the control centre in RINEX format at both 1 s and 15 s interval. Access to data is charged according to a subscription system, where unlimited access to data from all SWEPOS stations costs approximately €3200 for one year or approximately €50 for one day data from five stations.

Users of post-processing software for production applications where SWEPOS data is used are found in organisations with different demands on accuracy. It could be high demands like in cadastral surveying, aerial photogrammetry and airborne laser scanning, as well as GIS applications etc.

4.2 SWEPOS Automated Processing Service

SWEPOS Automated Processing Service has been developed in order to facilitate the use of SWEPOS data for high-precision static point positioning automatically. The user does not have to perform the computations in a standard post-processing software himself. Instead the Bernese GPS Software and a web-application on the SWEPOS web-page developed by Lantmäteriet are used for the computations. The service was introduced in the autumn 2000. During 2008, the service has started to use version 5.0 of the Bernese GPS Software instead of version 4.2.

The user submits an observation file containing dual frequency data along with information about the used GNSS antenna in RINEX format to the service. When the processing is completed (typically after 5-10 minutes) the web-page is updated and a text file with a summary of the processing along with quality parameters is sent to the user by e-mail. The final coordinates are delivered in the national reference frame SWEREF 99, a realisation of the European reference system ETRS 89. From 2-3 hours of observation time standard deviations of 1 centimetre per horizontal component and 1.5-2 centimetres in height are obtained. The use of the processing service is charged according to a subscription system. Unlimited use together with access to data from all SWEPOS stations costs approximately €3800 for one year or approximately €60 per observation day for an unlimited number of measurements.

4.3 SWEPOS Network RTK Service

SWEPOS Network RTK Service was launched on January 1st 2004, following the successful completion of some so-called pre-study projects. These pre-study projects were carried out from 1999 and onward, in order to evaluate the network RTK technique together with users. The main purpose of these projects, which lasted for approximately one year each, was to establish limited station networks for network RTK, by regional densification of the original 21 SWEPOS stations. The pre-study projects were financed as collaboration projects, with participants from governmental agencies, municipal authorities, private companies and academic institutions. The SWEPOS network has since 2004 been further extended step by step through similar projects and one project is still running. These projects have also been part-financed by Structural Funds from the European Union. The main part of Sweden is now (spring 2008) covered by the network RTK service and the coverage area coincides with the green area in Figure 1-1.

SWEPOS Network-RTK Service is based on the VRS concept (Virtual Reference Station) with two-way communication between the control centre and RTK rovers. GSM and GPRS (i.e. mobile Internet connection) are used as the main distribution channels for the real-time GNSS data. Since April 1st 2006, data for both GPS and GLONASS is provided in the RTCM standard format, version 3.0. The expected position accuracy is approximately 0.15 mm horizontally (68 %) and 0.25 mm vertically (95 %). Data for SWEPOS Network-RTK Service is charged according to a subscription system, see Table 4-1. All data distribution costs are paid by the users directly to the GSM/GPRS operator.

	Fee	**Fee**	**Fee**
Service	***Network RTK with GPS only***	***Network RTK with GPS/ GLONASS***	***Network DGNSS with GPS/ GLONASS***
Registration	€550 per GSM number	€550 per GSM number	€550 per GSM number
Unlimited data access	€1500/yr per GSM number	€2000/yr per GSM number	€950/yr per GSM number
Per minute access	€550/yr per GSM number + €0.50/m	€850/yr per GSM number + €0.50/m	N/A

Table 4-1: Approximate user fees for access to the SWEPOS Network RTK and Network DGNSS Services. Organizations with more than 5 GSM connections can get on offer pricing.

Many of the users of SWEPOS Network RTK service do not belong to the conventional surveying community. This has resulted in the development of a field manual for network RTK measurements with the service (Norin et al., 2007), which is distributed to all new users. The major Swedish GNSS equipment dealers also provide ready-to-go packages for the SWEPOS positioning services. These packages are tailor-made for different applications, and minimize the need for new users to master all aspects of their equipment in order to use the positioning services.

