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# The dangers of GPS/GNSS


A cGIT publication


# In this issue

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## Articles



## Columns



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# Defining limits

A group of Japanese professionals and lawyers have asked Google to stop providing the detailed street level images of Japanese cities.

Their concern is that it violates privacy rights.

The 'owners of the technology' tend to demonstrate the extent to which the technology can go and what it can do.

The benefits of such efforts are convincing but the concerns being raised cannot and should not be ruled out.

Banning' or even 'constraining' such service providers is not an answer.

It is neither appropriate nor practical.

However, it is the time to be more sensitive towards the concerns being raised.

Apparently, there is a conflict between 'right to information' and 'right to privacy'.

**Bal Krishna, Editor**
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# The dangers of GPS/GNSS

The problem is that nothing works 100 %. GPS is very close, but for some users under some circumstances, "very close" is not good enough

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GNSS (Global Navigation Satellite Systems) is a common acronym encompassing all existing and planned satellite-based navigation systems. So far, the US-built GPS dominates the scene completely, but the Russian GLONASS is approaching around-the-clock global operational status, and other systems are being developed (the European Galileo, the Chinese Compass/Beidou and the Indian IRNSS). There are also augmentation systems of more or less operational status (the US WAAS, the European EGNOS, the Japanese MSAS and the Indian GAGAN). Satellite navigation is becoming part of everyday life, user equipments are becoming cheaper, smaller, easier to handle and with increasingly improved performance. This development is expected to continue for the foreseeable future with receivers in mobile phones and cars as dominating markets (Figs. 1-3).

The following discussion for obvious reasons mostly refers to GPS, but the arguments are generally valid for all global navigation satellite-based systems.

## Actual performance

Today's average performance of GPS is used as a starting point for our discussion. In not too distant a future, even better numbers can be expected.

PDOP Availability: Requirement - PDOP of 6 or less, 98% of the time or better; Actual - 99.98%.

Horizontal Service Availability: Requirement - 95% threshold of 36 metres, 99% of the time or better; Actual – 3.7 metres.

Vertical Service Availability: Requirement - 95% threshold of 77 metres, 99% of the time or better; Actual – 5.3 metres.

User Range Error: Requirement - 6 metres or less; Constellation Average Actual - 1.2 metres.

## What's the problem?

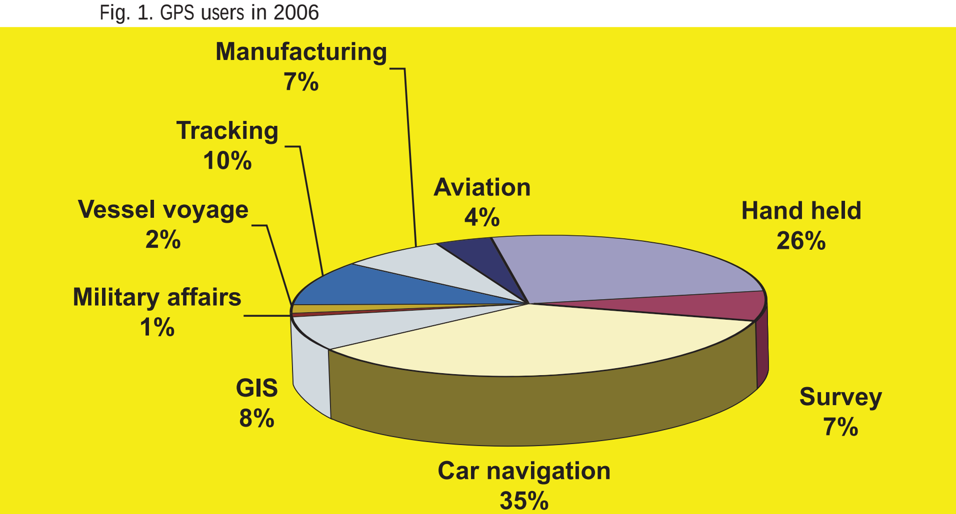
The problem is that nothing works 100 %. GPS is very close, but for some users under some circumstances, "very close" is not good enough. The situation in general is as follows:

- Most GPS users know nothing about GPS vulnerability.
- Most users don't care.
- Most GPS users can stand some interruptions or performance reduction.
- Most politicians and representatives of authorities in the field of navigation don't know of GPS vulnerability.
- Back-up systems are being closed down (e.g. LORAN-C), and there is little or no contact between different countries about these matters.

GPS (and all satellite navigation systems, more or less) are vulnerable because of

- Very low signal power received;
- A few frequencies (in the GPS case today, only one for general use) and a known signal structure;

Fig. 1. GPS users in 2006



- Spectrum competition;
- Worldwide military applications drive a GPS disruption industry;
- Jamming techniques are well known, devices are available, or can be built easily (fig. 4).

In 2001 (just before the infamous 9/11), the U.S. Department of Transportation's Volpe National Transportation Systems Center published results from an investigation into the vulnerability of the transportation infrastructure relying on GPS. Conclusions to be drawn from that investigation are:

- Awareness should be created in the navigation and timing communities of the need for back-up systems or operational procedures;
- All transportation modes should be encouraged to pay attention to autonomous integrity monitoring of GPS/GNSS signals;
- All GPS/GNSS receivers in critical applications must provide a timely warning when the signals are degraded or lost;
- Development of certifiable, integrated (multipurpose) receivers should be encouraged;
- A comprehensive analysis of GPS/GNSS back-up navigation and precise timing options (e.g. LORAN, VOR/DME, ILS, INS) and operating procedures should be conducted.

## Causes of trouble

There are many possible reasons for degraded performance or service interruption for users of GNSS:

- Satellite or control-segment malfunctions.

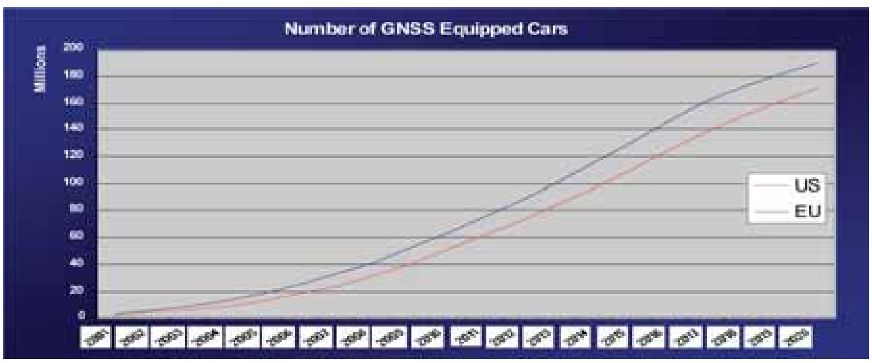


Fig. 2. Experienced and expected use of GPS/GNSS in cars

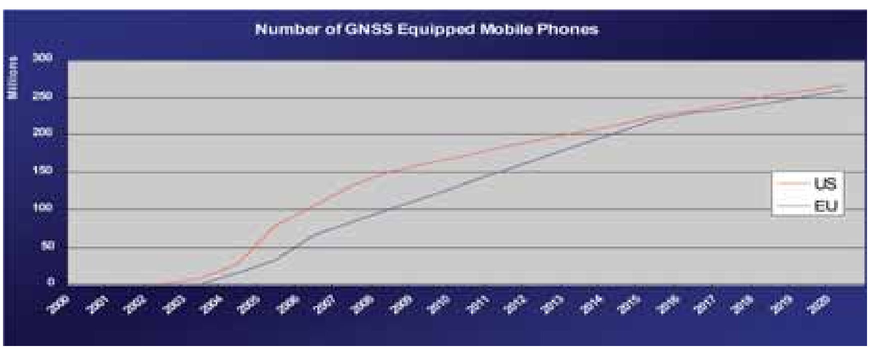


Fig. 3. Experienced and expected use of GPS/GNSS in mobile phones


Fig. 4. This dice is a 10 mW GPS jammer.

Fig. 5. Example of a car navigation problem.

- Unintentional interference:
  - Radio-frequency interference (RFI) from external sources (spectrum congestion, harmonics, high-power signals saturating receiver front ends);
  - Testing at system level;
  - Ionospheric influence (solar maxima, magnetic storms, scintillations);
  - Multipath.
- Intentional interference:
  - Jamming;
  - Spoofing (false signals into the receiver);
  - Meaconing (interception and re-broadcast of navigation signals).
- Human factors:
  - User equipment and satellite design errors;
  - Over-reliance;
  - Lack of knowledge and/or training.

The main technical explanation of GNSS receiver vulnerabilities to external interference can be summarised as very low power received from the satellites. The minimum power level is usually between -150 and -160 dBW. Looking at the details for GPS, we see that

- acquisition requires 6 – 10 dB higher signal-to-noise ratio (SNR) than tracking,
- loss-of-lock sometimes occurs for interference-to-signal ratios (I/S) below 30 dB,
- receiver detection of loss-of-lock is delayed because of narrowband code-tracking loops,
- some lines in the GPS C/A-code spectrum are more vulnerable than others because of higher power levels (Gold code spectra do not exactly follow a sinc shape, and spectral lines work as local oscillator frequencies for received interference signals),
- modulated interference is generally

worse than white noise, and narrow-band interference is worse than wide-band.

## Recorded examples of GPS troubles

During the long (and — don't forget! — usually very successful) history of GPS, a number of satellite malfunctions and interference problems have been recorded. Taking the record of April – August of the year 2005 for examples of satellite malfunctions, we find the following:

- SVN37 (PRN7): 3 Apr – Load-shed;
- SVN31 (PRN31): 14 Apr – Baseband reset;
- SVN27 (PRN27): 14 May – Rubidium #1 runoff leads to clock swap;
- SVN26 (PRN26): 9 Jun – Rubidium #1 clock jump;
- SVN15 (PRN15): 22 Jun – Comparator Reference Value Change;
- SVN32 (PRN1): 24 Jul – Load-shed;
- SVN26 (PRN26): 21 Aug – Crypto Variable Upload.

Experienced jamming and other records of intentional interference are (for obvious reasons) less available, but unintentional interference examples are abundant. Let us look at just two of them.

An infamous example is Moss Landing in California. From May 2001 and several months onward, no use of commercial GPS receivers was possible in the whole harbour area out to a distance at sea of at least one kilometer. After the first user reports about GPS unavailability, considerable efforts were launched to find the source of the interfering signal(s). Finally, it was discovered that there were in fact three sources, all of them being active UHF/VHF TV antennas with preamplifiers onboard pleasure boats.

In December the same year, a GPS jammer caused GPS failures within 180 nautical miles of Mesa, Arizona. Boeing was preparing for upcoming tests and accidentally left a jammer on the L1 frequency, radiating just 0.8 mW. The jammer operated continuously for 4.5 days. There were several impacts to ATC operations during the six days of jamming:

- Aircraft lost GPS 45 nm from Phoenix, performed a 35° turn toward traffic;
- NOTAM was not issued until 2nd day;
- numerous pilots reported loss of GPS;
- There were reports of hand-held GPS receivers not working.

## Time users

Users of GPS as a time and/or frequency reference are an often forgotten or unknown but very important part of the GPS community. Some applications where GPS time is used:

- Navigation;
- Telecommunications;
- Digital broadcasting;
- Power generation and distribution;
- Metrology;
- Meteorology;
- Radar;
- Tests and measurements
- Time tagging (Internet and transport)
- Time-of-day distribution.

Many users of these applications are crucially dependent on GPS for their systems to work properly.

## Countermeasures

If satellite signals do not meet requirements, the only thing users can do is to acquire information about the malfunction(s) from other sources as quickly as possible. Such information acquisition is called integrity monitoring. It can be receiver autonomous (RAIM) or received from external wide-area augmentation sources (e.g. WAAS, EGNOS, MSAS, GAGAN) or from local monitors (GBAS = Ground-Based Augmentation Systems).

Integration of GNSS receiving equipment with other sensors (e.g. inertial systems, LORAN) can be very useful in case of satellite signal malfunctioning. Such integration can also be efficient against interference and jamming.

Other countermeasures against all kinds of external interference are filtering and advanced signal processing, including adaptive antennas and null-steering.

A question which is often asked is whether upcoming systems (Galileo, INRSS, etc.) will solve the problem. The answer is that they will reduce the problem but not solve it completely.

## Satellite navigation problems in cars

Drivers using car navigation equipment experience problems fairly often (Fig. 5). Due to lack of knowledge, these problems are often wrongly ascribed to the satellite system instead of to the real cause, the map system. (In fact, a lot of users call their car navigator "my GPS"). A summary of these problems might be written:

- Satellite-based car-navigation equipment attracts negative attention for doing a job logically… but unintelligently;
- Expectations for such equipment are high – expected to be smarter than the driver (which-in fact-it often is!);
- Road classification is difficult – one person's farm track is another's handy shortcut.

## Conclusions and recommendations

All GNSS users must evaluate and analyse their own situation:

What would be the consequences in case of GNSS problems?

