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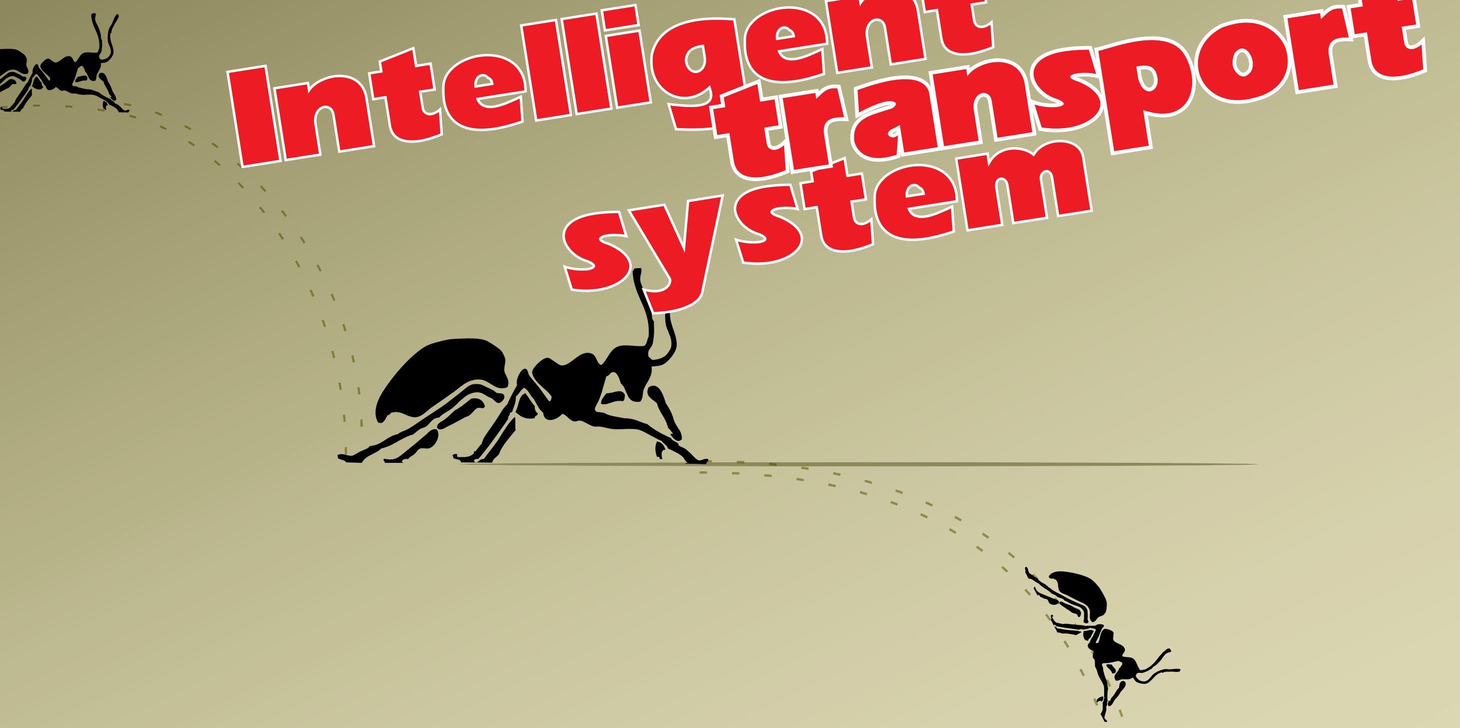
Intelligent transport system



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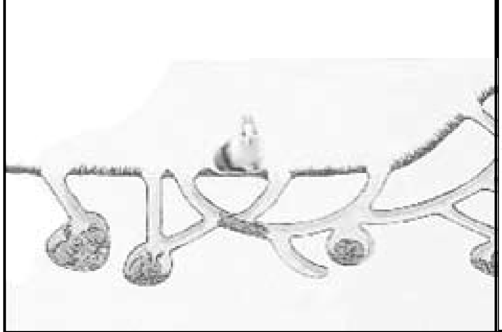

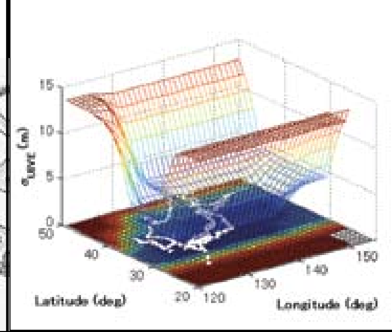

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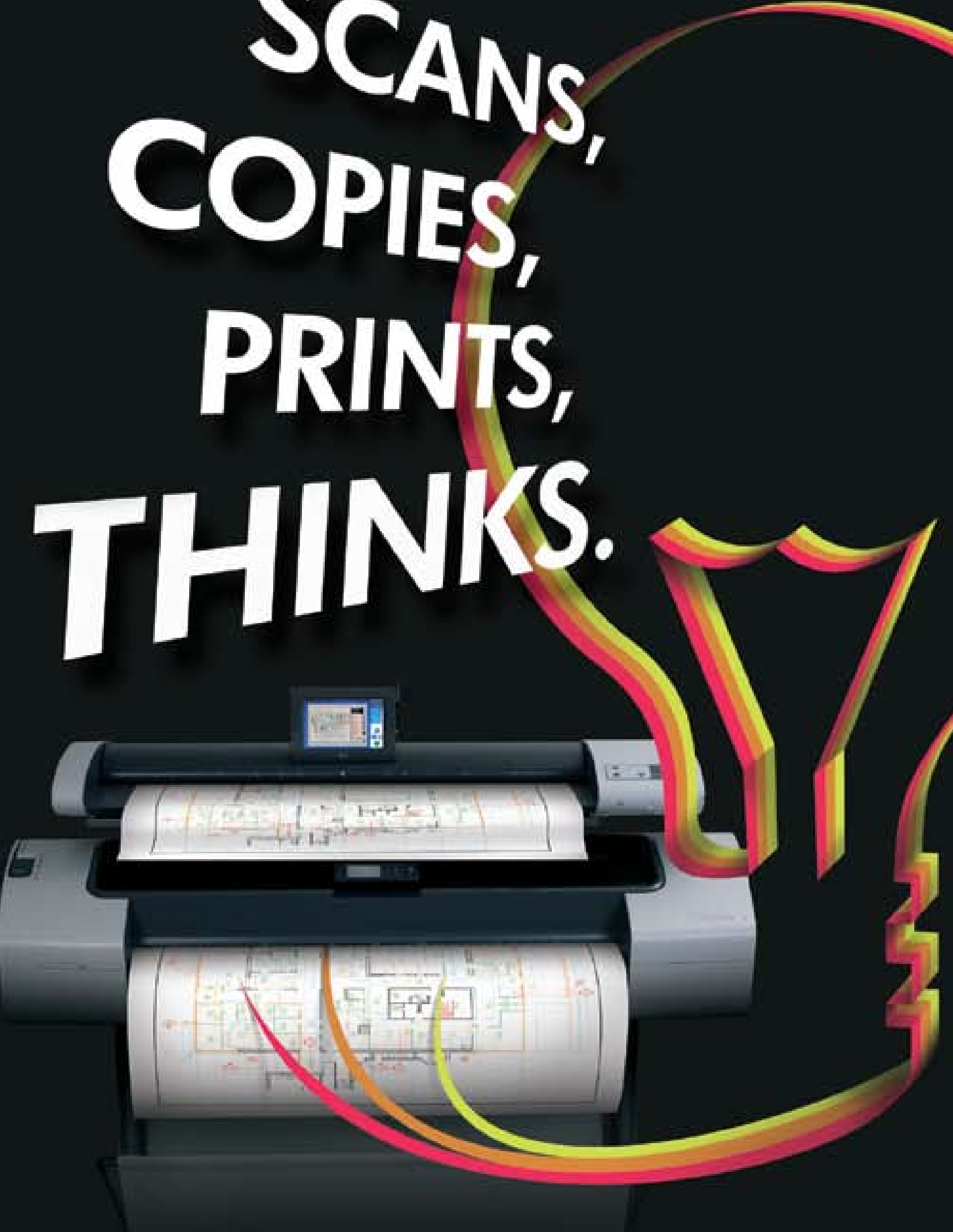

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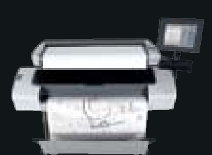

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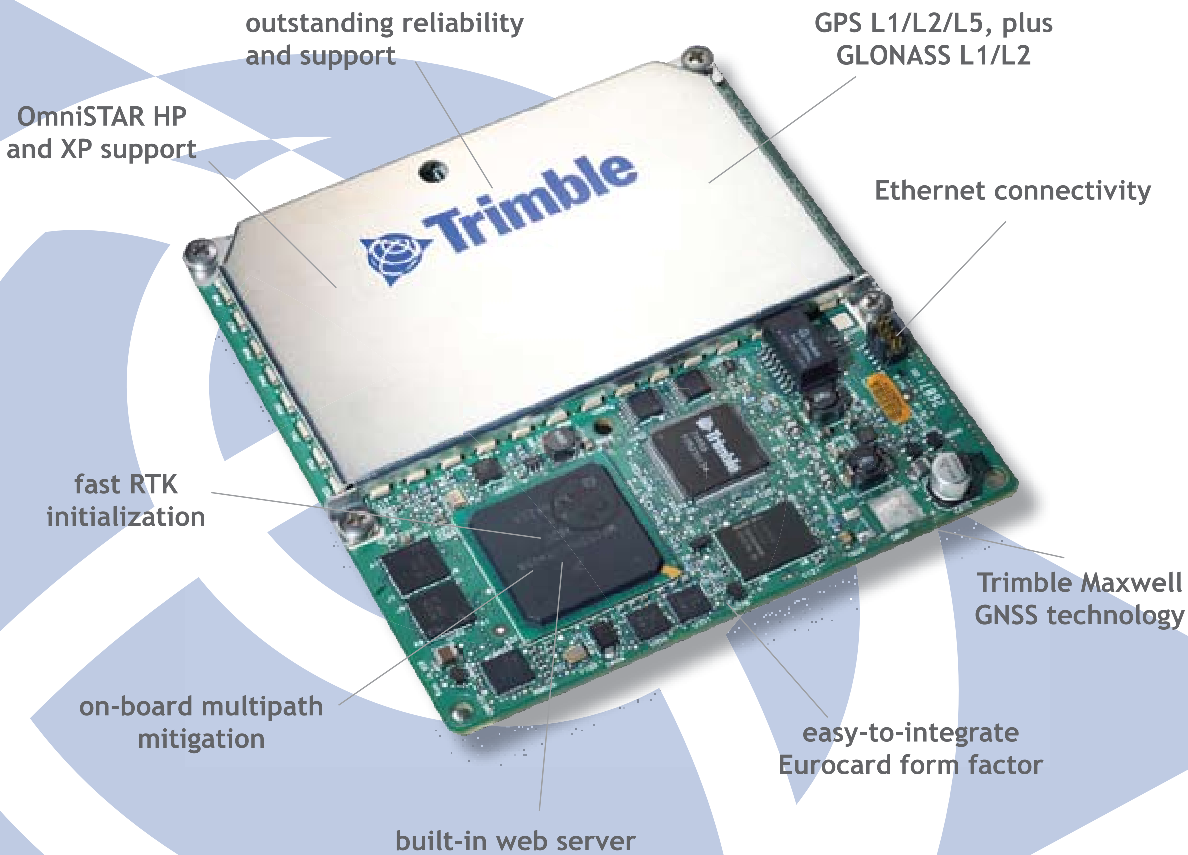

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Intelligent transport system

Recent advancements provide means for exploitation of mobile user location-related data for location-based and ITS services

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Transport of people and goods is one of the pilars of civilisation. The exchange of goods, services and ideas is in foundation of modern economy, as well as it was in the past. However, growing population generates new challenges for traffic control that leaves no space for classic solution but calls for the innovative and multidsciplinary approach based on the latest scientific and technology achievements.

Considered in the past as a self-sufficient and self-controllable system, road traffic issues cannot be resolved by traditional methods today (McDonald et al, 2006; Liu et al, 2008). Latest strategy, research and standardisation developments strongly call for the New-Generation Intelligent Transport System (NG ITS) development, based on cooperation between various navigation, communication and road sensor networks, thus providing so far un-seen excellence in situation awareness (COMeSafety, 2009; Liu et al, 2008). Telecommunications play a vital role in achieving the synergy between various networks, due to both their performance in data transfer, and opportunity to exploit so-far hidden location-related data within telecommunication networks Filjar et al, 2008). Here we argue that the telecom location-related data exploitation, generated and collected by the pure nature of mobile communication networks, will act as a key factor in establishing the New-Generation Intelligent Transport Systems.

Fig 1 ITS is the only foreseeable solution for resolving congestion problems in urban areas

Importance of navigation

Navigation is intrinsically embedded in human nature (Farell, 2008; Taylor and Blewitt, 2006, Filjar et al, 2008). Seeing it that way and considering numerous navigation tasks we perform every day, we all can be seen as navigators. Successful guidance of mobile objects from starting to ending point of the voyage following the safest and the most feasible path was, has been and will be one of the most important factors of both prosperity of the economy and survival of individuals (Farell, 2008). However, modern times has brought additional requirement in optimisation of traffic flow, which should be resolved by navigation systems as well (COMeSafety, 2009; McDonald et al, 2006).

Modern road traffic needs the optimisation of traffic flow in order to either resolve or ease the issues like traffic congestions, tails caused by sequential road charging etc. With the satellite navigation systems widely available (GPS fully operational, and Glonass, Beidou and Galileo striving to this condition) and vehicles neatly equipped with various sensors that can be used in traffic control, the task emerges to integrate all available signals and data sets in order to provide optimal situation awareness and optimised traffic control (Farell, 2008; Taylor and Blewitt, 2006; Filjar et al, 2008; Filjar at al, 2004; Filjar, 2008). This task is not only very complex to achieve, but is also need immediatelly to come as a rescue from challenges of modern life and economy.