A recent trend is the increasing use of the network RTK service for machine guidance and precision navigation, most notably in the form of flexible and redundant services that are tailor-made for large-scale projects. One example of this concept is the project service mainly set up for a 20 km long road and rail construction project in the Gothenburg area. Lantmäteriet has here, in collaboration with the National Road Administration and the National Rail Administration, established five additional SWEPOS stations (i.e. a local densification of the SWEPOS RTK network) with redundant equipment and TCP/IP connections. Radio modems are used for one-way distribution of network RTK data in the project area. The short inter-station distances (~10 km) make it possible to use radio modems, and furthermore to reach better accuracy than in the ordinary network RTK service. Expected position accuracies are in the order of 0.010 m horizontally (68 %) and 0.015 m vertically (68 %).

4.3.1 Users of SWEPOS Network RTK Service

The number of registered users of the network RTK service is approximately 950 (spring 2008). There are also 250 additional users who are coming from universities, are GNSS equipment dealers etc. or are still part of the ongoing pre-study project. The goal is to have 1500 users within the next three years. The rapid increase in the usage of the network RTK service is exemplified by looking at total user connection time, see Figure 4-1.

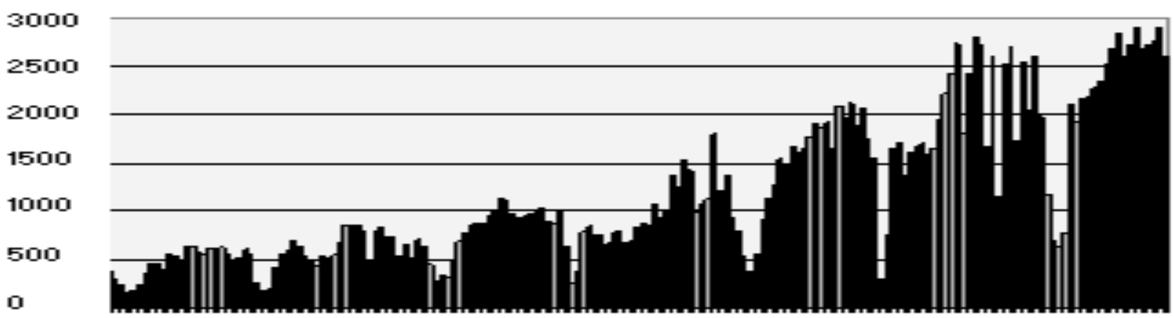

Figure 4-1: Total user connection time (in hours) per week for the SWEPOS Network RTK Service, from mid summer 2004 to late 2007.

The network RTK service is widely used for data capture in mapping applications, but also in several other areas such as cadastral surveying and for building and construction work. Figure 4-2 shows some statistics of service usage, according to choice of subscription and type of user organization.

