UK COMMERCIAL GPS NETWORK SOLUTION

From OSNET to SmartNet

On 20th December 2005 Leica Geosystems announced a partnership with Ordnance Survey to offer commercial delivery of a GPS network solution across Great Britain. The network now consists of over 110 reference stations based on GPS and GPS/Glonass receivers, creating a full national GNSS RTK solution for over two hundred users.

Built upon the leading GPS Spider reference station software, SmartNet enables a further increase in GPS and GPS/Glonass productivity and reliability with reduced hardware costs. The 24/7 National GNSS Network solution is based on a common datum and covers entire Great Britain. Users can expect centimetre-level Network RTK accuracy, through to sub-metre DGPS, or raw data for post-processing. The network consists of the following sub-systems: (1) reference station infrastructure, (2) control centre, (3) generation of network corrections, (4) delivery of corrections and support, (5) security and backup and (6) network QA/QC.

Infrastructure
The reference station infrastructure, the most important part of any network, is built in partnership with Ordnance Survey (OS) which has its own internal RTK network known as OSNET and available only to internal staff. However, OS has made available raw data from OSNET to participatingcommercialpartners who are able to supply network software, control centre, communications and expertise on a national scale. The network will be further strengthened to create a high-density, high-redundancy network, and 'active' Leica reference stations will be added in co-operation with TSA members so as to deploy the latest GPS and Glonass reference stations receivers. In co-operation with Nottingham University's Institute of Engineering Surveying & Space Geodesy, the full GNSS RTK system will operate up to fourteen Quality Monitoring reference sites. SpiderNET software at the control centre handles and disseminates all corrections.

Corrections
A cluster is a sub-network of stations processed together to achieve a common level of ambiguity. One small network may consist of one cluster. Larger networks such as SmartNet, where performance, redundancy and reliability are at issue, consist of several clusters, and individual sites may be in more than one cluster, allowing overlap. Each cluster may or may not be on the same integer level. A cell is a selection of sites from a cluster consisting of one master station and several auxiliary stations, used to generate master-auxiliary corrections. Since SpiderNET processes all data together, every site in the cluster is reduced to the same ambiguity level and, in contrast to other approaches, no artificial limit of three reference stations is imposed. Use of more than three reference stations can improve network geometry, helps estimation of larger-scale atmospheric effects and prevents the rover from losing its fix if one reference station drops out due, for example, to unreliable communication links. Using two-way communications SpiderNet can also decide from rover location which site or cell is best suited. After receiving the position ofthe navigated rover SmartNet will collect all reference sites (reduced to a common ambiguity level) relevant for that position. Six stations are typically selected: the nearest as master station with full corrections and the others as auxiliary correction differences. Corrections are then returned to the user via Nearest, MAX or iMAX products, in appropriate formats (Figure 4). The GPS Spider solution enables new modules to be added, such as additional support for modernised GPS, Glonass and Galileo.

Delivery and Support
Each client rover is authenticated and administrated either by Internet GPRS or GSM Cell. The user can either negotiate their own sim card tariff from providers or, for subscribed rovers, obtain one from SmartNet administration. For GPRS access the user will be given anIP address, a unique user ID and password, which will normally be entered under the standard NTRIP options on manufacturer's software. For the GSM the user will require only user ID, password and phone number to dial. Flexible subscription plans have also been arranged, users not being restricted to one licence per rover system. In fact, as long as there is only one connection at a time, users will be able to switch their single licence between multiple users. Full network support is provided to users subscribing to SmartNet, with guidelines for setting up different types of rover receivers.

Security and Backup
The software architecture is based on a secured site of network servers, streaming raw data from reference stations and computing corrections to a proxy server or web-server for dissemination to users by NTRIP GPRS, access router GSM or RINEX file web downloads. Full security systems, including multiple firewalls, full network redundancy and backup servers, are also supported. The security concept separates the network operation and computation from data dissemination, thereby protecting the key infrastructure and sensitive user and billing information. The architecture is situated in a high-security, co-

location data centre in London's Docklands. There is full system redundancy with backup servers at the data centre. Should any problem arise within network mechanisms a full switch to backup systems is immediately implemented.

Quality Control
Leica GNSS QC software is installed at the control centre to continuously monitor data within the network and make regular audits of station multipath errors etc. Leica SpiderWeb software is fully integrated with GNSS QC, enabling real-time reports and statistics to be pushed to the web-server and giving users the ability to view network performance and statistics by way of real-time live charts on the SmartNet website. Full 1-30 second Rinex downloads are also available for service subscribers.

MAX and iMAX
Leica Geosystems has for many years been researching, promoting and realising Network RTK solutions and working towards an industry standard for Network RTK corrections. The company has jointly with other RTCM members developed and driven MAC, the future of networked RTK and basis for the newly approved RTCM 3.1 Network RTK messages. Up until now there have been no official internationally accepted standards for network RTK corrections. At the May 2006 RTCM SC104 meeting the proposed new network RTK messages for RTCM V3 were approved and the decision taken to release them with the next update of RTCM in V3.1; in October 2006 RTCM 3.1 version was formally released for Network RTK. The RTCM V3.1 network RTK messages provide an open, unambiguous and manufacturer-independent standard for network RTK corrections. The new standard, in addition to promoting increased compatibility and innovation, offers some distinct user advantages over previous non-standardised methods. Users of older receiver types are not restricted; to provide access to the entire GPS community corrections known as iMAX are available. These require two-way communications, may be transmitted in RTCM 2.3 or RTCM 3.0 format, and provide the same performance as a rover fully supporting MAX.

Concluding Remarks
To date, the network services more then two hundred RTK users. Figure 5 demonstrates that on working days on average nearly half of these are connected, and even the weekends show GNSS surveying activities.

Further Reading

• Leica Geosystems, 2006, Introducing SmartNet – An introduction to SmartNet the first commercial Network RTK service from Leica Geosystems, white paper, FIG/Intergeo.
• Leica Geosystems, 2005, Take it to the MAX! – An introduction to the philosophy and technology behind Leica Geosystems' SpiderNET revolutionary Network RTK software and algorithms, white paper, Leica Geosystems.
• Keenan, R., Brown, N., Richter, B. and Troyer, L., 2005, Advances in Ambiguity Resolution for RTK Applications Using the New RTCM V3.0 Master-Auxiliary Messages,white paper, ION GNSS.
• Ordnance Survey GB, 'Improved Positioning Using the National GPS Network', www.gps.gov.uk.

https://www.gim-international.com/content/article/from-osnet-to-smartnet