

Network RTK in Northern and Central Europe

Edited by

Andreas Engfeldt

L A N T M Ä T E R I E T





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Preface

This short report gives an overview of the operational Network RTK services in Northern and Central Europe, February-March 2005.

The information has been collected from a questionnaire which was distributed to 14 different networks, of which all have answered.

Many thanks to the contact persons for the Network RTK services, who have spent some time filling in the questionnaires.

Network RTK in Northern and Central Europe

1. Networks and services, a short summary	9
2. Network operators	10
Owners	10
Financing	10
Service started	10
Number of stations	13
Average distance between the stations	13
Operation hours	13
Communication link between station and control centre	13
3. Network design	15
Distribution channels	15
Information channels	15
Possibility for post processing	16
Possibility for using Network DGPS	16
Brands of receivers	17
Brands of antennas	17
4. User distribution	18
User fees for Network RTK data	18
User fees for Network RTK distribution	18
User fees for post processing	18
No of users	21
Users per nat stn	21
Distribution of users	21
Typical applications today and in the future	21
5. Future plans	23
Plans for the near future	23

6. Currencies	24
7. Pictures	26
7.1 APOS	26
7.2 FLEPOS	27
7.3 WALCORS	28
7.4 GPSNet.dk	29
7.5 GPS-Referencen	30
7.6 GPSNet.fi	31
7.7 ASCOS	33
7.8 SAPOS	35
7.9 Ordnance Survey RTK Network	36
7.10 06-GPS	38
7.11 SATREF	39
7.12 SWEPOS	40
7.13 AGNES	42
7.14 SWISSAT	43
8. Contact persons for the listed networks	44
9. Acknowledgement	44

Network RTK in Northern and Central Europe

1. Networks and services, a short summary

In Northern and Central Europe there are services for Network RTK in the following countries:

Austria (APOS),

Belgium (FLEPOS and WALCORS),

Denmark (GPSNet.dk and GPS-Referencen),

Finland (GPSNet.fi),

Germany (ASCOS and SAPOSTM (the service is called HEPS)),

Great Britain (Ordnance Survey RTK Network),

the Netherlands (06-GPS),

Norway (SATREFTM (the service is called CPOS)),

Sweden (SWEPOSTM),

Switzerland (swiposTM (based on the AGNES network) and SWISSAT).

There is a mixture of private and governmental services. In the chapters below the characteristics for the networks and services are shown.

2. Network operators

Networks	Owners	Financing	Service started
APOS, the Austrian network	The Federal Office of Metrology and Surveying of Austria (Bundesamt für Eich- und Vermessungswesen - BEV)	At present APOS is financed from the federal budget	It will start in 2006
FLEPOS, the Flemish network	Support Center for GIS Flanders (department of the Flemish Land Agency)	Governmental	October 2002
WALCORS, the Wallonie network	MET, Ministry of the Equipment and Transports in the Walloon region	Governmental	End of 2003
GPSNet.dk, one of the Danish networks	Trimble Center Denmark A/S - a 100% privately owned company	100% private investment by Trimble Center Denmark A/S	Early 2001
GPS-Referencen, one of the Danish networks	GPS-Referencen is responsible for the network and the distribution and has made an agreement with Leica Geosystems as administrator and provider of service to the network	GPS-Referencen A.m.b.a. is a co-operative society by companies owning the participating reference stations	In June 2001
GPSNet.fi, the Finnish network	Geotrim Ltd	By user fees	2000-2001
ASCOS, one of the German networks	E.ON Ruhrgas AG, an international gas company	Financed by E.ON Ruhrgas AG / by the charges of their customers	1999

Networks	Owners	Financing	Service started
SAPOS, one of the German networks	The Working Committee of the Surveying Authorities of the States of the Federal Republic of Germany (Arbeitsgemeinschaft der Vermessungsverwaltungen der Länder der Bundesrepublik Deutschland, AdV). Each state provides its own stations. For nation-wide users there exist the Central Bureau SAPOS, which coordinates SAPOS Germany-wide	SAPOS is a governmental positioning service. SAPOS users have to pay a utilization fee	First stations in 1992. Official start of SAPOS in 1998. Since 2002/2003 there is a Germany-wide network of reference stations. Three different services: HEPS (cm-accuracy, and the one which is considered here), EPS (m-accuracy) and GPPS/GHPS (post processing)
Ordnance Survey RTK Network, the British network	Ordnance Survey, the Government Agency responsible for national mapping and geodesy in Great Britain	By Ordnance Survey	At moment not a service, it is now only used by Ordnance Survey
06-GPS, the Dutch network	06-GPS, a (small) private firm	By private funds/investments	In September 2002 and had national coverage in January 2003
SATREF, the Norwegian network	Statens Kartverk, the Norwegian Mapping Authorities	User fees	Three different services: MPOS for m-accuracy, DPOS for dm-accuracy (Network DGPS) and CPOS for cm-accuracy. Test from autumn 2001, first customer in August 2002. The rest is about CPOS
SWEPOS, the Swedish network	Lantmäteriet, National Land Survey, the mapping authorities of Sweden	User fees and governmental funds	The first stations were up in 1993, the RTK service started in January 2004, but RTK projects for the service area have been going on since 2000

Networks	Owners	Financing	Service started
AGNES, one of the Swiss networks	Swisstopo	-	The network was started in 1997, the swipos service is operational since 2001
SWISSAT, one of the Swiss networks	SWISSAT AG	Private	1999