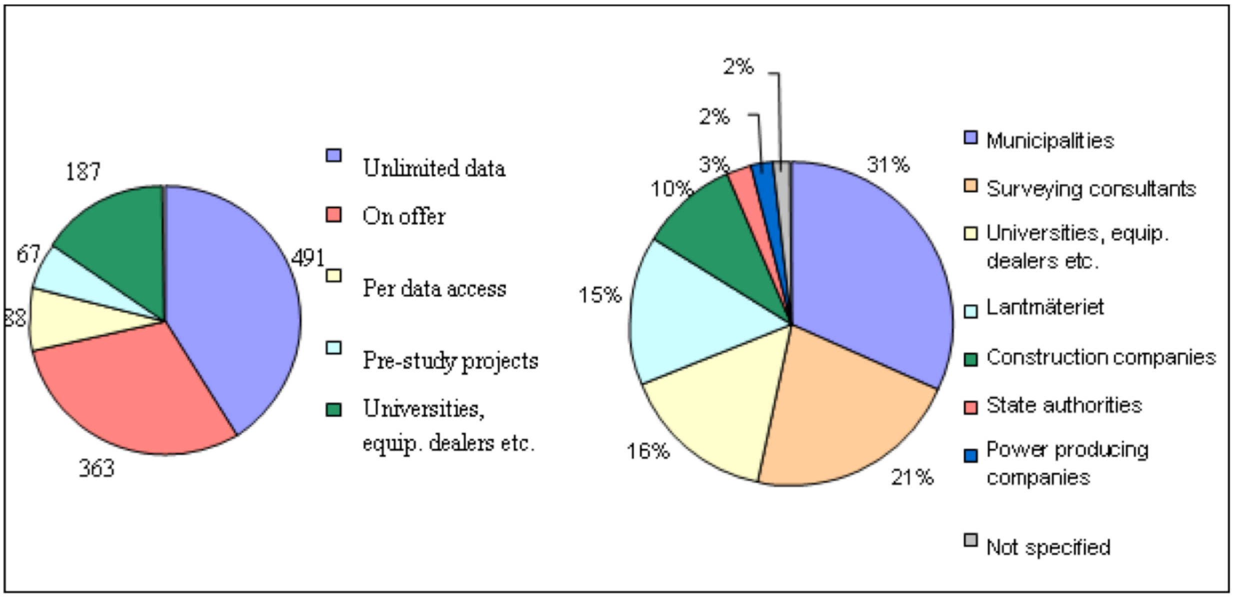

Figure 4-2: Number of SWEPOS Network RTK Service users per subscription alternative and SWEPOS Network RTK Service users per organization category (early April 2008).

During February 2008, a survey of the users of SWEPOS and its services was carried out by questionnaire. The survey had special focus on SWEPOS Network-RTK Service. Close to 400 answers were received from the 950 users. Most of the users are very satisfied with the performance of the network RTK service and consider it to be worth its price. The users are also very satisfied with the support from the personnel at the SWEPOS control centre.

The present horizontal accuracy 15 mm (standard error) of the service meets the demands from most of the users, but a better accuracy than the present 25 mm (standard error) in height are required by 40 percent of the users. Almost 50 percent of the users can today perform all their positioning with SWEPOS Network RTK Service. The coverage of the mobile phone networks is in some parts of Sweden still a bottleneck.

The users of the SWEPOS services expect high availability and high service performance. This is a combination of the performance of the GNSS satellites, the GNSS rover equipments, SWEPOS and the mobile phone networks. Therefore it can sometimes be hard to locate the reason behind a bad RTK initialization of the user's rover equipment, since there are so many links in the chain. A standard for the internal accuracy of the position which is reported in the rovers and better initialization algorithms when you have many satellites at the elevation 15 degrees above the horizon are some proposals for the improvements of the GNSS rovers. Improved accuracy for the height of the position, better information about failures in the operation of SWEPOS through SMS messaging and the SWEPOS Web-site, and also improved performance of the mobile Internet service GPRS are other proposals from the users.

For the future the users expect that SWEPOS Network RTK Service is an improved tool in their toolbox which can be used in almost all their positioning needs because of increased number of signals and satellites, improved accuracy of the positions and improved coverage of mobile Internet. Of course the users also expect a reduction in subscription fees for the service.

4.4 SWEPOS Network DGNSS Service

SWEPOS single frequency Network DGNSS Service was launched on April 1st 2006. This service runs on the same platform as SWEPOS Network RTK Service, and is therefore also built around the VRS concept. The network DGNSS service provides differential GPS/GLONASS data in the format RTCM 2.3. The interstation distances used are about 200 km. The expected position accuracy is in rather open areas approximately 0.2 m horizontally (68 %) and 0.4 m vertically (68 %). Data from the service is charged according to a subscription system, see Table 4-1. All data distribution costs are paid by the users directly to the GSM/GPRS operator.

4.5 The DGPS service Epos

The Epos service is a DGPS service for metre accuracy, operated by the Swedish company Teracom. The service is based on single-base DGPS corrections from a number of SWEPOS stations, distributed via FM radio. Epos was launched in 1994 when Selective Availability (SA) was activated in the GPS system. Typical applications are found within farming, forestry and GIS data capture.

