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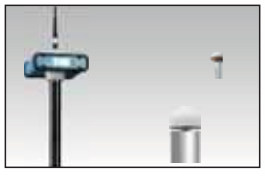

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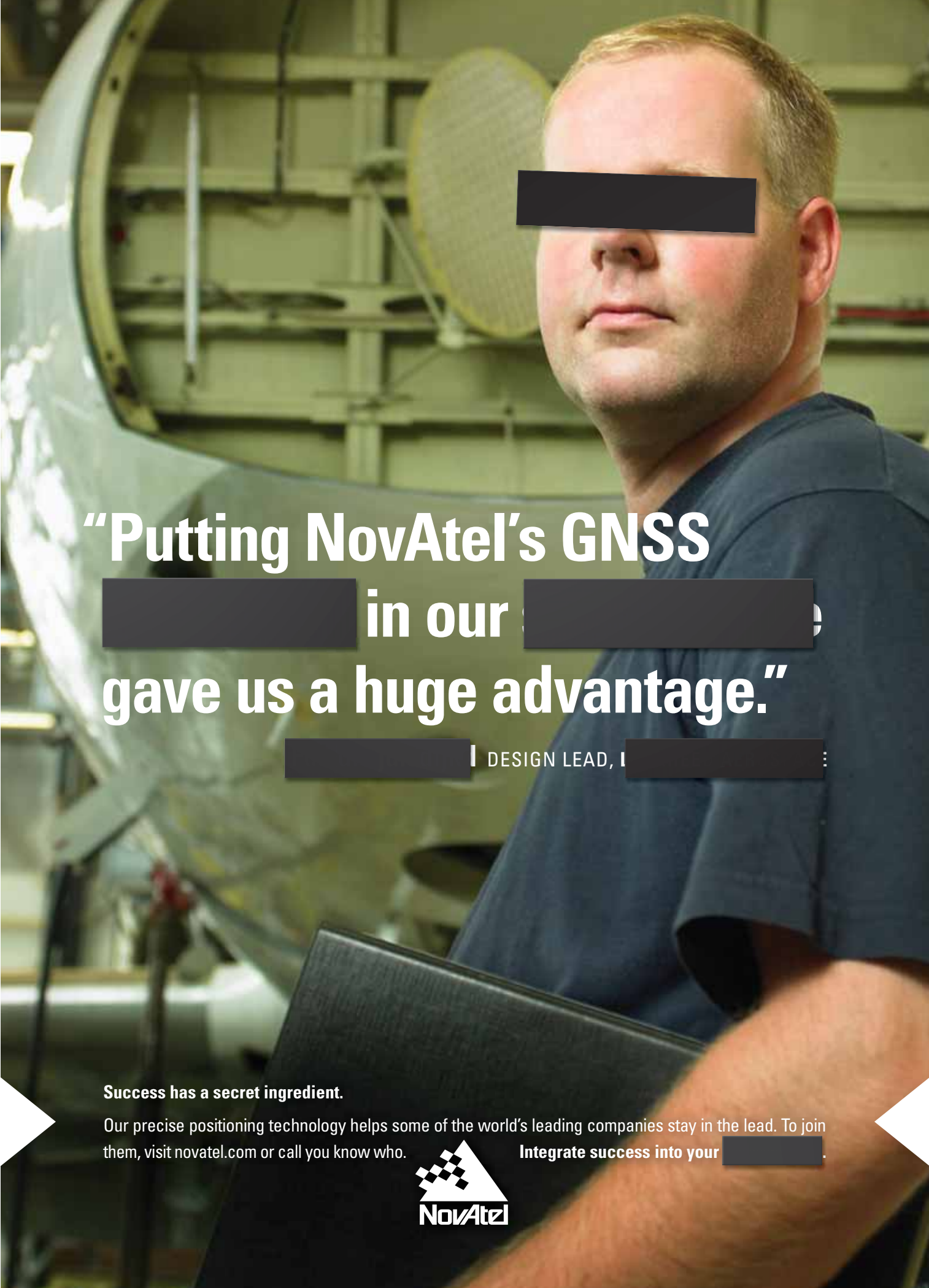
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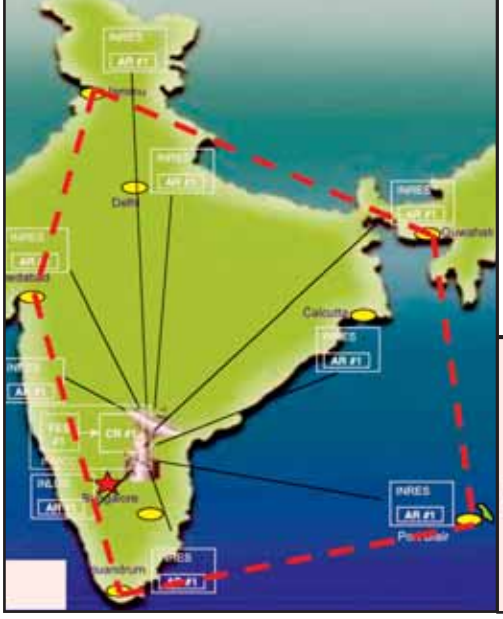

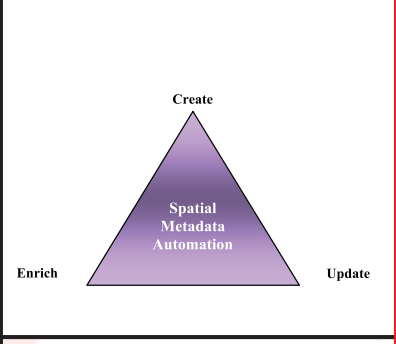

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Might is right!

It is not a GNSS race.

It is about space.

Capturing the space.

It is not about the 'rules' of the race.

It is about 'who will rule'.

It is not about 'roles'.

It is about 'controls'.

It is not about wrongs and 'rights'.

It is about 'the rights'.

.. It is about might, only, the might.

Bal Krishna, Editor
bal@mycoordinates.org

The GNSS race

There are some countries trying to develop their own GNSS system. Is there any race? If yes, how appropriate and where would it lead to? Here are some views

"Well first of all there is the issue of robustness and putting all your eggs in one basket – that is one aspect and a major legitimate concern. The other, is a matter of national pride. In Europe there is a feeling that GPS dominates things. The national pride also relates to perceived economic benefits. Last, GPS has a signal that is used for our military and allies. I think in some cases other countries would like to have such a signal. The military aspect and having control of a GPS-based precision weapon delivery system is just part of the way the world operates. I think the reason the Chinese are developing Compass, more than anything else, is to support their military, though I am certain they are going to make a portion of their system available for civil use as well"

Dr Bradford W Parkinson
Chief Architect of GPS
Coordinates, January 2010

What race?

Chris Rizos
Vice President of the International Association of Geodesy (IAG)

A "Race" implies competitors (& spectators), a winner (& losers?), prize, rules, admirable technique and arduous training. So are the current and planned Global Navigation Satellite Systems (GNSSs) and Regional Navigation Satellite Systems (RNSSs) running a Race? If it is a question of who is in the lead, then the U.S.'s Global Positioning System (GPS) is the undisputed champion. But are we really just observing the spectacle of the same race being run over and over again, in the faint hope that there will be another winner? That GPS will tire, or falter? Is this no different to the punter, who no matter how many times they lose at poker, just demands "one more game"?

GPS is still the gold standard, the World Champion, the GNSS that all others must aspire to out-perform. GPS is not young, with the first test satellite launched in 1978 and full operational capability announced in mid-1995 – almost 15 years ago. It is true that GPS has evolved, albeit rather slowly, through the Block II generations. But like a champion who has not been given a strenuous workout, it has only be forced to make modest performance improvements. That will change with the Block IIF and Block III generations.

However, for a long time GPS did not even acknowledge there was a "Race" – although GPS-Glonass rivalry was a vestige of the Cold War Era. That was not a true competition, as each insisted on being treated "unique" and "incomparable". When the E.U. started seriously to consider building its own GNSS about a decade ago, the U.S. was genuinely surprised. The E.U.'s Galileo system sought to challenge GPS's supremacy on unfamiliar grounds – changing the rules of the "Race"? Galileo would compete on the basis of providing guaranteed levels of performance, a better suite of services targeting different markets, not being military-controlled, and – even if it were found to be inferior to GPS in some respect – would claim Galileo was necessary to ensure the E.U.'s sovereignty over navigation infrastructure. Although now other GNSSs and RNSSs acknowledge the validity of some of the Galileo claims, it is clearly in a race-of-its-own. All other GNSSs and RNSSs tote national security and the need to develop "smart weapons" as (most?) important drivers.

So is there a "GNSS Race"? That does imply that all will compete according to the same "rules" – after all, what sort of race would a track & field event be if one competitor is running, the other competitor is doing a hop-skip-jump, the other is jumping hurdles, and so on. That each GNSS/RNSS has its own rationale – even national pride – and "business case" to justify its development is to be acknowledged. However many of us believe that only with the establishment of the U.N.'s International Committee on GNSS as a forum to bring together the different GNSS/RNSS signal providers and promoted the concept of "interoperability" – that the combination of capabilities is superior to each individual GNSS/RNSS – that we now see what could be described as a true "GNSS Race".

GPS is clearly still in the lead, however as it throws out challenges to the other GNSSs and RNSSs, they must in turn respond, if only to acknowledge that they are "competitors". Challenges include, providing a free open service, publicly available specification documents and

performance standards, descriptions of time and geodetic reference frames used, frequency interoperability and compatibility, free trade in GNSS products, and others. The world (the spectators to this "Race") benefits by seeing the responses to the challenges, by observing efforts to change the rules, by GNSS/RNSS signal providers working together to ensure that the world will not be "dominated" by GPS, and more.

We no longer doubt that a multi-GNSS world is better than one reliant on only one GNSS – no matter how good it is. Interoperability – as one of the motives to compete in the "Race" – has meant that the L1 and L5 frequencies, and that CDMA-type signals modulated on these frequencies, will be provided by all GNSSs and RNSSs. The benefit will be low-cost, dual-frequency, multi-GNSS receivers with far better performance than is currently possible with dual-frequency GPS receivers. This is but one example of how this "GNSS Race" makes us all winners.

There is a great potential for international cooperation

Sergej G Revnivych
Deputy Director General
Central Research Institute of Machine Building, leading institute of Federal Space Agency

First of all I would suggest that GNSS race be approached from two angles. On the one hand there is a competition between user equipment designers, manufacturers and navigation service providers. On the other hand one can implicate the competition between GNSS providers or between governments operating or developing their own satellite navigation systems in the seemingly competitive GNSS environment.

The competition between user equipment manufacturers or service providers has been and will be inevitable. Users will only benefit from that. What counts most here is the ability of the manufacturer to competently and efficiently take advantage of each system's virtues to match user expectations at the most. I'm sure in the nearest future navigation receivers will be able to use all available navigation information sources. Limitations will be governed by size, mass, power consumption and, of course, cost – each of these parameters having prevailing meaning for certain application area. Hence the crucial factor here is the demand of this or that user market segment.

