Public Private Partnership between SAPOS and ascos

Successful German Cooperation in Satellite Positioning

In April 2003 the German gas company E.ON Ruhrgas AG (ascos – satellite positioning services) and the federal states operating SAPOS signed a cooperation agreement. Hereby ascos has gained access to the nationwide network of SAPOS reference stations. ascos refines and markets the raw data made available by SAPOS. This allows ascos to make its correction data available to users of GNSS positioning applications across Germany, open up new sales opportunities for satellite positioning and launch innovative developments in satellite-based navigation and surveying technologies.

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Figure 1: one of the main areas of GNSS use is pipeline documentation for grid operation purposes.

Precise Position for the Industry

E.ON Ruhrgas started to develop ascos as a special service in 2001. Originally, the idea was to use satellite positioning to obtain precise coordinates for surveying the company's 13,000 km gas pipeline system. To this end, the company set up a network of what have since become 30 reference stations in North-Rhine Westphalia, Rhineland-Palatinate, Hesse and Saarland. Using these reference stations whose exact positions have been determined with high precision, correction data can be calculated for each point where a coordinate has been obtained by approximation using mobile satellite surveying systems, see figure 1. The correction data take account of satellite signal errors such as clock, orbit or time delay errors and atmospheric interference. This makes it possible to achieve positioning accuracies down to a few centimetres. The digital positioning data collected locally using mobile satellite positioning systems and ascos correction data were recorded in a geographic information system, see figure 2, for further processing and storage. This way, the entire natural gas pipeline network was entered into the system. Since 2002, the company has been making ascos correction data commercially available to other users.

Forward-Looking Cooperation

To be able to offer its reference service also to other companies, ascos has teamed up with the federal states as the operator of SAPOS under a Public Private Partnership (PPP). As part of what is their sovereign task, the state surveying authorities generate and administer fundamental geographic data, which are made available as a public service in accordance with data protection laws. It is for this purpose that the federal states operate the SAPOS system. Using a nationwide network of more than 260 reference stations to provide official correction data for GPS positioning applications, SAPOS represents Germany's official coordinate reference system. The cooperation agreement allows ascos to use the GPS correction data provided by SAPOS in addition to the data from its own reference stations. The SAPOS data are transmitted in real time on leased lines to the E.ON Ruhrgas data processing centre. Since the signing of the agreement, the reference stations of all federal states have been incorporated into the ascos reference network. Being able to use E.ON Ruhrgas's own reference stations, the SAPOS stations and the stations of the Federal Agency for Cartography and Geodesy (BKG), which are also made available, ascos is able to access to a Germany-wide network of more than 300 reference stations, see figure 3.

Added Value

The partnership between ascos and the federal states as the operator of SAPOS goes well beyond data provision: both partners see their cooperation as a way of creating added value for the national economy by allowing a multiple use of existing infrastructures and by making positioning and correction data services more readily available. The federal states have a basic interest in offering these official infrastructure services to as broad a group of users as possible while also promoting the sale of SAPOS data in order to refinance part of the investments paid for from tax money. The cooperation between SAPOS and ascos enables both partners to pool sales and marketing potential and to offer a 'one-stop shop' for satellite-based services. This in turn allows satellite-based positioning systems in Germany to be promoted more effectively, thus facilitating a swift introduction to the market in as many customer segments as possible.

Figure 2: the coordinates generated can be transferred into a geographic information system (GIS) directly at site, or be used for digital maps.

Private Partner

The economic objectives underlying this cooperation project include the tapping of new markets for real-time positioning services and the generation of more added value from geographic data. After all, far-reaching and innovative services cannot be delivered by merely offering positioning tools with a uniform geodetic spatial reference as provided by the state surveying authorities in accordance with their legal responsibilities. It is here that the private partner can offer value-added services. With SAPOS being able to focus on its sovereign tasks, ascos can concentrate its efforts on marketing and promoting real-time reference services designed for commercial users while at the same time developing new customer-driven services for the private sector. PPP can therefore be seen as a strategic step towards strengthening the German position in the rapidly developing GNSS market in Europe.

Germany-Wide Service

Using the raw data provided by the SAPOS, BKG and E.ON Ruhrgas reference stations, ascos can provide its customers across Germany with high-quality, rapid, secure and efficient real-time correction data for a wide range of applications on a 24/7/365 basis. The precise real-time service (PED) by ascos offers standard correction data for GPS signals and, in some areas, for GPS and GLONASS, thanks to some 60 reference stations. This allows measurement accuracies of up to 2 cm when using GNSS applications. With its real-time service (ED), which also includes Germany-wide GLONASS correction data, ascos now makes it possible to use simple one-frequency receivers to increase positioning accuracies of 1 - 3 m to as much as 0.3 m.