New-generation intelligent transport systems

The interest in Intelligent Transport systems emerges from the challenges caused by traffic congestion and a synergy of new information technology for simulation, real-time control and communications networks. Intelligent Transport Systems (ITS) intend to add information and communications technology (ICT) to transport infrastructure and vehicles (COMeSafety, 2009) in an effort to improve:

–Safety

–reliability

–efficiency and

–quality of means of transport.

Thus, building up Intelligent Transport Systems had the aim to integrate several stakeholders of transport business process (road and other transport network operators, police, customs, telecommunication operators, etc) using technologies like:

- satelite navigation sytems,
- information and communication technologies (mobile communication systems; positioning, navigation and tracking (PNT) algorithms and methods; distributed computing),
- radars,
- advanced sensor elements (state of the road detection, either embedded within the vehicle, or distributed along the road infrastructure).

New concept of the Intelligent Transport Systems developments requires smart synergy of all business process stakeholders with all related technologies engaged. The new-generation ITS approach (COMeSafety, 2009) has already been agreed upon within related decision-making and standardisation communities (such as, the European Telecommunications Standardisation Institute, ETSI, who established the concept of the new-generation ITS, as presented on Fig 2). The main issue in the new-generation ITS development is the introduction of co-operativeness, which increases the importance of telecommunication systems involved (COMeSafety, 2009).

Telecoms in support of NG-ITS development

Telecommunication systems has always been assumed a fundamental component of the ITS (COMeSafety, 2009; Drilo aet al, 2009). Their capabilities intend to be very important for cooperation among road traffic participants and road traffic infrastructure.

NG – ITS is considered to substantially improve the level of safety for driving, transportation efficiency, and human comfort and contribute to environment conservation, by controlling the three key elements of human, road and vehicles taking advantage of advanced information and telecommunications technologies. From an architectural perspective the content of above-mentioned elements is structured as the European cooperative ITS architecture view in Figure 3 (COMeSafety, 2009). In actual fact, a certain telecommunication network builds the core for the cooperative behaviour and the basis for all system stations.

Numerous data related to whereabouts of mobile phone users are being collected and stored by the telecommunication network. The purpose of collecting these data is to approximately estimate mobile user's position in order to support operations like charging, hand-over, etc. Simple methods and procedures, such as Cell-ID and Timing Advance (TA)

Figure 2 General concept of the Intelligent Transport System (courtesy ETSI)

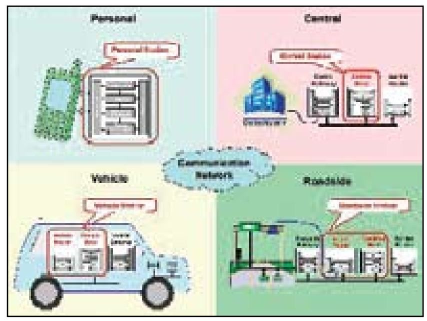

Figure 3 European ITS Communication Architecture (COMeSafety, 2009)

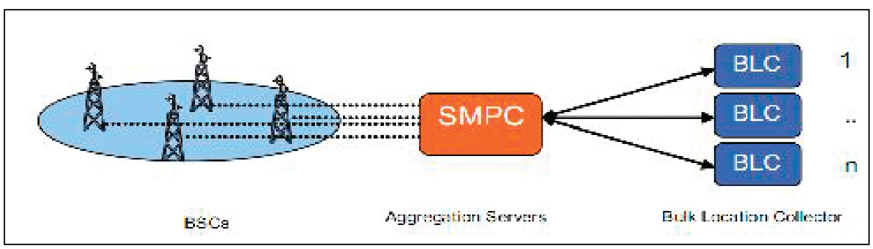

Figure 4 The Anonymous Bulk Location Data unit by Ericsson

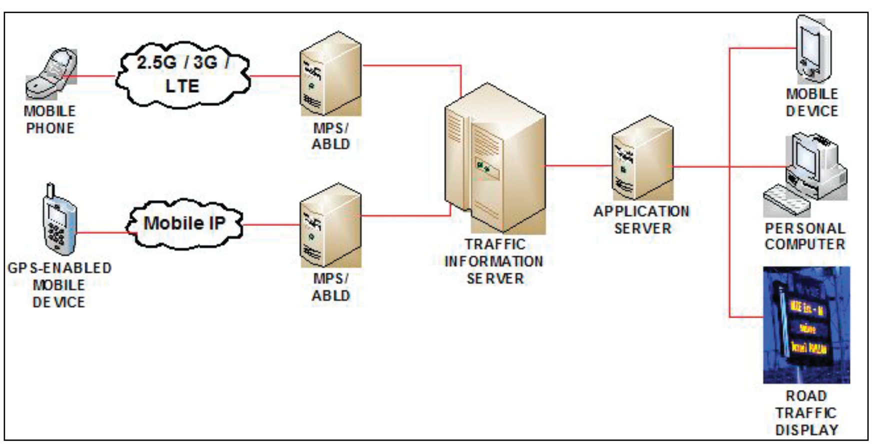

Fig 5 System architecture in support of mobile network-based TIS. Public communication systems are used for data exchange between mobile units and the system (data flow related to MPS/ABLD is conducted through the mobile network signalling procedures).

positioning methods, have been deployed in mobile communication systems with a view to support mentioned network operations (Filjar et al, 2008; Taylor and Blewitt, 2006). The collected and in a raw format provided data have not been so far rather exploited. These data, which have been left deeply within the core mobile communication network, can be transformed into valuable information about the networks user's mobility by applying some modest activities. According to privacy and safety standards, the above-mentioned raw data sets (Cell-ID and TA readings in appropriate time-steps) can can be converted anonymous in a way that the real identification of the mobile communication network user is intentionally dismissed, and an anonymous ID assigned to data (Figure 4). A set of anonymous particles with known essential parameters of movement is formed by this process. These anonymous particles can be further used for creating of near-life time situation status (Liu et al, 2008).

Additional integration with geospatial database systems and utilisation of advanced positioning methods (GPS/Galileo/GNSS) can focus the efforts toward continuous monitoring of road network status (Taylor and Blewitt, 2006). It is important to emphasise that the market penetration of GPS-enabled mobile units grows steadily, and that telecommunication networks already provide the means for exchange GPS-related data collected on mobile units with the appropriate mobile communication network elements.

Traffic information system: A case study

Development of a Traffic Information System (TIS) providing near-real time traffic status information is a case study for deployment of utilisation of location-related data embedded in mobile communication networks. The accurate traffic status estimation requiers a large number of data distributed both spatially and in time accross the area of interest. In a classical approach, dedicated floating cars are deployed to act as a mobile traffic sensors. Those should be equipped with special navigation and communication units, and privacy and security issues should be resolved before the implementation, usually by finding a group of mobile users who voluntarily provide their location data in order to yield other benefits. For instance, taxi drivers may be interested in providing their whereabouts in exchange for continuous monitoring and assistance in case of being attacked.

Mobile communications-based TIS resolves the obstacles of classical TIS by utilisation of the anonymous mobile user data, combined with GPS readings, where and when available.

Every mobile user effectively become a floatin particle, sensing the traffic status of his/her surroundings. Naturally, not everyone can be considered travelling in a vehicle. Therefore, in the process of data preparation a filtering procedure is needed to extract only those particle data sets referring to mobile users involved in traffic. This can be conducted by monitoring the history of particle's velocity, for instance. After selection of mobile users involved in traffic, the sets of velocity estimation data area used in traffic status estimation for specified road segments. The accuracy of the estimation depends on both particle's velocity and positioning estimation. Processed data and traffic status estimates for pre-selected road segments are stored in a database and available for provision within various information services (traffic status on mobile devices, internet, traffic displays along the roads, travel time estimations etc.). An architecture supporting mobile network-based TIS is depicted on Fig 5.

Conclusion

Location-related data collected and stored within the core mobile communication network have been unexploited so far. Recent advancements provide means for exploitation of mobile user location-related data for location-based and ITS services, with preserved privacy of mobile users and without need for building separate ITS infrastructure.

Improvement of the quality of service for the mobile network-based ITS through development of advanced algorithms and methods for traffic status estimation and system integration with GNSS/GPS-based systems will be issues for further development.

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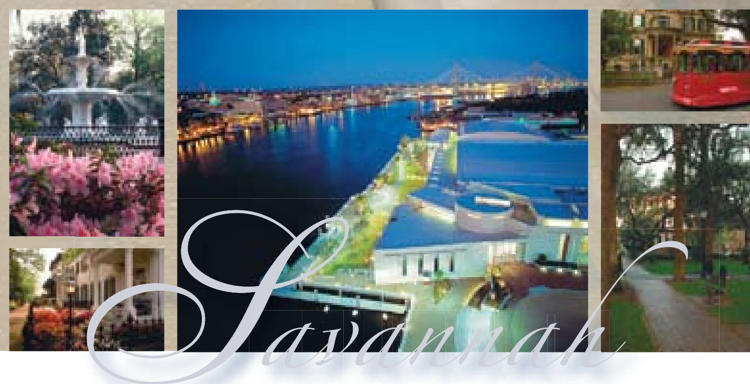

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- Program Updates: High Integrity Systems
- GNSS Applications For Governmental Use (Road Tolling, Emergency Responders, School Bus Fleet Management, etc.)
- GNSS Extensions to Deep Indoor Navigation — What Solutions Will Prevail?
- GNSS Spectrum Protection Issues
- GNSS in Uninhabited Vehicles

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- Algorithms for Multi-sensor Fusion
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- GNSS Space Based Augmentation Systems (SBAS)
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- Timing & Scientific Applications
- Atmospheric Effects & Modeling
- Aviation Applications
- Alternatives and Backups to GNSS
- Galileo Signal Structure, GPS/Galileo Interoperability
- Galileo System Design & Services
- Portable Navigation Devices
- GNSS Signals for non-PNT Applications
- Multipath Effects & Mitigation
- Remote Sensing with GNSS & Integrated Sensors
- Surveying & Geodesy
- Wireless Sensor Networks
- Navigation-Related Guidance & Control Systems
- Land Based Applications
- GNSS Ground Based Augmentation Systems (GBAS)
- Enhanced and Developing Systems
- Space Applications
- Urban & Indoor Navigation Technology
- Marine Applications
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- GLONASS Modernization, QZSS, & Other GNSS

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"Our technology is a great fit for aftermarket product realizations"

Steven Koles, President & Chief Executive Officer Hemisphere GPS on product, technology and market scenario

What does the achieving of the ISO 9001:2008 certification by Hemisphere GPS mean for its customers?

In its interest to continually improve and certify its quality management system, Hemisphere GPS underwent an intensive process and audits, and raised the standards of its organizational discipline to qualify for the international recognition. The certification reinforces Hemisphere GPS' commitment to customer satisfaction through high-quality design, development, assembly, testing, delivery, and technical support.

Hemisphere GPS has a total of 50 issued or pending patents, which of these would you say were 'landmarks' in the company's growth?

Our patent portfolio is quite focused on both our core technology and the market segments that we serve. We carefully select our patent topics and we have been successful in securing patents that directly contribute to the strength of our intellectual property and technology portfolio for our business today and for future growth.

"OEM partnerships are key to our success." Could you please elaborate?

Our technology is a great fit for aftermarket product realizations as well as highly integrated systems. Our technology is advanced enough to easily and meaningfully integrate into advanced equipment in various applications including agriculture, marine and others. We have been successful in working with Original Equipment Manufacturers (OEM) in various markets. Such OEM relationships provide for committed long term technology and product growth plans that secure the growth of the business and reduce the seasonality in the revenue stream. While aftermarket technology will continue to be in demand, factory-installed technology is a trend that we want and can embrace.

Could you tell us how 'e-Dif' software enables standard GPS receivers to achieve 1 meter accuracy without any help from differential correction signals?

The Hemisphere GPS e-Dif technology allows a receiver to create its own local corrections upon initialization, then allows the receiver to apply those same corrections to its own position for a period of time. To do this, COAST technology is used to minimize degradation of the corrections over time, with typically less than 0.5 m drift in 40 minutes. Overall, e-Dif provides positions that drift significantly less than autonomous positioning, resulting in relative position accuracies that are sub meter.
To begin, the receiver is turned on and the user stays stationary for approximately 10 minutes while the receiver obtains a good position fix and begins the e-Dif algorithms. The user sends a command to indicate they are ready to move and the e-Dif algorithms begin correcting the positions. The e-Dif algorithm continues to monitor the satellite signals and after approximately 40 minutes it will begin to continually re-model the corrections. In this way e-Dif continues

to minimize the position drift.

Alternately the user can come to a stop and perform another stationary initialization. This will ensure the lowest possible drift, but can introduce a more pronounced shift in position at the time the initialization is performed. Sometimes this is not desirable, such as in precision agriculture where they are looking to minimize drift from pass to pass, and they are not as concerned about the longer term effects of absolute position drift.

Please tell us more about your recently introduced A21 GPS Antenna.

The A21 antenna is a robust, single frequency, DGPS antenna that works with SBAS (WAAS) and OmniSTAR differential sources. The A21 was built to withstand RF and electrical interference and is an improvement over existing antenna products.

Agriculture is a thrust sector for Hemisphere GPS and 'slower farm spending' has reduced revenues for the company in the first quarter of 2009. How do you see the rest of the year panning out vis-à-vis this sector?

Similar to many companies with exposure to Agriculture, we have seen recent caution in terms of farmer spending. This is a result of recessionary economic conditions, financial media headlines, international currency volatility, and weaker commodity prices. We are encouraged to see some confidence returning to the Agriculture market as prices for commodities such as corn and soybeans are now reaching new highs not seen since the fall of 2008. While we expect short term caution will continue, with the increasing confidence levels we expect our results to improve on a relative basis throughout the fiscal year. Over the medium to long term, we remain very optimistic about our opportunities with new products, new customers, and new markets.