Networks	Number of stations	Average distance between the stations	Operation hours	Communication link between station and control centre
APOS	More than 30	50 to 70 km	This is in discussion	Ethernet, Internet (Ntrip), Internet (VPN - under construction)
FLEPOS	38 in Flanders and 2 stations from 06-GPS	25-30 km	24 hours 7 days a week, helpdesk 5/7 from 8-16/17	TCP/IP over Flemish government network
WALCORS	23 stations	35 km	24 hours 7 days a week, but monitored only during working hours	RS232 (own MUX network)
GPSNet.dk	25 network-stations plus 1 single base station	60-70 km	24 hours 7 days a week	Regular ADSL lines 256/256 MB
GPS-Referencen	59	Approx. 45 km	24 hours 7 days a week	Will be using ADSL
GPSNet.fi	76	50-100 km	24 hours 7 days a week	ADSL lines
ASCOS	More than 180, many of them are SAPOS-stations	60-70 km	24 hours 7 days a week	ISDN, X.25
SAPOS	250-260. There is a co-operation with 06-GPS (4 stations), AGNES (5 stations) and APOS (4 stations)	50-70 km	24 hours 7 days a week	TCP/IP over different channels

Networks	Number of stations	Average distance between the stations	Operation hours	Communication link between station and control centre
Ordnance Survey RTK Network	61	About 70 km	24 hours 7 days a week	TCP/IP over Ordnance Survey's wide area network.
06-GPS	23 stations in the network, 13 of them are in the Netherlands, 8 in Germany (SAPOS) and 2 in Flanders (FLEPOS)	About 70 km	24 hours, 7 days a week, with active monitoring during working hours	Managed VPN from Dutch KPN. DSL or Frame Relay technique
SATREF	34	60-70 km	24 hours 7 days a week, errors only corrected during ordinary work time	Leased lines
SWEPOS	SWEPOS consists of 73 stations. 50 of them are included in the Network-RTK service	60-70 km	24 hours 7 days a week	128 kb leased line and 56 kb dial-up modem as backup
AGNES	29	50 km	-	-
SWISSAT	21 or 24	-	24 hours 7 days a week	Frame relay

3. Network design

Networks	Distribution channels	Information channels
APOS	GSM and GPRS (in the near future)	SMS is an option for the user at the time
FLEPOS	GSM	Website (status of stations), no individual messages
WALCORS	GSM (DAB and IP under study)	Helpdesk during working hours (Web and SMS under study)
GPSNet.dk	GSM, GPRS, NTRIP	SMS, email, web
GPS-Referencen	GSM and GPRS	SMS and web
GPSNet.fi	GSM and GPRS	Web server, text messages
ASCOS	GSM and GPRS	Email, web, SMS, direct calls
SAPOS	GSM, IP-based channels (GPRS, UMTS, W-LAN) => NTRIP , 2m band radio	Telephone hotline, SMS, web presentation, newsletter
Ordnance Survey RTK Network	GSM, although GPRS is being tested	SMS
06-GPS	60 individual phone lines (GSM) and also Internet (NTRIP)	Web and telephonic helpdesk.
SATREF	GSM	SMS, web, phone (for special occasions)
SWEPOS	GSM and also one line for GPRS (will be more in the near future), radio (in the Gothenburg area)	SMS, web, helpdesk, email
AGNES	GSM and GPRS/NTRIP	Hotline
SWISSAT	GSM	Email, SMS

Networks	Possibility for post processing	Possibility for using Network DGPS
APOS	Yes. Availability: RINEX-files and Station-time-series on the web in the near future. The www.BEV portal is under construction	No
FLEPOS	Yes, 10 s RINEX available for 60 days and 1 s RINEX available for 10 days	No
WALCORS	Yes (Applet Java)	No
GPSNet.dk	Yes, all data is available for 21 days. 30 s data will be available for years (for research etc)	Yes
GPS-Referencen	Yes, RINEX data is available on demand	No
GPSNet.fi	Yes, webserver	Yes, a VRS DGPS service is available
ASCOS	Yes	Yes
SAPOS	Yes	No standard
Ordnance Survey RTK Network	Data is stored for 60 days for post processing	No
06-GPS	RINEX data 1 second interval from all stations, including possibility of VRS RINEX data	No, but it is currently tested
SATREF	Yes, the data is on disc for 14 days and can be ordered by email, fax or telephone	Yes, the service DPOS
SWEPOS	Yes	No, but tests are going on
AGNES	Yes, RINEX data	Yes, a VRS - DGPS service is available
SWISSAT	Yes	Yes

Networks	Brands of receivers	Brands of antennas
APOS	Leica 500 series, Trimble NetRS	Dorne Margolin Choke Ring, Trimble Zephyr
FLEPOS	Leica RS500/530	Leica AT504
WALCORS	Leica RS500	Leica AT504
GPSNet.dk	Trimble 4700	Micro Centered L1/L2 antennas with groundplane
GPS-Referencen	Typically Leica, but Ashtech is also in use	Typically Leica, but Ashtech is also in use
GPSNet.fi	70% Trimble 5700/NetRs, some Ashtech, Javad, Leica	70% Zephyr geodetic/choke ring, some Ashtech, Javad, Leica
ASCOS	Topcon, Trimble, Leica	Topcon, Trimble, Leica
SAPOS	Many different	Many different
Ordnance Survey RTK Network	Leica System 500	Leica AT504 mostly, but also some Ashtech 700936E with radome
06-GPS	A combination of Trimble, Topcon, Leica and Novatel equipment	See left, mostly individually calibrated by Geo++
SATREF	Trimble MS750, Trimble NetRS, Javad Legacy	Antennas for the receivers mentioned left
SWEPOS	Javad and Ashtech	Dorne Margolin Choke ring antennas from the manufacturers Ashtech and Allen Osborne
AGNES	Trimble 4700	Trimble Choke Ring, Trimble Microcentered, Trimble Zephyr
SWISSAT	Topcon	Topcon