If the answer is 'no serious consequences', then "business as usual".

But if there are possible serious consequences, users must prepare for the unexpected !



# Challenges before National Mapping Organisations

Here are some perspectives

## Geographic innovation platforms and support networks

Vanessa Lawrence CB
Director General & CEO
Ordnance Survey, UK

Over the last few years we have seen significant, global, often disruptive, change in the technological and social environment within which National Mapping Organisations (NMOs) operate. These changes will continue to have profound effects on both: the way geographic information (GI) is captured, managed, traded and used; and the role and function of national mapping agencies.

GI is now part of the mainstream information economy with global players (Google, Yahoo, Microsoft and Nokia and other device and service providers) providing common user interfaces to GI both at home and in the workplace. It is now exchanged under global (W3C based) information standards and influenced by developments in: wireless, mobile, positioning, sensing, location, imaging, storage and processing technologies. These developments enable GI to be expressed and visualized in 2-, 3- and as 4Dimensions (the temporal dimension) as well as in virtual and augmented reality and increasingly, to be delivered as part of an on-line service. Most profoundly however we have seen a change in the general information model: from a linear, publishing, "push" model to an inter-networked, participatory model where users create, share and "mash-up" data using application programming interfaces and open source. Against this background of rapid technological developments the world today faces unprecedented global challenges: sustainable (one planet) living and working, climate change, aging populations, competition for scarce resources, asymmetric warfare and the effects of globalisation. Tackling these "grand" challenges requires unprecedented local to global collaboration, between governments, businesses, communities and ourselves as individuals. Whilst the technological developments have led to an explosion in the availability of data, captured and served by many, they have made the information management task, in tackling such grand challenges, more complex.

In a world where others can do what we do as national mapping agencies, NMO's must address the following challenges:

1. Provide geographic information frameworks as a critical means of ordering and managing information complexity, most of which resolves to location or place. This is an essential requirement in enabling local to global collaboration across government, businesses and third sector communities in addressing grand challenges. The recently published UK Location Strategy Place Matters: the Location Strategy for the United Kingdom begins to set out that geographical framework for the Nation. Endorsed by British Ministers phrases such as "In almost everything, people need to know when and where things happen: place matters" are now common place. User generated content can also ordered within these frameworks thus making best use of information collected.

2. Governments globally are increasingly looking to the third sector as a channel of service delivery to their communities. High quality service delivery requires, accurate, current, trusted, and maintained GI as an ingredient - a role NMOs are familiar with.

3. Provide for ease of use and ease of access to geographic information at users time, point and context of need. Providing the right information at the right time in the right way to meet users' expectations in a given situation is a requirement of good information service design and one NMO's are beginning to address.

> Whilst the technological developments have led to an explosion in the availability of data, they have made the information management task more complexed.

4. Provide geographic innovation platforms and support networks that encourage open and user led innovation from communities of users in government, business and the third sector. Both business and social value can be derived from these networks, growing the market for GI and quality of life for a globalised population. Ordnance Survey's OS OpenSpace is an experiment in just such an innovation platform.

The challenge for NMO's going forward is to provide the information frameworks, innovation platforms, ease of access and ease of use of accurate maintained geographic information which are needed to address local to global challenges, efficiently and effectively.

# Challenge is how to get our hands on good authoritative data

Lam Joon Khoi
Chief Executive, Singapore Land Authority, Singapore

Despite the economic gloom and challenges currently confronting the whole world, I believe the use of geospatial information will continue to grow, and grow rapidly. Why do I think so? As countries put more people and things into cities, the urbanization of cities will increase the complexity in land usage. As cities become densely populated and well developed with modern infrastructures, we can expect more geospatial information to be available for capture. More help is then needed to manage and analyse the vast information. The content of information also changes over time and that too has to be managed. I can see the transformation happening in Singapore too. Singapore is adding more road and rail infrastructures. More lands are re-developed with higher intensification. We are using the subterranean space more intensely than more. Hence, information over different levels of space (e.g. from subterranean, to ground level and into the airspace) will be captured. In short, the supply of geospatial information will continue to grow in scope and quantity. Information will be in 2-dimensional and even 3-dimensional form. There is also the time dimension of geospatial information to manage. Beyond the cities, there are other geospatial information to manage – natural resources, the environmental issues (such as climate change, water issues) and so on.

I also believe the demand for geospatial information will correspondingly increase. People and organizations need to know when and where things happen. Increasing ownership of mobile devices, such as handphones and PDAs with GPS, adds to the demand for more location-based services. Once decision-makers understand and appreciate the value of graphical presentation of situation, analysis and simulation using GIS, there is no turning back. The common saying – A picture is worth a thousand words – needs no further elaboration. The increases in supply of and demand for geospatial information provide a positive outlook for the industry.

While many countries recognized that geospatial information and its exploitation is a rapidly growing and profitable industry, each has its own challenges. Let me share with you a little about the Singapore Geospatial Story.

## The Singapore geospatial story

In Nov 2007, at a similar ESRI user conference in Singapore, I spoke about the importance of geospatial information for decision-making. I shared that the use of geospatial information in the Singapore Public Service has been around for many years, primarily in the security and land planning authorities. Our Land Data Hub, for instance, was in place since 1989. Today, 15 public agencies are sharing some 125 layers of geospatial information through our network, known as LandNet. Since April 2008, the Singapore Public Service has embarked on a new phase. We have decided to link up the Land Data Hub and 3 other data hubs under a national spatial data infrastructure (NSDI) framework. The other data hubs are repositories of data concerning people, businesses and security matters owned by various public agencies. Hitherto, all the 4 data hubs have been developed and operated independently. In our concept of NSDI, Singapore aims to develop an environment in which public agencies can collaborate and share data more easily.

> We must persevere to create a mindset of sharing and responsible usage of geographic information

We named our NSDI initiative as the Singapore Geospatial Collaborative Environment, or SG SPACE in short. The implementation of SG SPACE will allow geospatial information from many public sector sources to be shared within a consistent reference framework across the public sector. It is our vision for this initiative to go beyond the public sector to encompass the private and people sector, through licensing and the provision of common goods. The initiative will result in removing duplication of data collection, encouraging re-use of data, and making informed decisions and monitoring. A multi-agency and inclusive committee has been formed to drive and coordinate the various action plans. We hope the strong leadership and governance in the committee is sufficient to drive the changes and implementation.

We will be inviting the industry in a few months' time to help us build a national clearing house for geospatial data. In essence, the clearing house will link up all the 4 hubs that I spoke about earlier. It will provide a gateway for easy discovery and rapid access to geospatial information across the public sector.

One of the goals of SG SPACE is to strengthen our policy formulation and evaluation. We know geospatial information is essential to support our approach to emergencies, environmental challenges (e.g. climate change and water issues), disease management and control, and so on. But we are not just looking inwards. We believe SG SPACE can potentially provide the private and people sector with useful information that helps them to deliver their products and services better. Hence, we are also building an intelligence map system that is interactive to serve the public better. Besides presenting the public sector information, the intelligence map system can potentially allow individuals and businesses to use some of the public geospatial information via mash-up. All in all, everyone stands to gain in SG SPACE.

## Challenges

There are many challenges facing those developing an NSDI. I shall highlight 2 of them which I believe are not unique to Singapore.

One challenge is how to get our hands on good authoritative data? Authoritative data are those that are closest to the source, authentic and accurate for the functions that they are intended for. Unless we collect all the data ourselves, which is impractical and duplicative, we have to rely on others. However, often the data source owner needs to be thoroughly convinced on our needs before it can agree to provide or share the information. That to me is a reasonable precaution on the part of the data owner. However, sometimes the issue of privacy and security of data could be used conveniently as a reason for not sharing the data. Some of the impediments to sharing are even stipulated by the legislations. Recently, the terrorists who wrecked havoc in Mumbai were reported to have used Google Earth for "location intelligence" and operational planning. This event will undoubtedly reinforce the list of considerations in any future releases of geospatial information. I believe there is no short cut to overcome the impediments to sharing and we must persevere to create a mindset of sharing, and responsible usage. A transparent and collaborative environment is perhaps a good approach to begin.

Another challenge is how to convince decision-makers to invest in geospatial applications and information…. Many decision-makers have not realized that geospatial information is essential to them and their businesses. Having been in the military service for 20 years, I appreciate the value of GIS for operations and analysis. Therefore, it did not take my staff long to convince me that geospatial information is essential to the public service too and the idea led to the birth of SG SPACE.

*Excerpts from the address at the ESRI Asia Pacific User Conference, Singapore International Convention & Exhibition Centre, 20 -21 Jan 2009*

# NMOs working in isolation are no longer a solution

Dr P Nag
Director, National Atlas & Thematic Mapping Organisation (NATMO), India

For any institution challenges are all the time. In the history of institution building challenges are considered to be opportunities. These opportunities are to be encashed in time with right vigor. The institutions have to keep on shifting their focus within their mandates. Same is true for the national mapping organizations (NMOs) in India. If we see the growth patterns of the Indian NMOs, Survey of India and the National Atlas & Thematic Mapping Organisation (NATMO), we will find that former got impetus during the 1961 Indo-China war; and latter after independence when the country required maps different from topographical maps for national reconstruction and planning. Both were challenges during those times.

The biggest challenge before the NMOs is the management of such institutions. These challenges have come due to (a) reducing man-power, (b) fast changing geospatial technology, (c) new data sources, and (d) new market and application driven requirements. The scenario is changing so fast that the manual, procedures and training become out-dated in no time. NMOs are used to have their own traditions in map-making. It has become difficult to hold these traditions. However, the core properties of the data are still maintained, whether required or not. Nevertheless, such stringent criteria are not always appreciated.

Due to the nature of demand, security priorities and requirements for openness of geographic data, a new Open Map Series (OSM) has been initiated by the Government. This has increased the workload on Survey of India at least five times due to : (a) digital data of OSM, (b) digital data of the Defence Map Series (DSM), (c) hard copy of OSM, (d) hard copy of DSM, and (e) maintaining of the National Topographic Data Base. Though technology is reducing the workload, the depleting strength is coming in the way. The story of NATMO is also not different. The Golden Map Service has increased the workload several times.

Perhaps one solution is to out-source the mapping activities to the industry. Considering several projects which have either been completed recently or now under-completion, we find that there is a gap in understanding between the NMOs and industry. The NMOs are tied down with rules, procedures, method of acceptance of data and mode of payments. These regulations are not always appreciated by the industry. A new method of sharing responsibility is to be worked out. Some models are being practiced by the NMOs but they are not always foolproof.

> The issue is whether NMOs can cope up with the ever-increasing expectations of the Government and the people at large?

The issue is whether NMOs can cope up with the ever-increasing workload and expectations of the Government and the people at large? What kind of control they should exercise? How the responsibility about the quality of the geographic data is to be shared? What should be the model of participating in this national task? How a revenue model is to be worked out? Examples from abroad are often quoted to answer these intricate questions. But the prevailing conditions are not similar. A serious debate is required in this regard. Even several surveys of geospatial industry conducted recently are silent on this subject. NMOs working in isolation are no longer a solution for India.

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# Quality evaluation of NRTK correction transmission

The paper investigates the quality variation of the NRTK correction transmission, and reveals its influence on the positioning solution

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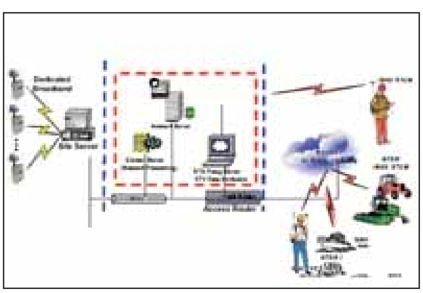

Figure 1: Network RTK system architecture which consists of a network reference stations (left), central processing facility (middle) and the user groups (right)

GNSS positioning/navigation devices are rapidly merging into and changing our modern lives, just like the personal computer in the 1980's and the cellular phone in the 1990's. It is predicted that by 2012, the annual shipment of navigation devices will increase to over 65 million units, which is more than three times the 19.8 million shipped in 2006 [1]. Also in a situation personal computer and cellular phone ever faced, a higher standard service demand has been placed in front of the GNSS technology, and becoming a bottleneck before its potential mass market can be exploited. More precisely, at present, real time and high accuracy are the two major concerns for many promising commercial GNSS plans, such as Road Pricing and Intelligent Transportation Systems Services (ITSS) [2].

For these high demand applications, Real-Time Kinematic (RTK) positioning is one of the most significant solutions and has been widely tested and commercialized in many countries [3-5]. Its latest evolving trend has been leading in the Network RTK (NRTK) direction. NRTK technology can remove spatially correlated errors and effectively mitigate distance-dependent errors in the GNSS measurements, and achieve a centimetre-level positioning solution [6]. In such a high accuracy real time system, reliable and high-speed server-rover communication (i.e. correction message transmission) plays an important role in the final performance. Our work will investigate the quality variation of the NRTK correction transmission, and reveal its influence on the positioning solution.