As for the GNSS providers virtually represented by state governments operating or deploying their own global or regional navigation satellite systems, the term "race" should not applicable. Despite the fact that GNSS civil applications account for more than 90% of GNSS market, a system itself has always been and is going to be a strategic facility, a critical state infrastructure element ensuring national security and navigation independence. In my opinion in recent years there has been a tendency for the nation having its own navigation satellite system to gain scores in the profile. The same is for the nation having its own space or/and nuclear industry.

If we are talking about civil applications it would be sufficient to have any two systems with total constellation of 50-60 operational satellites. Further increase of spacecraft number in MEO would hardly result in enhanced availability.

At the same time creating own navigation satellite system requires enormous spending and, in my view, no investment in such a system can be compensated by gains from its commercial use. The Europeans ultimately got evidence of that as they finally decided on financing the Galileo program from the EU budget.

GNSS and RNSS development programs should be viewed as national infrastructure projects. Taking into account the strategic nature of any GNSS, its deployment and further development is a government responsibility. Hence the systems are paid and will be paid for from public funds. Even if we supposed the navigation systems never found use in civil community, they in any case would be developed and paid for.

The GNSS providers' primary task is to make their systems as good as possible. Meeting user requirements with civil user requirements among them is of great importance for making systems good. In this respect, as GNSS civil applications make the only objective reality, there is a great potential for international cooperation to provide compatibility and interoperability of existing and future systems. And it's the businessmen task to think up the way of maximizing gain from navigation systems' use.

Not appropriate to encourage unnecessary competition in the development of global public infrastructure

David A Turner
Deputy Director
Space and Advanced Technology
US Department of State

My initial reaction to the term "GNSS race" is to reject its use. It does not seem appropriate to encourage unnecessary competition in the development of global public infrastructure, which is an appropriate way of viewing the non-military aspects of GNSS constellations and their open signals. However, it is clear, as Dr. Brad Parkinson pointed out in January 2010 issue of Coordinates, that other aspects of positioning, navigation, and timing capabilities lead nations to their own strategic reasons for developing global or regional navigation satellite systems. If

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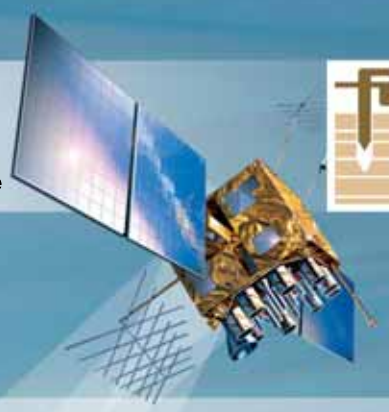

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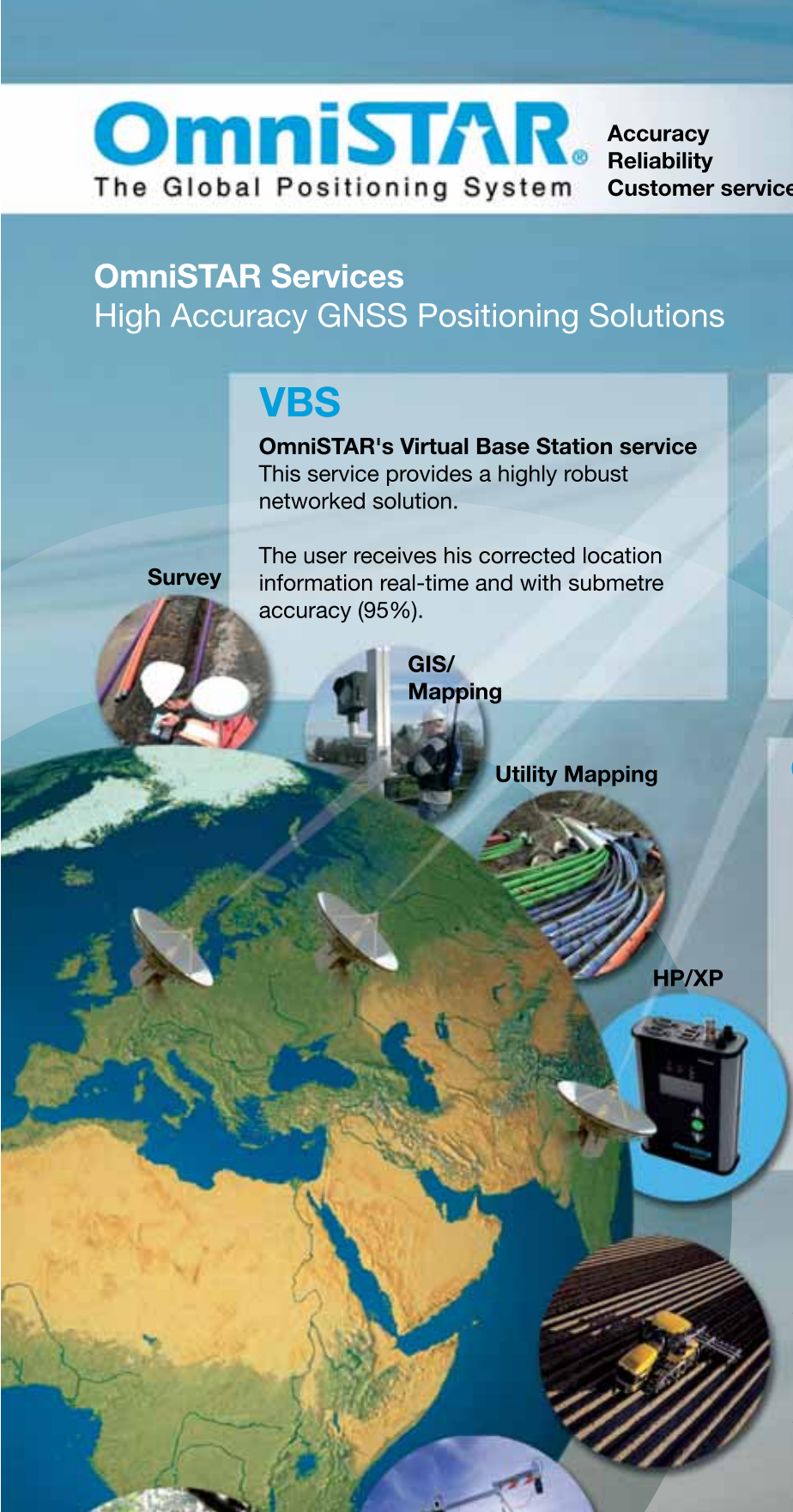

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we take this as a given, and choose not to question the motivations for developing multiple systems, then the race's emphasis can shift from the start to the finish line, and GNSS providers can focus on establishing rules that enable the private sector to compete in a way that the race can be won by all civil users worldwide.

Through the International Committee on GNSS (ICG), a voluntary organization facilitated by the United Nations Office for Outer Space Affairs, current and planned system providers have established three important principles that will help ensure a fair race is run. These are compatibility, interoperability, and transparency. Paraphrasing the exact wording of these principles as defined by the ICG, compatibility requires that the signals from one GNSS will not interfere with the signals of another and seeks to avoid overlap between limited access signals intended for secure or authorized services provided by individual systems. Interoperability means that the signals provided by one GNSS can be used with others in a manner that improves overall service. The easier it is for a multi-system receiver to be developed and manufactured, the more interoperable two or more GNSS can be considered. Finally, transparency in the provision of open signals requires that providers publish documentation that describes signal and system information, policies of provision, and minimum levels of performance. In other words, all the information that a manufacturer needs to build receivers, and enough information to let users know what kind of service quality they can expect.

Working out the details of implementing these principles will be an ongoing challenge, and in some cases, the kind of delicate discussions required may best be left to bilateral meetings of the providers involved. In other cases, formal rules may need to be set through appropriate international standard setting bodies. Either way, civil users cannot win the GNSS race unless the focus remains squarely on them and the commercial GNSS equipment and value-added services industries, and not on perceived competition among government system providers.

Every country has the legal right to build its own satellite navigation system

Bernd Eissfeller
Faculty of Aerospace Engineering
University of the Armed Forces Munich, Germany

The term GNSS Race, which came up already some years ago, clearly implies that in this field a situation like in car racing or other disciplines of sport is present. And it looks like that at a first glance: One system i.e. GPS was in the pool position, and also GLONASS was in excellent position in the early 90ties. Other systems entered into the race later. But however, a race goes typically over many rounds and a long distance. In many cases the pool position is the key to be the winner at final end but not in any case. If a racing car gets out of control a severe collision and damage with the other drivers could result. Sometimes the race has to be terminated and will never be finished.

For my point of view the analogy between the competition in satellite navigation and a Grand Prix is somewhat misleading: The motivation for major countries to invest in satellite navigation is driven by more serious reasoning and not by the idea of sports: On the one hand a main driver is the sovereignty issue and on the other hand a significant commercial motivation exists, getting access to the high tech market of GNSS user equipment and integrated navigation systems. Being a dual use system GNSS does offer the opportunity to cover these two main motivations by a single system or in other words by a single investment in the required infrastructure. Thus, I think every country has the legal right to built-up a satellite navigation system on its own. But however, in order to mitigate the risk of collision or better inter-system interference international standards, regulations and methodologies should be elaborated for GNSS compatibility and should be observed by all players. A fair competition between systems is beneficial like we see in the case of GPS and Galileo, because competition is enhancing the process of innovation. If such fair and accepted rules are followed by each participant the GNSS race will be an enjoyable event and will be of benefit to the globalized world.

But coming finally back to sports: If rules in sports are violated there is usually a way of sanctioning. Installing such a process for GNSS compatibility based on international law is a big challenge for the international community of states. Some indications are visible today that the GNSS race will not work without international rules.

Complementary relationship will grow stronger in the future

Hiroaki Tateshita
Satellite Application and Promotion Center, Space Applications Mission Directorate, Japan

Japan is one of GNSS providers, which has been developing Quasi Zenith Satellite System (QZSS) and participates in the International Committee on GNSS (ICG). The first Quasi Zenith Satellite (QZS-1) will be launched in this summer.

In Japan, the utilization of geospatial information is regarded as the significant topic, and Japanese government enacted relevant strategic policies such as "Basic Act on the Advancement of Utilizing Geospatial Information", and "Basic plan on the Advancement of Utilizing Geospatial Information". In these policies, Space-based PNT service with QZSS is positioned as one of the necessary elements.

Regarding "GNSS race" (I don't actually think it is "RACE"), I imagine the complementary relationship will grow stronger in the future. As a result of Multi GNSS, we might see more than 100 SVs around the earth. Satellite positioning service by GPS has become a social infrastructure. I believe Multi GNSS brings more convenient PNT service to users, such as wider service area and more detailed positioning. I think the GNSS providers might pay attentions to the attractive benefits of Multi GNSS.