4. User distribution

Network	User fees for Network RTK data	User fees for Network RTK distribution	User fees for post processing
APOS	To be determined	In discussion	In discussion
FLEPOS	Free of charge	Depends on the contract with GSM-provider of the user	Free of charge
WALCORS	Free of charge	Free	Free
GPSNet.dk	13075 DKK per year in annual fee + 1.29 DKK per minute including GSM or annual fee + 0.19 DKK per minute for the first hour and 0.99 DKK per minute the rest of the day + own distribution (GSM or GPRS)	See the previous column	8000 DKK per year for 5 s phase data
GPS-Referencen	12000 DKK in annual subscription	Current GSM-price is 0,60 DKK per minute	At moment free
GPSNet.fi	3500-2600 Euro/year (1-5 year subscription)	The user pay its own GSM/GPRS costs	2500 Euro/year (all data included: single station/VRS postprocessing data)
ASCOS	Between 0.08 and 0.70 Euro/minute, depending on expected sales	GSM: included (0.11 Euro or more), Internet/GPRS: not included (0.08 Euro or more)	15 Euro/hour/station
SAPOS	0.10 Euro per minute	Depends on the contract with the GSM provider of the user. Best conditions are about 6 cent a minute + basic charge	0.20 Euro per minute for 1 s RINEX

Network	User fees for Network RTK data	User fees for Network RTK distribution	User fees for post processing
Ordnance Survey RTK Network	To be determined	To be determined	To be determined
06-GPS	5000 Euro/year + 0.25 Euro/ minute or 450 Euro/month plus 0.25 Euro/ minute or 1.25 Euro/minute and no subscription	Every customer provides his own means of communication	RINEX 1 second: 20 Euro per hour per station; RINEX 5 seconds: 10 Euro per hour per station. VRS data on request.
SATREF	30000 NOK/year in subscription	The users must have a subscription from a telecompany (Netcom or Telenor)	500 NOK per day and station
SWEPOS	15000 SEK per year or 5000 SEK per year + 5 SEK per minute	The user pay its own communication cost, but can get a special offer of 0.53 SEK/min + 0.22 SEK/call + 48 SEK / month through our deals with the telephone company	500 SEK per day or 10000 SEK per year for data from five stations, 30000 SEK per year for data from all stations There is also an automated Computation Service which is included in the cost
AGNES	3000 CHF per year for the first subscription, 1000 CHF for every other subscription 0.70 CHF per minute	The user pay its own communication cost	RINEX, 1 second data 60 CHF per hour. Many other intervals (2, 5, 10, 15, 20, 30 and 60 s) are also available (costs 50, 40, 35, 30, 25, 20 and 15 CHF resp./ hour).

Network	User fees for Network RTK data	User fees for Network RTK distribution	User fees for post processing
SWISSAT	3000 CHF for the first rover, 1000 CHF for every other subscription, 3900 CHF for the first GPS+GLONASS rover, 1300 CHF for every other subscription 0.60 CHF per minute	The user pay its own communication cost	Yes

Network	No of users	Users per nat stn	Distribution of users	Typical applications today and in the future
APOS	At moment only test users	-	-	RTK-VRS for cadastre, high accuracy applications
FLEPOS	170	4.47	Surveyors - mainly governmental, consultancy and utility firms	Mainly surveying activities
WALCORS	About 180	7.83	40% public (connection time)	Survey, INS-GPS, machine guidance, permanent object monitoring
GPSNet.dk	150	5.77	-	-
GPS-Referencen	Approx. 190	3.22	Utility companies, chartered surveyors, municipalities, contractors	Surveying for non-surveyors, GIS, field-to-office
GPSNet.fi	About 180	2.37	Many types of users like governmental/ municipality organisations, cities, power utility companies, telecommunication companies, surveying and construction companies, GIS users, National Land Survey etc.	All types of surveying and GIS applications, machine control
ASCOS	Hundreds	-	Different, mainly private companies	Surveying, machine guidance

Network	No of users	Users per nat stn	Distribution of users	Typical applications today and in the future
SAPOS	About 1500	6.00	70% governmental organisations, 30% private companies	Different surveying activities (real estate cadastre, GIS applications, ...)
Ordnance Survey RTK Network	At moment the service is available for 150 surveyors	2.46	At moment only users from Ordnance Survey	Currently the sole application is for cartographic data collection, but when the public service is developed they expect a wide range of application from engineering to asset management / tracking
06-GPS	Over 220 registered rovers from about 120 different clients	16.92	Governmental: 30%; Municipality: 5%; Consultancy firms: 40%; Contractors: 15%	All types of surveying and staking out. From cadastral applications to hydrography, archaeology and even police work (registration of accidents)
SATREF	119	3.50	-	Surveying for municipalities, governmental use, for electricity supply, private contractors
SWEPOS	306	6.12	Municipalities 50%, governmental companies 15%, consultant agencies 35%	Different types of surveying, machine guidance
AGNES	100	3.33	Official surveyors, municipalities, construction, GIS	All types of surveying, construction, geodynamical movements, weather predictions etc
SWISSAT	?	?	Privately owned companies	All kind of surveying applications