## NRTK background

In the traditional RTK technology, by differencing the carrier phase observables between the receiver and a reference station with known high-accuracy position, spatially correlated errors can be removed, and positioning accuracy can be improved from tens of meters (Stand Alone mode) to centimetre level.

The limitation of traditional RTK is that some distance-dependent errors (such as ionosphere delay) will increase with the increasing length of the baseline between the rover and the reference station. Normally for an implementation with centimetre-level accuracy requirement, the baseline length should not be more than 20km [2]. For national GNSS applications, this limitation would result in a dense reference station network and considerable investment in infrastructure.

To overcome this constraint, NRTK was developed in recent years. In a NRTK GNSS facility, a central data server collects the raw observations from a number of reference stations, and sends corrections to a rover positioning terminal after carrying out an integrated processing. The rover then combines these corrections with its local carrier phase observations, to obtain a high accuracy real time positioning solution. The architecture of NRTK system is shown in Figure 1.

In a NRTK implementation, through the interpolation of corrections from a set of reference stations, the distance-dependent errors are mitigated and the high-accuracy solution can be achieved in a much greater area than a traditional RTK implementation. The separation between the NRTK reference stations can be extended to 100km [7], which means only 600 stations could cover the whole European area.

## Data dissemination

Much research in NRTK technology has focused on the efficiency and effectiveness of the reference stations measurement usage, through improving models (especially for the ionosphere model) and the data processing technique to reduce the number of stations and cost. When a network is getting sparse, the length of data communication will extend accordingly. In the meantime, due to the rapid change of the satellite geometry and also the atmospheric conditions, the correction messages from the data server have a time-limited validity. Thus the challenge for NRTK data dissemination is to keep a reliable and high speed wide-bandwidth service in a long distance transmission. The variations during the correction data transmission, i.e. message delay and loss, may increase with the increase of the baseline and eventually degrade the high accuracy solution. Therefore the quality of the RTK correction data dissemination should be taken seriously.

The RTK data transmission channel is a combination of cable connection and wireless connection. In terms of the cable connection part, public Internet is the dominating choice. In 2003 an application-level protocol, Network Transport of RTCM via Internet Protocol (NTRIP) was developed by the Federal Agency for Cartography and Geodesy (BKG), Germany [8]. It is dedicated to streaming GNSS data over the Internet. The data server of a RTK network is both a TCP/IP server and an NTRIP caster.

In terms of the wireless connection part, there are several available transmission methods which can be utilized for NRTK positioning [9]. Table 1 includes the comparison of the major features of these methods and it can be concluded that only commercial cellular communication and satellite communication can be used in the large area applications. Comparing these two methods, the former has great economic and practical predominance at the current stage. Among the various mobile networks in today's market, the GPRS (EDGE) and 3G network are the best options [10] and the former has a further advantage in the service coverage.

Currently both public Internet and GPRS can provide high-quality services. However, these services are not guaranteed. RTK data does not have any priority on these channels, although it is quite time-sensitive. During the transmission, frequent route switching, channel congestion in peak-time and even any faulty from the service provider's equipment might cause the RTK messages to be delayed or lost.

## Evaluation System

To study the impacts of these transmission variations, parallel tests were conducted using the setup as shown in Figure 2 in a research lab within the Institute of Engineering Surveying and Space Geodesy (IESSG) in the University of Nottingham. The tests were carried out in a static NRTK mode with a GNSS antenna fixed on a precisely measured point to minimize the influence from irrelevant factors.

The whole system can be separated into three sections: Data Source, Data Dissemination Route and Data User. In the data source section, a dedicated RTK GPS network established jointly by the IESSG and the Leica Geosystems is utilized. This network consists of 14 high grade geodetic GNSS station sites and covers an area of

| Type of Comm. | Radio | Cellular | Satellite | Wi-Fi |
|---|---|---|---|---|
| Range | short | large | large | very short |
| Coverage | line of sight | nearly full | full | limited |
| Bandwidth | Wide | Wide/limited | limited | Wide |
| IP supporting | no | yes | yes | yes |
| Service charge | no | medium | high | low |
| Licensing | required | no | no | no |
| reliability | dedicated | not guaranteed | Exclusive service | not guaranteed |

Table 1: Comparison of Different Correction Dissemination Approaches

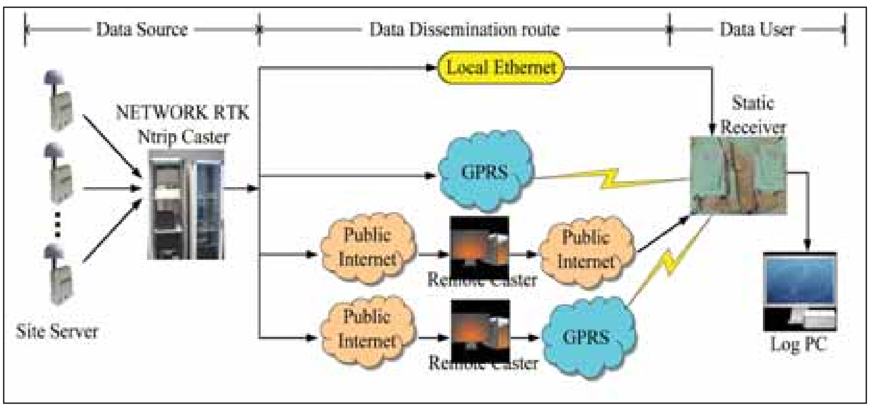


Figure 2: Evaluation System Design

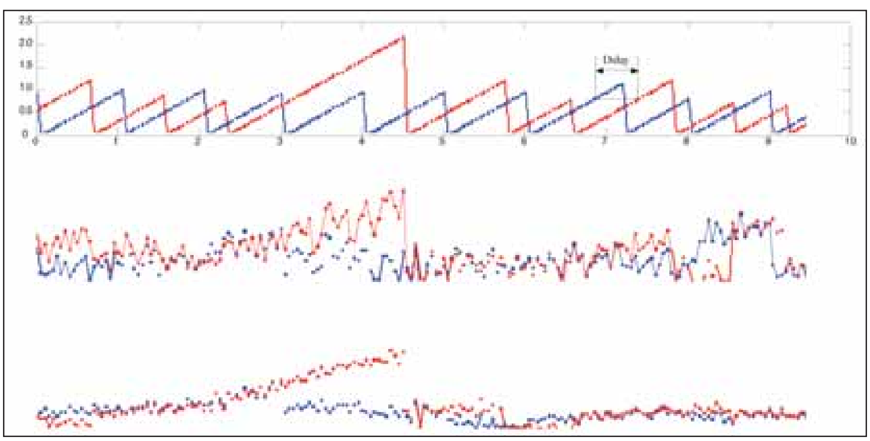

Figure 3 Data latency and corresponding horizontal and vertical errors;
Blue : Benchmark solution, Red: GPRS + Long Distance solution

~20,000 km2 in the Midlands region in the UK. The raw observations from these site servers were sent to an NTRIP caster in the central data processing centre, which is located in the IESSG. Professional NRTK software Leica Spider v3.0 was adopted to organize the raw data, generate correction data for any receiver request and disseminate the correction messages in the Radio Technical Commission for Maritime services (RTCM) format.

In the data dissemination section, four different transmission scenarios are considered. The first one is through a short local Ethernet link, in which case the cabled connection between the receiver and the NRTK server is only tens of meters long, and can simulate an ideal transmission link. This transmission is assumed to have zero message loss and delay, and is used as a benchmark to compare with the other three transmissions.

The second configuration is through a commercial GPRS link, where the receiver communicates to the NRTK server via a dedicated cellular modem. The third configuration is through a long-distance public Internet link. In this scenario the RTK data is relayed via a remote NTRIP caster which is located at the Finnish Geodetic Institute (FGI), Helsinki, Finland, and sent back to the receiver. The public Internet link used here is over 2000km long. This scenario is designed to simulate a rigorous cabled connection environment. The last configuration is a combination of the second and third setting, i.e. a long-distance public Internet plus a GPRS link. The RTK data is sent to the remote NTRIP caster in Helsinki and sent back to the receiver via a commercial GPRS link, which can represent a typical commercial NRTK correction transmission.

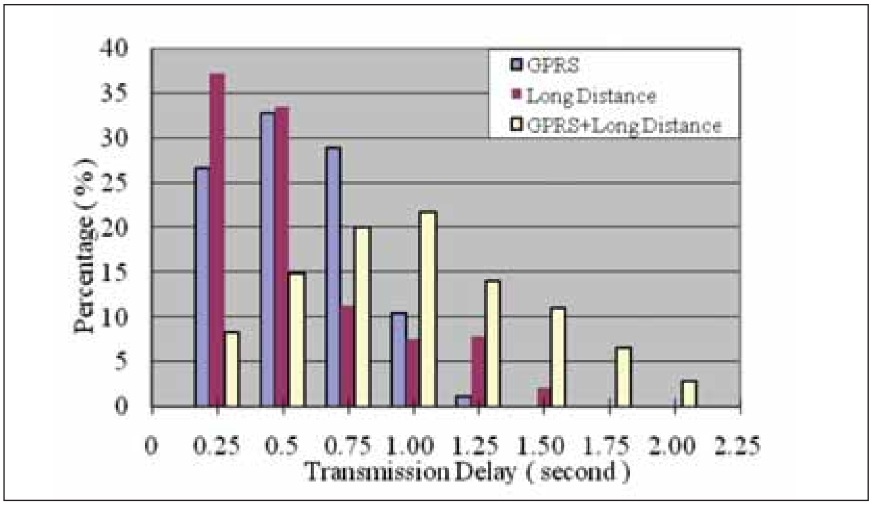


Figure 4 Distribution of the message delay

| | Message Delay (sec) | | Message Loss |
|---|---|---|---|
| | Average | Std. | |
| Benchmark | 0 | 0.03 | 0% |
| GPRS | 0.44 | 0.24 | 1.1% |
| Long Distance | 0.43 | 0.34 | 12.4% |
| GPRS +Long Distance | 0.85 | 0.45 | 20.6% |

Table 2  Statistics of the message delay and loss

| | <0.5cm | 0.5~1 cm | >1 cm | Std. (cm) |
|---|---|---|---|---|
| Benchmark | 89.43% | 10.55% | 0.03% | 0.16 |
| GPRS | 80.93% | 18.60% | 0.47% | 0.18 |
| Long Distance | 70.53% | 27.13% | 2.35% | 0.24 |
| GPRS + Long Distance | 68.09% | 29.30% | 2.60% | 0.25 |

Table 3  Statistic of the horizontal error

| | <1 cm | 1~2 cm | >2 cm | Std. (cm) |
|---|---|---|---|---|
| Benchmark | 97.01% | 2.98% | 0.01% | 0.45 |
| GPRS | 87.70% | 11.90% | 0.40% | 0.64 |
| Long Distance | 83.84% | 15.50% | 0.66% | 0.69 |
| GPRS +Long Distance | 82.11% | 16.81% | 1.09% | 0.73 |

Table 4  Statistic of the vertical error

In the data user section in Figure 2, a geodetic Leica 1200 receiver was employed. Its outputs are provided in NMEA $GPGGA format at 20Hz and are logged by a PC. Besides the positioning solution, the data latency, or the "age of correction" (i.e. the elapsed time from the time of the latest RTK correction to the time of the current solution made [11]) is available in the GGA sentence and can be used to determine the message delay.

To avoid the influence of irrelevant factor, the parallel tests are carried out at the same time, and utilizing the same type of receivers, sharing a common GPS antenna and keeping all the same configurations except the transmission methods. Therefore differences between the benchmark and the other three solutions are only caused by the transmission variation. Also, although the solutions are made in the RTK mode, all the tests are carried out as static, to avoid the unnecessary kinematic disturbance.

## Data Analysis

Figure 3 illustrates a comparison between the benchmark solution and the solution via the GPRS combined with the long distance Internet link, in a 10-second-long timeslot. The comparison is made in terms of the latency, the horizontal error and the vertical error respectively.

Because the receiver makes the solutions at 20 Hz, the latency will gradually increase by 0.05 second at each logging point over the time axis, until a new correction message is received, which brings the latency value back to zero. Therefore the height of the triangle shape in the latency figure can show the receiving time interval

between two consecutive messages. In the benchmark solution it can be seen that, due to the ideal transmission environment, the messages are received at a nearly constant one-second-interval; while in the combined link solution, the messages are received at varying intervals, which can show that the condition of the transmission route was unstable. It can be seen from the latter solution that there is a triangle with a two-second height. This shows a message loss in its scheduled time.

Because of the delay, the same message may arrive at different times in two links. Accordingly, in the latency chart of Figure 3, the channel delay results in a separation between the two different colour triangles. Considering the zero transmission delay in the ideal benchmark solution, this separation can determine the message transmission delay in the combined link solution, as marked in the figure.