The increase of SV, which is provided by complementary relationship, must dramatically improve the reliability, availability, accuracy, and economic efficiency. I imagine the GNSS providers will choose those attractive improvements while they keep national pride and military needs to the minimum. I understand the GNSS providers are seeking what they can contribute and take charge of through IGC. Japan has designed QZSS to be fully interoperable with GPS. The development plan of second and later satellites of QZSS has not been decided yet, but I think the interoperability with Multi GNSS is very important for those satellites. For upcoming the Multi GNSS era, I hope the QZSS would become a good model to develop complementary relationship among the GNSS systems.

It is my personal opinion that Japan, as one of world economic powers, should contribute to the world with space development which requires high risks and major investments. Space-based PNT service is one of the most common and indispensable services in our daily life. In terms of contribution with space development, I believe Japan should contribute to the world in the field of Space-based PNT service, cooperating with the international society. It is very significant for Japan to keep the technology and position to contribute to the world when the Multi-GNSS era comes. As a person who is in charge of the application and promotion of QZSS, I'm very happy to promote Japanese contribution to the world by using the Japanese technology of Space-based PNT service. I will do my best to launch the Multi GNSS Demonstration Campaign framework in order to promote Multi GNSS complementary relationship and to share the benefit of Multi GNSS with countries in the world.

The ultimate goal of ICG is to build a GNSS system of systems

Sharafat Gadimova
Programme Officer
ICG Executive Secretariat
UNOOSA, Vienna

Today we are involved in international space cooperation. Currently the Global Navigation Satellite Systems (GNSS) provide a signal that is being used for a wide spectrum of applications of science and technology with economic benefits for users. Based on the "Vienna Declaration: Space Millennium for Human Development" of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), the International Committee on Global Navigation Satellite Systems (ICG), established under umbrella of the United Nations, is meeting annually to promote the enhancement of and universal access to space-based navigation and positioning systems and their compatibility and interoperability. Part of the capacity-building and information dissemination efforts of ICG, as a unique combination of GNSS service providers, is the support for the International Space Weather Initiative, the development of GNSS education and training programmes, creation of awareness of global GNSS applications, and increasing information on and accessibility to the technical characteristics of existing GNSS systems. The ultimate goal of ICG is to build a GNSS system of systems. This will be achieved through the ICG by harmonizing different GNSS systems through cooperation among the providers and by taking into account needs of the user community.

GAGAN signal in space-validation and utilization

The paper covers the validation and utilization of GAGAN-TDS SIS through various static and dynamic tests

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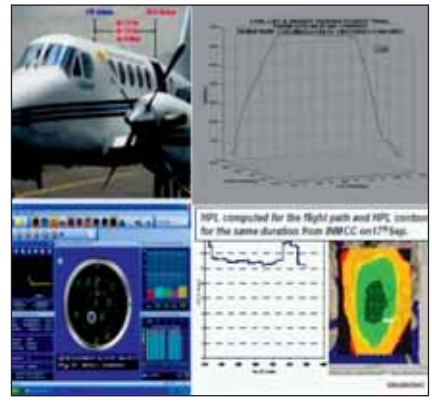
GAGAN (GPS Aided Geo Augmented Navigation) is an Indian SBAS (Satellite Based Augmentation System) intended to provide accurate and reliable navigation information for all phases of flight over the Indian FIR (Flight Information Region) and in the adjoining areas applicable for safety-of-life operations meeting the performance requirements of ICAO. The implementation of the GAGAN program is being realized through the following two phases:

- GAGAN-TDS (Technology Demonstration System)
- GAGAN-FOP (Final Operational Phase)

The objective of GAGAN-TDS was to demonstrate the feasibility of SBAS implementation over the Indian region with a minimum set of elements, and to establish the requirements for an operational SBAS. This phase has been completed in August, 2007. The objective of GAGAN-FOP is to realize a certified and operational SBAS over the Indian FIR with provision for expansion. During GAGAN-FOP, it is planned to add redundancies to the existing TDS elements and install additional elements in ground and space segments. The ultimate goal is to provide RNP-0.1 service over Indian landmass and APV-1.0/APV-1.5 service in the Indian FIR. The GAGAN FOP shall comply with ICAO safety-of-life operations. The implemented



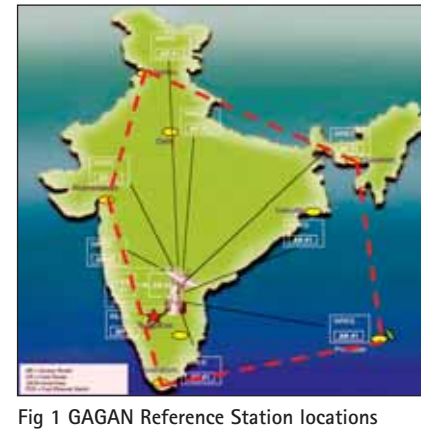


Fig 1 GAGAN Reference Station locations

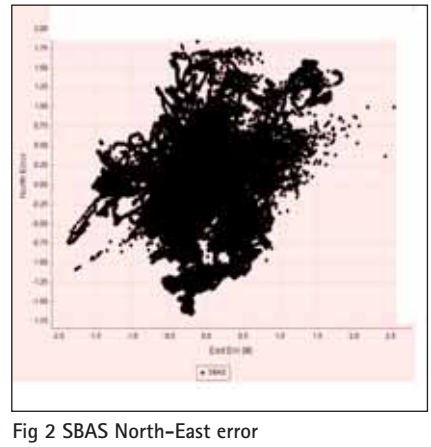


Fig 2 SBAS North-East error

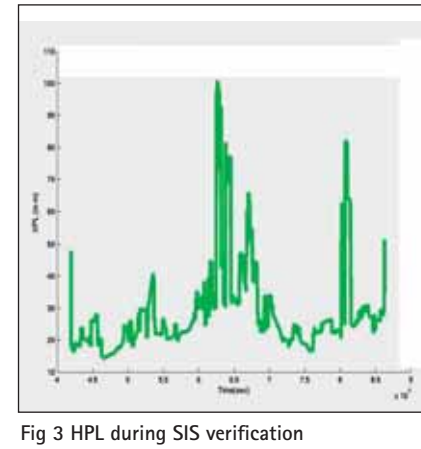


Fig 3 HPL during SIS verification

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GAGAN shall be compatible and interoperable with other SBAS systems and provide seamless air navigation services across regional boundaries.

The FSAT (Final System Acceptance Test) for GAGAN-TDS was completed on 14-15th August, 2007 using the signal-in-space (SIS) from INMARSAT-4F1. This paper discusses the activities conducted using GAGAN Signal in space (SIS) for performance validation and SIS utilization. The performance of GAGAN SIS has been validated in static and dynamic modes and the SIS has been utilized for verification of GAGAN Signal in Space availability in fringe areas, GAGAN SIS dynamic tests on aircraft and validation through DGPS and establishment of reference points at airports.

First experiment was conducted to verify the GAGAN SIS availability at various fringe locations of India (beyond the perimeter covered by the GAGAN reference stations). This exercise was carried out at Dibrugarh and Agatti airports in January 2008. In this activity, two SBAS receivers were programmed, one as SBAS receiver and another as GPS receiver. The parameters like signal strength, improvement in positional accuracy of SBAS over GPS and availability of service in that area were checked.

The second experiment was to carry out dynamic tests using aircraft with the objective of verifying the performance over a day in terms of accuracy, level of service and availability through comparison against conventional Nav-aids, validation with DGPS and SIS availability. A flight-certified SBAS receiver was flown between Hyderabad and Bangalore on an NRSA aircraft. The accuracies and availability of SIS during the flight was verified through independent verification of the results observed at the GAGAN control centre. Another exercise was carried out with FIU (Flight Inspection Unit) aircraft at Calicut airport in December, 2007 and at Bangalore in the 1st week of February 2008.

The utilization of GAGAN SIS was achieved through establishing reference points at the selected airports to aid the FIU (Flight Inspection Unit) in validating the GAGAN signal in space. The establishment was carried out at Bangalore airport and major airports including Delhi, Amritsar, Jaipur, Ahmedabad, Bombay, Gauwahati, Agartala, Imphal, Calcutta, Chennai, Hyderabad, Trivandrum, Mangalore and Coimbatore. Further activity will include the placement of a reference or base station at established reference point and the rover receiver on board the FIU aircraft. The activity would require the recording of GAGAN SIS data with SBAS receiver over a period of 72 hours. The reference point position will be calculated with suitable post processing techniques for better positional accuracy (1 m). The reference point position calculated will become the baseline for FIU related accuracy and availability checks to calibrate other conventional navigational aids at the airport.

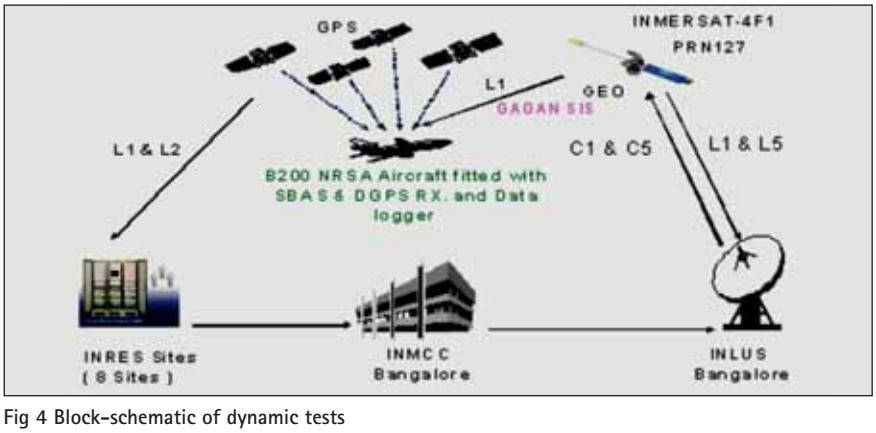

Fig 4 Block-schematic of dynamic tests

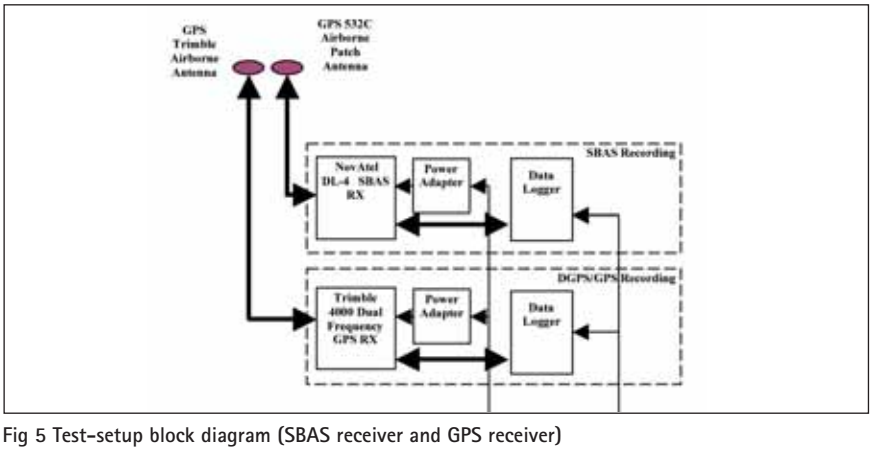

Fig 5 Test-setup block diagram (SBAS receiver and GPS receiver)

Introduction

The paper provides a detailed description of a few of the technical activities, which were carried out during the performance validation and utilization of GAGAN SIS in India i.e. SIS availability at fringe locations, Dynamic tests using aircraft and validation through DGPS and Reference points at airports. Each of these activities was designed with specific objectives and a detailed plan was laid out to complete the experiment with relevant instrumentation for the experiment. A few of the interesting results obtained during each of the experiments have been included in this paper.