5. Future plans

Networks	Plans for the near future
APOS	GPRS as distribution channel
FLEPOS	Exchanging 2-3 stations with WALCORS; GPRS as distribution channel
WALCORS	Stations exchange with SAPOS and FLEPOS (6 stations); DAB and IP as distribution channels; Object monitoring; Status to users on the field
GPSNet.dk	-
GPS-Referencen	New products with corrections of varying accuracy
GPSNet.fi	Covering whole Finland summer 2005
ASCOS	Extension (neighbouring countries); UMTS as distribution channel; Many more plans
SAPOS	New data format (RTCM 3,0) with network messages
Ordnance Survey RTK Network	To cover England, Wales and the majority of Scotland by end of October 2005. Further plans for the service-side of the network depend on the final form of the public service and the interests of any third parties involved
06-GPS	Network DGPS is currently tested under VRS via NTRIP. NTRIP/Internet will be used more and more
SATREF	Extensions; Exchanging data with SWEPOS; GPRS, FM/DARC, satellite telephone as distribution channel
SWEPOS	Extensions; Exchanging data with SATREF; FM/DARC, satellite telephone as distribution channel, Network DGPS
AGNES	5 SAPOS-stations and 4 APOS-stations already integrated in the network; Integration of 4 stations from IREALP network in Lombardy; Construction of 1 new Swiss station
SWISSAT	Extensions; New distribution channels

6. Currencies

All prices are mentioned in the currencies used in the country providing the service. To make the following table easier to read, the currencies have been translated into Euro (€).

Currency status April 13, 2005:

1 DKK = € 0.134272

1 CHF = € 0.645360

1 NOK = € 0.122293

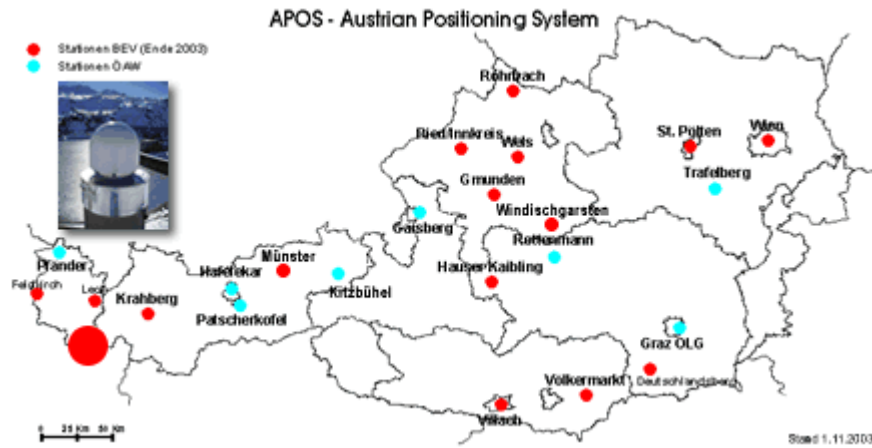
1 SEK = € 0.109384

	Service	Subscription per year (€)	GSM fee per minute (€)	For RINEX 1 s data per hour/station (€)	For RINEX 1 s data per year (€)
Austria	APOS	-	-	-	-
Belgium	FLEPOS	0	t.o.	0	0
Belgium	WALCORS	0	3.75 per month + 0.119 per min + 21 % tax	0	0
Denmark	GPSNet.dk	1756	0.17	-	1074 for 5 s data
Denmark	GPS-Referencen	1611	t.o.	0	0
Finland	GPSNet.fi	3500	t.o.	-	2500
Germany	ASCOS	-	0.08 - 0.70	15	-
Germany	HEPS (SAPOS)	-	0.10 + 0.06 t.o.	12	-
Great Britain	Ordnance Survey...	-	-	-	-
Holland	06-GPS	5000	0.25 + 0.09 t.o.	20	-
Norway	CPOS (SATREF)	3669	t.o.	61 per day	-
Sweden	SWEPOS	1531	0.06 per min t.o. + 5.25 per month t.o.	55 per day / 5 stations	3282 / 5 stations
Switzerland	swipos (AGNES)	1936	0.45 + t.o.	39	-
Switzerland	SWISSAT	1936	0.39 + t.o.		

Abbreviation in the table: t.o. = to operator.

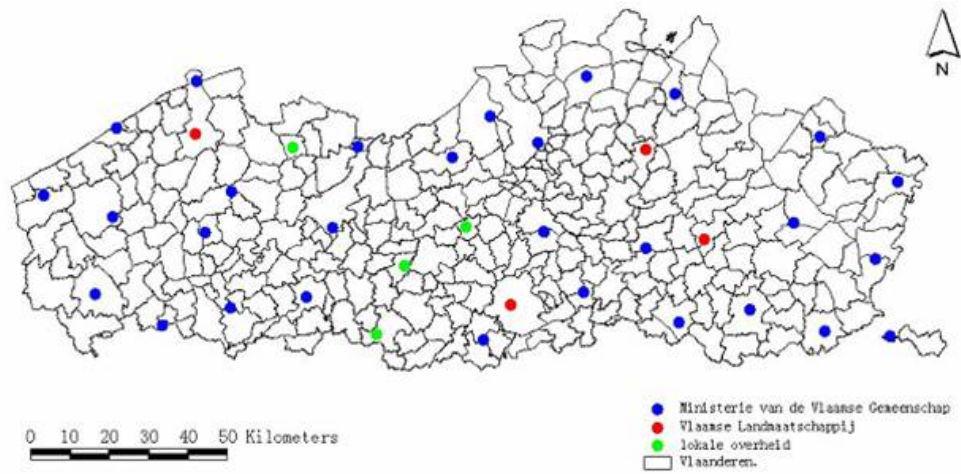
7. Pictures

7.1 APOS



The APOS network and one APOS station.

7.2 FLEPOS



The FLEPOS network.



A FLEPOS station.



The inside of a FLEPOS station.