Statistics of both the message delay and loss in different solutions are shown in Table 2. It can be seen that the average delay of the GPRS and the long distance Internet link are at the same level, and the average delay of the combined link is close to a second (0.85 sec). Both the standard deviation of the message delay and the message loss percentage show the stability of the transmission, where the GPRS link is relatively more stable than the long distance Internet link, and the combined link is the worst. Comparing to the GPRS link, the long distance Internet link suffered much more message loss, and 20% of the messages were lost in the combining link.

Figure 4 shows the distribution of the message delay, for the three transmission scenarios. The long distance Internet link shows a greater spread in the delay than the GPRS link, due to its larger number of packet switchings during the transmission. There is no delay higher than two seconds in these two links, because if a message arrives later than the following message, it will simply be rejected by the receiver and will be treated as a message loss. The combined link does have a small percentage of message delays higher than two seconds, because the following message may also not arrive on time due to its rigorous environment.

With increasing message delay and loss, the receiver may not have the latest RTK corrections on time and only can 'predict' the present correction from the past RTK data [12]. The time-sensitive error will increase and the positioning solution will drift away from the true coordinates. In Figure 3, it can clearly be seen that, during the message-lost period, both the horizontal error and the vertical error are increased and a 'degradation peak' is formed. The statistics of the horizontal error and the vertical error are shown in Table 3 and Table 4 respectively. It can be seen that both the GPRS link and the long distance Internet link introduce some 'degradation peaks' and degrade the positioning solution precision eventually. Again, the long distance Internet link shows a larger influence than the GPRS link. Comparing to the benchmark solution, the precision of the combined link solution is degraded by 60%.

## Conclusion

This paper presents a study to investigate the quality of the NRTK data transmission methods. The two transmission variations, message delay and loss, were both observed whilst the GPRS link and the long distance Internet link were used. The combination of the two links was shown to have a 0.85 second average delay and 20% message loss. It is demonstrated that these variations might introduce 60% degradation in the precision of the positioning solution in a static test. When designing a RTK network in a large-area, this transmission influence should be considered, and as a compensation, a more frequent message sending scheme could be considered.

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# TRIUMPH-1

## 216 channels

### GPS + GLONASS + Galileo

# Better than 30 cm GIS... instantly or 5 cm static


Actual size

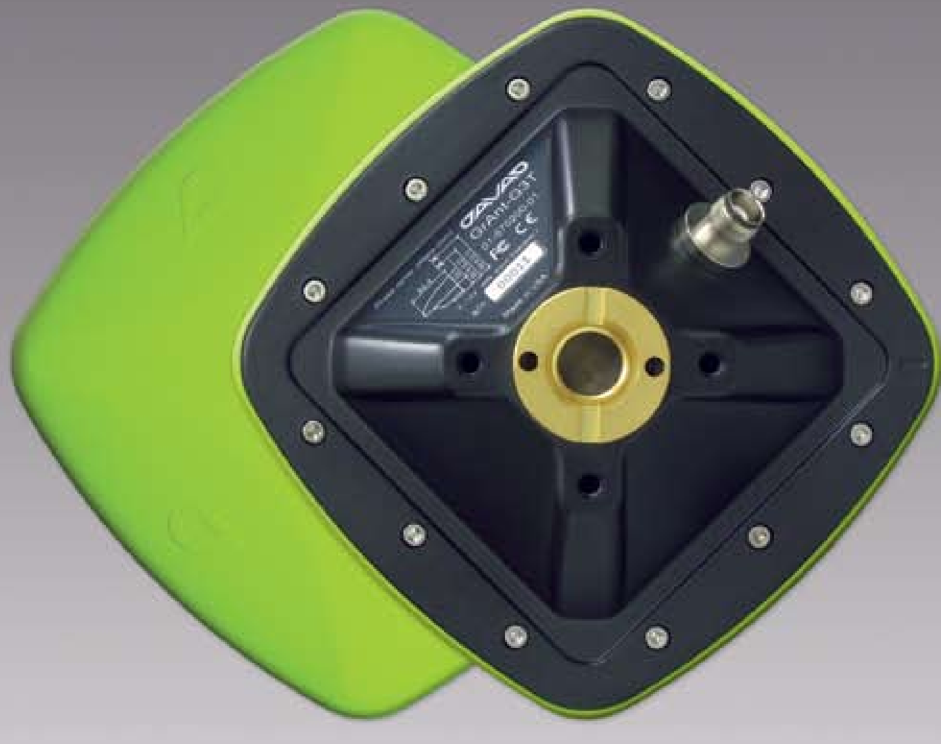
## GISmore

stand-alone or inside the hat

## Bluetooth wireless connection to GISmore

- GPS L1
- Galileo E1
- GLONASS L1
- 100 Hz update rate
- 100 Hz update rate
- RAIM
- WAAS/EGNOS
- Rechargeable Li-Ion Battery
- GNSS Antenna
- GSM Module
- Bluetooth® Interface
- Bluetooth/GSM Antenna

## Many ways to use



# GrAnt-G3T/G3

**GrAnt-G3T**
**is a versatile high performance antenna with GPS L1/L2/L5; Glonass L1/L2; Galileo L1/E5**
140x140x62 mm, 0.52 kg

- Protection Against ESD
- Have good vibration and shock resistance

**GrAnt-G3** have similar case as GrAnt-G3T
**with L1 GPS/Glonass/Galileo capability**
140x140x62 mm, 0.45 kg

- All GrAnt-G3T mounting options and accessories valid for this antenna

Possible design options:

TNC side view connector (regular design)

N-type connector (side view)

TNC on centre for pipe mounting

Snow Cone options

- 3 different mounting method available:
  female thread 5/8”-11
  female thread 1”-14
  4 holes M5 ϕ50
- Available integration design GrAnt-G3T with receiver boards TR-G2T and TR-G3 or IMU

# TyrAnt-G2T/G3

**TyrAnt is our GrAnt antenna integrated with our TR-G3 or TR-G2T OEM board. It is the first and only smart antenna with triple frequency GPS with Galileo option.**

140x140x62 mm, 0.6 kg

- Communication is provided via RS422 or CAN interface.


# GyrAnt

**GyrAnt is the GrAnt antenna integrated with Inertial Measurement Unit (IMU) consisting of three accelerometers and three gyros on three axes.**

140x140x62 mm, 0.6 kg

- Communication is provided via RS422 or CAN interface.


# AirAnt

**AirAnt is designed to be mounted on aircrafts and applications where low profile and aerodynamic shape are desired.**

120x74x44.5 mm, 0.32 kg

- GPS L1/L2/L5
  Glonass L1/L2
  Galileo L1/E5

# TriAnt

**TriAnt is small, thin, and rugged high performance GNSS antenna. It is ideal for applications like navigation and surround antennas of TRIUMPH-4X. With GPS L1/L2/L5; Glonass L1/L2; Galileo L1/E5**

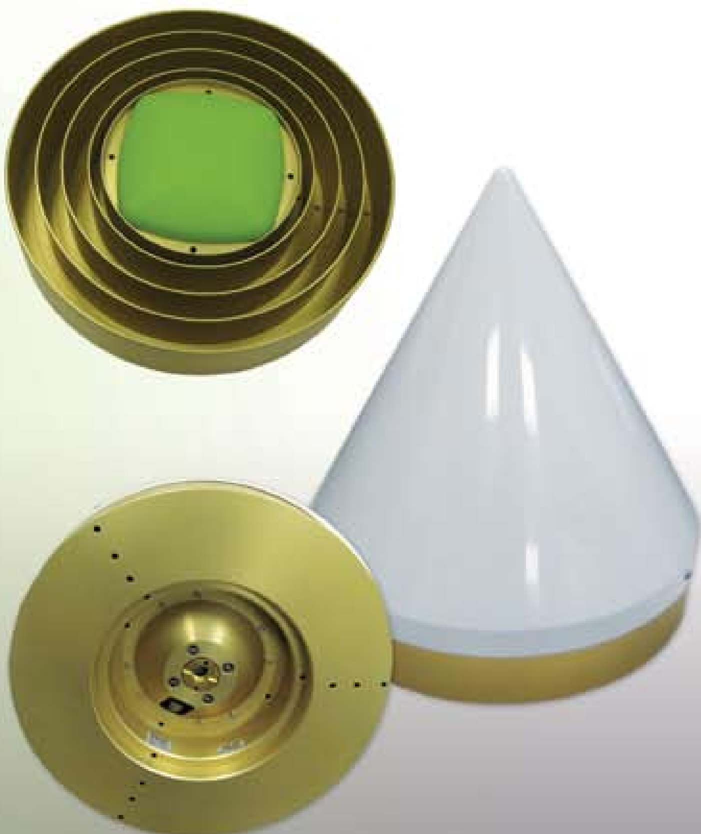
128x128x55 mm, 0.47 kg

- 2 different mounting options:
  female thread 1”-14
  3 holes M5 ϕ50

# RingAnt-G3T

**It is our GrAnt antenna mounted on our own choke ring ground plate. With GPS L1/L2/L5; Glonass L1/L2; Galileo L1/E5**

ϕ326x88 mm, 2.71 kg



# RingAnt-DM

**Traditional choke ring with Galileo option and Dorne-Margolin element.**

- GPS L1/L2/L5
  Glonass L1/L2
  Galileo L1/E5/E6

## ALPHA

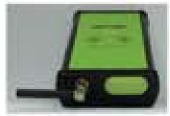
- Internal battery
- Charger
- GSM
- Bluetooth

for: TR-G3, TR-G2T, TR-G3T

**Front panel connectors:**

Power Input + serial port A + USB + Antenna

**Back panel connectors:**



Can have up to 3 connectors of 1-PPS • Event Marker • IRIG • GSM Antenna (without Bluetooth antenna).

When Bluetooth antenna is installed only one extra connector can be installed.

Example 1: BT Antenna + GSM Antenna
Example 2: 1-PPS output + Event Marker + GSM Antenna

---

## DELTA

for: TRE-G2T, TRE-G3T, Duo-G2, Duo-G2D, Quattro-G3D

**Front panel connectors:**

Option 1: Power Input + Serial A + Serial B + Serial C + Antenna

Option 2: Power Input + USB + Serial A + Serial C + Antenna

Options 3: Power Input + USB + Serial A + Serial C + Ethernet

**Back panel connectors:**

Can have up to 4 connector of 1-PPS A • 1-PPS B • Event A • Event B • Antenna • CAN • IRIG B

Example: 1-PPS A + 1-PPS B + Event A + Event B

---

## SIGMA

- Internal battery
- Charger
- Modem
- GSM
- Bluetooth

for: TRE-G2T, TRE-G3T, Duo-G2, Duo-G2D, Quattro-G3D

**Front panel connectors:**

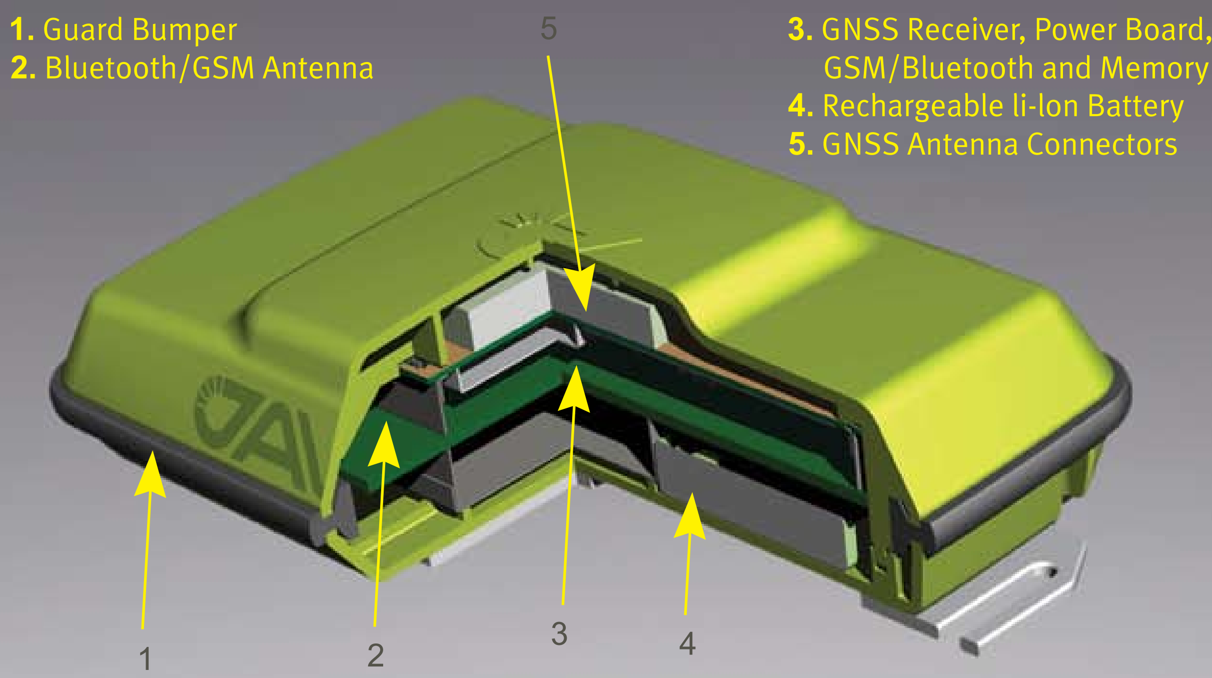
Can have Power Input • Second Power Input • USB • Serial A • Serial B or C • Ethernet

and up to 4 connectors of 1-PPS A • 1-PPS B • Event A • Event B • Antenna • CAN • IRIG • RS422