GSM Technology

For correction data transmission, ascos relies on mobile communication because only two-way data exchange ensures the high transmission accuracy, security and speed required. The transfer standard used is the long-established GSM technology. GPRS also allows Internet services to be integrated. The advantage of this forward-looking concept is the ability to access several mobile services at the same time. This makes it possible to accurately determine positions using correction data while downloading documents from the company server via the Internet and forwarding data directly to the office for post-processing or sending e-mails. The always-on functionality of the GPRS standard dispenses with the need for repeated, time-consuming dial-in procedures because the equipment is permanently online. There are usually no additional costs for the mobile communication hardware because most standard mobile phones are already GPRS-compatible.

Compression Rate

The format used for data transfer is the RTCM 3.0 protocol. This protocol enables standardised GPS data transmission from reference station networks using a web-based dial-in system or GSM. The main benefit over previous RTCM versions is the compression rate, which allows data to be compressed to about 40 per cent without any loss of content, thereby reducing connection costs for volume-based tariffs.

ascos also guarantees a high reliability of its data through permanent technical supervision, real-time monitoring and regular quality assurance. All raw data received from the reference stations are analysed by the Federal Agency for Cartography and Geodesy on a daily basis. Responsibility for quality assurance of the SAPOS data lies with the relevant federal states. Permanent network monitoring is a key focus as it provides a quick update on the quality of the reference network. This makes it possible for the user to determine his coordinates in a uniform geodetic spatial reference – relying on European Terrestrial Reference System 1989 (ETRS89) – with quality-assured data accuracy.

Innovative Services

Cooperation with SAPOS has increased the marketing area for ascos correction data, which in turn has translated into a large number of users. This made it economically viable for ascos to include several new technical developments in its range of services. Using ascos-Trans, customers can now receive correction data which have already been adapted to the network deviations of the local state's system or to the customer's specific requirements. The customer simply dials a certain number to log on to the ascos centre by mobile phone or GPRS/Internet and then transmits its approximate position as usual using the ETRS89 geodetic spatial reference system. The ascos computer centre uses this information to calculate the correction data. The data are already modified as necessary for the user's local coordinate system. This process involves making three-dimensional calculations to transform both the horizontal and vertical coordinates. The transformation is operated from the homogeneous ETRS89/WGS84 coordinate system into the official DHDN/DHHN92 coordinate systems of the German horizontal and vertical reference point networks. Even national borders with unsteady transitions are no longer a problem: the resulting coordinates are always adjacency-preserving, uniform and homogeneous. There are no stand-alone solutions as with conventional methods. Moreover, the user saves time because the transformation does not require measurements to be made for known points.

NTRIP Standard

Since January 2006, ascos has been offering ascos-NET, a new correction data service offering positioning for GPS and GLONASS signals in the meter range. Like the other ascos services, ascos-NET can be received anywhere in Germany. Another benefit is that the service is based on the Networked Transport of RTCM via Internet Protocol (NTRIP) standard, the internationally recognised protocol for correction data transfer via mobile Internet connections. NTRIP uses IP streaming (voice over IP), which was originally developed for telephony, and the mobile communication standards GPRS and UMTS. This allows far higher data transfer rates than with ALF, while also offering two-directional communication between the user and the reference data centre as well as easy integration of Internet-based applications. The hardware required to receive correction data via NTRIP is a standard, low-cost GPRS mobile phone. GPRS is recommended for economic reasons because billing is based on volume rather than time of use. Using the GPRS standard, NTRIP relies on the data format known as Hypertext Transfer Protocol (HTTP), which is also used for websites. Subdividing the systems into computers only for data collection and computers only for data stream distribution allows a large number of users to be served without affecting the data collection computers in any way.

Both partners see their cooperation as a way of creating added value for the national economy by allowing a multiple use of existing infrastructures and by making positioning and correction data services more readily available.

Road Accident Recording System

Additional sales potential for the correction data service is now being tapped by establishing a network of renowned companies and institutions developing and selling industry-specific hardware and software components for GNSS surveying systems and equipment, some of them with ascos support. These applications include, inter alia, a GPS-based road accident recording system which allows circumstances surrounding the accident to be recorded four to six times faster and far more accurately than with conventional equipment such as cameras, a notepad and a tape measure. In addition, ascos actively supports scientific research in the field of GNSS satellite surveying. Field trials for new, broader GNSS applications in the utility industry are already underway: together with the German Aerospace Centre (DLR) and the Brandenburg-based company Adlares, E.ON Ruhrgas AG is developing a laser-based remote natural gas detection system known as CHARM (CH4 Airborne Remote Monitoring) for routine gas pipeline inspection by helicopter, see figure 4. Another area is "precise farming", which involves the accurate control of vehicles and machinery in forestry and agriculture, providing additional market opportunities for the real-time correction data service.