SIS at fringe locations

The GAGAN SIS was primarily intended to be available over the perimeter covered by 5 reference stations in GAGAN i.e. Jammu, Ahmedabad, Trivandrum, Port Blair and Gauwahati (Figure 1).

The SIS availability at fringe locations was verified which are outside the perimeter. A few results are included. The figure 2 shows the SBAS East-North error, which is contained well within 2.0 m accuracy, as per the specifications of SBAS. The figure 3 shows the integrity parameter

2010 FOIF NEW PRODUCT

A20 GNSS Receiver

- 3G Satellites tracking (GPS, Glonass, Galileo)
- All-in-one Flexibility
- Voice messages
- OLED display with super brightness & weatherability
- Advanced GNSS tracking performance
- Advanced multipath mitigation
- Advanced rugged design

TS650/680 can work together with data collector by bluetooth

Total Station

- **RTS/OTS650 series**
  - OLED display with super brightness & weatherability
  - Arctic option for a wide range of applications
  - Bluetooth cable-free connection
- **RTS/OTS680 series**
  - RTOS & GUI platform
  - 3D road design and stake out
  - SD card and internal memory
  - Bluetooth cable-free connection
- **RTS/OTS810 series**
  - Windows CE 5.0 Operating system
  - Large full color graphic display
  - Touch screen
  - Guide light system
  - Professional onboard software: FOIF Survey_TS or FOIF FieldGenius
- **FOIF Geomatics CAD desktop software**
  FOIF FieldGenius field software

FOIF Since 1958
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of Horizontal Protection Limit (HPL), reaching a peak value of 100 m, which is meeting the RNP-0.1 specifications of 185 m HAL (Horizontal Alert Limit).

The above tests confirmed the accuracy and integrity of GAGAN SIS on the fringe locations of GAGAN-TDS perimeter.

Dynamic tests using aircraft and validation through DGPS

The dynamic tests using a SBAS receiver on a Beach King Aircraft VT-EBB of NRSA were conducted for assessing GAGAN-TDS SIS performance. These tests were carried out between 12 -18 September 2007, for different sorties between Hyderabad and Bangalore with multiple numbers of reference stations along the track. The figure 4 represents the block schematic of the dynamic tests.

The block diagram of test setup (SBAS receiver and a GPS receiver) is shown in figure 5:

The aircraft was fitted with one SBAS antenna connected to SBAS receiver recording logs in real time. Another antenna was connected to Trimble GPS Receiver. The 6 ground reference points along the track: Hyderabad, Shadnagar, Nagar Kurnool, Emiganoor, Ananthapur and Hindpur (separated by 100 Km) were positioned with GPS Reference receivers during the flight trials (Figure 6). The reference data was collected from all six reference stations and the real time data collected onboard GPS was post processed for DGPS position in order to get the reference trajectory. Additionally, the SBAS receiver receives the GPS signals on-board the aircraft and applies the corrections broadcast by GAGAN GEO to obtain improved position. The accuracies (GAGAN with respect to DGPS) as obtained in Up, North and East directions are provided in figure 7, 8 and 9 respectively.

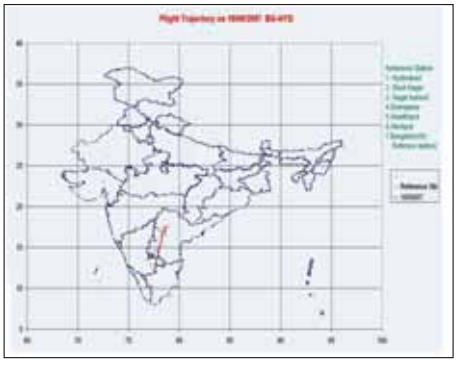


Fig 6 Flight Trajectory (Bangalore-Hyderabad)

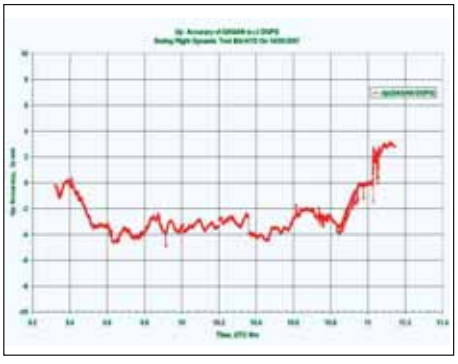


Fig 7 Up accuracy of GAGAN with respect to DGPS

Fig 8 North accuracy of GAGAN with respect to DGPS

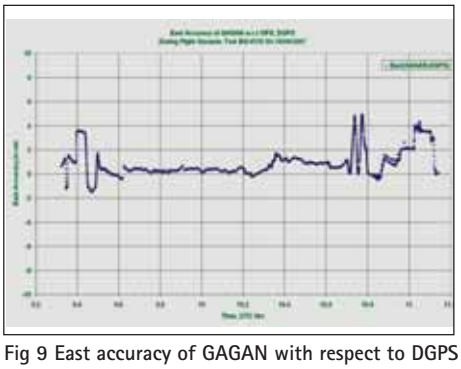


Fig 9 East accuracy of GAGAN with respect to DGPS

Fig 10 Locations of Airport Reference Points

Reference points at airports

GAGAN SIS was utilized to establish the reference points at various airports in India (Figure 10)

These reference points will be used for FIU aircraft related activities of accuracy and availability checks and also to calibrate other conventional navigational aids at the airports.

Conclusions

The paper has covered the validation and utilization of GAGAN-TDS SIS through various static and dynamic tests, which provided a verification of the achieved accuracy and integrity.

The future scope of work in GAGAN-FOP involves the certification of SBAS to provide improved accuracy and integrity required for APV-1.0/ APV-1.5. GAGAN-FOP is planned as an augmentation of GAGAN-TDS with the addition of ground elements (reference stations, uplink stations and master control centre), apart from the development and implementation of a region-specific ionosphere model. The space segment in GAGAN-FOP will consist of GSAT-4, GSAT-8 and GSAT-10.

Acknowledgements

The authors thank Dr S Pal, Distinguished Scientist, Associate Director, ISAC and Program Director, Satellite Navigation Program, ISAC for his continuous encouragement, guidance and support for the project.

The authors also wish to express their sincere thanks and acknowledgement to various working teams on GAGAN from AAI and ISRO; responsible for carrying out the activities described in this paper. The relevant technical information was generated as a result of the analysis of various experiments, which have been used extensively in the preparation of this paper.

"There will always be a continuing desire for backup PNT systems"

says Donald G DeGryse, Vice President, Navigation Systems for Space Systems Company, Lockheed Martin

The Navigation Systems business unit was established in 2001 and has had an eventful journey so far. What in your opinion are three 'landmarks' achieved by the unit since 2001?

Navigation Systems was established to combine Lockheed Martin's world-class system engineering and integration capabilities and our extensive navigation experience to meet our customer's position, navigation and timing needs.

Key landmark achievements since 2001 include the successful delivery and launch of 15 GPS IIR and IIR-M spacecraft for our Air Force customer. We are extremely proud of our effort in successfully modernizing the last eight satellites in GPS IIR program which is bringing new capabilities today to the GPS constellation. The IIR-M satellite series have significantly enhanced operations and navigation signal performance for military and civilian GPS users around the globe. One of these satellites also included an innovative L5 demonstration "Safety of Life" signal which broadcast for the first time, securing the allocation of the L5 frequency and paving the way for the operational signal. During the past year, the fleet of IIR/IIR-M spacecraft achieved the milestone of 100 cumulative years of successful on-orbit operations.

Finally, we were honoured that the U.S. Air Force selected Lockheed Martin to be its partner to build the next-generation of GPS satellites, known as GPS III. We are now focused on delivering this essential capability to our customer on schedule and on cost. The GPS IIIA satellites will offer significant benefits beyond the soon to be launched GPS IIF satellites. The GPS IIIA satellites will provide signals that are three times more accurate than GPS IIF and provide three times more signal power for military users, while also providing a new Galileo-compatible civilian signal. We anticipate that the first GPS IIIA spacecraft will be available for launch in 2014.

Space Systems includes space launch, commercial satellites, government satellites, and strategic lines of business.' What is the role of the Navigation Systems business unit in each of these lines of business of Lockheed Martin Space Systems Company?

Our nation and the world are becoming more dependent than ever on space-based capabilities. Lockheed Martin has a long history of developing cutting-edge spacecraft and technologies that allow us to explore the outer limits of our universe and to connect and protect our world.

Building upon our extensive mission experience, we leverage our breadth and depth of proven capabilities, including our navigation systems expertise, to provide superior products in many different areas. Specifically, the Lockheed Martin Space Systems team leverages Corporate-wide technical talent and experience to ensure operational excellence and mission success on GPS III.

GPS and Lockheed Martin – much has been said and written. Would you please elaborate on some recent developments at Lockheed Martin vis-à-vis GPS III?

The GPS III program is based on a "back-to-basics" acquisition approach. This approach assures successful program execution through program stability and a focus on providing our warfighters needed capabilities with cost and schedule confidence. Our program plan is founded upon a close partnership with our Air Force customer and retains world-class industry teammates with the deepest experience base of over 19 years of partnership demonstrating mission success. In conjunction with our customer we recognize that program success depends on the stability of requirements, funding, and leadership. In addition, our internal focus is on operational excellence in all aspects of program execution, leading to mission success.

In 2009, our team completed a highly successful Preliminary Design Review (PDR) phase on schedule and is now progressing steadily into the Critical Design Review (CDR) phase of the program.

This includes conducting over 65 individual CDRs for key GPS III spacecraft subsystems, assemblies and elements. The phase will culminate in the fall of 2010 with a final Space Vehicle CDR that will validate the detailed GPS III design to ensure it meets warfighter and civil requirements. Given our progress to date, we are on track to a first launch in 2014.

The GPS Block IIR and IIR-M satellites designed and built by Lockheed Martin accumulated 100 years of successful on-orbit operations, with a reliability record of better than 99.9 percent. Would you like to share some of the challenges faced in achieving this unmatched record of exceptional performance and reliability for GPS?

Introducing a more capable satellite into an existing constellation always has its

challenges. When GPS IIR made its debut into the operational arena it brought a significant leap in technology – software reprogrammability, automated sun-earth re-acquisition, and redundancy management to name a few.

Our Test Like You Fly philosophy as well as our stable, disciplined execution team were significant contributors to our exceptional performance. Once the performance and accuracy numbers came in, GPS IIR became a favourite to the warfighters and civil users. Now that the bar is set so high on accuracy, we face a new challenge of meeting those expectations every day.