**Back panel connectors:**

Can have SIM door and GSM Antenna connector and up to 4 connectors of 1-PPS A • 1-PPS B • Event A • Event B • Antenna • IRIG • Modem Antenna • Bluetooth Antenna

Example: GSM Antenna + SIM door + 1-PPS A + 1-PPS B + Event A + Modem Antenna




# 216-channel TRIUMPH

## Tracking Specification

Tracking Channels
GPS L1/Galileo E1/GLONASS L1

Signals Tracked
L1 C/A, Code & Carrier

## Power Specification

Battery
Internal Li-Ion battery (3.7 V, 1.05 Ah) with internal charger

| | |
|---|---|
| Operating time | Standby mode |
| | Call mode |
| Input Voltage | +4.5 to +6.5 volts |

## GNSS Antenna Specifications

| | |
|---|---|
| GNSS Antenna | Internal |
| Antenna Type | Microstrip (Zero Centred) |
| Ground Plane | Antenna on a flat ground plane |

## Radio Specifications

GSM/GPRS Module
Internal GSM/GPRS quad-band module, GPRS Class 10

| | |
|---|---|
| GSM/GPRS Antenna | Internal |

## I/O

Communication Port
Bluetooth V2.0+EDR Class 2 supporting SPP Slave and Master Profiles

| | |
|---|---|
| External Power port | 1 port |
| GSM Status Indicator | One LED |

## Performance Specifications

Static, Fast Static Accuracy
Horizontal: 5 cm + 0.5 ppm * base_line_length
Vertical: 5 cm + 0.5 ppm * base_line_length

Kinematic Accuracy
Horizontal: 5 cm +1 ppm * base_line_length
Vertical: 5 cm +1.5 ppm * base_line_length

RTK(OTF) Accuracy
Horizontal: 5 cm +1 ppm * base_line_length
Vertical: 5 cm + 1.5 ppm * base_line_length

| | |
|---|---|
| DGPS Accuracy | < 0.25 m Post Processing,<br>< 0.5 m Real Time |
| Cold Start | <65 seconds |
| Warm Start | <5 seconds |
| Reacquisition | <1 second |

## Memory & Recording

Internal Memory
Up to 256 MB of onboard non-removable memory for data storage

Raw Data Recording
Up to 100 times per second (100 Hz)

Data Type
Code and Carrier from GPS L1/Galileo E1/GLONASS L1

## Environmental Specifications

| | |
|---|---|
| Enclosure | Aluminum extrusion, waterproof |
| Operating Temperature | -40° C to +55° C |
| Dimensions | W: 79 mm x H: 33 mm x D: 131 mm |
| Weight | 210 g |

# TR/TRE Evaluation Kit

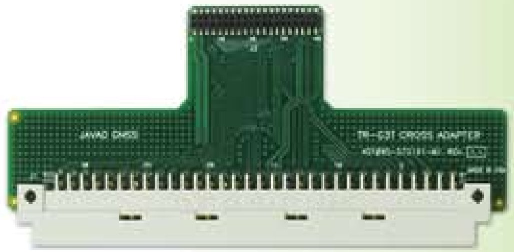
The evaluation and development kit for all TR and TRE Javad GNSS OEM boards

## Include 4 items:

1. TR-G3T Cross Adapter
2. TRE-Interface Adapter
3. Power cable
4. TNC-MMCX RA 0,19 m RF cable

JAVAD

WWW.JAVAD.COM

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# Accuracy performance of hand-held GPS

## A comparative study

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Satellite positioning is the term used to describe the determination of the absolute and relative coordinates of points on (or above) the Earth's land or sea surface by processing measurements to, and/or form, artificial Earth Satellites. In this context, absolute coordinates refer to the position of a point in a specified coordinate system, whereas relative coordinates refer to the position of one point with respect to another (again in a specified coordinate system). Relative positions are generally more useful in surveying and can usually be more accurately determined.

The first applications of the technique were made in the early 1960s, but at that time the lengthy observing periods (weeks or months at a station) and rather low accuracy (standard errors of several meters) mean that it was only really useful for global geodesy. Important results were, however, obtained, especially in the connection of various national and continental terrestrial networks and in the determination of the overall position, scale and orientation of national coordinate systems. Nowadays, relative positions can, in certain favorable circumstances, be determined from satellite measurements with standard errors of a few millimeters within a few minutes. Clearly this makes satellite positioning a powerful tool for a wide variety of engineering applications.

Moreover, satellite positioning has two very important advantages over its traditional terrestrial counterpart. Firstly, as in the case of inertial surveying, the derived positions are genuinely three-dimensional. This is in direct contrast to traditional techniques where plan and height control have invariably been treated separately, both from a point of view of station siting (plan control points are normally on hilltops whereas height control points are usually located along roads and railway lines) and from a point of view of measurement and computation. Secondly, and perhaps most importantly, the traditional requirements of intervisibility between survey stations are not relevant. All that is required is that the stations should have a line of sight (in the appropriate part of the electromagnetic spectrum) to the satellite(s) being observed. These two advantages mean that all-purpose control points can usually be placed directly where they are needed, and are the essential reasons for the revolutionary effect that satellite positioning is having on many branches of surveying.

## GPS measurement

The satellite based positioning had been performed with TRANSIT system before the GPS was developed. This earlier system had two major shortcomings: the large time gaps in coverage and relatively low navigational accuracy. GPS was developed to replace the TRANSIT system in order to overcome these drawbacks (Hofmann-Wellenhof et al., 1992). Today, GPS provides continuous 24 hours a day and 365 days a year 3-dimentional positioning being it real-time or post-processing at any location all over the world.

GPS is based on pseudorange measurement. Pseudorange is a distance between the satellite and the receiver. Any person anywhere on the earth could determine his own three-dimensional positioning expressed in ellipsoidal latitude, longitude and height (or cartesian coordinates). This procedure is accomplished by the simple resection process using the distance measured to satellites. The receiver clock is not synchronized with the satellite clock. This synchronization is the reason for the term pseudorange (Seeber, 1993). Hence, at least four satellites have to be observed at the same time to determine the three-dimensional position (Figure 1)

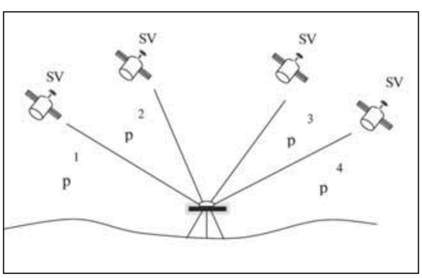

Fig. 1. Single Point Positioning.

The pseudorange is measured via code and/or carrier phase. Meter level accuracy can be performed by the code ranges whereas millimeter level accuracy by the carrier phases (Leick, 1995). Inherent GPS error sources are summarize in Table 1 (Holloway, 1997).

## Geodetic GPS receivers

In this respect, one notices that there is typically, much technical jargon. Esoteric phrases like double difference, carrier phase, pseudorange, cycleslip and integer ambiguity are part of the GPS user's day-to-day vocabulary. There are different processing techniques which are also part of the GPS story. Terms like static, kinematic, pseudokinematic, semikinematic and fiducial GPS can, at times, be confusing even to the most experienced GPS user. Inevitably, a large number of companies currently manufacture GPS receivers. Some of these have been designed purely for the military user whilst others are for civilian use, some are just for navigating whilst others can be used for precise geodetic measurement. This paper is concerned with the first type. After the removal of selective availability by the U.S.A army in May 2000, the positional accuracy of these hand-held single-point navigator-type devices is improved from about ±1000m to perhaps better than ±20m. This happening also boosted the use of this type of receivers to an ever-expanding types of application from reconnaissance surveys through hydrography to the more challenging tasks of troops deployment.

| Error Source | Stand-alone (hand-held) GPS (m) | DGPS (m) |
|---|---|---|
| Satellite Clocks | 3.0 | 0.0 |
| Orbit Errors | 2.7 | 0.0 |
| Ionosphere | 8.2 | 0.4 |
| Troposphere | 1.8 | 0.2 |
| Receiver Noise | 0.3 | 0.3 |
| Multipath | 0.6 | 0.6 |
| User Equivalent Range Error | ±9.4 | ±0.9 |

Table 1: Inherent GPS Error Sources and their Magnitudes

| Receiver Type | Origin | Claimed Positional Accuracy | No. of channels | Weight |
|---|---|---|---|---|
| Garmin 12 | USA | ± 25m | 12 | 9.5 ounce |
| Garmin 48 | USA | ±15m | 12 | 9.5 ounce |
| Garmin GPS III | USA | ±10m | 12 | 9.9 ounce |
| PARM-406 | Russia | ±5m | 24 (GLONASS+ GPS) | 420gm |
| PARM-406N | Russia | ±5m | 24 (GLONASS+ GPS) | 310gm |
| Garmin 12xL | USA | ±15m | 12 | 10 ounce |

Table (2): Some Main Characteristics of the Test Instruments

| Receiver Type | $\sigma_x$(m) | $\sigma_y$ (m) | $\sigma_p$ (m) | $\sigma_h$(m) |
|---|---|---|---|---|
| Garmin 12 | ±10.0 | ±10.6 | ±14.6 | ±14.2 |
| Garmin 48 | ±9.1 | ±9.4 | ±13.1 | ±13.1 |
| Garmin GPS III plus | ±6.6 | ±7.3 | ±9.8 | ±12.8 |
| PARM-406 | ±4.2 | ±4.5 | ±6.2 | ±9.9 |
| PARM-406N | ±4.4 | ±4.1 | ±6.0 | ±9.0 |
| Garmin 12xL | ±9.7 | ±9.3 | ±13.4 | ±15.4 |

Table (3): Results of the Test

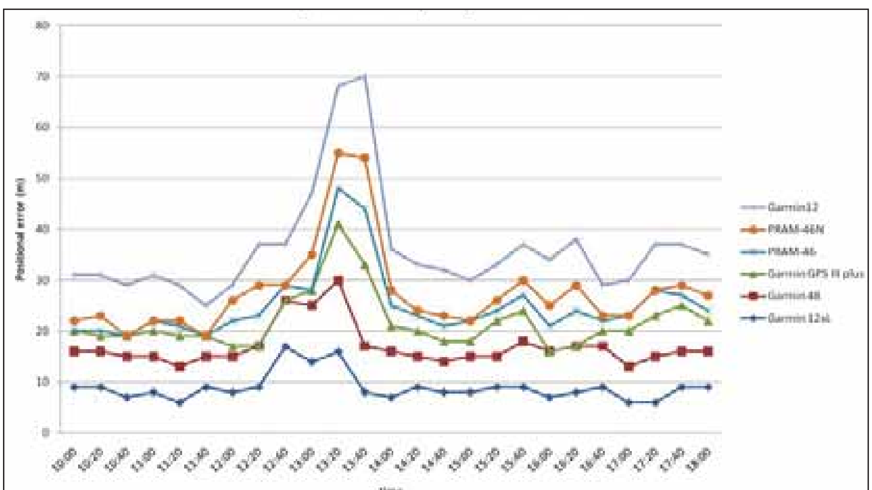


Fig 2: Accuracy Diagrams of Test

## Aim of the test

Hand-held GPS receivers are now quite ubiquitous. They come from a number of manufacturers worldwide in a variety of designs, capabilities and potential applications. Their use has been widespread since the shutting off of selective availability (SA) by the U.S.A army in 2005. A quick glance at the Internet will show you a mind-boggling range of hand-held GPS receivers from vendors in Asia, Europe, Russia, U.S.A and Canada. A GPS user therefore will, understandably, wonder which GPS receiver will be commensurate with his kind of work. Receiver characteristics such as cost, user-friendliness, light weight, ease of use are important.