7.4 GPSNet.dk



The GPSNet.dk network.

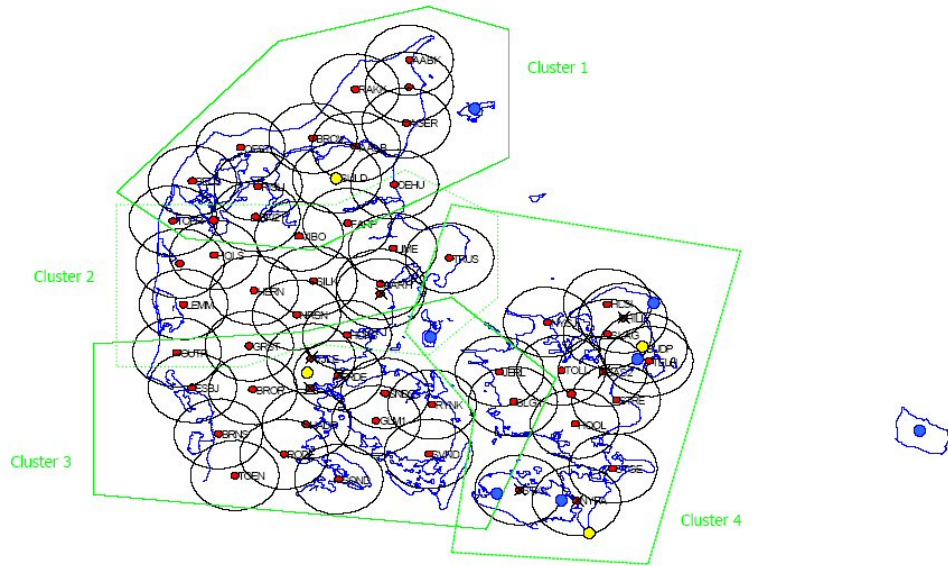


A GPSNet.dk station.



The inside of a GPSNet.dk station.

7.5 GPS-Referenzen



The GPS-Referenzen network.

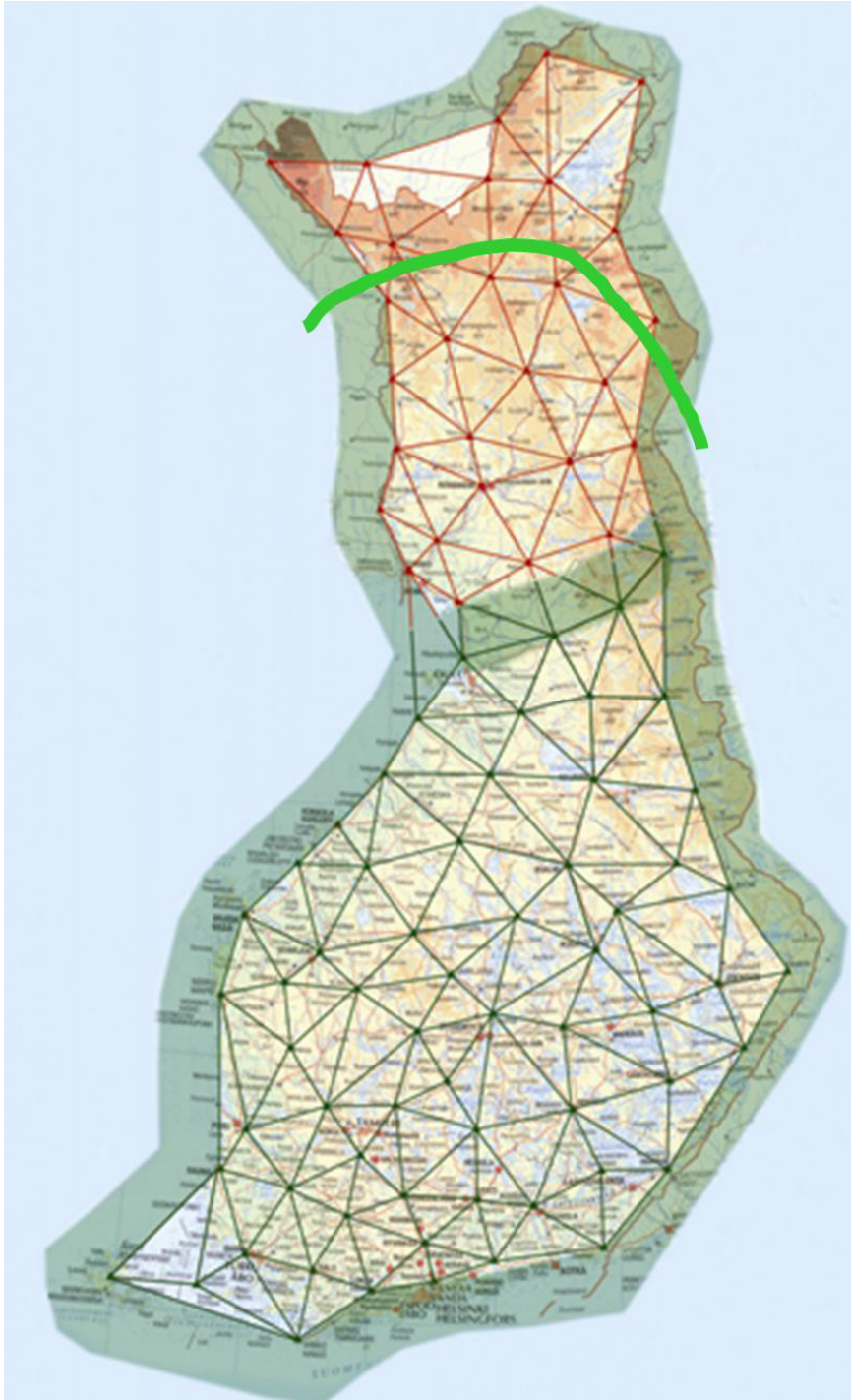


A GPS-Referenzen station.