5. DEVELOPMENT OF SWEPOS THROUGH DIPLOMA WORKS

SWEPOS is continuously developed and new technical solutions are regularly implemented. A good way to verify the benefits from new solutions in SWEPOS and its services is to let students from universities perform diploma works. Several diploma works have in this way supported the development of SWEPOS. This also makes the introduction of young surveyors into the surveying profession easier. They will at the same time bring new knowledge to the profession and also the capacity to broaden the applications that can be solved by GNSS measurements

5.1 Recent diploma works dealing with SWEPOS Automated Processing Service

The users of SWEPOS Automated Processing Service receive a summary of the processing along with quality parameters. Some guidelines on how to evaluate these quality paramaters were established when the service was intruduced. A diploma work carried out during recent years has confirmed these guidelines (Ivarsson, 2007).

5.2 Recent diploma works dealing with SWEPOS Network RTK Service

A lot of test measurements have been done during the early developments of SWEPOS Network RTK Service. These measurements have had the purpose to verify the accuracy and performance of the service. Some measurements were done in diploma works, which also included comparisons to single-station RTK.

Before GLONASS data was included in the service April 1st 2006, a diploma work compared the performance of the service with and without GLONASS (Eriksson & Hedlund, 2005). Since the measurements were done on points with good visibility towards the satellites, no large differences in performance were shown. Another diploma work with measurements on six points with much more variation in visibility towards the satellites was performed during the winter 2007 (Johnsson & Wallerström, 2007). Panorama pictures of 360 degrees were taken around each point to show the vegetation around them, see Figure 5-1.

Figure 5-1: Panorama picture of 360 degrees on the point with most vegetation in the diploma work. South is in the middle of the picture. The upper and lower edges of the picture have an elevation angle of 30 and 70 degrees respectively.

A total number of 1440 measurements were done in the diploma work with three different brands of RTK equipments and three things were mainly studied from the measurements:

- Successful measurements
- Differences between measured and known positions
- Times to fixed solution

A measurement was considered to be successful if a fixed solution was obtained within three minutes. The combination GPS/GLONASS gave more successful measurements than only GPS. (Table 5-1). Concerning accuracy expressed as RMS values of the differences between measured and known positions, only GPS showed slightly better values than the combination GPS/GLONASS (Table 5-1). This can however be explained by the fact that there were more successful measurements with the combination GPS/GLONASS, and these measurements were taken during rather bad conditions. To summarize the diploma work, the combination GPS/GLONASS showed better performance than only GPS in SWEPOS Network RTK Service, but the accuracy was on the same level.

	Successful measurements	RMS horizontally	RMS vertically
GPS/GLONASS	89 %	16 mm	24 mm
GPS	82 %	14 mm	21 mm

Table 5-1: Number of successful measurements and RMS values of the differences between measured and known positions in the diploma work. Only successful measurements are included in the RMS values.

Another diploma work studying SWEPOS Network RTK Service was performed during the spring 2007. This diploma work was focused on network RTK in large-scale construction projects. In the project in the Gothenburg area mentioned in Section 4.3, conventional radio distribution of RTK data has been chosen as an alternative to the ordinary distribution through GSM/GPRS. The main purpose with the diploma work was to compare the two different ways to distribute network RTK data, radio and GPRS (Halvardsson & Johansson, 2007).

A total number of 960 measurements (all fixed solutions) on points with known positions were done and both GPS and GLONASS data were used. Both distribution techniques showed the same result concerning accuracies and times to fixed solution. The accuracy was also as expected considerable better than for ordinary network RTK. The RMS values of the differences between measured and known positions were for both distribution techniques 11-12 mm horizontally and 15 mm vertically.

5.3 Recent diploma works dealing with SWEPOS Network DGNSS Service

A diploma work carried out during 2005 made a comparison of a preliminary version of SWEPOS Network DGNSS Service and the DGPS service Epos (von Malmborg, 2006). The purpose was to compare the accuracy of a network DGPS network with inter-station distances of 70 km and 200 km with that for Epos. The result indicated an improvement in the position accuracy of 2.5 times horizontally and 1.5 times vertically using network DGPS. No major improvements could be found for the denser network DGPS network with inter-station distances of 70 km. The launch of SWEPOS Network DGNSS Service in April 2006 was based on the results from the diploma work.