GPS has proved its 'reliability' over the years, what is your opinion on the talk about 'having a backup for GPS'?

The need for improved navigation has progressed throughout history where today the GPS space-based approach is the leading technology for providing precise positioning, navigation, and timing information throughout the globe.

However, one of the lessons that every navigator has learned is the importance of a backup system available whenever possible, and GPS is no different. While some may propose that global navigation satellite systems such as Galileo can act as a backup to GPS, all navigation satellite systems including GPS and Galileo are subject to vulnerabilities that can interrupt service.

As such, there will always be a continuing desire for backup PNT systems to ensure the continuity of performance for critical applications such as those involving safety of life. The issue of which systems should be retained as backup systems will be particularly challenging in today's fiscally constrained environment.

Initial signals from the GPS IIR-20(M) launched in March 2009, were inconsistent with the performance of other GPS IIR-M satellites. What were the reasons for this and how was the problem resolved?

The GPS Wing is continuing to access the situation with GPS IIR-20(M), SVN 49. The GPS Wing wants to understand and verify to the greatest extent possible the effects that these distorted signals from SVN 49 will have on civilian and/or military users.

This verification takes time, in part because the widespread use of GPS in myriad applications worldwide. GPS has a fully operational constellation of 30 satellites (not including SVN 49) providing a high quality of service throughout the globe today, so there is no urgency to set SVN 49 healthy for constellation sustainment. This allows the GPS Wing to carry out a thorough, methodical evaluation of the impact of the distorted signals from SVN 49.
The GPS Wing is in the process of testing civilian and military receivers with the signals from SVN 49. Once all potential options are fully understood and their impact on the user community evaluated, a decision will be made when to activate the vehicle in the operational constellation.

A recent interview Dr. Brad Parkinson has said that fears about a GPS 'blackout' are unjustified, but there is a possibility of a 'brownout' – with fewer satellites in the constellation than what are available now. Would you like to comment?

Today, the GPS constellation is a robust constellation 30 or more satellites, and that has been maintained that for quite some time. While a number of these satellites are aging, GPS satellites often exceed their design life and I anticipate that will continue in the future.

The bar is set so high on accuracy, we face a new challenge of meeting those expectations every day

In addition, the GPS IIF satellites are expected to be available for replenishment this summer or early fall. As evidence of the confidence the Air Force has in maintaining the current constellation, the Air Force recently made the decision to reposition the satellites to a 24+3 constellation to better serve GPS users worldwide by optimizing the position of the GPS spacecraft on orbit today.

Finally, Lockheed Martin is well along in the program developing the GPS IIIA spacecraft. The GPS IIIA program is currently on budget and on schedule to have GPS IIIA spacecraft available for launch in 2014.

Besides GPS what are the other priority projects of the Navigation Systems business unit?

The Navigation Systems portfolio is comprised of initiatives that leverage the systems engineering, systems integration and product development capabilities within the corporation, to not only respond to near-term customer initiatives, but to develop solutions to issues our customers may encounter in the future. By proactively looking ahead and assessing the "what if's", we have been able to develop a robust pipeline for several years to come.

Our priority continues to be the execution of the GPS III program to include a rigorous Capability Insertion Program that will bring in new capabilities and improved performance for the world wide user community. In addition we continue to provide IIR/IIR-M operations and sustainment support for the current constellation.

What new applications in GNSS do you envision five years from now?

The impact that this technology has had on the counties of the world and their economies over the past decade has been tremendous. New applications using GNSS are emerging every day and I anticipate that will continue for years to come.

Certainly, location based services are going to grow in the future. In the area of transportation, the continued implementation will proceed across all modes of transportation to include Intelligent Transportation Systems. In addition, GNSS applications will bring tremendous benefits to the developing world in the areas of agriculture and disaster management.

Looking ahead, I expect that positioning, navigation, and timing capabilities, products, and services will play a vital and ever growing role in the global economic and security environment.

How do you view the coming up of other GNSS systems around the world? Is it leading to some kind of race?

Clearly, international recognition of the benefits of GNSS capabilities has increased over the past decade. In the mid 1990's, GPS was the only fully operational GNSS system. Today at least six nations are in various stages of implementing global or regional navigation satellite systems.

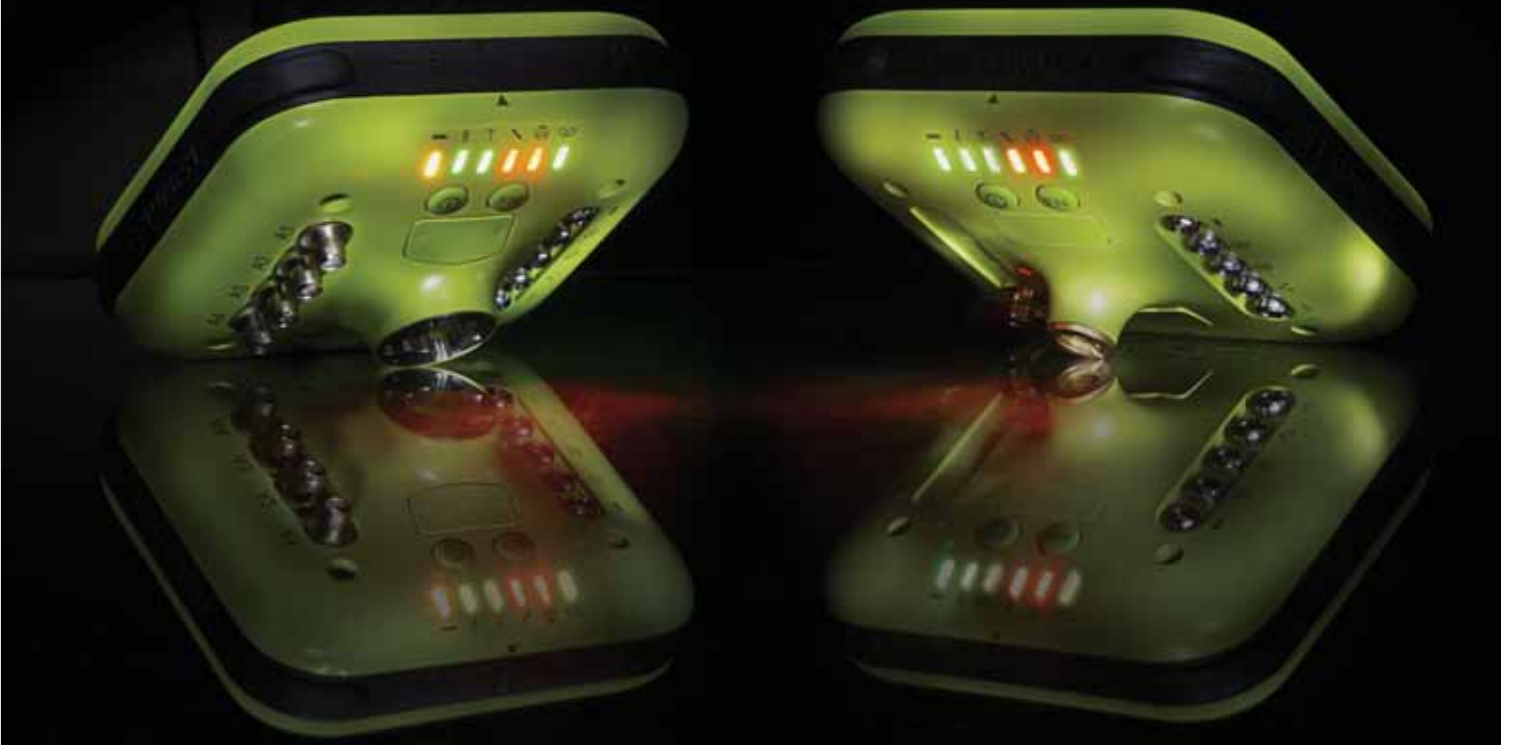
By 2020, there could be as many as 12 systems in orbit which include both primary as well as augmentation systems. Many nations that want to be major players on the world stage in the first part of this century believe that it is critical that they be a provider of space-based navigation services.

Working closely with the U.S. Government and our Air Force partner, we look forward to meeting our GPS III commitment of achieving mission success by completing key milestones on-time and on-budget and delivering improved space-based PNT capabilities for users around the globe.

JAVAD
WWW.JAVAD.COM

TRIUMPH 1
TRIUMPH – 4X
216 channels

JAVAD ArcPad Extension
in focus



JAVAD ArcPad Extension

In response to a long-standing request from ESRI, JAVAD GNSS is pleased to announce that ArcPad users can now communicate directly with ESRI ArcGIS Server via our Triumph receiver so no additional devices (external radio) or settings are required. Real-time centimeter-level positioning is now possible in the field for ArcPad users.

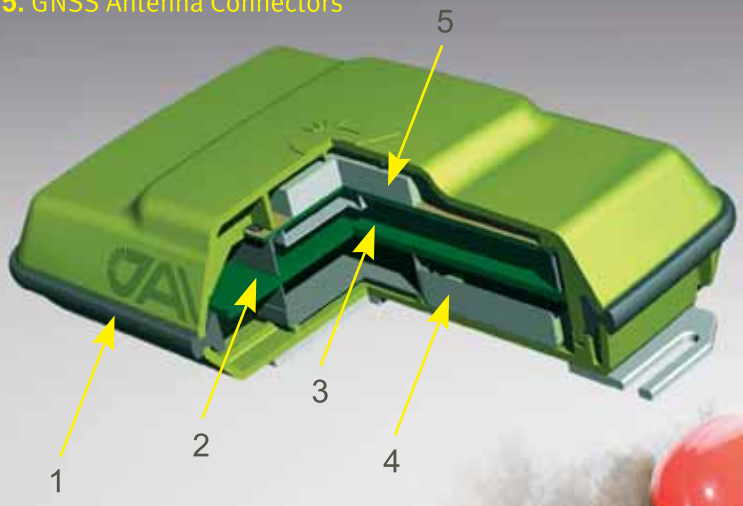
- JAVAD ArcPad Extension enhances the spectrum of ArcPad's surveying capabilities by adding state of the art JAVAD GNSS solutions. JAVAD ArcPad Extension provides a full range of functions to control the GNSS receiver and manage the surveying process.
- JAVAD ArcPad Extension establishes a connection to the receiver via serial, USB, or Bluetooth and configures the base station parameters that govern the RTK and UHF radio setups, and GSM modem settings.

- Quality control of real-time positioning results are assured in the field. The JAVAD GNSS Victor PDA displays the status/process progress continuously via the Bluetooth connection to the receiver.
- Advanced RTK accuracy and ArcPad vector/raster map visualization capabilities deliver reliable object positioning and a new level of job control in the field.
- JAVAD ArcPad Extension is an optimal ESRI-compatible solution for a wide variety of civil engineering or cartography tasks where centimeter level accuracies are required. At the core of this solution lies highly integrated JAVAD GNSS technology optimized for use with ESRI's GIS software.