However, level of positional accuracy achievable is the most important characteristic of any surveying system. This paper, therefore, reports the results of a modest experiment concerned assessing the accuracy of a selected number of hand-held navigator-type GPS receivers with different designs and capabilities, the aim being to give an insight into the expected accuracy ranges attainable in surveys carried out with such receivers and to explore possible application areas of such accuracy ranges. It is to be made clear from the outset, however, that it is not the intention of the present author to rate any of these instruments. Rather, the aim is not test their individual positional abilities in a limited and

# Geomatics in Pakistan

GIS culture is spreading. Everyone talks about it and wants to acquire it but majority are unaware that for quality GIS basic requirement is quality geomatics data

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Geomatics is the art and science of measurements on the surface of earth including what is below the earth and in the oceans. This is the simplest form of definition; more exact and elaborate definition has been produced by FIG[1]. In other simple words Geomatics is the new terminology for the centuries old profession of Surveying and Mapping. There is far more demand interlinked with other allied professions and disciplines from the surveying profession and as such need for new name / definition. The developed nations plus others have adopted the change and now train

their engineers and technicians to be geomaticians whereas we are very reluctant to change on our own. We are waiting for someone to give us a push in the direction of change. One institution on writer's suggestion have adopted the name geomatics in their courses of study e.g. Government College. University and University of Engineering & Technology (UET) Lahore do tell their engineers what geomatics stands for.

In the recorded history early Egyptians practiced the profession of surveying (modern day geomatics) for cadastral and construction works. Other civilizations have built massive structures and planning well organized cities like Ghandara (Sind), and Harapa (Punjab) in Pakistan and similar ones in India, South America, (Maya civilization for one). All of this was not possible without the knowledge of surveying profession.

The British introduced the modern surveying technology and practices to the Indian sub-continent when they wanted to consolidate their grip on the territory for collection of land revenue and for military purposes. The Surveying and mapping data was classified information and only very trusted Indians were trained in this profession. British established very large triangulation and leveling networks which were a great scientific achievement of the time. We do salute them as well as the Indians (of undivided India) who carried out major share of the field survey work when traveling was on foot or horse back through malaria and other deceases infected Jungles / swamps etc. Those brave men produced mapping through pain staking process of Plane Tabling in some of the most difficult terrain in the world. We are using that triangulation data more than a century later although it is high time to critically review and update it. But once again limited financial resources hinder our desire to achieve the goal in the near future.

Geomatics is basic to all civil engineering projects and quality of survey data has direct bearing on the design and quantities of the project. Our country constructed very large water related works in the sixties as a part of the Indus Basin Water Treaty. We know that for all major projects at the time both the foreign consultants and the contractors brought in their own expatriate Chief Surveyor for the projects and in some cases even senior surveyors were also expatriates. The reason being we were not producing senior level surveyors at any of our technical institutes. We were producing at best technician level personnel. Khewra Mining School and Rasul Technical College were the only two instituions which imparted surveying training in the form of survey diploma courses. No effort was ever made to upgrade them to graduate level in the form of B.Sc. Engineering in Surveying like it was done in Europe, North America and elsewhere in the world including in Iran and India. The only change that has come about is that Polytechnics all over the country now undertake generally one year surveying diploma course. The standard of students output by these institutions is not as good as one would desire. They learn very elementary theory of surveying at Polytechnics and then get on job training once they are in service with Public or Private sector. The root cause of poor standard is the shortage of trained and experienced teaching staff and absence of modern surveying instruments to train the students on.

University of Engineering and Technology (UET) Lahore, the prime engineering university of the country does teach civil, mining and architectural engineering undergraduates surveying during their degree programme and include a 10 day or two weeks field camp to carry out field surveying activities in the hills around Abbottabad but nothing further at post graduate level. They could have taken lead in introducing degree programme in geomatics. This did not happen.

This stems from short sightedness of our education policy makers. Part of the blame for this neglect also falls on Survey of Pakistan (SOP) who did little towards the development of the profession. This department continues to live in cloud of secrecy inherited from the British Policy of 18th and 19th century. The British gradually slackened and eventually abandoned the policy of secrecy about survey data in their own country but we continue to live with it even in this age of satellite imagery and GPS when nothing is hidden or secret from rest of the world. SOP does have their own training institute but the quality of teaching at an institute is directly related to the teaching faculty of the institute.

Geomatics is also very basic and important activity in cadastre. An important government activity for all nation states is building and maintaining a land administration system (LAS) with the primary objective of supporting an efficient and effective land market. This usually includes cadastral surveys to identify and subdivide land, land registry systems to support simple land trading (buying, selling, mortgaging and leasing land) and land information systems (LIS) to facilitate access to the relevant information, increasingly through an Internet enabled e-government environment[2].

In Pakistan unfortunately cadastre is in the hands of poorly qualified revenue department's famous or should we say infamous personnel called Patwaris. Their performance in land related surveying work is full of opportunities for cheats to flourish unchecked and innocent citizens to suffer. Computerization of land record is in progress at district level and one would hope that Patwari culture may end soon.

In our country courts are loaded with land related civil cases and other disputes including very many murder cases stemming from land disputes. Geomatics can be instrumental to put an end to all this. No LAS or LIS can function without credible basic land related data and only geomatics will provide this. It is a very important technology of this age and we have neglected it for too long.

GIS culture is also spreading like wild fire everyone talks about it and wants to acquire it but majority are unaware that for quality GIS basic requirement is quality geomatics data. Quality geomatics data will be produced by non other than qualified and trained surveyors (geomaticians). Our institutions and universities which are to say the least poorly staffed and inadequately equipped for this purpose. It may take a while for the situation to improve for the simple reason shortage of resources and lack of determination to excel.

As we look further deep down we notice that fewer of our young persons go for this profession when they go abroad at undergraduate level and in our own country no university offers degree course in geomatics. In this age of internet we only need to key in the word geomatics and see for ourselves the places and the countries offering degree courses in this technology. Pakistani technical universities are lagging behind others in this discipline.

In the private sector surveying companies, and there are plenty here, are run by technicians in general with the exception of a couple headed by civil engineers and there is only one which is in the hands of a professional survey engineer. This situation is the direct result of the absence of any licensing system for surveyors or surveying companies. Any one who can run line leveling and operate a total station, and has resources to buy a total station; sets up his surveying company. The price competition between a technician run survey company and that of an engineer / professional survey engineer goes in favor of the former. The public sector departments, major source of surveying contracts and even bulk of the private sector companies go for the cheapest quotation with complete disregard for quality of end product. The amazing thing is that it will be a multibillion dollar project and the owner would be trying to make savings and compromise quality of survey data on which the project design and earth work quantities are to be based.

There is a need for controlling authority through an act of parliament on the same lines as Pakistan Engineering Council. In the last parliament we had a surveyor turned politician as deputy speaker and he could have done something on these lines. As a politician his priorities were different and the opportunity is lost until another surveyor gets into the parliament. We can only hope that it happens soon.

## References:

1. FIG – Federation Internationale des Geometres (International Federation of Surveyors).

2. Using Cadastres to Support Sustainable Development - Professor Ian WILLIAMSON, Centre for Spatial Data Infrastructures and Land Administration, The University of Melbourne, Australia

## MapMart unveils one-stop portal

IntraSearch Inc. unveiled a new interface on its MapMart online mapping portal where satellite imagery customers can search, preview and order high-resolution data from DigitalGlobe, GeoEye, SPOT and KOMPSAT. *www.mapmart.com*

## China to grant remote sensing satellite to Indonesia

The Chinese government will grant Indonesia a remote sensing satellite to help monitor and provide early detections on events taking place in the sea. *www.antara.co.id*

## QCoherent releases free LiDAR viewer

QCoherent Software, announced the release of its free LiDAR viewer, LP Viewer. *www.QCoherent.com.*

## Singapore Ground Station as GeoEye-1 satellite imagery regional affiliate

GeoEye, Inc. has signed a multi-year agreement with the National University of Singapore to allow the Centre for Remote Imaging, Sensing and Processing (CRISP) to collect and sell Earth imagery and related products from its GeoEye-1 satellite. *www.geoeye.com*

## NOAA names first woman to direct National Geodetic Survey

Juliana P. Blackwell has been named the new director of NOAA's Office of National Geodetic Survey where she will oversee NOAA's responsibilities for the nation's spatial reference system. *www.noaa.gov*

## New Japanese satellite to monitor global warming

The Japan Aerospace Exploration Agency confirmed that the Greenhouse Gases Observing Satellite "IBUKI" (GOSAT) is now ready for the initial functional verification operation. The satellite is scheduled to be in orbit for 5 years and preliminary data is expected to be ready soon. UN climate officials are hoping to work out a new emission treaty by December 2009, but this satellite should help to monitor gases before and after any treaty is signed. *www.jaxa.jp/index_e.html*

## Japanese group asks Google to stop map service

A group of Japanese lawyers and professors has asked Google Inc to stop providing detailed street-level images of Japanese cities on the Internet, saying they violated privacy rights. Google's Street View offers ground-level, 360-degree views of streets in 12 Japanese cities and is also offered for some 50 cities in the US and certain areas in Europe. Privacy concerns about this service have grown in Japanese media oflate. Similar concerns have been raised in other parts of the world, including the US and Europe. *Reuters*

## 3DVU announces Web-to-Mobile 3D aerial photo navigation

3DVU, announced Way2Go, an online web-based navigation planner combined with free mobile viewer of 3D aerial photography with real landscape elevation. It will be available soon for over 200m mobile users with Symbian S60 devices providing geo-coverage of the entire USA, UK and major Western Europe. *www.3dvu.com*

## CNES relies on ERDAS Enterprise Solutions

Recently, CNES presented the catalog for the International Charter's imagery resources powered by ERDAS' enterprise solutions. The International Charter gathers ten space agencies from all over the world, including USGS (USA), ESA (Europe), JAXA (Japan), CNSA (China) and ISRO (India).

In case of natural or man-made disaster, a unified system enables acquisition of space data resources from all Charter members, providing emergency and rescue services with the accurate and up-to-date information on the impacted area. *www.cnes.fr*

## Pirates seen from Space

ImageSat International, Israel utilised EROS B satellite to receive a series of images with spatial resolution of up to 0.7m featuring the area offshore Somalia where vessels seized by pirates are


clearly seen. It provided ScanEx RDC with satellite images showing villages and bases of pirates on the coast of Somalia, moorings of their speedboats and motorboats. *http://www.scanex.com/*

## South African space agency to be established this year

South Africa shall have its own space agency later this year. According to the Department of Science and Technology, the agency would promote the peaceful use of outer space, foster research in astronomy, earth observation, communications, navigation and space physics, foster international cooperation in space-related activities, and advance scientific, engineering, and technological competencies through human capital development. *http://www.dst.gov.za/*

## Beijing Earth Observation to distribute RapidEye products

RapidEye, announced that Beijing Earth Observation, Inc. (BEO), a subsidiary of Eastdawn Group. Inc., will be their Chinese distributor. *www.rapideye.de*

# Bundaberg GIS with centimeter accuracy

The Bundaberg Regional Council, located in Bundaberg, Australia, is updating its GIS as accurately as possible. The area governed by the council comprises approximately 90,000 residents and more than $1.5 billion Australian dollar worth of assets.

The council is in the process of collecting spatially accurate data on hundreds of thousands of critical assets both above

ground and underground using a system comprising of Trimble equipment like the Trimble® NetR5™ multi-channel, multi-frequency GNSS receiver which it uses as a permanent base station; three Trimble R8 receivers (one as a mobile base); a Trimble S6 robotic/reflectorless total station for integrated GPS and conventional surveying; three Trimble TSC2™ rugged handheld computers; and three Trimark 3 radios.

“It’s great that we’ve been able to find one vendor that can provide everything we need for capturing data, from survey to mapping to GIS and machine control without having to rely on third party hardware or software suppliers,” said Steve Bowden, GIS coordinator at Bundaberg Regional Council. The Council began by establishing a first-of-its-kind local government partnership with Geoscience Australia, the government entity that manages the Australia Regional GPS Network and oversees the country’s spatial data infrastructure, to establish a permanent base station at the Bundaberg airport.

Now, using the new system, field workers are able to collect data about the council’s assets using the survey equipment in the field and the NetR5 and R8 reference receivers to produce Real Time Kinematic (RTK) corrections with centimeter accuracy. The S6 Total Station is operated with a TSC2 running Survey Controller software. The Council’s asset section uses TerraSync™ software with the R8 receiver to capture field asset locations while the remaining TSC2 handheld is normally running

Survey Controller software with the R8 receiver for RTK GPS surveying.

The NetR5 base station also sends continuous, real-time data to Geoscience Australia for inclusion in the Australian Regional GPS network (ARGN). This assists in scientific research pertaining to crustal dynamics and continental drift, meteorology, improved orbits for GPS satellites, and more.

## Russia will carry out 39 launches in 2009

Russia is planning to establish a world record, effectuating a total of 39 space launches in 2009, despite of the current global financial crisis, according to the Russian Space Agency.