> **The long term fundamentals of our business are strong and we continue to pursue great opportunities for our future growth and scalability.**

The US, Europe and Australia has been key markets for your products. What is your view about other emerging markets the world over?

We have a great interest in emerging markets. As a matter of fact, we have just announced our newest addition to our agriculture product line; the S-Lite in the Simple Chinese language. This is a case where we recognized a specific emerging market need and catered our existing products to meet the demand.

Over the past few years, the Chinese government has put great efforts into supporting agriculture and offering subsidies to farmers towards the purchase of agricultural equipment and we see that as a great catalyst to our opportunity in that market. We are also looking at other emerging markets around the world including for agriculture and other precision GPS positioning and navigation opportunities. These new markets include India, Russia and South America.

Despite a reduction in revenues, the research and development expenses have seen an increase from $1.8 to $2.1 million at Hemisphere GPS. Please elaborate.

The long term fundamentals of our business are strong and we continue to pursue great opportunities for our future growth and scalability. While the market conditions have proven to be volatile at this time, our technology continues to be the cornerstone of our growth and we need to continue to invest in it without reacting to what we believe is temporary market conditions.

In a global economic situation where many companies were cutting back, Hemisphere GPS saw 35% increase in 2008 revenues. How was it made possible?

2008 growth was driven by our focused execution of our business plan through new product releases and effective sales strategies. This was coupled by favourable market conditions in agriculture. Strong grain commodity prices lead to record net farm income in the United States in 2007, and similarly in other countries, which in turn drove stronger sales of agricultural products.

As to our non-agriculture business through the Precision Products segment - including sales to marine, GIS and original equipment manufacture ("OEM") customers, the strength in 2008 sales was a result of many factors including a focused global sales channel initiative which has resulted in increased demand for GPS receivers and board level GPS equipment from OEMs and custom integrators.

Flight test evaluation of a GPS/INS based integrity monitoring

Japan Aerospace Exploration Agency (JAXA) developed a FDE software for integrity monitoring based on a filter bank method, and evaluated its performance by using flight test data. Since a Japanese satellite based augmentation system, MSAS, has been operational since September 2007, the MSAS differential correction data were also used in order to evaluate the effect of reducing protection level.

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GPS/INS integrated navigation system has been a candidate of integrity monitoring system since an inertial sensor could improve performance of the fault detection and exclusion (FDE) functions. Japan Aerospace Exploration Agency (JAXA) has developed several GPS/INS systems called GAIA (GPS Aided Inertial navigation Avionics) for over ten years and succeeded in automatic landing of unmanned experimental vehicle in differential mode. Although high accuracy at the level of Category III approach and landing was achieved, GAIA could not be used for civil aviation since its integrity was not ensured. Therefore, JAXA has commenced research on FDE algorithms for GPS/INS navigation system, and a prototype software based on a filter bank method was developed.

On the other hand, a Japanese satellite based augmentation system, MSAS (MTSAT Satellite-based Augmentation System), which is compatible with the United States WAAS and the European EGNOS systems, has been developed by the Japan Civil Aviation Bureau (Kondo, et. al, 2001), and has been operational since September 2007. The MSAS ground infrastructure, consisting of two Master Control Stations (MCS) and four Ground Monitor Stations (GMS) located in Japan and two Monitor Ranging Stations (MRS) in Hawaii and Australia (Figure 1). Two MTSAT satellites are in orbit as space components of MSAS.

JAXA has conducted several flight experiments since July 2007 in order to collect the GPS/MSAS data as well as INS data for research purposes. By using these data, horizontal protection level (HPL) was computed based on the GPS/INS filter bank algorithm, and compared to the HPL_{SBAS} , which was computed based on MOPS for GPS/WAAS airborne equipment (RTCA, 2006).

The results of two flight tests are shown in this paper. One was conducted in July 2007 at Taiki in Hokkaido, northern Japan, while another test was conducted in February 2008 at Hachijo, a southern Island in Tokyo. Both locations are shown in Figure 1.

GPS aided inertial navigation avionics (GAIA)

GAIA GPS/INS integrated navigation system was originally developed by the National Aerospace Laboratory (NAL) and the National Space Development Agency of Japan (NASDA) for the High Speed Flight Demonstration (HSFD) project, a test program for the planned HOPE-X space plane (Harigae, et. al, 2001). (NAL) and NASDA, and another organization, Institute for Space and Astronautical Science (ISAS), were merged into JAXA in October 2003.) A key objective of the HSFD Phase I experiment was to examine automatic takeoff and landing technology using carrier-phase DGPS/

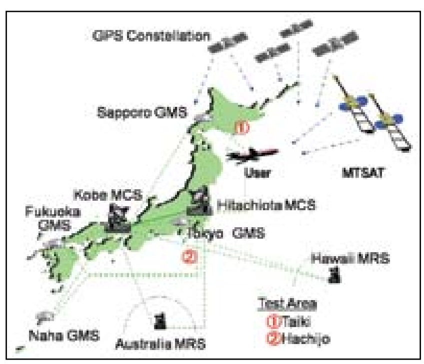

Figure 1. MSAS Overview and Flight Test Area

INS (CDGPS/INS) integrated navigation, and high accuracy at the level of Category III approach and landing was demonstrated in differential mode.

The onboard avionics consists of a Kearfott T-24 Inertial Measurement Unit (IMU) with ring laser gyro and servo accelerometer, an Ashtech G12 single-frequency GPS receiver, and a DX4 (66MHz) CPU for navigation processing. Figure 2 shows a photograph of the GAIA and Table 1 gives its specifications.

GAIA is currently installed in JAXA's experimental aircraft Beechcraft Model 65 QueenAir and provides navigation data for research purposes. Since GAIA was not capable to decode MSAS message, an Ashtech DG16 GPS/WAAS receiver was installed for these flight tests. Onboard equipment system is depicted in Figure 3.

The data recorded onboard were used for offline analyses. The processing software was originally developed for MSAS-GAIA (Tomita el al., 2003) and modified to add integrity monitoring function. MSAS-GAIA is a further development of GAIA which utilizes SBAS capability.

The navigation algorithm of GPS/MSAS/INS is outlined in Figure 4. MSAS-GAIA adopts a tightly-coupled GPS/INS integrated navigation algorithm that corrects IMU errors (acceleration and angular rate) as well as the INS navigation results (position, velocity and attitude) using GPS data, and avoids the divergence of inertial navigation.

Several integrity monitoring algorithms have been proposed for GPS/INS navigation system (Brenner 1995, Diesel and Dunn 1996, Young and McGraw 2003). JAXA adopted the normalized solution separation method using filter bank (Young and McGraw 2003) for a prototype software. In the analyses later, HPL are computed for en route through LNAV approach. Therefore, probability of missed alert, which is assumed to be equivalent with P_{MD}, false alert rate, and fault-free integrity probability are 0.001, 10^{-5}/hour, and 10^{-5}/hour, respectively. The HPL computed as above is denoted as HPL_{FD} hereafter.

Flight experiment and results

Two flight tests were conducted in order to evaluate the developed algorithms. The first flight experiment (CASE 1) was carried out on July 23, 2007 at Taiki (see Figure 1) in Hokkaido, northern Japan (Tsujii, et. al, 2008). The Beech 65 aircraft took off from Obihiro Airport, about 40 km north west of Taiki, flew to Taiki airfield and carried out lots of circling patterns with up to 30 degree bank above the airfield and Pacific Ocean coastline, then went back to Obihiro airport.

Figure 2. GAIA (Right, Left is an uplink receiver for DGPS)

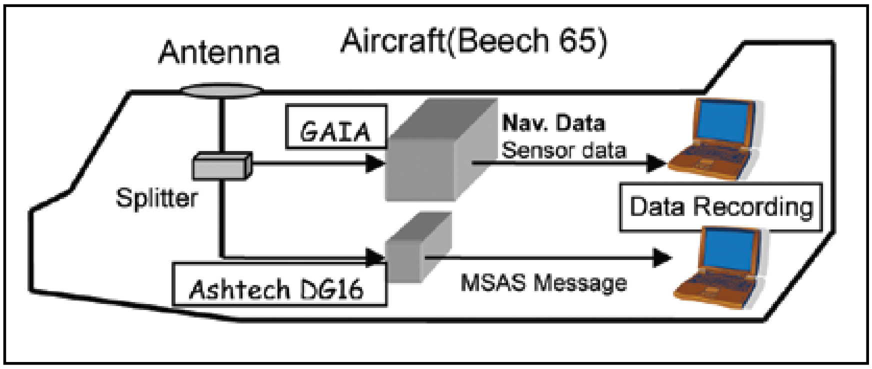

Figure 3. Onboard Equipment System

The horizontal protection level computed by the GPS/INS filter bank method (HPL_{FD}) and that computed by the SBAS method (HPL_{SBAS}) without MSAS correction were shown in upper part of Figure 5, while the number of observed satellites and $\sqrt{\lambda_{max}}$, which is a test static for the fault detection, were shown in lower part.

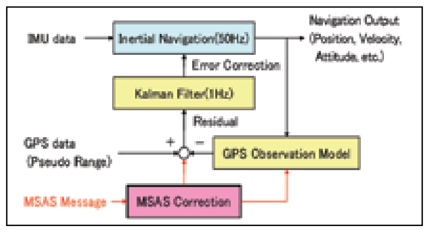

Figure 4. Outline of GPS/MSAS/INS Navigation Algorithm

It is clear that integrating GPS with INS drastically reduces the value of HPL. Also, HPL_{FD} seemed very stable while HPL_{SBAS} was affected by the number of satellites and resulting satellite geometry. This superior performance is basically attributed to accurate position estimate of navigation filter. HPL_{SBAS} was directly affected by the range error variance which was very conservative for safety reason. On the other hand, HPL_{FD} was calculated based on the filter covariance, which was smooth and small due to the effects of hybridization with INS. Therefore, HPL_{FD} was reduced even though the same value of range error variance was used. The HPL_{FD} and HPL_{SBAS} when pseudoranges were corrected by using

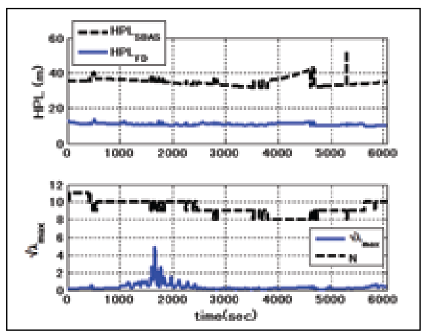

Figure 5. HPL without MSAS Correction

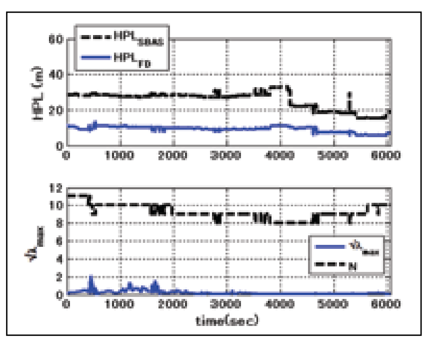

Figure 6. HPL with MSAS Correction

MSAS message were shown in Figure 6. Compared to Figure 5, HPL_{SBAS} was improved since GPS range errors were reduced. On the other hand, improvement of HPL_{FD} by MSAS correction was not significant. Note that there were sufficient satellites during all the flight. An example where fewer satellites were

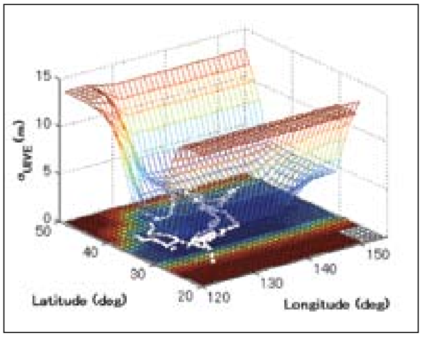

Figure 7. Magnitude of σ_{UIVE}

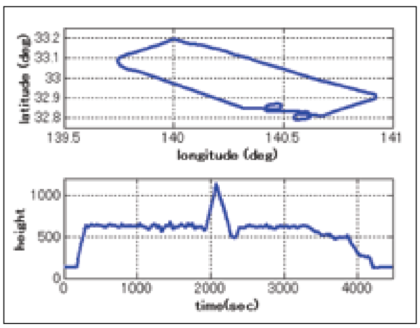

Figure 8. Trajectory of Aircraft

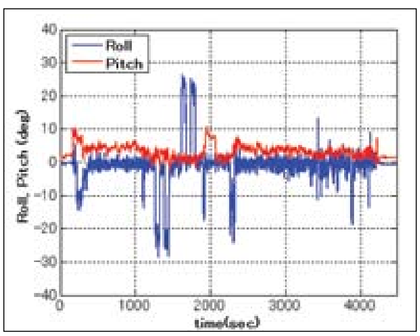

Figure 9. Roll and Pitch Angle

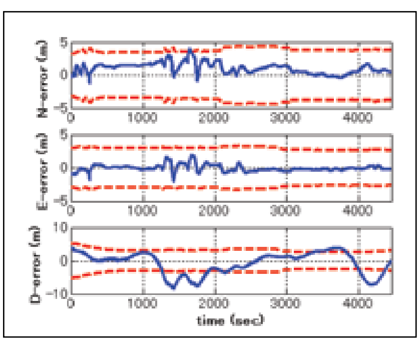

Figure 10. GPS/INS position error (without MSAS correction) and its estimate (95%; dotted line)

observed is shown in the next section.