Please see www.javad.com for details.

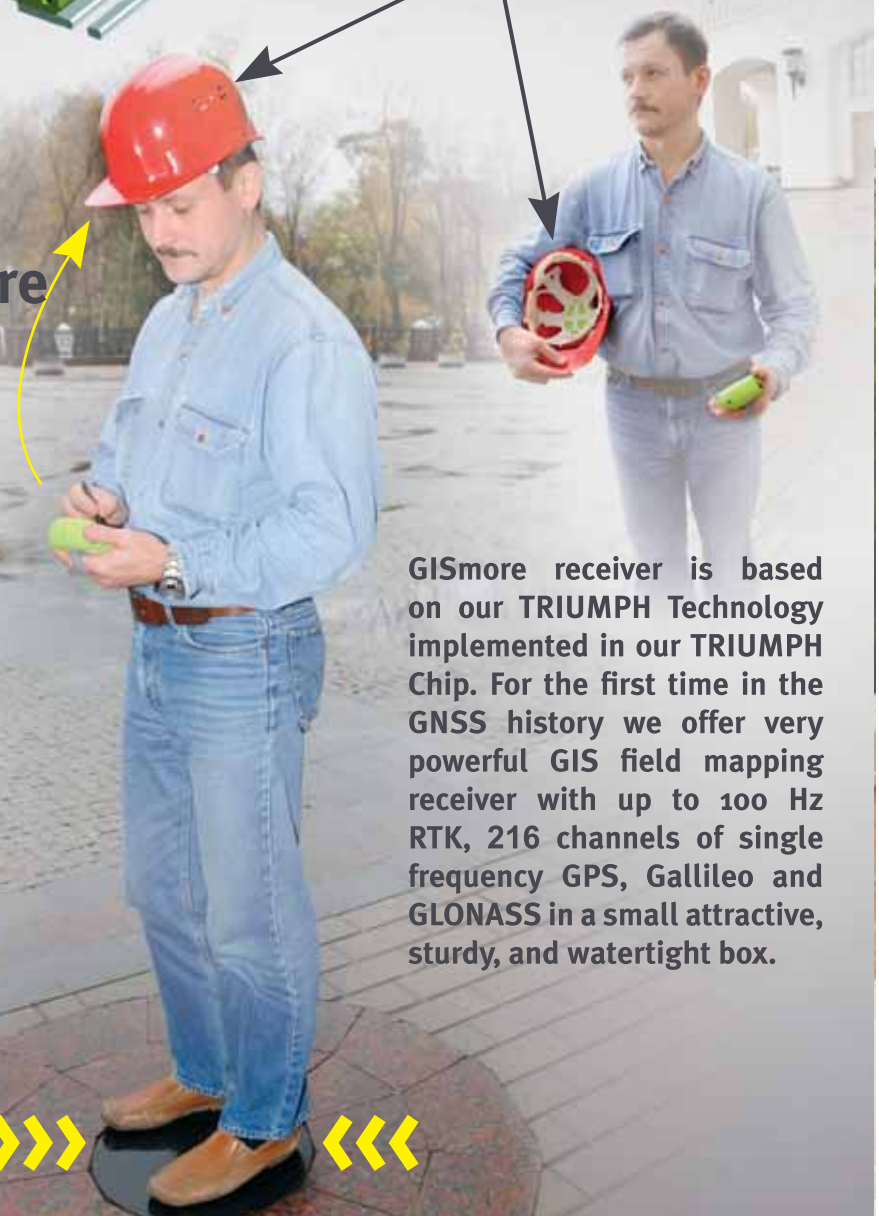
Actual size

1. Guard Bumper
2. Bluetooth/GSM Antenna
3. GNSS Receiver, Power Board, GSM/Bluetooth and Memory
4. Rechargeable li-Ion Battery
5. GNSS Antenna Connectors



GISmore

stand-alone or inside the hat



Bluetooth wireless connection to GISmore

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

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.

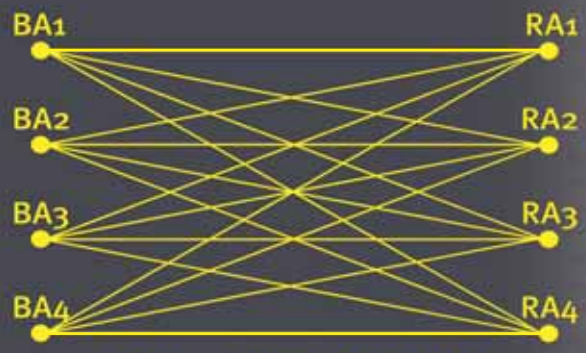
Many ways to use

GPS + GLONASS + Galileo

TRIUMPH 1

4x4... ALL WILL DRIVE... RTK!

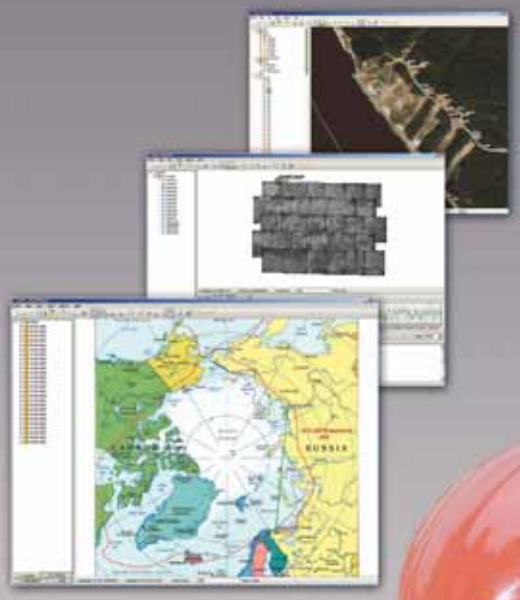
TRIUMPH-4x



4 base — 4 rover, 16 baselines

Please see www.javad.com for details

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.

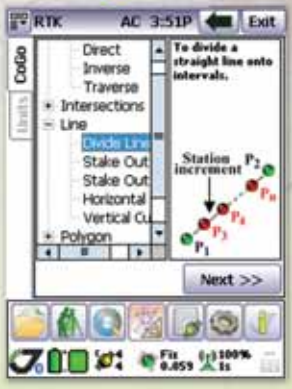
Victor

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.

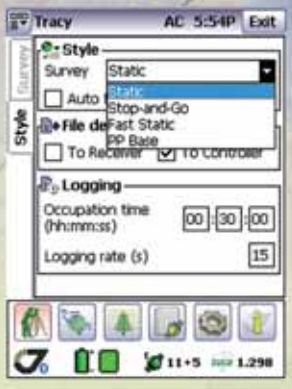
- **Lightweight (17 ounces; 482 grams) magnesium case with easy-to-grip over-molding**
- **Operating temperature -22°F to 122°F (-30°C to 50°C)**
- **Connectivity via built in Bluetooth, USB Host and Client, plus 9-pin RS-232 and optional WiFi and Modems**
- **Rechargeable, field replaceable, Li-Ion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

Giodis

Full-featured office post-processing software



Support for survey and stakeout projects



Static, Fast Static and Stop&Go surveying

Configuration of all hardware

Tracy

A versatile and powerful field software

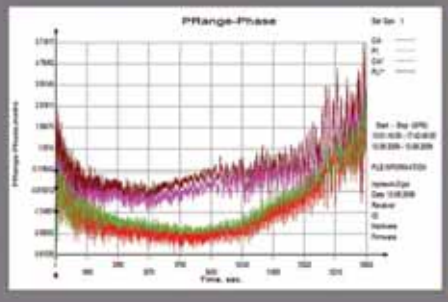
Software for Windows Mobile OS to control receivers, automated GNSS post processing surveying tasks (Static, Fast Static, Stop&Go, Data Acquisition), and to perform RTK survey and stakeout tasks.

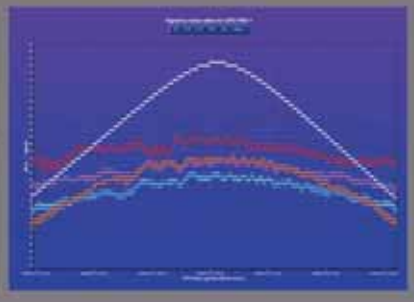
Javad eliminates GPS SVN 49 anomalies

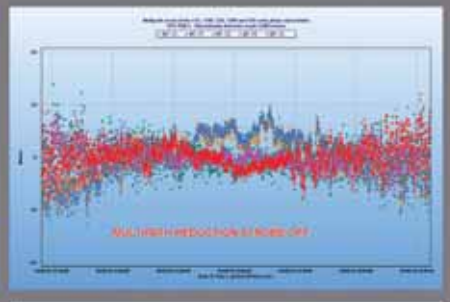
The anomalies in the recently launched SVN49(PRN1) was a chance to demonstrate the advanced multipath reduction capabilities of JAVAD GNSS Triumph technologies.

Figure below shows SNV49 (PRN1) code-minus-phase plot for usual correlator (magenta - C/A code, brown - P/L1 code) and for “mpnew” (red - C/A code, green - P/L1 code), which shows almost all anomalies and satellite multipath are removed.

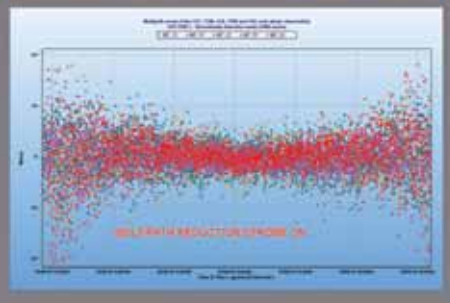
Figures below also describe the multipath performance of a pair of Triumph-1 receivers we ran in a zero baseline test. The left figure depicts the code multipath errors of the GPS PRN1 pseudoranges measured by the receiver with the ‘normal’ strobe enabled. The right figure shows the code multipath as estimated for the second receiver, where the optimized multipath reduction strobe was enabled. The center screenshot displays the signal-to-noise ratios and elevation angles of GPS SVN49 over the time interval analyzed.

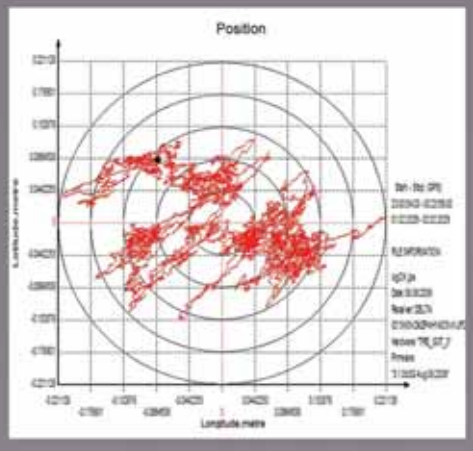






The optimized multipath mitigation technique implemented in our Triumph technology allows nearly complete compensation for the satellite-induced multipath anomalies that would otherwise badly affect GPS SVN49 measurements. The same multipath reduction capabilities which removed the SVN49 multipath anomalies can remove the multipath effects which are a major source of error in precision positioning.