The inside of a GPS-Referenzen station.

7.6 GPSNet.fi



The GPSNet.fi network. Above the green line are planned stations and below the line are the present stations.



A GPSNet.fi station.

7.7 ASCOS

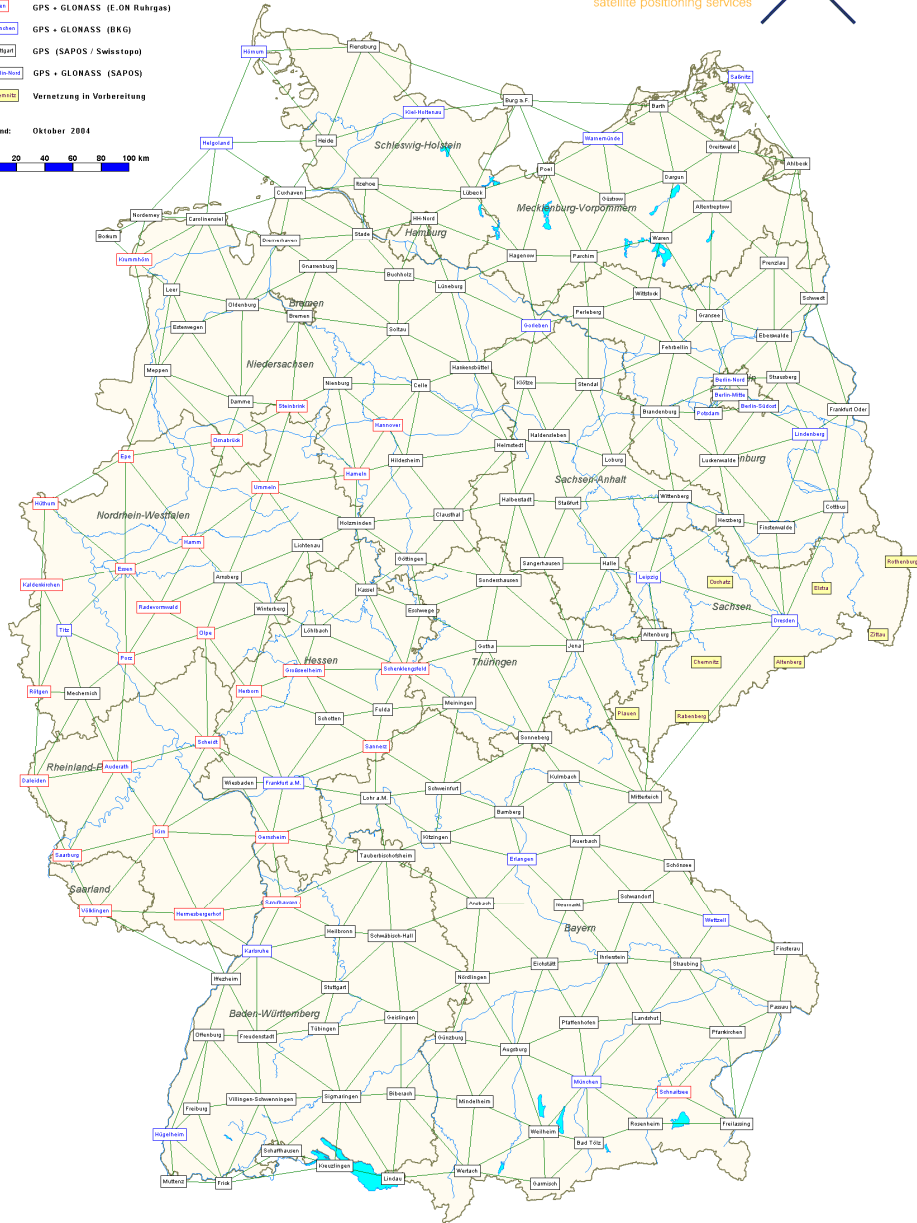
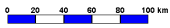
Deutschlandweit messen.



Referenzstationen des ascos-PEP

- Coxa GPS + GLONASS (E-ON Ruhrgebiet)
- Münster GPS + GLONASS (BKG)
- Stuttgart GPS (SAPOS / Swisstopo)
- Bonn-Hof GPS + GLONASS (SAPOS)
- Chemnitz Vernetzung in Vorbereitung

Stand: Oktober 2004



The ASCOS network.



An ASCOS station.