## Oft delayed IR-20 launch scheduled for March’09

The GPS satellite carrying the first payload to transmit the L5 signal is scheduled for launch in March. The delay has begun to concern the GNSS community, because unless a U.S. satellite begins broadcasting on the L5 frequency (1176.45 MHz) by August 26, the U.S. government may lose its International Telecommunications Union allocation for that frequency. Plans for the modernized GPS fleet, including GPS III, call for the use of L5 as a third civilian signal, namely for safety-of-life applications. *Spaceflightnow.com*

## SiRF partners with M/A-COM Technology Solutions

SiRF Technology Holdings, Inc. has partnered with M/A-COM Technology Solutions, Inc. to help create the networked GPS module that provides location information to vehicle-based communications and entertainment systems. SiRF also introduced the GSC3e/LPa single-chip GPS receiver, which is the first SiRFstarIII architecture product. *www.sirf.com.*

## China to have global satellite navigation system by 2015

China plans to complete its independent GNSS by launching about 30 more orbiters before 2015. It plans to send 10 navigation satellites into the space in 2009 and 2010, said Zhang Xiaojin, director of astronautics department with China Aerospace Science and Technology Corporation. China has sent 5 positioning orbiters into the space. The current Beidou system only provides regional navigation service within China’s territory. Since Beidou’s fifth orbiter launched in April 2007, China has started to upgrade the navigation system to the second generation, code named COMPASS. *www.chinaview.cn*

### 2G satellite system on horizon

China will launch more navigation satellites next year to develop the second-generation Beidou satellite navigation system. According to China National Administration of Global Navigation Satellite System, it aims to complete the second-generation Beidou system by 2011,. There are currently 5 Beidou satellites in space. Xinhua News Agency

### Chinese version of "Google Earth"

The State Bureau of Surveying and Mapping launched a programme to set up a service platform on national geographic information for the general public. The move marks fundamental changes in China's traditional services to supply basic geographic information. Upon completion, the programme will provide comprehensive online geographic information services similar to "Google Earth" and "Google Maps" to all types of institutions and to the general public. *http://english.people.com.cn*

### GNSS Providers Working Group to discuss compatibility, interoperability

The International Committee on GNSS (ICG) working group on compatibility and interoperability shall meet soon in Munich, Germany. The discussions will focus on compatibility and interoperability issues and system/service characteristics, such as current and planned signals, system time and geodetic reference frame standards, performance standards and actual system performance, service provision policies, and deployment and operation timetables.

The result of deliberations will be used to guide the ongoing work of the ICG to encourage compatibility and interoperability among all current and future GNSS providers. *www.oosa.unvienna.org/oosa/en/SAP/gnss/icg.html*

# Galileo update

### IFEN to upgrade Galileo open air test bed signals

The German Aerospace Center has contracted with IFEN GmbH for the signal upgrade of the Galileo Test and Development Environment (GATE), per the latest versions of the European Space Agency's Galileo Signal-in-Space Interface Control Document (ICD) and the GNSS Supervisory Authority Public Galileo Open Service ICD. After completion of the signal upgrade at the end of 2009, the GATE test infrastructure will be capable of transmitting the new CBOC signal structure on the Galileo E1 frequency band and a broader bandwidth of 92.07 MHz on the E5 frequency band, according to IFEN. *www.ifen.com*

### LMU Computer Scientists involved in Galileo research: Project launched for indoor navigation

The Federal Ministry of Education and Research recently approved the two-year project "Indoor", which will run until the end of 2010. In this project, Ludwig-Maximilians-Universität (LMU), Munich computer scientists shall be developing positioning and navigation technologies to be used in the field of traffic logistics and for emergency services. What they are focusing on in particular is indoor positioning and navigation. The aim of the "Indoor" project is to improve certain algorithms that will increase the energy and cost efficiency of location-based service applications. *www.en.uni-muenchen.de/about_lmu/index.html*

### Positive signals for Galileo

The in-orbit validation programme for Galileo, Europe's global satellite navigation system, is celebrating three years since the first signal was broadcast by the GIOVE-A satellite. The programme has been gathering momentum since the launch of the GIOVE-A satellite and its success in securing the critical Galileo frequency filing with the International Telecommunications Union (ITU) before the filing expired in June 2006.Originally designed for a 27 month mission, the satellite has already been operating for more than 3 years.

The launch of the SSTL-built GIOVE-A satellite on 28th December 2005, gave a real boost to the Galileo programme. Just two weeks after launch on 12th January 2006, the satellite transmitted Galileo signals from space for the first time and over the subsequent three months secured the required ITU frequency filing. GIOVE-A has enabled Europe to acquire and maintain the Galileo frequency filing. Over the last two years GIOVE-A has achieved greater than 99.8% availability and in April 2008 ESA declared GIOVE-A "a full mission success". In 2008 GIOVE-A was joined by the EADS Astrium-built GIOVE-B satellite - the first to carry an onboard passive hydrogen maser clock, which promises to be the most stable and accurate clock ever flown in space. SSTL staff assisted ESA with the in-orbit testing of GIOVE-B using the same test facilities as had been developed for GIOVE-A. Recently, a team led by Bremen based OHB-System AG, which includes SSTL as a core team member, has been shortlisted as a possible supplier for the provision of fully operational Galileo satellites to be launched before 2013. *www.giove.esa.int*

## MetaCarta's LBS for 2012 Olympics

MetaCarta, Inc., and the British Transport Police (BTP) shall provide location based situational awareness for the 2012 Olympics. BTP will use MetaCarta geographic search and referencing solutions to geo-enable and consolidate information from multiple data sources by geographic location and display it in MapView, BTP's intranet map-based visualisation tool. *www.metacarta.com*

## Telesoft launches LBS in India

Telesoft Technologies has released HINTON Locator passive monitoring probe in India. Connecting to the cellular radio access network the HINTON Locator is a passive monitoring probe that can be connected to any mobile network. *www.telesoft-technologies.com/*

## Zoodango tries 'intelligent location' for hyperlocal services

Zoodango.com, a map-based online service, has launched a hyperlocal service that uses computer intelligence and geo-search to help consumers find restaurants and businesses. The main differentiator between Zoodango's search and other search sites is that while the other sites do searches based on a keyword, Zoodango relies on geo-searches. *www.zoodango.com*

## Alternative Positioning Technologies will provide 25% of solutions by 2014

Many next-generation LBS applications such as social networking, local search, advertising, and geo-tagging are expected to be used in urban and indoor environments where GPS either underperforms in terms of fix times or accuracy, or fails altogether. So, alternative positioning technologies such as Wi-Fi and Cell-ID will become increasingly important. A-GPS, Wi-Fi and Cell-ID will be the winning combination offering accuracy, availability, interoperability and short fix times at low cost. It will represent 25% of all positioning solutions by 2014. *www.abiresearch.com*

## Satellite helps make transportation of dangerous waste safer

A new tracking system is making use of satellite navigation data to ensure safe roads in Europe. Developed by an Italian company, Allix in the Italian Lombardy region, the system monitors daily the displacement of 200 containers carrying industrial waste on 100 trucks. The system has been developed which uses location data from GNSS to accurately track all movements of the industrial waste throughout its journey. *www.esa.int/esaCP/SEMUS6VPXPF_index_0.html*

## GPS-Enabled carbon application

Clear Standards has announced the availability of "Carbon Tracker," a GPS-enabled carbon footprint application for the iPhone. Available for free download at the iPhone App Store, the initial version enables users to easily calculate the carbon footprint from daily commuting, vacations, or business trips. *www.clearstandards.com/carbontracker*

## TeleNav Shotgun(TM) GPS navigation device automates mileage tracking

TeleNav, Inc has added new features to TeleNav Shotgun, a two-way, Internet-connected GPS PND developed for business travellers. It can be used to track miles driven, saving valuable time and resources that anyone may have otherwise spent compiling expense reports. *www.telenav.com/shotgun*

## Nokia and Securitas bring location-security services to the S60 masses

Nokia and Securitas collaboration will bring mobile services for personal security and safety to Nokia's S60 platform. The service bundle, Securitas Safe-2-Go, consists of four components: Assist (security alert), Find (locate person), Zone (SMS boundary alerts) and Friends (general friend locator). Safe-2-Go will launch in Sweden in the first half of 2009. *www.nokia.com*



## Bhubaneswar to have GIS-based holdings' assessment

Bhubaneswar Municipal Corporation (BMC), Orissa, India is putting in place a GIS-based system which will create maps for the individual properties in the Capital. *www.orissa.gov.in/ourbmc/*

## Mumbai to detect underground water leakages

The first pilot project by Brihan Mumbai Mahanagarpalika (BMC), the city's civic body, to detect underground leakages in pipelines will begin soon using GIS along with sound sensors and ground penetration radars. *http://timesofindia.indiatimes.com*

## Lucknow to m lable online

The Lucknow Development Authority (LDA), Uttar Pradesh, India has launched a portal that will enable an allottee to get the details of any property in Lucknow. All one needs is to type the property number and the computer would flash the name of the owner, property's registry number and the number of installments paid. *www.ldalucknow.com*

## IISc takes a shot at urban planning

Indian Institute of Science (IISc), Bangalore in collaboration with the government, inaugurated a Centre for Infrastructure, Sustainable Transportation and Urban Planning, recently. It will help in conducting basic and applied research in infrastructure, transportation systems and urban planning. The centre will set up laboratory in GIS, remote sensing, GPS and disaster mitigation. *http://timesofindia.indiatimes.com*

## MWH releases GIS-centric decision support software

MWH Soft, has released CapPlan for InfoWater, a GIS-centric decision support software for water infrastructure management and risk assessment. *www.mwhsoft.com*

## Satellite-based sprinkler system

Faced with historic droughts, the governments of Georgia, California and Idaho are turning to GIS maps and satellite-based computerised sprinklers for drought recovery and to prepare for a future of less water. The sprinkler has a satellite that tracks weather patterns and automatically adjusts water schedules based on an environment's needs. *www.governmentnews.com.au*

## SuperGIS Server 1.0 beta version

SuperGeo is going to release the beta version of SuperGIS Server 1.0 for open testing. The end users only need to install desktop or mobile application software and use internet to connect SuperGIS Server to acquire data and functions from the server. *www.supergeotek.com*

## New version of GeoConcept

The new version of GIS software from MapMechanics, GeoConcept 6.5, is claimed to be significantly faster than before and is easier to use. It brings improvements in both thematic analysis and map displays, and is fully compliant with Microsoft's .NET programming environment. *www.mapmechanics.com/*

## OGC server for climate change studies

The Open Geospatial Consortium (OGC), Australian Bureau of Meteorology (BOM) and the Open Source Geospatial Foundation (OSGeo) have announced that a Climate Change Integration Plugfest (CCIP) server would be launched at the FOSS4G conference, 20-23 October 2009. *www.opengeospatial.org*

## ArcGIS API for Silverlight

The beta release of the ArcGIS API for Microsoft (MS) Silverlight will allow application developers to integrate ArcGIS Server and Microsoft Virtual Earth services and capabilities in a Silverlight application. *www.esri.com*

## Spectra Precision introduces EPOCH 35 RTK GNSS System

EPOCH 35 GNSS system by Spectra Precision uses GPS and Glonass technology for cadastral, topographic, control, stakeout and other precision survey applications. It includes a base, rover, field software, data collector, and radio. The rover features integrated Bluetooth capability, an internal radio modem and battery. The system operates with TDS Survey Pro™ field software in the US and Spectra Precision Field Surveyor outside the states. *www.spectraprecision.com/*

## Trimble introduces Nomad 800X series handhelds and Trimble Access

Trimble introduced the AT&T Inc. - enabled Nomad 800X Series computers. It includes three new models of its outdoor rugged handheld computer that offer Wireless Wide Area Network (WWAN) functionality and integrated quad-band GSM cellular data transmission, digital photography and bar-code scanning in one device. location. *www.trimble.com.*

Trimble Access software is a new field and office solution for surveyors that is claimed to expedite data collection, processing, analysis, and project information delivery. *www.trimble.com*

## Tridex launches 3D laser scanning services in India

Tridex Solutions has launched 3D scanning solutions in India. It involves capturing of real world data, modeling and visualisation through use of laser scanning survey technology. The company has setup data processing center in STPI area, Gurgaon. *http://tridexsolutions.com*

## NavDog launches intelligent map search

NavDog.com launched a new map search technology that uses intelligence to refine content and search results in real time. It is based on NavDog's new Geographic Business Intelligence Engine, which is designed to process user actions in order to derive their intent, which is matched with relevant map content. *www.navdog.com*

## Envitia releases MapRite Capture Tool 1.1

Envitia, has released MapRite Capture Tool version 1.1, which enhances its automated facility for the generation of Basic Land and Property Unit boundaries, with a built-in feature to maintain the dataset as additional Change Only Update map data is applied. It automatically generates the polygon extents with associated Topographic Identifiers and associated confidence levels. *www.envitia.com*

## Blaupunkt sold to Aurelius

Munich-based AURELIUS acquired the business from the Car Multimedia Division of Robert Bosch GmbH, better known under the brand name 'Blaupunkt'. *www.aureliusinvest.de/adhoc_westfalia_en.html*