JAVAD GNSS receivers tracked all current and future Galileo satellite signals

JAVAD GNSS receivers successfully tracked all Galileo satellites from Spirent simulator and produced Galileo-only and triple satellite (Gps+Glonass+Galileo) positions. Up to 27 satellites were tracked simultaneously.

The experiments were performed jointly by Spirent and JAVAD GNSS.

Sat	(Fn)	El	Az	C/A	P1	P2	TC	Count	F_C/A	F_P1	F_P2	Use
Gps	1	29	--	46	0	0	63	3818	0xA153	------	------	Y(0)
Gps	3	24	--	47	0	0	86	4986	0xA153	------	------	Y(0)
Gps	6	27	--	46	0	0	86	4986	0xA153	------	------	Y(0)
Gps	11	14	--	44	0	0	77	4622	0xA153	------	------	Y(0)
Gps	14	20	--	45	0	0	86	4986	0xA153	------	------	Y(0)
Gps	16	78	--	49	0	0	86	4986	0xA153	------	------	Y(0)
Gps	18	7	--	47	0	0	86	4986	0xA153	------	------	Y(0)
Gps	19	10	--	48	0	0	86	4986	0xA153	------	------	Y(0)
Gps	20	7	--	47	0	0	4	272	0xA153	------	------	Y(0)
Gps	22	38	--	47	0	0	86	4986	0xA153	------	------	Y(0)
Gps	31	23	--	45	0	0	86	4986	0xA153	------	------	Y(0)
Gln	6(-2)	24	--	51	0	0	87	4986	0xA153	------	------	Y(0)
Gln	7(-1)	28	--	51	0	0	87	4986	0xA153	------	------	Y(0)
Gln	9(1)	21	--	50	0	0	87	4986	0xA153	------	------	Y(0)
Gln	10(2)	76	--	52	0	0	87	4986	0xA153	------	------	Y(0)
Gln	11(3)	44	--	50	0	0	81	4911	0xA153	------	------	Y(0)
Gal	71	18	--	50	0	0	85	4986	0xA153	------	------	Y(0)
Gal	78	18	--	50	0	0	81	4892	0xA153	------	------	Y(0)
Gal	79	30	--	49	0	0	85	4986	0xA153	------	------	Y(0)
Gal	83	23	--	48	0	0	59	3572	0xA153	------	------	Y(0)
Gal	84	70	--	49	0	0	86	4986	0xA153	------	------	Y(0)
Gal	85	58	--	50	0	0	84	4986	0xA153	------	------	Y(0)
Gal	86	13	--	49	0	0	86	4986	0xA153	------	------	Y(0)
Gal	89	33	--	50	0	0	85	4986	0xA153	------	------	Y(0)
Gal	90	35	--	51	0	0	86	4986	0xA153	------	------	Y(0)
Gal	91	11	--	51	0	0	86	4986	0xA153	------	------	Y(0)
Gal	97	8	--	50	0	0	29	1742	0xA153	------	------	Y(0)

Other Receivers

ALPHA

- Internal battery
- Charger
- GSM
- Bluetooth

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

Front panel connectors:

Power Input + serial port A + USB + Antenna

Back panel connectors:

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

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

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

DELTA

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

Front panel connectors:

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

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

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

Back panel connectors:

Can have up to 4 connectors of 1-PPS A · 1-PPS B · Event A · Event B · Antenna · CAN · IRIG B

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

SIGMA

- Internal battery
- Charger
- Modem
- GSM
- Bluetooth

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

Front panel connectors:

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

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

Back panel connectors:

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

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

A synchronisation approach to automate spatial metadata updating process

This paper presents a new approach to automate spatial metadata updating process, by which dataset properties are read from the dataset file and written into its metadata file automatically.

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Metadata is commonly defined as "data about data" and also plays a critical role in any Spatial Data Infrastructure (SDI) initiatives. Metadata not only provides users of spatial data with information about the purpose, quality, actuality and accuracy of spatial datasets, but also performs vital functions that make spatial data interoperable, that is, capable of being shared between systems. Metadata enables both professional and non-professional spatial users to find the most appropriate, applicable and accessible datasets for use (Rajabifard et al., 2009).

Regardless of numerous benefits of metadata, issues and obstacles to the creation and update of such geospatial surrogates are numerous. Spatial metadata which is created and updated manually or semiautomatically, is considered as monotonous and time consuming, a labour-intensive process by organisations and it is commonly viewed as an overhead and extra cost. Also, metadata for spatial datasets is often missing or incomplete and is acquired in heterogeneous ways. Moreover, metadata is usually created and stored separately to the actual dataset it relates to, and is often managed by people with a limited knowledge of its value. Separation of storage creates two independent datasets that must be managed and updated - spatial data and metadata. These are often redundant and inconsistent. Thus the reliability of spatial information and the extent it can be used are unclear.

To address some of these issues, particularly relevant to spatial metadata update processes, this paper aims at exploring a new synchronisation approach as an automated fashion for updating spatial metadata which is based on an ongoing research by authors on "Spatial Metadata Automation". The paper firstly compares different methods of spatial metadata generation and focuses on an automation framework. This framework embraces three streamlines including create, update and enrich. Finally, a new synchronisation approach is introduced to address the automatic update streamline.

Spatial metadata generation approaches

The generation of spatial metadata can be separated into automatic, semiautomatic and manual data mining methods (Taussi, 2007). These approaches have been formed and evolved based on the technological initiatives over time and the characteristics of spatial metadata such as type and format have been influenced by these initiatives. For instance, after the PC Era and Internet initiative the spatial metadata were generated in Markup Languages (e.g. Hyper Text Markup Language (HTML) and eXtensible Markup Language (XML)) since early 1990s. Figure 1 illustrates the spatial metadata creation approaches and different types of spatial metadata based on technological initiatives.

Among these approaches, many people view manual metadata generation as monotonous and time consuming, a labour-intensive process which is a major undertaking in itself (West and Hess, 2002), resulting in a pervasive outlook which shuns metadata creation (Mathys, 2004). Moreover, it is commonly viewed

by organisations as an overhead and extra cost. Also, metadata for spatial datasets is often missing or incomplete and is acquired in heterogeneous ways (Rajabifard et al., 2009).

The use of automatic processing can, in turn, permit human resources to be directed to more intellectually challenging metadata creation and evaluation tasks. These factors underlie automatic metadata generation research efforts and the desire to build superior and robust automatic metadata generation applications (Greenberg et al., 2005). More importantly, the ability to automatically generate metadata relating to spatial data, and make it available through SDI will have important benefits all practitioners including spatial data producers, vendors, distributor and user. Many organisations are also looking at automated metadata systems to reap automatic metadata generation benefits. This is evidenced by the large number of projects and companies who are creating programs which automate metadata (Baird and Jorum Team, 2006). Accordingly, a conceptual framework for spatial metadata automation which has been introduced by (Kalantari et al., 2009) is reviewed as below.

Spatial metadata automation framework

Today, automatic metadata generation should move beyond subject representation to encompass the production of author, title, date, format, spatial extension and many other types of metadata. In addition, thousands of spatial databases are now networked via the Internet, and information resources are frequently rendered in open and interoperable standards (e.g. XML). These developments should enable automatic metadata generation systems to work on far larger spatial data directories.

For that reason, a framework for automating spatial metadata which is based on three main streamlines including automatic creation, enrichment and update is illustrated in figure 2 (Kalantari et al., 2009).

Automatic Creation: When there is no existing metadata associated with spatial data, there is a need for exploring methods to create spatial metadata. Several automatic metadata extraction methods have been studied so far, e.g. hand-coded rule-based parsers and machine learning (Han et al., 2003).

Automatic enrichment: Automatic enrichment involves improving content of metadata through monitoring tags that are used by users for finding datasets. This kind of spatial metadata can help describing an item and allowing it to be found again by browsing or searching.

Automatic update: Automatic spatial metadata update or synchronisation is a process by which properties of a spatial dataset are read from the dataset and written into its spatial metadata. This automatic function will support the spatial metadata to be updated at the same time with its related spatial data update process. However, the automatic update implementation still faces with some obstacles and restrictions which have been discussed as following.

Automatic spatial metadata update – Current restrictions

Automatic update is one of the main streamlines of automation framework which is regarded with some obstructions. The structure of spatial data and metadata data models is an important part of these limitations. Whereas, dataset creation and editing are detached from metadata creation and editing procedures, necessitating diligent update practices involving at minimum two separate applications (Batcheller, 2008). Rajabifard et al. (2009) also stated that separation of storage creates two independent datasets that must be managed and updated - spatial data and metadata. These are often redundant and inconsistent. Thus the reliability of spatial information and the extent it can be used are unclear. They also discussed the significance of an integrated data model for handling spatial metadata by combining spatial data and metadata in a seamless approach. The research in metadata integration should focus on utilise metadata standards and developments in order to combine metadata and spatial data within an integrated package, so that the process of updating or creating spatial data and metadata – where feasible – becomes one process rather than two.

As a result of this, automatic update should provide a synchronised process through which the spatial data and metadata can be updated simultaneously. In other words, this synchronisation process not only should complete as much of the metadata elements as possible automatically but also it should make sure that the metadata is kept up-to-date with changes to the dataset. ESRI Company through ArcCatalog application has developed some algorithms to synchronise the metadata content when values in the spatial data change. For instance, when a change occurs with a spatial data property such as its projection, the metadata will be updated with the new information (Westbrooks, 2004). The process of synchronisation is accomplished using metadata standard specific synchronizers. For example, three synchronizers are provided with ArcCatalog: an FGDC synchronizer, an ISO synchronizer, and a Geography Network synchronizer.

However, the current synchronisation process generates and updates a limited

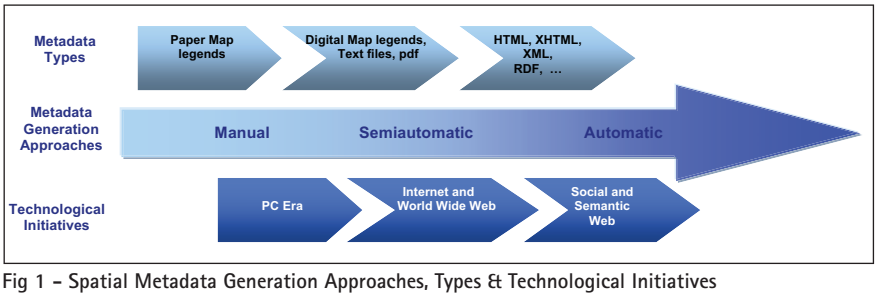

Fig 1 – Spatial Metadata Generation Approaches, Types & Technological Initiatives

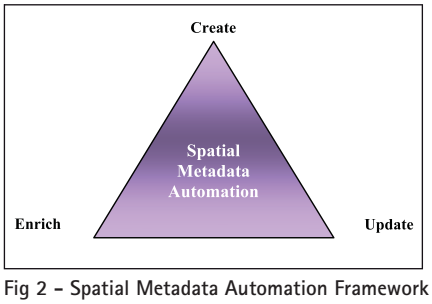

Fig 2 – Spatial Metadata Automation Framework

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amount of spatial metadata elements in different standard schemas automatically and a large amount of spatial data elements should be imported manually. Moreover, spatial data are usually created and stored by organisations in different formats (e.g. Shp, Dwg, Dxf, Coverage, Dgn, etc.) which make the synchronisation process complex. In fact, complicated algorithms should be provided to support the synchronisation process to update the spatial metadata associated with these diverse spatial datasets.