7.8 SAPOS

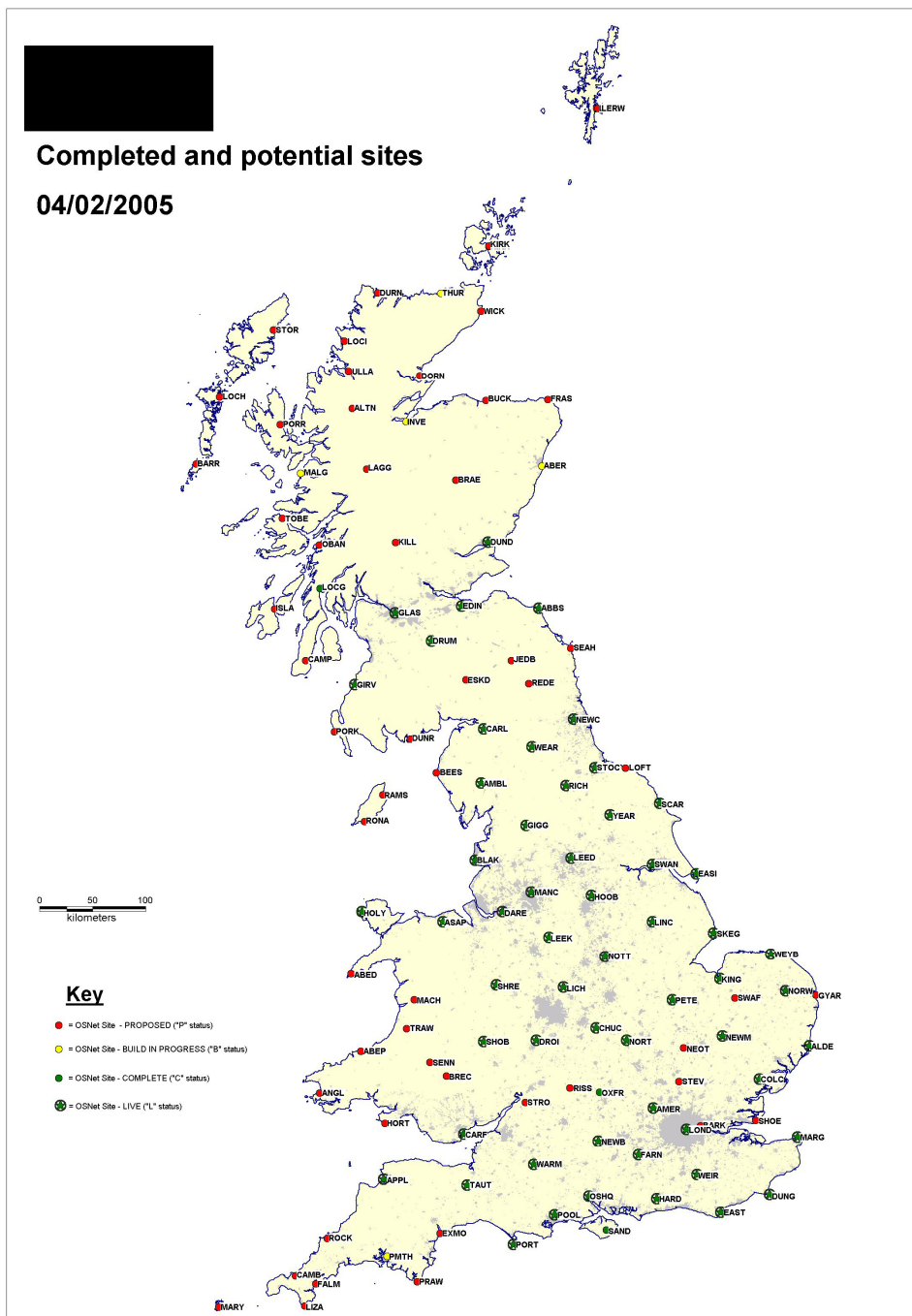


The SAPOS network.

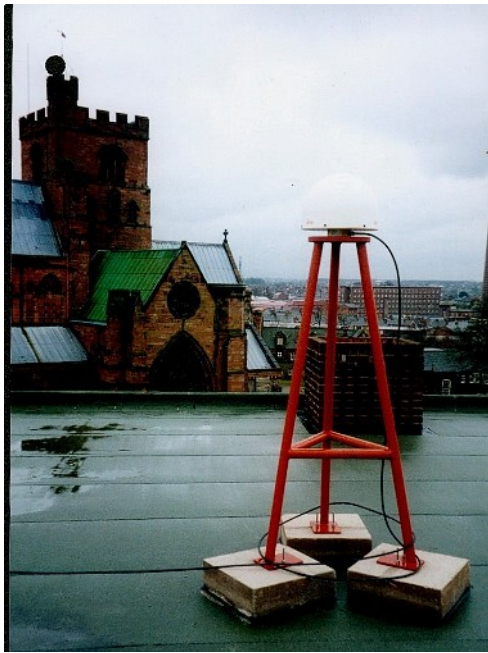


A SAPOS-station in Bavaria.

7.9 Ordnance Survey RTK Network

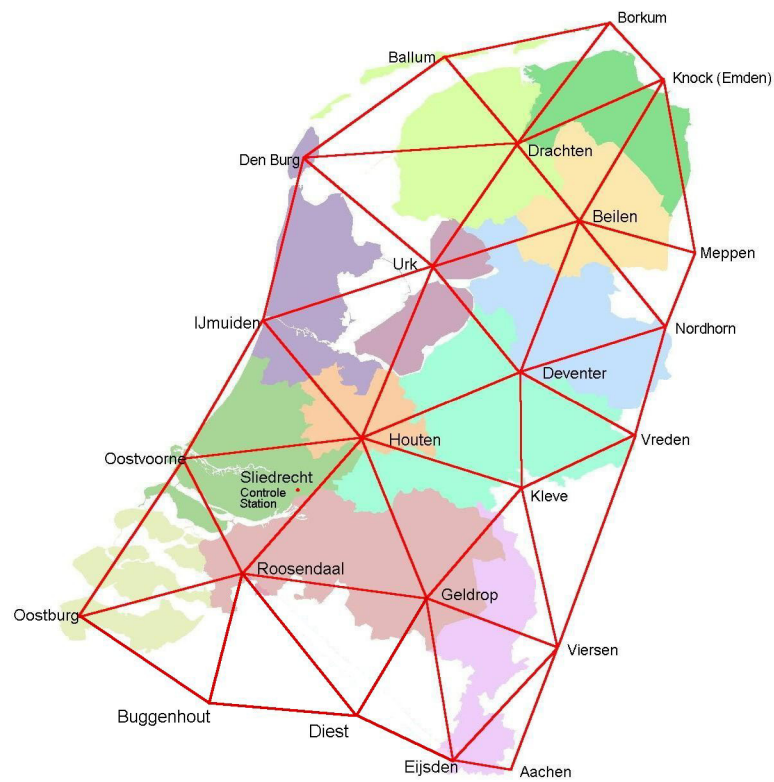


The Ordnance Survey RTK network, with present and planned stations.