The second experiment (CASE 2) was conducted 7, 2008 at Hachijo-Island, Tokyo, Japan. Since Hachijo-Island is located southern, the ionospheric effect is severe than in CASE 1. An example of vertical ionospheric delay error (σ_{UIVE}) is depicted in Figure 7. σ_{UIVE} is computed by interpolation using the grid ionospheric vertical error (σ_{UIVE}) which is given at each grid point with five degrees separation in longitude and latitude.

Trajectory of aircraft at Hachijo-Island on February 7, 2008 is shown in Figure 8. The Beech 65 took off Hachijo-Island airport and flew south east, then conducted counter clockwise circling twice and clockwise circling twice. Next, it ascended to height 1200m, and descended to 600m, then landed at the Hachijo-Island airport. The height of the airport above the ellipsoid (WGS84) is about 130m. The origin of time is at the completion of INS alignment. The attitude of aircraft is shown in Figure 9. Since roll angles at four circling were over 25 degrees, the satellite at lower elevation might be blocked by aircraft itself.

The error of position estimated by the full filter and estimated error range (95%) from the filter covariance are shown in Figure 10 (without MSAS correction), and in Figure 11 (with MSAS correction). The efficacy of MSAS corrections was seen since the same satellites were used in both cases. The error range was properly estimated in horizontal direction, therefore the horizontal position estimates and covariance were able to use for HPL calculations. In this test, a ground GPS receiver was installed nearby the airport, and kinematic GPS solutions obtained from onboard/ground data were used to compute position error.

The horizontal protection level computed by GPS/INS filter bank method (HPL_{FD}) and that computed by SBAS method (HPL_{SBAS}) without MSAS correction were shown in upper part of Figure12, while the number of observed satellites and $\sqrt{\lambda_{max}}$ were shown in lower part. When six or more satellites were observed, HPL was reduced by integrating INS with GPS. At the time 2083s, number of observed satellites dropped to five and gradually increasing HPL_{FD} temporally exceeded HPL_{SBAS}. During this period, HPL_{SBAS} did not change drastically compared to HPL_{FD}, which became large due to the decreased number of satellites. This is because an undetected satellite failure is assumed in computation of HPL_{FD} and therefore HPL_{FD} may become large when sufficient satellites are not observed. On the other hand, all satellites are assumed healthy in computation of HPL_{SBAS} if no fault is broadcasted.

It was seen in lower part of Figure 12 $\sqrt{\lambda_{max}}$ that became very large at the time 1420s, where the number of observed satellites dropped to five temporally due to the circling with large bank angle (see Figure 9.). When number of observed satellites is five and six, the thresholds of $\sqrt{\lambda}$ for fault detection are 6.5286 and

Table 1. Specifications of GAIA

Item	Spec.
Size	H180mm x W180mm x D280mm
Weight	9.8 kg
Power	46 W (28VDC)
Functions	CDGPS/INS, GPS/INS, INS,
Environment	Temperature: -40 – +55 degree Celsius Altitude: 0 – 32 km Humidity: <85% Acceleration: 8G Shock: 15G (11 ms half sine) Vibration: 0.04 G2/Hz (15–1000 Hz), 8.03Grms
Interface	MIL-STD-1553B
Data rate	50 Hz
Reliability	MTBF: more than 3,700 hour

6.5564, respectively. Therefore, a satellite fault was falsely detected in this case.

Next, HPL_{FD} and HPL_{SBAS} with MSAS corrections are shown in Figure 13. Compared to Figure 12., it is clear that HPL_{SBAS} was reduced by using MSAS corrections. The HPL_{FD} with MSAS corrections was smaller than the HPL_{SBAS} except the case where five satellites were observed. Also, the value of $\sqrt{\lambda_{max}}$ at about t=1420s did not exceed the threshold. MSAS corrections was effective to make the GPS/INS based FD function work properly when the number of satellites was insufficient

Summary

An integrity function based on a filter bank method was implemented into the navigation software of JAXA's GPS/INS avionics, GAIA. Flight experiments were conducted and offline analyses using collected data of GPS, MSAS, and INS were carried out.

As results, when six or more satellites were observed, the HPL_{FD} based on GPS/INS was better than HPL_{SBAS}, in both with and without MSAS corrections. However, if there were only five satellites observed, the HPL_{SBAS} was sometimes smaller than HPL_{FD}. This is because an undetected satellite failure is assumed in computation of HPL_{FD} and therefore HPL_{FD} may become large when sufficient satellites are not observed, while all satellites are assumed healthy in computation of HPL_{SBAS} if no fault is broadcasted. Also, a satellite fault might be detected falsely when only five satellites were observed and MSAS corrections were not used. Therefore, MSAS corrections would be necessary in order to use the GPS/INS based integrity monitoring when the number of satellites was insufficient.

In this paper, the GPS/INS based HPL for only en route through LNAV approach was investigated. In order to apply this method for precision approach, the vertical protection level has to be computed. However, as seen in Figure 10 and 11, the vertical positioning error could not be properly monitored by the used GPS/INS navigation filter. An improvement of vertical positioning performance by an ionospheric delay estimation method such as precise point positioning (PPP), and/or by an integration of altimeter would be required. Future GNSS such as GPS-III and GALILEO, which will implement dual frequency operation, would make precision approach possible. JAXA plans to conduct simulation analyses to investigate the potential of future GNSS/INS for precision approach.

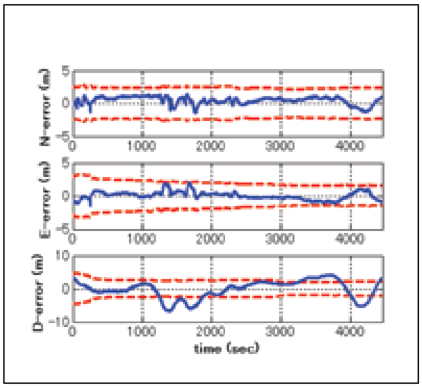

Figure 11. GPS/INS position error (with MSAS correction) and its estimate (95%; dotted line)

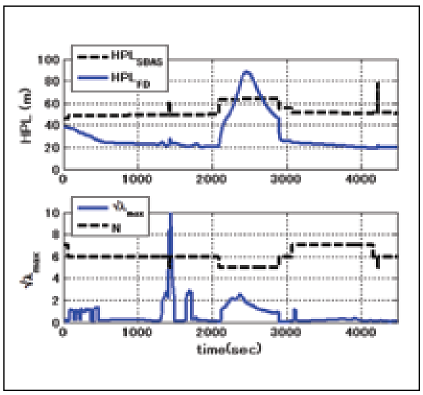

Figure 12. HPL, number of satellites, and $\sqrt{\lambda_{max}}$ (without MSAS corrections)

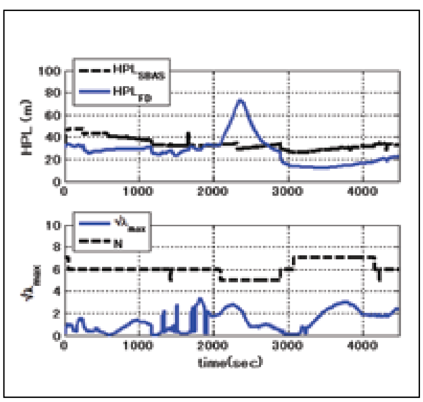

Figure 13. HPL, number of satellites, and $\sqrt{\lambda_{max}}$ (with MSAS corrections)

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TRIUMPH 1
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in focus

216 channels

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

Actual size

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- GPS L1
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- 100 Hz update rate
- RAIM
- WAAS/EGNOS
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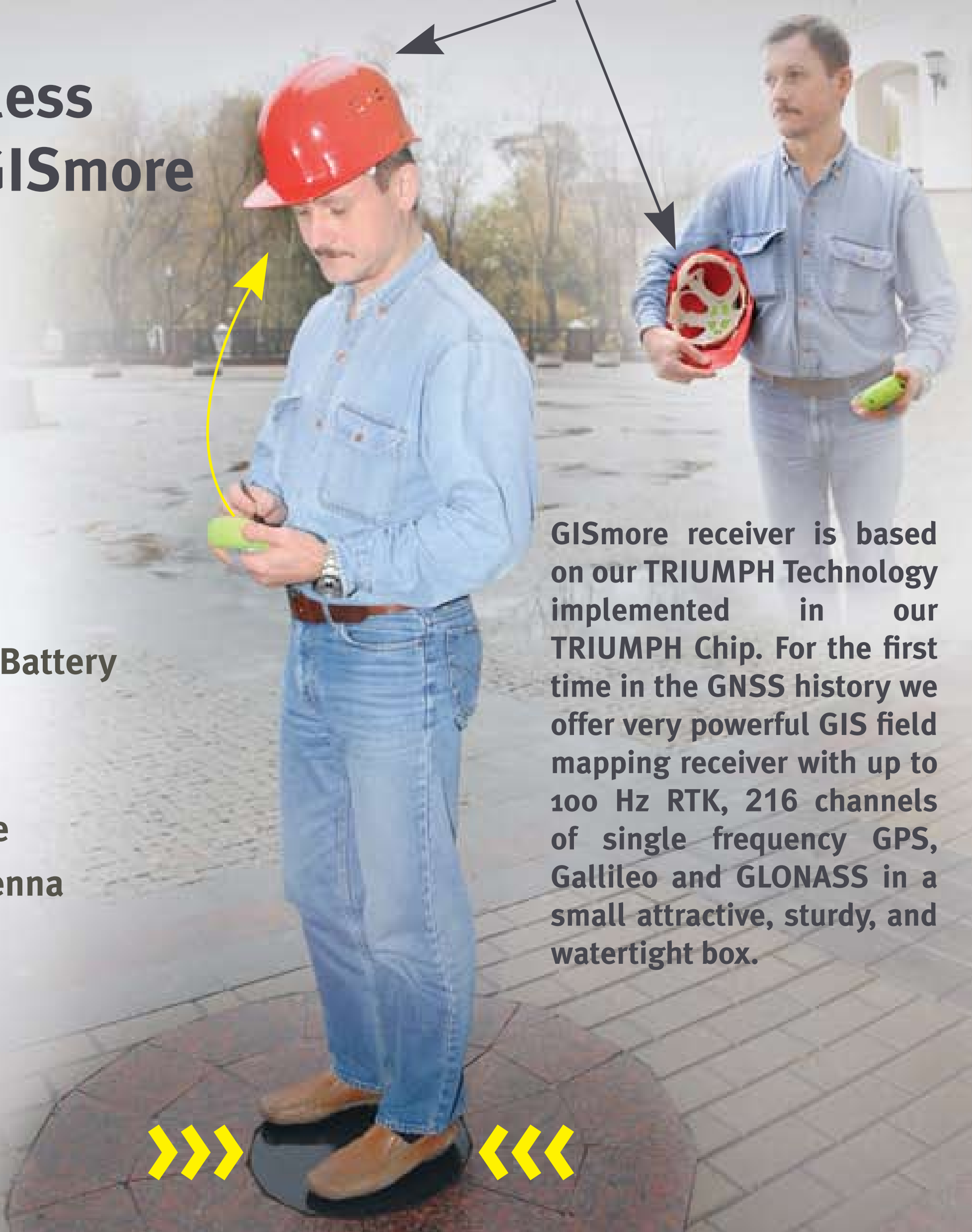
- GNSS Antenna
- GSM Module
- Bluetooth® Interface
- Bluetooth/GSM Antenna



GISmore receiver is based on our TRIUMPH Technology implemented in our TRIUMPH Chip. For the first time in the GNSS history we offer very powerful GIS field mapping receiver with up to 100 Hz RTK, 216 channels of single frequency GPS, Gallileo and GLONASS in a small attractive, sturdy, and watertight box.

Many ways to use

TRIUMPH 1

TRIUMPH

TRIUMPH – 4x

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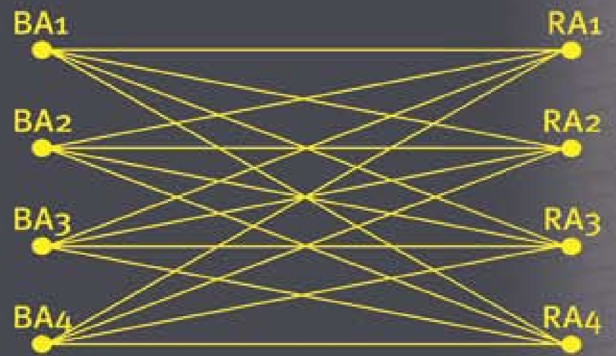
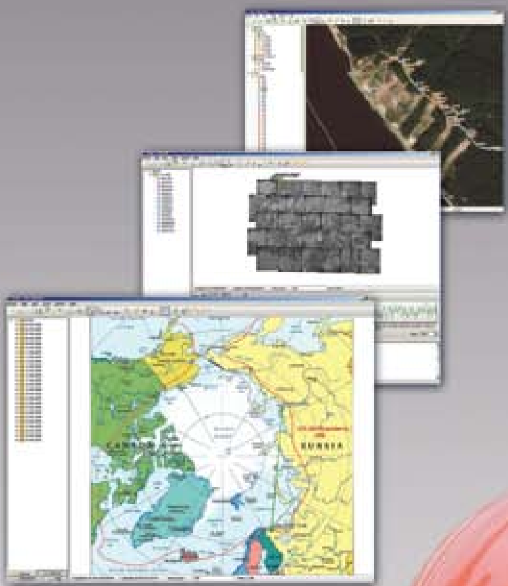


4 base — 4 rover, 16 baselines

Software solutions for all tasks



Justin

A comprehensive Survey and GIS software

Justin has integrated native tools to use ESRI or MapInfo cartography windows.

It can import data files as well as whole folders. Justin employs special technique to process high rover data rates (up to 100 Hz) using low base data rates. Other features include single epoch static solution, manual postprocessing with time line chart, using vertical profile to filter out suspected data and scientific data analysis and viewer.