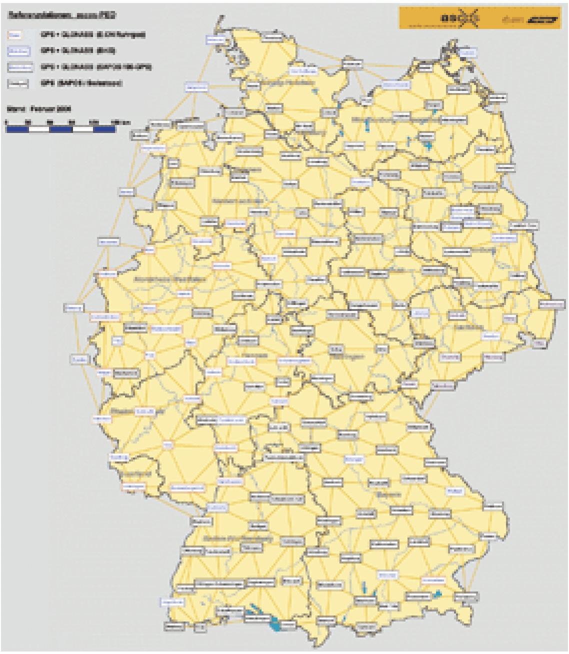

Figure 3: germany-wide network of more than 300 reference stations.

Satellite-Based Future

Progress is not only being made through new or improved hardware and software to receive or process satellite signals. Global navigation satellite systems themselves are also being upgraded, with older GPS satellites scheduled for replacement by newer versions over the coming years. In inner cities, forests or deep canyons, it is often not possible to receive signals when using only GPS. For this reason, apart from providing correction data for GPS, ascos has always delivered data also for GLONASS. This prevents the user from becoming dependent on one system while allowing him to make full use of the benefits of both technologies. This strategy now seems to have been adopted also by hardware manufacturers. While until recently there was only one manufacturer offering GLONASS receivers, other renowned manufacturers are now expected to include GLONASS-ready equipment in their product range.

Galileo

The Galileo Integrated Georeference Applications (GIGA) project consortium is led by ascos. Since September 2005, the six consortium members have been looking at possible GNSS applications for the energy industry and the additional optimisation potential that may be unlocked by using Galileo.

During the recently completed first phase of the project, a GIGA team headed by HiTec Marketing asked grid operators and surveying companies in Germany, Austria, Belgium, Italy, the Netherlands and the UK about their technology and how it is used. Most of the companies said they were using satellite navigation systems mainly for routine monitoring of their gas, oil and power grids, for the first-time digital recording of existing lines, and also for grid expansions, modifications and maintenance work.

Digital Map Systems

The survey showed that initial measurement involving digital tools was seen as offering substantial potential until 2010 because some 30 per cent of the grids still have to be entered into digital map systems. About half of the surveying work is currently done using satellite positioning systems. According to the respondents, this figure is expected to increase to 60 per cent by 2010, 80 per cent by 2015 and, ultimately, even 90 per cent by 2020. According to the companies interviewed, a new, civil satellite positioning system such as Galileo is generally viewed positively. Factors favouring the use of Galileo were said to include:

- improved availability of the satellite signals;
- higher signal integrity and less signal interference;
- more accurate and faster positioning;
- better positioning accuracy at elevated locations;
- improvements in communication technology;
- increased legal certainty through GNSS-based surveying and documentation;
- and hence more efficient and economic grid operation.

In a second step, the results of the analysis will now be corroborated through feasibility studies and there will be field presentations and information events to brief potential users on the technologies available. ascos will also include the Galileo satellite signals in its correction data service. Once the Galileo system has been fully established in 2010, users of the ascos reference service will be able to choose between signals of three fully operational systems: GLONASS, GPS and the European satellite system.

Conclusion

On the one hand, it takes initiative by private companies to open up markets for new technologies such as satellite positioning, to make these systems available for larger user groups and to develop innovative applications. On the other hand, the collection and administration of fundamental geodetic data is part of the general infrastructure-related work performed by public authorities as part of their services for the public. The cooperation between SAPOS and ascos has shown that a Public Private Partnership is a good way of merging governmental responsibilities and private industry objectives in the interest of both sides and for the benefit of the national economy as a whole.

Figure 4: the new detection system CHARM allows the remote monitoring of natural gas pipelines for leakages and is based on infrared laser light.

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