An Ordnance Survey RTK Network station

7.10 06-GPS



The 06-GPS network



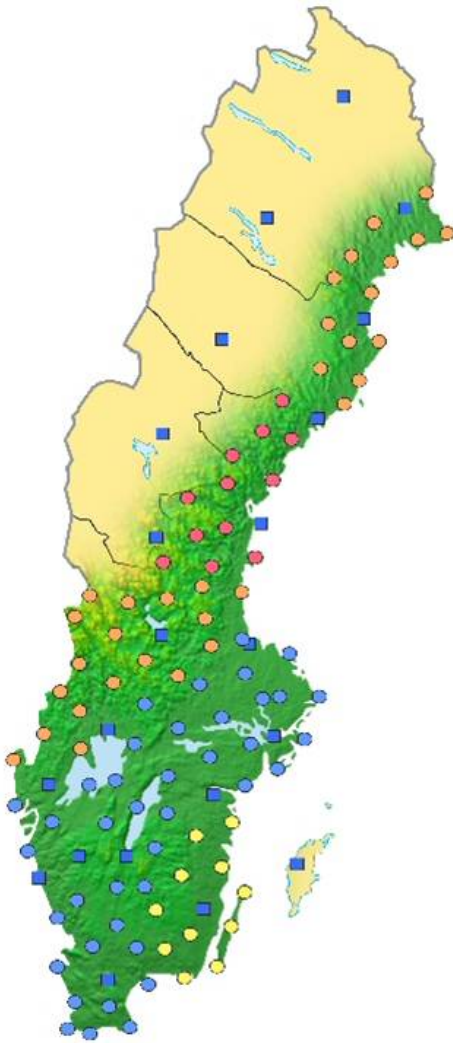
The 06-GPS station Houten

7.11 SATREF



The CPOS network. SATREF stations are evenly distributed through the whole of Norway.

7.12 SWEPOS



The blue and yellow dots are showing the position of the existing stations. The orange and red dots are planned stations.

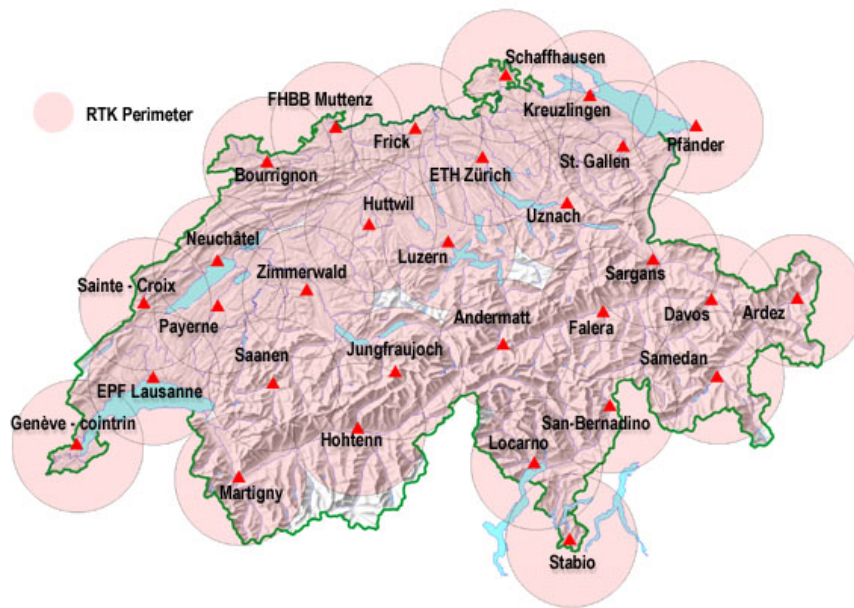


The SWEPOS station Visby, one of 23 stations with the antenna mounted on bedrock (Blue squares on the map + two blue dots).



The SWEPOS station Skillinge, one of the simplified stations with the antenna mounted on the building.

7.13 AGNES



The AGNES network



The AGNES station in Davos

7.14 SWISSAT



The SWISSAT network



The SWISSAT station in Interlaken

8. Contact persons for the listed networks

The persons listed below have answered the questionnaire and they have also checked the information about their network in this report.

06-GPS: Jean-Paul Henry, info@06-gps.nl

APOS: Ernst Zahn, Ernst.Zahn@bev.gv.at

ASCOS: Johannes Piechel, Johannes.Piechel@eon-ruhrgas-service.de

FLEPOS: Wim Van Huele, Wim.VanHuele@vlm.be

GPSNet.dk: Henrik Gosvig Thomsen, hgt@trimblecenter.dk

GPSNet.fi: Seppo Tötterström, Seppo.Totterstrom@geotrim.fi

GPS-Referencen: Klaus Juul Sørensen, knjs@tdc.dk

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Swipos (AGNES): Simon Grünig, Simon.Gruenig@swisstopo.ch

SWISSAT: Zdenko Kurtovic, Zdenko.Kurtovic@swissat.ch

WALCORS: Jean-Pierre Dejardin, gps@met.wallonie.be

9. Acknowledgement

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L A N T M Ä T E R I E T



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