Victor

Victor is pre-loaded with our Tracy field software. When turned on, Victor automatically connects to TRIUMPH-1, TRIUMPH–4X or GISmore via its internal Bluetooth and guides you through field operations. It manages the GNSS receiver and modem operations automatically.

- **Lightweight (17 ounces; 482 grams) magnesium case with easy-to-grip over-molding**
- **Operating temperature -22°F to 122°F (-30°C to 50°C)**
- **Connectivity via built in Bluetooth, USB Host and Client, plus 9-pin RS-232 and optional WiFi and Modems**
- **Rechargeable, field replaceable, Li-Ion battery** It operates for more than 20 hours on one charge (3 to 5 hours of charging time)

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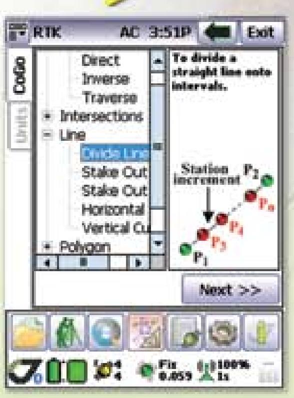
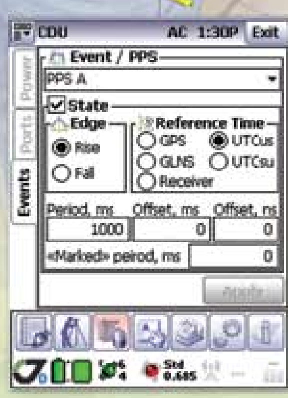


Support for survey and stakeout projects

Static, Fast Static and Stop&Go surveying



Configuration of all hardware

Tracy

A versatile and powerful field software

Software for Windows Mobile OS to control receivers, automated GNSS post processing surveying tasks (Static, Fast Static, Stop&Go, Data Acquisition), and to perform RTK survey and stakeout tasks.

Antennas

GrAnt-G3T/G3

GrAnt-G3T
is a versatile high performance antenna with GPS L1/L2/L5; Glonass L1/L2; Galileo L1/E5

GrAnt-G3
Have similar case as GrAnt-G3T.
With GPS L1; Glonass L1; Galileo E1

Snow Cone options

- Protection Against ESD
- Have good vibration and shock resistance
- Possible options:
  N-type connector
  TNC on center
  Snow Cone

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

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 via M12 8 pin connector

AirAnt

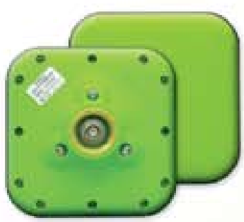
AirAnt is designed to be mounted on aircrafts and applications where low profile and aerodynamic shape are desired. GPS L1/L2/L5; Glonass L1/L2; Galileo L1/E5

120x74x44.5 mm,
0.32 kg

- Overload protection
- Improved rejection out-of-band signal rejection

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

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

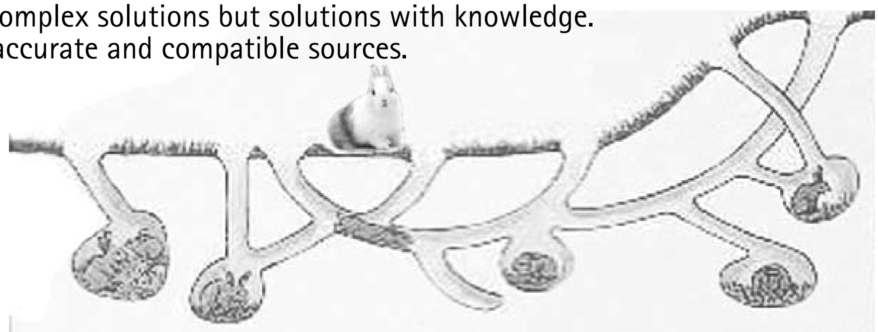
RingAnt-DM

traditional choke ring with Galileo option and Dorne-Margolin element.
With GPS L1/L2/L5;
Glonass L1/L2; Galileo L1/E5/E6

SDI: Purpose and direction

Complex problems do not require complex solutions but solutions with knowledge. Knowledge derived from multiple, accurate and compatible sources.

Jesús Olvera Ramirez
Direction of the Spatial Data Infrastructure
Direction General of Geography and Environment
National Institute of Statistics and Geography
Mexico
jesus.olvera@inegi.org.mx



How can we plan and decide upon urban growth?, which house to buy as a secure investment?, which properties are at risk? All these are critical questions we have to face in a changing world and that may affect permanently our lives. For this reason, today it is much more important to make the correct decisions, whether for designing the national economy or making personal plans for the future.

Making decisions requires knowledge, knowledge requires reliable information and reliable information requires integrated data from different sources, with a certain degree of accuracy and reliability since the beginning. One of the key factors in most decisions is the geographical location, the common denominator for connecting data and information with a specific feature, such as an address, building, river, a point in a highway, a gas or water pipeline. At present, geographical information is worldwide recognized, particularly by the governments, as a key component of the so-called national information infrastructure, becoming a facilitator of knowledge economy which potential may be used as the basis of sharing and exploitation of significant geo-referenced information coming from several organizations.
In this sense, providing accurate information with the appropriate quality, reliability and opportunity is crucial.

Nevertheless, this situation is not automatically reached, but with leadership and a user-oriented scope. Financial support is also necessary for the infrastructure sustainability, in good or bad times and in spite of political changes. In some way, this scenery is common to all countries that are trying to improve their economies based on geographical data and information.

One of the objectives of several governments is the establishment of a geographical reference base, reliable and integrated, capable of supporting the e-economy, both in the governmental and commercial sectors, because of the need of geo-referenced data and information for the strengthening of potential users-producers interchange of added-value data in "location-based services". For consistent results, with the proper quality, a "national geographical frame" is required, not only as organized data but interrelated and integrated at some level of intended information, easy to be handled and supported by a set of national policies for its production, sharing, interchange, access and acquisition.
A reasonable general model does not need exorbitant price –or absolute free-products and services, but a balance that benefits both users and producers.

Data and Information

The concept of the evolving chain of Data ► Information ► Knowledge ► Wisdom is becoming more and more important day by day. A hierarchical chain where each concept adds value to the previous one: Data is at the basic level, Information adds a certain context, Knowledge implies a clearer notion of the intended use of the information and Wisdom adds the what for notion used to solve a complex situation

This evolving chain is an intellectual model useful for defining a reasonable position in spatial or territorial analysis. This model -called DIKW by Russel Ackoff- is directly related to the Spatial Data Infrastructure (SDI) concept.

The term Spatial Data Infrastructure implies (and it is true) that "Data" is being dealt with, although experts and non experts sometimes expect that SDI solve complex spatial problems.

It is evident that "Data" is not part of a magic solution because of its natural attributes. There is a complex relation between data and information, where the difference is usually vague. The information production begins with the primary data obtained in different ways, including several observation techniques with instruments. Data are delivered as standardized observations and measurements, therefore data can not provide knowledge (here we assume that the more complex the problem, the further the data is from the solution). Data may exist in any organized form, useful or not.

Now, what about information? Well, information has an intention level given by the relations between spatial objects (previously designed, selected and characterized according to standards and specifications). Data is then integrated, analyzed, interpreted and transmitted to users as information. While data may be standardly stored and managed and be useful for many years, even centuries, information is user-oriented and its useful life is comparatively short. So, information may answer simple questions such as who, what, where, when, but not "how" or "why", which is a matter of analysis.

Here it is when knowledge answers to "how" and "why", information obtains a meaning through interpretation, becoming knowledge (only the Man can interpret).

Wisdom appears after understanding of knowledge, particularly when it refers to human well-being. Therefore, wisdom is a mental process by which we distinguish, evaluate and decide what is correct or not for us. This may be useful to understand the gap between making decisions based on "Data" or based on a "Structure of Spatial knowledge".

According to the English official agency responsible of the spatial information (Ordnance Survey), the geographical information includes two data classes, generally in graphic form:

- Reference Data (known together as "Base Map")
- Thematic Data or User Data (what is placed on the "Base Map")

These two commonly known classes of geographical information and their distinction have been developed by the INSPIRE initiative of the European Commission, (European Commission [EC], 2003), in order to produce consistent geographical information all around the region.

Typically, the "Reference Data" includes territorial data, for example, plots, buildings, highways, rivers, elevation data and imagery, among others. In this context, the "Reference Data", interrelated and separated in similar groups, takes the sense on "information", which users may use to overlay their own data, that is, pipeline networks, electric plants and underground cables, site location of police interest, census data and health or poverty situation, among others.

The Past and the Digital Age

In the world of the paper maps, it has been very difficult to interchange and combine data and information because users and producers apply different levels of detail, and diverse geographic reference systems and cartographic projection systems; furthermore, usually methodologies, accuracy statements and producer are not documented properly.

On the other hand, the problem with paper maps is that data and information are geometrically represented, then the handmade combination of polygons of different maps is extremely time consuming. Also, in many countries the lack of technological and methodological capacity to combine geometric elements with statistics data derived from human activities has been a not easily surmountable aspect.

The digital age arrival has caused organizations to apply the new technology first with map conversion to a digital format, repeating what was done in the "world of paper".

During the last decade, we have noticed that the investment on data and information production, particularly on their maintenance, is financially significative, requiring a flash of wisdom. In that respect, the lack of wisdom to decide how to spend the funds and on what may lead to a situation where the ability or capacity is so poor that an efficient data and information integration from different sources is not possible, and instead of solving problems this production becomes an obstacle to progress.

Frequently, users have to adapt the spatial data acquired in order to be usable to their needs, whether formatting or matching the data with a group of data from other source. In many countries data may be non updated or need a "cleaning" process for a certain purpose, and although these activities are necessary, they are not always welcome. The ideal situation is that data comply with quality standards, be produced only once, be updated and be used several times. These simple tasks add cost and time to the projects, whatever their dimension or importance, minimizing national efficiency and knowledge economy. Evidence suggests that there is a great potential in supporting the national economy with a rigorous spatial data infrastructure both to face present challenges and improve the future position of a country within the e-economy.

Another classical situation in geography is that the cartographic works represent past facts, that is, historical views or quasi "recent" phenomena. With this perspective, almost all maps represent different moments of the change in the elements of the territory, without the spatial relation with phenomena associated to human activity. None map shows people living conditions, nor their influence on the physical environment. Maps are usually a retrospection of some events on the land. We need to look forward. Accepting this consideration as true, digital spatial data and its map representation should be useful for society and government to look to the future with two purposes: to prevent and/or preserve certain conditions or phenomena of interest to the Territory-Society relation, and to facilitate the intellectual work of designing the future and creating the sceneries where this relation be in balance.

The Spatial Data Infrastructures

The SDI concept is an answer to conclusive events with positive effects on certain regions or countries, or negative on others. For example, in regions with geographical information available, along with the power of the Geographic Information Systems (GIS), the tools for supporting decision making, the databases, the world wide web (www) and the necessary interoperability, the way in which societies with better resources face critical affairs of social importance, of environment and of economies changes quickly and accordingly. Nevertheless, in the age of the computers and the big web, users have great difficulties to find and use suitable geographical information. This situation may lead to abandon projects or to repeat the geographic data and information production unnecessarily and costly.

Because of this reason and others, the need to access spatial data from different sources at all scales as a guide for decision making is quite obvious. Then, our ability to make intelligent decisions collectively at the local, national, regional and global levels, firstly depends on the conceptualization, development and results of the Spatial Data Infrastructures that must facilitate and achieve the access and use of data and information under the following terms: Comparability, Shareability, Compatibility, Reliability, Consistency and Completeness.

In order to achieve a sustainable development, updated spatial information of quality is required, which may help to show the situation and interdependence of economic, demographic and social phenomena, as well as their relation to the physical environment and the territorial space. Then, the spatial information is the necessary input for knowledge generation useful in the definition of policies and decision making in order to achieve the well-being of the Society and the development of Mexico.

Consequently, the societies need to be aware of the existence of data and information, rely on their quality, determine their level of application and access them easily, with the purpose of sharing and integrating information from different sources. Although the technology required is available, the dissimilar characteristics of data have become evident and they are the result of partial and local scopes in the production of information during the previous decade.

The need to minimize the gap in knowledge between developed and developing countries has been declared in several regional and global forums, such as the Rio Summit (1992), the United Nations Regional Cartographic Conferences, the world development report “Knowledge for Development” (1998-1999), and lately the Johannesburg Summit (September 2002) and the World Summit on the Information Society (Geneve, December 2003), where the subject of information and technology for development has been dealt with.

In Johannesburg, the progress achieved by different countries with respect to production and use of geographical information was supported through the establishment of agreements addressed to promote the development and wider use of earth observation technologies, including remote sensors, global cartography and geographic information systems, for quality data collection that facilitates the evaluation and coordination among systems and research programs, considering the need to create capacity and share data from different sources.

As an answer to the initiatives and the derived agreements, the spatial data infrastructures emerged and became stronger in the last years, and have created a cooperation space around the world among government producers, private sector, academy and user community in order to work together in the establishment of systems, network connections, standards, specifications and all the institutional elements required to guarantee the production, access and use of geographical information.

In the past ten years, more than a half of the countries in the world have developed spatial data infrastructures initiatives with the purpose to promote good government, and economic and sustainable development. The growth and adoption of these initiatives has contributed to the improvement and wider use of the Information and Communication Technology (ICT) jointly addressed to decision making for sustainable development of countries. The existence of successful SDI is making a significant difference between countries with low or high development, specifically with respect to environment management, disaster prevention and mitigation, transportation and infrastructure planning, drinking water distribution, poverty reduction, and defense and security. Therefore SDI have become a basic element in planning, at all levels of world-wide governments, because spatial data and information in an adequate communication setting may lead to government efficiency.