The Cadastral Services Division of Lantmäteriet makes use of SWEPOS Network DGNSS Service. To evaluate if cadastral surveying of nature reserves can be more effective by the service, a diploma work was carried out during 2007 (Magni, 2007). A single-frequency GNSS receiver (Trimble GeoXT) was used for measurements in both open and forested areas. The horizontal RMS value of the differences between measured and known positions was in the order of 7 decimetres for all measurements, when an external GNSS antenna was used. There were however large variation depending on the forest, the RMS value was below 2 decimetres in open areas.

6. NORDIC COLLABORATION

Lantmäteriet is participating in Nordic geodetic projects through the Nordic Geodetic Commission (NKG). Ongoing collaborative efforts related to SWEPOS are focusing on the exchange of GNSS data from the reference stations that are located close to the border lines between Denmark, Norway and Sweden, for use in the national positioning services. Agreements and routines for the data exchange have been developed. Another important issue for the collaboration has been the exchange of knowledge concerning the network RTK and network DGNSS techniques.

NORPOS Web, a Nordic web portal for GNSS data for post-processing from the Danish, Norwegian and Swedish reference stations, is in progress. A computer network between the control centres of the Nordic networks of permanent reference stations has also been established and routines for exchange of GNSS data from reference stations have been developed. A classification system for Nordic reference stations has been developed in order to facilitate the communication between the National Mapping authorities in the Nordic countries.

Future plans include improvements in the standard for real-time data exchange between the existing networks of permanent reference stations, both in terms of data formats/protocols and mutual reference frames. This will facilitate the use of national positioning services in border areas, as well as the potential development of common Nordic positioning services.

7. FUTURE PLANS

The remaining extension of the SWEPOS network will be carried out during 2009, see Figure 1-1. As with previous pre-study projects, this will be a co-operative effort between a number of private and public participants, in order to create a viable user base for future contributions to operation and maintenance costs.

A task for the network RTK service for 2008 will be the implementation of network RTK messages according to the RTCM standard format, version 3.1. A diploma work is currently (spring 2008) doing an evaluation of this technique.

A likely scenario in the near future will be an increasing demand for flexible solutions, primarily for real-time positioning in advanced applications (e.g. services fit for large-scale construction projects). Special attention will be paid to the use of SWEPOS Network RTK Service for machine guidance and other forms of high-precision navigation.

The infrastructure of SWEPOS will continue to be modernized, in order to benefit from further enhancements of present GNSS (such as the introduction of new frequencies), as well as the development of new satellite systems (Galileo).

8. CONCLUSIONS

A multi-purpose network of permanent reference stations is beneficial for both users and providers of national geodetic infrastructure. It facilitates the development of services for positioning and non-safety-of-live navigation, and also the successful integration of GNSS technique into a wide range of applications. The professional use of these techniques is increasing very rapidly outside the conventional surveying community, which in turn spurs the development of more user friendly equipment and positioning concepts.

The long-term plan for SWEPOS, which was developed in the early nineties, will be completed in coming years.

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BIOGRAPHICAL NOTES

Mr Dan Norin graduated with a M. Sc. with emphasis on geodesy and photogrammetry from the Royal Institute of Technology in Stockholm in 1991. He has been working as a research geodesist at Lantmäteriet 1991-1996 and since 2002. During the years 1996-2002 he was employed at the Stockholm City Planning Administration as an expert within mapping, surveying and geodesy.

Mr Bo Jonsson graduated with a B. Sc. in mathematics, physics and astronomy from University of Lund in 1969 and courses in Geodesy at the University of Uppsala in 1974. He is working as GPS Program Manager and is Deputy Head of the Geodetic Research Division at Lantmäteriet since 1996.

Mr Peter Wiklund graduated as diploma engineer in mapping and surveying at the University of Gävle in 1996. He is Project Manager at Lantmäteriet for the SWEPOS Network RTK Service.

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