## Autodesk offers three new Mac creative software tools

Autodesk, introduced three new creative software tools for the Mac platform; Toxik, a procedural compositing tool; Mudbox, designed for digital sculpting and texture painting; and ImageModeler, image-based modeling and photogrammetry software. *www.autodesk.in*

## AAMHatch deploys satellite tracker

AAMHatch has adopted a new system to allow its land and air operations to communicate in times of emergency, SPOT – Satellite Personal Tracker. The SPOT system has the advantage by being able to transmit together the field teams exact GPS location with a pre-programmed safety message, through the GlobalStar satellite network to multiple contacts (i.e. Office Coordinator, Safety Manager, Client Representative and the emergency services). *www.aamhatch.com.au*

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www.southinstrument.com
http://us.southinstrument.com


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2" or 5"
Measuring range without prism :300m
Accuracy: 5+3ppm
Measuring range with single prism: 5Km
Accuracy:2+2ppm

## Hugel and Tele Atlas partner on Middle Eastern GPS device

Hügel GmbH and Tele Atlas, have launched a Point2Point personal navigation device for the Middle Eastern consumer market. Arabic and English voice prompts help motorists maintain focus while driving, and support information is offered in multiple languages. *www.teleatlas.com*

## MiTAC acquires Magellan GPS Consumer Products Division

Magellan Navigation, Inc., has entered into a definitive agreement to sell the Magellan consumer products division to MiTAC International Corp. of Taiwan. *www.magellangps.com*

## Navteq expands global business arrangement with Microsoft

Microsoft now can access all 74 countries in the Navteq map database. The agreement with Navteq gives the company right to use Navteq content, including Extended Listings, Navteq Discover Cities, Navteq Transport, and Navteq Voice. Microsoft will use Navteq data in its Internet and mapping software solutions. *www.navteq.com*

## AgTerra launches new pesticide application tracking product

AgTerra Technologies, Inc. of Sheridan, Wyoming, has released SprayLogger product, a GPS-based system that automatically records information during a pesticide application. It automatically tracks geographic locations of pesticide applications, work order parameters, environmental conditions, amount of chemical used and more. *www.agterra.com*

## Spatial Networks announces acquisition of TrekServ, LLC

Spatial Networks has acquired Tampa-based TrekServ, LLC, a privately held global tracking technology firm. It acquisition includes proprietary, patent-pending technologies that provide secure, global tracking of mobile assets and at-risk personnel. *spatialnetworks.com*

## Manava Bharati India International School wins Future Cities India 2020 Student Design Competition

The Ministry of Science & Technology, Government of India, and Bentley Systems, announced that the project designed by students of Manava Bharati India International School, Panchsheel won top honors in the 2008-2009 Future Cities India 2020 competition. This year's challenge centered on Indian Railway's plans to refurbish the country's aging

railway stations into world-class facilities. Student teams submitted conceptual designs for the rehabilitation of the New Delhi railway station. The winners were awarded scholarships and trophies, and the teachers and technical professionals who served as counselors and mentors also received awards and recognition. Members of the winning team included Harkeerat Singh, Sambit Ghosh, Ujjawal Gupta and Shwetank Chaudhry. Second place honors went to Amity International, Gurgaon. *www.futurecitiesindia2020.co.in.*

## AeroVironment selects Rockwell Collins navigation system

The Rockwell Collins Athena 411 Inertial Navigation, Global Positioning, Air Data, Attitude, Heading, Reference System (INS/GPS/ADAHRS) has been selected by AeroVironment for their Global Observer, a liquid hydrogen-powered Unmanned Aircraft System (UAS) that will fly at an altitude of 65,000 feet for up to seven days, for the U.S. Special Operations Command as well as for other military and civilian applications. *www.rockwellcollins.com.*

## Allianz Insurance plc selects Cadcorp SIS software

Allianz Insurance plc has placed a contract for the supply of a number of licences of Cadcorp SIS Map Modeller desktop GIS software, together with associated training and consultancy services. The software will be used as part of an accumulation management and reporting application designed to carry out a set of spatial queries on Allianz insured locations. *www.cadcorp.com*

## XACT Technology selects GPS receiver technology from u-blox

u-blox, will supply XACT Technology LLC with GPS receiver modules for its new line of portable personal tracking devices called XACT|TRAX. It provides users with up-to-the-minute information on the location of loved ones, pets, vehicles and other assets wherever they may be. *www.u-blox.com*

## PCI Geomatics signs distribution agreement with Chinese Company

PCI Geomatics has signed a $4 million dollar technology agreement with a Chinese company. Working closely with PCI Geomatics Beijing, this Chinese company will assist in developing and expanding the PCI Geomatics brand within China. *www.pcigeomatics.com.*

## Hemisphere GPS awarded new patents

Hemisphere GPS has been awarded two new patents; the Satellite Based Vehicle Guidance Control in Straight and Contour Modes patent is for a method and system in which an agricultural vehicle is steered using GPS data. The Soil Cultivation Implement Control Apparatus and Method patent enables the position of a towed agricultural implement to be controlled and maintained using GPS data. *www.hemispheregps.com.*

## Leica XPro v4.0 provides ground processing workflow

The Leica XPro, developed jointly by Leica Geosystems and North West Geomatics Ltd., Canada, provides ground processing workflow from data download to image generation *www.leica-geosystems.com*

## NovAtel Inc. appoints Michael Ritter as new President and CEO

NovAtel Inc., announced that Michael Ritter has been named as the company's new President and CEO. *www.hexagon.se*

## Contex receives BERTL's Best Award for 2008

Contex announced today that BERTL has awarded the Contex SD4400 series scanners the 2008 BERTL's Best Award for best value for price in a wide format scanner. *www.contex.com.*

## Nav N Go presents mapping solutions for Chile, India and China

Nav N Go, has added map data solutions for two additional Asian countries - India and China, and one additional South American country –Chile. *www.navngo.com*

## Satellite firm's acquisition boosts competitiveness

Surrey Satellite Technology Ltd. formally became a subsidiary of Astrium Satellites, a division of European aerospace conglomerate EADS. *www. astrium.eads.net/en/homepage*

## Lowrance devices to be loaded with AccuTerra maps

A new line of handheld GPS devices from Lowrance will ship pre-loaded with Intermap's AccuTerra GPS starter maps. It will include high-resolution topographic maps, extensive outdoor trail networks, land management maps, and extensive points of interest for outdoor recreation. *www.accuterra.com*

## TomTom unveils web-enabled GO 740 LIVE navigation device

TomTom, has introduced GO 740 LIVE. The new in-vehicle navigator features a built-in GPRS-based data link, allowing it to recommend the quickest route to a destination, based on constantly updated traffic reports. It also comes equipped for Google searches on the go. *www.tomtom.com*

## Topcon, AeroTech sign OEM agreement

Topcon Positioning Systems has signed an agreement with AeroTech Sales LLC., of Fountain Valley, California, to represent the OEM market for TPS' mobile control products. *www.topconpositioning.com*

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## MARK YOUR CALENDAR

### February 2009

**3rd GEOSS Asia-Pacific Symposium**
4-6 February
Kyoto, Japan,
**geoss-ap3@restec.or.jp**
**www.prime-intl.co.jp/geoss/**

**Galileo Open Service**
12 February,
London, UK
**conference@rin.org.uk**
**http://rin.org.uk**

**Trimble Dimension 2009**
23-25, February
The Mirage, Las Vegas, USA
**http://www.trimbleevents.com/dimensions09**

### March 2009

**Munich Satellite Navigation SummitConference**
March 3-5,
Munich, Germany
**www.munich-satellite-navigation-summit.org**

**GEOFORM+'2009**
10-13 March
Moscow, Russia
**www.geoexpo.ru**

**iGEOMAP 2009**
March 20-21,IISc, Bangalore, India
**www.igeomap.org**

### April 2009

**GEO Siberia 2009**
21-23 April
Novosibirsk, Russia
**nenash@sibfair.ru**
**www.geosiberia.sibfair.ru**

### May 2009

**International Conference on Integrated Navigation Systems**
25-27 May
Saint Petersburg, Russia
**www.elektropribor.spb.ru**

### May 2009

**BE Conference 2009**
11-14 May
Charlotte, NC, USA
**www.bentley.com**

**2nd International Conference on Earth Observation for Global Changes (EOGC2009)**
25-29 May 2009
Chengdu, China
**http://www.eogc2009.com.cn/**

### June 2009

**GSDI 11 World Conference**
15-19 June
Rotterdam, The Netherlands
**http://gsdi.org/gsdi11/**

**TRANS-NAV 2009**
8th International Navigational Symposium
June 17-19
Gdynia, Poland
**http://transnav.am.gdynia.pl**

### August 2009

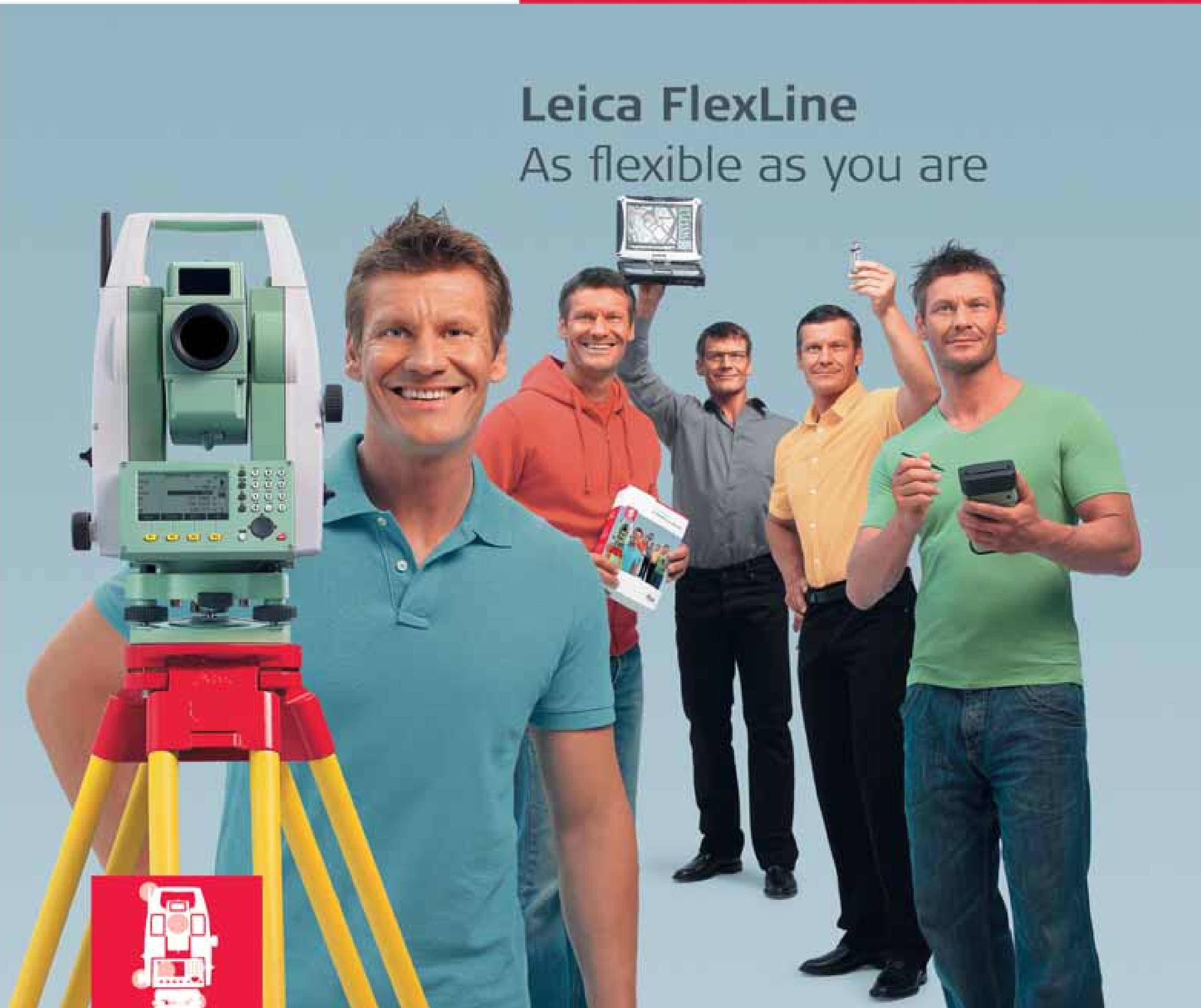
**SEASC 2009,**
4-7 August
Bali, Indonesia
**www.bakosurtanal.go.id/seasc2009/04/**

### September 2009

**ISDE 2009**
9-12 September
Beijing, China
**www.digitalearth-isde.org**

**INTERGEO 2009**
22-24 September
Karlsruhe, Germany
**www.intergeo.de**

**ION GNSS 2009**
22-25 September
Savannah, Georgia
**www.ion.org**

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