Two successful cases

In Great Britain, the use of geographical information has spread to many market sectors, central and local government, service companies and multi-applications in the private sector. A study performed by an independent consultant group (OXERA, 1999), showed that about 100 billion pounds sterling of gross domestic product (GDP) in 1996 were in some way supported by the spatial information of the Ordnance Survey.

The National Land Survey of Sweden (NLS) “Lantmäteriet” is the national cartographic agency and the national cadastre authority which provides a wide variety of modern data and consultant services with an income of

1.3 billion Swedish kronas, where 900 millions were the profit derived from the sale of data and services in 2001. This case shows that the business model applied produces incomes and profits for the organization, and supposedly contributes to the Sweden GDP.

The cultural change

If we assume that complex problems do not require complex solutions but solutions with knowledge, we have to accept that such knowledge should be derived from information of multiple, accurate and compatibles sources, that is enriched by diversity.

Then, we have to review and modify our present perspective, changing to a new organizational culture that may guarantee our capability in accomplishing the demands of the rising economy of knowledge. Also, we need to attract and retain experts in the key programs of production in order to assure that organizations be ready to give an answer to future requests.

What is Mexico doing?

Since 2004, the National Institute of Statistics and Geography (INEGI: Instituto Nacional de Estadística y Geografía) has formally embedded in its objectives the establishment and building of the Spatial Data Infrastructure of Mexico (IDEMex: Infraestructura de Datos Espaciales de México).

So that the IDEMex may achieve a complete development, the strategy of obtaining a government mandate along with the resources for its continuity brings clear advantages. The success of that strategy is closely related to an efficient and timely public service through a transparent access o the public to the government information, where the results of the mandate and the user satisfaction may be appreciated.

Also, the IDEMex expects to achieve a higher integration of producers and users of geographical information, admitting that some actors are more important than others and the commitment of the parts is not necessarily the same. Besides, this means that each actor must recognize the importance of his/her role and the responsibility in the collective work for the IDEMex development.

For the successful future of the IDEMex, the vital need of an increasing awareness of the decisions makers in considering the spatial data and information as a natural resource that has to be managed and coordinated according to national interests is highlighted, and in consequence all the participants must collaborate in this respect, depending of their responsibilities. Nowadays, there is an obligation and a necessity of designing strategies for the construction of a successful future for the IDEMex and Mexico, including the study and consideration of the best practices and changes in the way that some other countries are dealing with such themes as privatization, free market, and the increasing globalization of the production, analysis and distribution activities of the spatial data and information.

Measuring the impact of decisions based on geographical knowledge in the economy of any country demands an extensive and intensive research, that initially, is characterized for an unbalance: more questions and gaps, than certainties and indicators.

According to a study of The Economist, a decisive factor to place Mexico among the five bigger economies of the world in 2040 is the adequate financing of its most important activities. As already seen, at least in the case of Great Britain, the sustained investment on the official geographical information agency, the Ordnance Survey, has allowed the generation of measurable and improvable wealth.

The importance of the use of spatial data, information and knowledge in the economy, development and well-being of any country will have an evident impact, as in those ones where instead of waiting for the future, they decided to design it.

Is spatial special?

Prof Ian Williamson
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It is sometimes suggested that spatial data is just another form of data that can now be maintained in a data base and that in reality there is nothing "special about spatial". Nothing could be further from the truth. For example spatial data is not the same as integer, alphanumeric or symbolic data for a number of reasons. These are: spatial data is scale dependent: do I query for 37.3N 45.2W..or?

spatial queries are endemically computationally expensive: how does one efficiently query for such position or, even harder, distances, angles, etc., between locations? These types of queries are different from, for example, symbolic queries, as "locations" or "distances, angles" involve more than the actual numbers to include the underlying topology to search (there are implicit values between explicit numbers) and defined measures: a data model.

The data model is essential, particularly when associating spatial terms (location, relations, etc.) with an ontology. For example, optimizing where to locate a hospital given population densities, topography, transport data, etc., demands different kinds of spatial data information. No single data model applies to all situations.

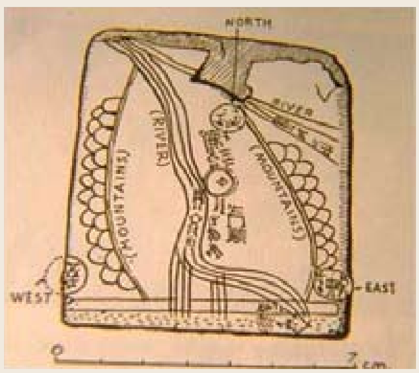
Integrating spatial data with other data types requires additional data types. For example, associating symbolic representations of locations (place names, etc.) is quite a different data structure than the reverse. So, while it is correct that spatial data can now be included and manipulated in large data bases along with textual data, understanding the collection, management, manipulation, integration, use, presentation and querying of spatial data is complex. The complexity and need to understand spatial data has been a central driver in the development of one of the oldest professions – land surveying – and one of the oldest disciplines – geography. Historically even hunter-gatherer societies used topologically correct mappings to communicate spatial information. Such spatial depictions are the essence of aboriginal paintings in Australia. Humans simply think spatially.

Urbanisation and the start of civil society meant that there was a need for spatial information which was less 'relative' and more 'geographic'; less symbolic and more quantitative. The result was the development of maps of cities and countries, which supported early cadastral systems for property ownership, infrastructure management and tax, as well as supporting trade and defense. These maps, which first appeared over 8500 years ago, exhibited consistent scale and orientation in order to meet the needs of government. These needs have continued to the present day where we see spatial data infrastructures (SDIs) supporting a wide range of economic, environmental and social objectives. Spatial information is now acknowledged as a key infrastructure and enabling technology in supporting modern society, in delivering the "triple bottom line", supporting good governance, being critical in defence, promoting efficiencies in business and in recent times supporting such things as e-government and our emerging virtual society.

The disciplines of surveying and geography are built on the spatial paradigm. Today almost every piece of data has a location, with the ability to assign a location to all natural and human activity having transformed the way modern societies manage both the natural and built environments. The result is that the traditional views of surveying and geography are coming closer together as they support the creation and maintenance of a virtual world.

The enabling science, technology and infrastructure provided by spatial information (SI) are transforming the way governments do business. However it is important to remember that SI is not an end in itself – it is an enabling infrastructure. This infrastructure, often termed a spatial data infrastructure as mentioned previously, is not just about databases. It is about linking people to data with a range of policies, technologies and standards. One of the biggest challenges facing the spatial information discipline is how to raise the level of awareness about the importance of this key infrastructure.

In order to capitalise on the potential SI offers a modern society in delivering the "triple bottom line", requires bringing together expertise in measurement science, GIS, ICT, land management and administration, natural resource management, law and public policy. In particular it is not possible to deliver sustainable development objectives unless we can consider the interaction between the natural and built environments. This requires bringing together natural and built environmental data in order to model both physical and human processes



and presenting them in a usable manner for analysis and use by decision and policy makers. Such use, integration and analysis present many problems and challenges.

For example spatial data presents particular issues when we try to integrate it with alphanumeric data. Spatial data is a very different type of data as compared to financial data for example, which has a specific data model and type – there are no choices with financial data while there are almost unlimited data model and data type choices with spatial data.

A specific data model and data type needs to be chosen for every piece of spatial data. There is a wide range of choice about the geoid, projection, accuracy and precision, and scale. Further, there are a whole range of uncertainty and fitness for use issues arising from the range of data types available, and from complex choices about data integration, aggregation and generalisation – and if not done with great care and expertise the results can simply be nonsense.

Spatial querying is also another very complex area with such technologies as a "spatial Google" still over the horizon. Again spatial querying relies on many assumptions about the data model and data type.

This almost takes us full circle to how early humans required topological pictures to understand their world – today we are no different in that a good picture or map or 3D visualization will always be easier to comprehend than pages of textual data generated from a data base.

In summary spatial data describes the location of objects in the real world and the relationships between objects. It provides both an infrastructure and enabling technology for modern society. It is recognised as fundamental for wealth creation, good governance, good decision making and supporting "triple bottom line" objectives.

Simply "spatial data is a special type of data" and requires a dedicated commitment and strategy in order to capitalise upon this enabling infrastructure and technology. As a result of the interest in the Australian Government's Department of Agriculture, Fisheries and Forestry (DAFF) on the topic, Brian Lees, Reader in Geography, Australian National University and Ian Williamson, Professor of Surveying and Land Information, University of Melbourne (at this time a Visiting Fellow, ANU) presented a Bureau of Rural Sciences Seminar on Friday 12 November, 2004 titled "Why is spatial special?" where the ideas in this section were explored further. The presentation can be viewed at http://www.affa.gov.au

Thanks also to Dr Brian Lees and Professor Terry Caelli, NICTA, ANU for ideas and discussion on this topic.

Re-Engineering the cadastre to support e-Government

Report on 3rd Land Administration Forum 24-26 May 2009-Tehran, Iran

The UN sponsored Permanent Committee on GIS Infrastructure (PCGIAP) together with Islamic Republic of Iran's Deeds and Properties Registration Organization, the International Federation of Surveyors (FIG), the Global Spatial Data Infrastructure Association (GSDI) and the Centre for Spatial Data Infrastructures and Land Administration, University of Melbourne, are organizing a three days Forum as part of the PCGIAP-Working Group 3 activities in Tehran to discuss land administration issues and the role of cadastre to support e-government in the Asia and Pacific region. The Seminar was Chaired by Prof Ian Williamson and co-chaired by Associate Professor Abbas Rajabifard.

Over 410 people from 15 countries and 4 international organisations attended the forum. The objectives of the forum in Tehran were:

- To discuss the role of cadastre to support e-Government strategies
- To share land administration experiences in the Asia and Pacific region with a focus on re-engineering cadastre to To share land administration experiences in the Asia and Pacific region with a focus on re-engineering cadastre to support e-government
- To discuss wide ranging land administration issues including access to land and security of tenure, the role of land administration in supporting sustainable development, the promotion of effective land markets, poverty reduction, protection of vulnerable groups, e-land administration, land registration, cadastral surveying and mapping etc.
- To continue discussion on the need for an ongoing land administration forum in the Asia and the Pacific region that was commenced at the Mongolian and Malaysian forums with a view to preparing a proposal and resolution to be put before the UN Cartographic Conference for Asia and the Pacific in Bangkok 26-29 October, 2009.

This initiative was the result of a Resolution passed by the 14th PCGIAP meeting in Malaysia in 2008 and a desire by many countries in the Asia and the Pacific region to have a forum to discuss and share land administration issues, best practice and experiences, in a similar manner to the Working Party on Land Administration (WPLA) for European countries, organized by the UN Economic Commission for Europe (UNECE).

The focus of the forum was developed both by the PCGIAP and the 2nd Land Administration Forum for Asia and the Pacific hosted by the Malaysian Government in 2008. It was also influenced by the first Land Administration Forum organized by the Mongolian Government in 2007 that was also supported by UNDP, UNECE (WPLA), GSDI Association, FIG, the Asian Development Bank, German Technical Assistance (GTZ), Eurogeographics and the National Land Survey of Sweden.

There were more than 20 presentations including invited presentations from FIG, GSDI and Eurogeographic, Europe and also selected countries from Asia-Pacific that presented. The countries presented were Australia, Bahrain, Brunei, China, Denmark, India, Iran, Laos, Malaysia, Mongolia, Pakistan, Singapore, Switzerland, The Netherlands, UAE.

In summary, the following is feedback from the Forum.

The 3rd Land Administration Forum acknowledges the warm welcome from the Head of the Judiciary Honorable Ayatollah Hashemi Shahrodi and noted his message to the Forum to consider issues and strategies that may be useful to Asia-Pacific member nations to improve their cadastre, land registration and related land administration and SDI activities. In response to this message the Forum has developed and endorsed the Tehran Declaration on Land Administration to Support Sustainable Land Markets and e-Government, and hopes that the declaration will be useful to improving the land administration systems in the region and contributing to a better quality of life for society.

Resolutions

Resolutions to be taken to PCGIAP to support a resolution to the United Nations Cartographic Conference for Asia and the Pacific, October, 2009.

The 3rd Land Administration Forum in Tehran 24-26 May 2009 resolved

- to support the resolution of the 14th PCGIAP to have an annual forum to discuss land administration issues, best practise and experiences in the Asia and the Pacific region.

- to propose that process re-engineering as part of an ICT strategy directed at land administration, cadastre and SDI and spatial enabled government and society be included in any strategies to improve land administration systems and also in the future workplan of PCGIAP-WG3 and land administration forums.

For details contact*:* Associate Professor Abbas Rajabifard (abbas.r@unimelb.edu.au) or visit at *http://www.csdila.unimelb.edu.au/projects/tehran/index.html or www.pcgiap.org.*

Tehran Declaration

The International Seminar on Land Market Management and the 3rd Land Administration Forum, sponsored by the UN supported Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP), discussed wide ranging issues concerned with the management of land, the cadastre, land administration, land markets, spatial data infrastructures, spatial enabled governments and societies, and e-government. The delegates endorsed the following declaration:

Every country should have a formal system of registration for land and property rights with an appropriate spatial framework in order to facilitate good governance and to support secure ownership of land, investments and other private and public interests in real estate. Effective systems for recording land ownership, land values and land use are the foundation on which the efficient operation of a market economy depends and underpin the sustainable and productive management of land resources. These systems reduce the risk to those who wish to invest in property and land development, facilitating greater efficiency and economic growth. Simply, sustainable land markets require good land administration systems.

A good land administration system supports sustainable development. It will guarantee ownership and security of tenure; support land and property taxation; provide opportunities for investment; develop and monitor land markets; protect land resources and support environmental monitoring; facilitate the management of State-owned land; reduce land disputes; facilitate rural land management; improve urban and rural planning and infrastructure development; provide statistical data in support of good governance; and provide a foundation for spatially enabling government, business and wider society. It should be affordable and open to everyone, meeting the needs of all its users, and must be sustainable. Good practice in land administration means:

The law should define the nature of land, the form and nature of ownership, the legally recognized forms of tenure and the rights, restrictions and responsibilities that must be registered;

The land administration system should be run on business lines, often in partnership with the private sector, with a long-term financial model and an appropriate regulatory framework and management system that focuses on meeting customer demands;

The operations of the land administration system must be transparent, with safe and easy access to the land market and affordable for all participants;

The efficiency, integrity and transparency of the land administration system must be constantly measured and monitored, through performance indicators relating for example to the time and cost of each transaction, and customer satisfaction;

In order to add value to the basic information, records of ownership, value and use of land should be spatially enabled and integrated either by having one organization responsible for their maintenance or through several organizations sharing data through an e-government strategy;

Land administration records should be based on a common referencing system such as coordinates on a geocentric datum and street addresses, as part of a spatial data infrastructure and an e-government strategy.

Both the Land Market Seminar and Land Administration Forum identified a number of key issues to assist improvement and management of land administration systems:

The creation of a vision or "big picture", and road map to support long term planning and implementation;

Developing a National Land Policy that addresses land-related issues in a holistic way and provides a foundation for economic development, ensures all have access to land and protects women and vulnerable groups; Taking action to improve the legal and institutional framework for land-related activities;

Making land-related information more open, transparent and accessible for the public;

Speeding up the processes of core land activities (registrations, plans, valuations, etc.) through process re-engineering, computerization and closer co-operation between all land-related agencies;

Developing an Information Policy to provide a framework for the sharing of data between agencies as part of an e-government strategy and, as appropriate, with the public;

Using Business Process Re-engineering (BPR) as an integral component of the introduction of Information and Communications Technology (ICT) to facilitate the modernization of land administration systems;

Strengthening the SDI within the general ICT Strategy as a key component of land administration;

Ensuring appropriate institutional and technical arrangements are in place to facilitate the integration of cadastral and topographic data within spatial data infrastructures (SDI) to support sustainable development;

Strengthening the relationship and understanding between the land administration and financial sectors;

Improving the system of land valuation by adopting international standards and adopting a system of fair and equitable land taxation;

Improving procedures for sharing the cost and risk in land development;

Strengthening the capacity inside as well as outside government agencies and in universities and initiating research in land administration, spatial data infrastructures and spatial enablement;

Encouraging participation in the land administration system through public awareness campaigns both within government and wider society and streamlining procedures to facilitate participation; and Co-operating with international organizations such as the UN-supported PCGIAP and the International Federation of Surveyors in the sharing of knowledge and understanding of issues related to land.

Ohio researcher tracks H1N1 virus

An Ohio State University Medical Centre biomedical informatics researcher is tapping the power of the Ohio Supercomputer Centre to monitor the spread of the H1N1 influenza virus. Associate professor Daniel Janies synthesizes large, diverse datasets to understand the spread of infectious diseases over hosts and geography. The resulting maps can be viewed with Google Earth. Janies will project the evolutionary tree of the virus' mutations and host shifts onto the globe using web application, Supramap. *www.osc.edu*

Business Strategy for Ordnance Survey announced

A series of reforms aimed at creating simpler and easier access to geographic data have been announced by Ordnance Survey Minister, Iain Wright. The new strategy will improve ease of access to geographic data and services for both commercial and non-commercial use. *www.ordnancesurvey.co.uk*

Bangalore sewerage board implements GIS

Bangalore Water Supply and Sewerage Board (BWSSB) has implemented GIS in the core city area. This is the biggest e-governance initiative of the Board and it will take 2 years to complete the entire BBMP limits. The GIS will help BWSSB to take quick management decisions. At present, 22 layers of information are available with BWSSB. *www.expressbuzz.com*

IIT Mumbai's low-cost GIS software

The Indian Institute of Technology (IIT) Mumbai has developed a low-cost GIS software which can be used for resource management by community development programmes, government sectors, NGOs and industries. It will be distributed by Bhugol GIS Pvt Ltd under the Society for Innovation and Entrepreneurship of IIT. *http://economictimes.indiatimes.com*

Third party database & technologies to drive mobile LBS

The consumer LBS market has steadily evolved over the past few years. A number of factors – including the development of third-party location databases and technologies – are poised to finally drive real LBS market growth on mobile phones. According to Frost & Sullivan, 'North America Consumer LBS Market - The Wireless Carrier Opportunity', estimates that carrier-generated consumer LBS revenues totalled over $480 million in 2008 and projects this figure to surpass $3.0 billion in 2013. *www.frost.com*

Photorealistic, 3D city models from Tele Atlas

Tele Atlas has released 3D, photorealistic advanced city models. Designed for use in navigation systems and location-based applications, advanced city models are 3D representations of major city centres that dramatically raise the clarity and reality of screen images within in-car and portable navigation systems and mobile devices. *www.teleatlas.com*

NAVTEQ, Lonely Planet Global Content Agreement

NAVTEQ has expanded its travel and leisure guide portfolio with the addition of Lonely Planet for its Travel Guide. It will cover 19 cities in Australia and New Zealand, with expansion in other countries such as India, Indonesia, Malaysia, Singapore, Taiwan and Thailand soon thereafter. Offering reviews for thousands of points of interest the content shall enable navigation applications to provide recommendations about where to stay, eat or spend leisure time. *www.navteq.com*

TomTom launches 220 connected PND

TomTom is introducing in Europe the TomTom XL LIVE IQ Routes Edition a midrange device which integrates the connected services (HD Traffic, Speedcams, Fuel prices, Google Local search, Weather). *www.tomtom.com*

Motorola deploys location infrastructure for NTT DOCOMO

Motorola with NTT DOCOMO, Japan shall soon deploy a new location infrastructure called Mobile Advanced Location System (MALS). It helps detect the user's location by calculating reference positions provided by mobile networks and GPS satellites. *www.motorola.com*

Nokia inks deal with Etisalat

Etisalat and Nokia will soon provide convenient access to advanced mobile Internet based services which include maps, navigation and games on Nokia devices. *www.nokia.com*

NAVITIME launches satnav in APAC

Japan's NAVITIME is launching its services in Australia, Singapore and Malaysia. Its multimodal system gives travel route using a combination of walking, driving, and public transportation. The application now supports total of 43 devices. *www.navitime.com*

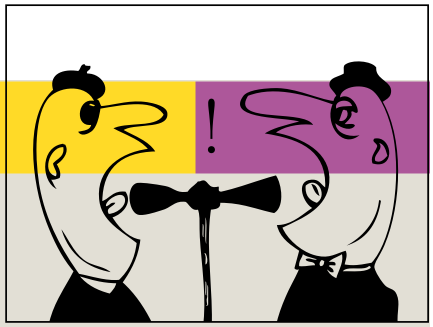
Marine enhances its Nav-Tracker 2.0

Marine has enhanced its Nav-Tracker 2.0 wireless boat location and GPS tracking system with SmartKEY, which automatically disarms the system when the vessel operator boards the vessel and re-arms it when the operator disembarks. SmartKEY uses RFID technology that allows for 'no touch' arming and disarming of the Nav-Tracker 2.0 system. *http://paradoxmarine.com*

Tata Indicom selects TCS

TeleCommunication Systems, Inc. (TCS) announced that its location-based infrastructure and Xypoint software are being leveraged by Tata Teleservices Limited (Tata Indicom), for its QUICKFINDER A-GPS service. Location-based services immediately available to Tata Indicom subscribers are POI Search and Navigator. *www.tataindicom.com*

Loran is best. Keep it!



Says a recent study which was completed in March 2007 by the Independent Assessment Team (IAT). The report has been let out of detention, just in time to counter recent efforts by the Obama administration, the Department of Homeland Security, and the US Coast Guard to throttle the program. The IAT "unanimously recommends that the US government complete the eLoran upgrade and commit to eLoran as the national backup to GPS for 20 years." The IAT's conclusion has long been informally known throughout the GPS industry, but the report's release adds considerable weight, expertise, and specifics to a long, determined campaign to preserve the program. Release of this report now comes only after an extensive Freedom of Information Act (FOIA) battle waged by industry representatives against the federal government. The report asserts that "eLoran is the only cost-effective backup for national needs; it is completely interoperable with and independent of GPS, with different propagation and failure mechanisms. ... It is a seamless backup, and its use will deter threats to US national and economic security by disrupting (jamming) GPS reception." *www.ida.org*

...Senate Committees support eLoran

Two leading Senate committees publicly back the eLoran system and question the US President's latest budget proposal. The FY 2010 Concurrent Budget Resolution releases views from the US Senate Committee on Commerce, Science and Transportation and the Committee on Homeland Security and Governmental Affairs backing the continued support for the Loran system, acknowledging the investment already made in infrastructure upgrades and recognizing the studies performed and multi-departmental conclusion that eLoran is the best backup to GPS. Senator Jay Rockefeller, the Chairman of the Committee on Commerce, Science and Transportation, wrote the committee recognized the priority in "maintaining LORAN-C while transitioning to eLORAN" as means to enhance the homeland security, marine safety and environmental protection missions of the Coast Guard. Senator Collins, the ranking member on the Committee on Homeland Security and Governmental Affairs wrote that the President's budget overview proposal to terminate the LORAN-C system is inconsistent with the recent investments, recognized studies and mission of the US Coast Guard. The letter recognizes the $160 million investment already made toward upgrading the LORAN-C system to support the full deployment of eLoran *http://budget.senate.gov/republican/pressarchive/CommitteePrint.pdf*

...US proposal to terminate loran-C draws fire from UK

A last-minute change in US loran policy has raised serious concerns among international navigation and security organizations. In late February, the Office of Management and Budget (OMB) removed loran-C funding from the President's budget, provoking an immediate response from the UK. The key issue was the continuing need for loran-C and eLoran to provide a backup to GPS, in the event of satellite failures or signal disruption. The UK's position was that until the OMB's announcement, the US supported the view that loran provides a backup to GPS, with the Department of Homeland Security stating that loran "will mitigate any safety, security or economic effects of a GPS outage or disruption." In January, a high-level DOT panel of independent experts, chaired by Professor Brad Parkinson - the former USAF official in charge of satnav development, now dubbed "The father of GPS" - unanimously recommended that "the US government complete the eLoran upgrade and commit to eLoran as the national backup to GPS for 20 years."

Today, government and commercial communications, finance, utilities, ATC and many other vital services in the US and overseas depend on precise GPS timing, and loran-C and eLoran are the only long-range, unjammable backups that can provide comparable accuracy. *www.ainonline.com*

GPS' India equivalent within 3 years

The Indian Regional Navigation Satellite System (IRNSS), similar to the GPS of the US, will be operational in three years' time, K. Radhakrishnan, Director, Vikram Sarabhai Space Centre has said. The country will have a space-based augmentation of the GPS system Gagan (GPS-aided Geo-augmented Navigation, which ISRO has developed with the US defence major Raytheon), to start with. "However, we plan to have our own IRNSS in three years. Covering the Indian Ocean region, this will provide positional accuracy of about 10 metres and is implemented using seven satellites, three in the geostationary transfer orbits and four in non-geostationary orbits," he said. *www.hindu.com*

Japan's QZSS-1 in 2010

The launch of the first satellite in Japan's Quazi Zenith Satellite System, Jun Ten Cho, has been scheduled for 2010.The project is divided into two phases. The current plan calls for Phase 1 to include R&D, the launch of QZSS-1 and subsequent on-orbit demonstration. Phase 2 will include building another two satellites and the launch of an operational environment before the end of 2013. The satellites will offer GPS-like signals and transmit on the same frequency so normal GPS receivers will be able to receive them. *www.aprsaf.org*

GPS at risk: Doomsday 2010

The United States Government Accountability Office (GAO) issued on May 7 an alarming report on the future of GPS, characterizing ongoing modernization efforts as shaky. The agency appears to single out the IIF program as the weak link between current stability and ensured future capability, calling into doubt "whether the Air Force will be able to acquire new satellites in time to maintain current GPS service without interruption." It asserts the very real possibility that "in 2010, as old satellites begin to fail, the overall GPS constellation will fall below the number of satellites required to provide the level of GPS service that the US government commits to."

The report concludes that "it is uncertain whether the Air Force will be able to acquire new satellites in time to maintain current GPS service without interruption. If not, some military operations and some civilian users could be adversely affected."

"In addition," the report summary continues, "military users will experience a delay in utilizing new GPS capabilities, including improved resistance to jamming of GPS signals, because of poor synchronization of the acquisition and development of the satellites with the ground control and user equipment. Finally, there are challenges in ensuring civilian requirements for GPS can be met and that GPS is compatible with other new, potentially competing global space-based positioning, navigation, and timing systems."

While the Department of Defence concurred with this recommendation, and while quite possibly it might effectuate the streamlined decision-making and corollary processes to remedy the highlighted deficiencies, it would run counter to the integral "dual-use" principle of GPS as dedicated to both civil and military users. Such a move could thus conceivably and adversely affect the interests of civil users. *http://gao.gov*

Yaogan 6 launched

China Aerospace Science and Technology Corporation have recently launched the Yaogan 6 remote sensing satellite. It will mainly be used for land resources survey, environmental surveillance and protection, urban planning, crop yield estimates, disaster prevention and reduction, and space science experiments. Xinhua Agency

IIT-Kanpur to launch nano satellite

The Indian Institute of Technology, Kanpur (IITK) has received the ISRO nod to launch its first and country's lightest nano satellite, Jugnu, by December 2009. It will be launched in the polar orbit from Sriharikota. *www.business-standard.com*

Blom to provide RS services to ENI

Blom has signed a 2 years agreement to supply high-tech remote sensing services to Italian ENI. It involves execution of remote services through the use of airborne sensors in both Italy and territories in Asia and Africa. ENI will use the remote sensing data to evaluate new investments. *www.blomasa.com*

Access to terabytes of satellite images

A network of UniScan™ ground receiving stations of ScanEx Centre daily receives raw data from 15 satellites at middle and high resolution (up to 0.7 m) covering the territory of Russia and some CIS countries. An archive of dozens of terabytes of data has already been collected. ScanEx will provide legal access to basically all the archives of satellite images of its Centre. *www.scanex.ru/en*

SAIC Web-Based Processing System

Science Applications International Corporation announced the launch of a web-based processing system delivering custom Landsat imagery directly to customer desktops. The new system provides fast and reliable data. *www.saic.com/landsat*

At a Glance

Financial Results

- 35% revenue growth of Hemisphere GPS in '2008.
- Commercial and industrial investment fell an alarming 37.9 percent during the first quarter of 2009, according to the U.S. Commerce Department's April 29th release on the GDP.
- $11.3 Million contract for Intermap Technologies to provide 3D digital elevation data and orthorectified radar imagery for an international project.
- GeoEye, Inc. first quarter of 2009 - revenues were $45.2 million, a 26% increase compared to $35.9 million in the first quarter of 2008
- TomTom first quarter 2009 revenue is €213 million, a decrease of 60% sequentially and a decrease of 31% compared with last year.
- Garmin announced its financial results for the first quarter of 2009 - total revenue was $437 million, down 34% year on year.
- GMV opens Commercial Offices in Asia, one in Malaysia and the other in the Korean Republic.
- Trimble announced revenue of $289.0 million for its first quarter 2009, down 19% from last year.
- PT Pageo Utama of Jakarta awards Veripos a contract for provision of GNSS precise positioning facilities.
- China Information Security Technology, Inc. won a contract for $3.4 million for Shenzhen's Border Control Bureau Police-use GIS ("PGIS") Command System.
- GeoEye has nearly doubled the production space, of its St. Louis, Missouri advanced production facility.

Galileo update

GIOVE-B marks its first year in orbit

The GIOVE-B navigation satellite has successfully completed its first year in orbit. The 500 kg satellite, which was built by an industrial team led by Astrium under contract to the European Space Agency, is the second of two in-orbit demonstration missions for Europe's Galileo satellite navigation system. Dr. Reinhold Lutz, Director of Navigation, Astrium said: "The success of GIOVE-B proves Astrium's expertise in developing complex navigation satellites. This mission has enabled engineers to carry out the necessary in-orbit tests of the new technologies required for Galileo and lead the way for a navigation system that is vital to both Europe's economic and technological future." *www.astrium.eads.net*

Galileo Masters Launched!

The 2009 European Satellite Navigation Competition has been launched in the UK. Also known as The Galileo Masters competition, this is the chance to kick-start innovative business solutions using satellite navigation, location or timing. As well as the first prize of EUR20,000 and help with business development, there are various special topic prizes from the likes of T-Systems, Navteq, ESA etc. Over the last 4 years, 296 ideas have been submitted from the UK; and last year's overall winners (Sci-Tech Systems) are from the UK and are well on the way to commercialising their maritime rescue system. As well as the material benefit from winning, entrants gain significant exposure to investors, potential partners and the press. Entries open on 1st May 2009 and close on 31st July 2009. *www.galileomasters.co.uk*

OREGIN, Galileo Services join forces

Galileo Services and OREGIN - the two most active organizations representing companies in the GNSS industry, particularly Europe's Galileo program - have decided to join forces. According to a statement of officials representing the two groups, the union will uniquely combine the innovation, flexibility, and responsiveness of the smallest enterprises with the strength, stability and reliability of the biggest industries. It will cover all the segments of the value chain and cover all application domains. France Developpement Conseil (FDC) is a founding member of both and serves as coordinator of OREGIN. Gard Ueland, president of Kongsberg Seatex and serves as the chairman of Galileo Services. *www.galileo-services.org*

US Trade Rep seek public comment on access to Galileo Markets

Prompted by a congressional footnote in the 2009 Omnibus Appropriations Act signed into law last month, the Office of the US Trade Representative (USTR) is soliciting public comment on American industry's access to the Galileo program and related markets. A notice published in the April 15 issue of the Federal Register invites comments on six questions regarding US equipment manufacturers' ability to participate in Europe's GNSS program. The three specific sections - Articles 5, 6, and 8 - of the 2004 Agreement on the Promotion, Provision and Use of Galileo and GPS Satellite-Based Navigation Systems and Related Applications between the European Community (EC) and the United States. *www.ustr.gov*

At a Glance

Mergers, Acquisitions and Partnerships

- ►Survey of Israel has signed an agreement for cooperation with Bureau of Surveying and Mapping, China.
- ►TeleCommunication Systems, Inc. has acquired LocationLogic
- ►Topcon has partnered with Applied Field Data Systems (AFDS) to sell and support Topcon GIS solutions in Texas, Oklahoma and Arkansas in USA.
- ►T-Mobile and NAVIGON forms a strategic partnership
- ►SuperGeo recruits a new reseller in Tamil Nadu, India.
- ►PCI Geomatics joins ESRI's Business Partner Program.
- ►ERDAS and Spot Image in a new partnership, increases their involvement in the Heterogeneous Mission Accessibility - Interoperability project.
- ►Intrinsyc Software partners with the Blom Group.
- ►Spotigo partners with location platform supplier Genasys..
- ►SPOT Image has signed an agreement with KAI Image for distribution of KOMPSAT-2 products in North America.
- ►The European Space Agency and European Space Imaging entered into an agreement giving ESA access to more than 15 million sqkms of IKONOS satellite imagery.
- ►NAVIGON stops PND business in North America.
- ►Greece's Data Protection Authority has banned Google Inc. from gathering images in Greece.

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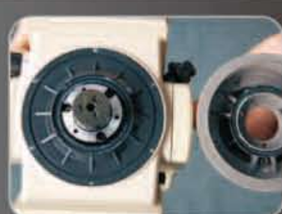

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HP announces expansion of Designjet

HP has expanded its Designjet large-format portfolio with a range of new workgroup and multifunction printers, software solutions and new media choices to address the needs of vertical segments, IT managers and production operators. The new products, solutions and large-format papers are ideal for GIS, architecture, engineering and construction (AEC) and mechanical computer aided design (MCAD) workgroups. *www.hp.com*

JAVAD GNSS track GPS L5 Signal

Customers of JAVAD GNSS "triple-frequency" type OEM boards and receivers can now track the GPS L5 signal. These receivers allow high quality code and carrier phase measurements of the L5 signal. The white-noise, multipath, etc tracking errors are comparable to what is normally seen for the L1 and L2 signals. *www.javad.com*

ZTE selects u-blox timing solution

ZTE Corporation has chosen u-blox' GPS-based precision timing solutions for 2G and 3G mobile base stations. It allows cellular base stations to achieve precision time-of-day to an accuracy of 15 billionths of a second. The 3G standard was recently adopted by China Mobile, the world's largest mobile service provider. *www.u-blox.com*

Rockwell Collins delivers 300,000th DAGR

Rockwell Collins has delivered 300,000 Defence Advanced Global Positioning System Receivers (DAGR) for use by US and international warfighters. *www.rockwellcollins.com*

ISRO implements ESRI software

The Indian Space Research Organisation (ISRO) has reached an agreement with NIIT GIS Limited (ESRI India) to equip its 5 Regional Remote Sensing Service Centres with ArcGIS Server and the Image extension. These centres are in Jodhpur, Dehradun, Kharagpur, Nagpur, and Bangalore. *www.esri.com.*

Autodesk 2010 Software

Autodesk India has released its 2D and 3D design and engineering software for manufacturers. The 2010 software releases introduce a range of design, visualization and simulation capabilities, along with tighter interoperability with both Autodesk software applications and other CAD tools. Autodesk Digital Prototyping software gives manufacturers the ability to digitally design, visualise and simulate how a product will work under real-world conditions before it is built. *www.autodesk.com*

Trimble-China joint venture for Compass

China Aerospace Science & Industry Academy of Information Technology (CASIC-IT) and Trimble will form a joint venture in China to develop receivers for Compass. It will be a 50/50 joint venture. *www.trimble.com*

Leica Geosystems new releases

Leica Geosystems introduced GNSS QC V2.2, the latest version of the GNSS quality control and data analysis software. The new version includes full support for GPS L5.

Leica Geosystems released Leica mojoGLIDE system for agricultural machinery with a new dual-frequency GLIDE positioning technology that provides 15 to 20 cm accuracy without subscription fees. It can be operated without base station. It is a dual frequency (DGPS) auto-steer system that can easily be upgraded to RTK accuracy.

Leica Rugby 260SG, 270SG and 280DG lasers are a new generation of multipurpose horizontal/vertical grade lasers for the general construction market. All lasers are equipped with a large LCD display and an easy-to-use five button key pad. *www.leica-geosystems.com*

Outdoor maps for US on SD Card

Magellan and Intermap Technologies announced availability of pre-loaded SD cards with Topo USA maps for Magellan Triton and eXplorist® handheld GPS products, providing outdoor enthusiasts with advanced topographic maps and off-road points of interest. It will be available in retail stores or from the Magellan website. *www.Intermap.com*

Irish research group invests in LANDINS

IXSEA shall supply LANDINS, its land-based INS positioning system, for a new mobile mapping system pioneered by StratAG, at the National University of Ireland, Maynooth. It is specifically designed for mobile mapping and route mapping applications in dense urban areas, where GPS quality is often poor and the need for geo-referenced information is most critical. *www.ixsea.com*

Cadcorp CCTV mapping system

Cadcorp has launched its CCTV Mapping System. It provides users in local authorities, emergency services and crime prevention agencies with the tools to manage and share CCTV information in their area. *www.cadcorp.com*

Pitney Bowes Business Insight teams with LandPoint Systems, Inc.

Pitney Bowes Business Insight (PBBI) is teaming with LandPoint Systems, Inc. to provide a mobile consumer survey service called FACES (Faster, Accurate, Current Economical Surveys). FACES, offered through LandPoint's KnowYourFaces division, provides retailers and restaurant companies with customizable surveys to help them better capture customer data at the point of experience.

GRS-1 for Mobile GIS Mapping

Topcon Positioning Systems' (TPS) new GRS-1 is a modular, all-in-one, dual-constellation mapping system that incorporates high-accuracy capabilities into a single, small hand-held device. It has a high-speed processor, increased memory, built-in compass and an integrated digital camera and cell phone modem that provides flexibility for the user in the field. *www.topcon.com*

Full-Crossline Laser LX442

SOKKIA BV, has released the new LX442 interior Laser. Featuring full-crossline projection, high-speed self-levelling, wireless operation and robust body, it significantly increases work efficiency in levelling, plumbing, squaring, alignment and layout applications. *www.sokkia.net*

GRACE collaborates with Spirent® Communications

The GNSS Research and Applications Centre of Excellence (GRACE) has procured Spirent GSS8000 hardware simulation system. It consists of a two chassis, 16 channel GSS8000 system controlled by Spirent's SimGEN software that can simulate current and future GPS signals, including L1, L2 and L5 signals and Galileo E1, E5 and E6 signals as well as WAAS and EGNOS Space Based Augmentation System signals. *www.grace.ac.uk*

Contex Partners with Resellers

Contex, wide format scanner manufacturer, is launching a Partner Program offering resellers financial benefits, sales and marketing support and product training. The Partner Program aims to encourage resellers to take a closer look at wide format scanners as a potential growth area.

It offers resellers rebates and other sales incentives, as well as sales and marketing support designed to help them grow wide format scanner sales. Contex is now launching the program in the US and UK. Other selected countries in Europe, Africa and Asia Pacific will follow later this month.

Hemisphere GPS new Outback S-Lite™

Hemisphere GPS launched a new version of the Outback S-Lite™ guidance system software that also supports simplified Chinese. With the new sales distribution partners established, the company expects to ship thousands of S-Lite units into China. It is an ideal entry-level GPS guidance solution for farming applications including spraying, spreading, broad-acre tillage and seeding applications. *www.hemispheregps.com*

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July 2009

ESRI International User Conference
13–17 July
San Diego, USA
www.esri.com

3rd International Summer School on GNSS
20-30 July
Berchtesgaden, Germany
www.munich-satellite-navigation-summerschool.org

August 2009

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

2009 IMTA Asia Pacific Conference & Trade Show
7-8, August
Darwin, Australia
http://www.maptrade.org/events/upcoming.php

September 2009

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

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

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

2nd GNSS Vulnerabilities & Solutions Conference
2- 5 September
Baska, Krk Island, Croatia
http://twitter.com/BaskaGNSS2009

October 2009

ACRS 2009
19-23 October
Beijing, China
http://www.aars-acrs.org/acrs

ILA 2009
Week of October 12
Portland Maine USA
www.loran.org

13th IAIN World Congress
27-30 October
Stockholm, Sweden
iain2009@congrex.com
www.congrex.com/nnf/iain2009/

7th FIG Regional Conference
19-22 October
Hanoi Vietnam
www.fig.net/vietnam/

18th UNRCC-AP
26-30 October
Bangkok, Thailan

November 2009

International Symposium on GPS/GNSS 2009
4-6 November
Jeju, Korea
gnssws@gnss.or.kr
www.gnsskorea2009.org

NAV09
Maritime: 10 November, Southampton
Positioning & Location: 12 November, Nottingham
Land: 19 November, Teddington
Timing: 20 November, Teddington
Air: 25 November, London
www.rin.org.uk/news-events/events

WALIS International Forum 2009
11-13 November
Perth Convention Exhibition Centre, Australia
www.walis.wa.gov.au

December 2009

IGNSS Society 2009
1- 3 December
Holiday Inn Gold Coast, Queensland, Australia
www.ignss.org

Middle East Spatial Technology Conference & Exhibition
7 - 9 December
Kingdom of Bahrain
rizwan@mohandis.org
www.mest.bh

Health GIS 2009

24-26 July
Hyderabad, India
www,e-geoinfo.net/healthgis

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