Consequently, in order to implement the synchronisation process especially in terms of automating this process as much as possible and also supporting different spatial dataset formats, a new approach has been proposed in the next section.

A synchronisation approach to automate spatial metadata update

Following the requirements for automatic update or synchronisation implementation, a new approach based on Geography Markup Language (GML) has been developed. GML is rapidly emerging as a world standard for the encoding, transport and storage of all forms of geographic information (Lake, 2005). The OGC proposed GML specifications that take advantage of XML to apply to geographic information sharing. In fact, GML is an XML grammar for expressing geographical features. GML serves as a modelling language for geographic systems as well as an open interchange format for geographic transactions on the Internet. As with most XML based grammars, there are two parts to the grammar – the schema that describes the document and the instance document that contains the actual data (OGC, 2009).

Using this method, practitioners may decide to store geographic application schemas and information in GML, or they may decide to convert from some other storage format on demand and use GML only for schema and data transport (OGC, 2007). GML provides several objects for describing geography, including features, coordinate reference systems, geometry, topology, time, units of measure, and generalized values. Applications can extend or restrict these GML objects to fit their requirements (Huang et al., 2009).

Although, GML does not provide an information model for metadata, instead a mechanism to include or reference metadata is provided for all object elements. Indeed, GML provides a framework by which arbitrary user-defined metadata can be attached to any GML object and be distinguished from the defining properties of the object. This is supported through the metadata property which can be optionally attached to anything derived from gml:AbstractGMLType. This metadata property points to or contains a metadata package of properties that are the metadata for the object in question. The content of the metadata package is defined by a metadata application schema (a property list), similar in structure to a GML application schema for features (Lake, 2005). For instance, if metadata following the conceptual model of ISO 19115 is to be encoded in a GML document, the corresponding implementation specification specified in ISO/TS 19139 shall be used to encode the metadata information (OGC, 2007).

With this in mind, the new synchronisation approach is developed based on XML/GML technologies (figure 3); as Huang et al. (2009) also claim that no GIS has been built on native XML/GML technologies so far.

In this new approach, metadata publishers continue creating or updating spatial datasets in required formats (e.g. shape files, cad files, etc.).Then each dataset is transformed to GML after creation or update through a transformation method. To implement this transformation, proper GML application schemas should be designed to encode the maximum range of metadata elements in a GML schema. Through the transformation, an instance document to contain the actual data and a GML schema to describe the document would be provided. Therefore, after the creation of dataset in GML format the synchronisation process would start. Through this process, spatial metadata elements which are encoded in GML

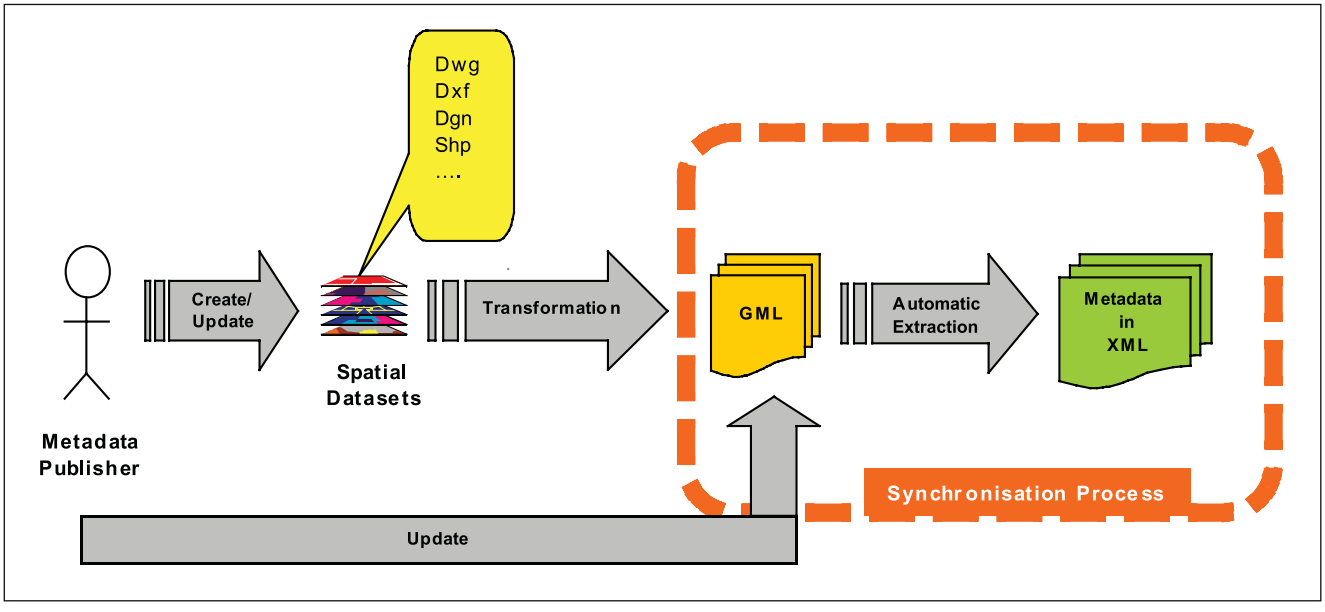

Fig 3 – Synchronisation approach to automatic spatial metadata update

INDIAN REMOTE SENSING SATELLITE (IRS)

Roving Eye in the Sky

CARTOSAT-2
10.01. 2007
PSLV-C7

CARTOSAT-1
05.05. 2005
PSLV-C6

RESOURCESAT-1
17.10. 2003
PSLV-C5

OCEANSAT-1
26.05.1999
PSLV-C2

IRS-1D
29.09.1997
PSLV-C1

IRS-1C
28.12.1995
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document would be identified based on a specific standard (e.g. ISO 19115) and extracted via an automatic extraction method and finally written into an XML document (based on XML application schema, e.g. ISO 19139) automatically. Actually, the synchronisation process output is metadata related to spatial dataset in XML format. Whenever a spatial dataset in GML format is updated, the synchroniser would be triggered and the spatial metadata would be updated in XML automatically; that is, spatial metadata will be updated automatically with any change in spatial dataset.

Conclusion

To addressing the issues regarding current spatial metadata updating process, a new synchronisation approach based on GML has been proposed. This new approach to updating spatial metadata automatically will benefit the spatial data and metadata publishers in different aspects. Firstly, it encourages the publishers to create spatial datasets in an international open standard which will help solve the interoperability issues relevant to spatial data transfer and storage through the web environment. Secondly, this approach will assist the publishers to update the spatial data and metadata simultaneously, thus more time, resources and energy could be saved through reducing the number of update processes. In addition, the approach based on GML as an open and neutral framework for spatial data will decrease the publishers' concerns on spatial data creation and update methods and output formats. Moreover, a large number of spatial metadata elements could be updated automatically through the new approach. Furthermore, less-complicated synchronisation algorithms are required in this approach. Finally, this new process will minimize the risk of spatial data and metadata inconsistency and redundancy.

Acknowledgements

This paper is based on an ongoing research project titled "Spatial Metadata Automation" as an Australian Research Council (ARC) linkage project, which aims to develop and demonstrate an approach for extracting, recording, updating and delivering metadata in an automated and integrated fashion. The research is also supported by industry partners; Department of Sustainability and Environment and Department of Primary Industries - Victoria, Department of Lands - New South Wales, AusSoft Solutions Pty Ltd, CubWerx Australia Pty Ltd and Logica CMG. The Authors acknowledge the support of the members of the Centre for Spatial Data Infrastructures and Land Administration, at the Department of Geomatics, University of Melbourne in the preparation of this paper and associated research; however, the views expressed in this paper are those of the authors and not the views of these groups.

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CE

Boeing ships GPS IIF satellite for launch

Boeing has shipped the first GPS IIF satellite aboard a Boeing-built C-17 Globemaster III airlifter. The new navigation spacecraft is now set to begin final preparations for launch. Space Vehicle 1 (SV-1), the first of 12 GPS IIF satellites for the U.S. Air Force, will lift off on a United Launch Alliance Delta IV vehicle later this year. The GPS IIF system will bring enhanced performance to the GPS constellation by providing twice the navigational accuracy of heritage satellites, more robust signals for commercial aviation and search-and-rescue, and greater resistance to jamming in hostile environments.*http://govconwire.com*

Hi-tech gadgets to track lions at Gir

Gujarat government in India is procuring gadgets like GPS, automated sensor grid and night vision devices to track lions and keep poachers at bay at the Gir National Park. The task force that was formed for the purpose has proposed to use GPS-based system for surveillance tracking, animal tracking and also tracking of vehicles coming inside the Gir Sanctuary. It is envisaged that all field level subordinates (foresters), supervisory staff and senior officers would be equipped with hand-held devices capable of voice, data and geo-coordinate transmission. The task force has also proposed that approximately 10% of the lion population should be fitted with GPS collars. *http://beta.thehindu.com*

Sat-nav devices face big errors as solar activity rises

Researchers say the Sun is awakening after a period of low activity, which does not bode well for a world ever more dependent on satellite navigation. The last time the Sun reached a peak in activity, satellite navigation was barely a consumer product. Solar flares - vast exhalations of magnetic energy from the Sun's surface - spray out radiation across the electromagnetic spectrum, from low-energy radio waves through to high-energy gamma-rays, along with bursts of high-energy particles toward the Earth. The radiation or waves that come from the Sun can make sat-nav receivers unable to pick out the weak signal from satellites from the solar flare's aftermath. There is little that current technology can do to mitigate this problem, with the exception of complex directional antennas used in military applications. *http://news.bbc.co.uk*

Russia to track Glonass satellites from Antarctic station

The Academician Fyodorov scientific research vessel has arrived at the Russian Antarctic outpost of Bellingshausen on a mission to set up a station for tracking the GLONASS navigation satellites. *RIA Novosti*

US, wary of China, mulls satellite substitutes

Gary Payton, deputy under secretary for space programs, voiced concern at Beijing's display of technology aimed at destroying missiles in mid-air, an area in which Washington has invested hundreds of billions of dollars to build a layered antimissile bulwark. The US demonstrated an anti-satellite capability of its own, using a specially modified Raytheon Co (RTN.N) Standard Missile-3 to destroy a wayward U.S. spy satellite in February 2008. *www.reuters.com*

Warrant mandatory for GPS tracking

Nowadays, police are tracking suspects with GPS technology, but now two lawmakers say that's an invasion of privacy unless there's an immediate danger to lives. They have introduced bills that would require police to get a warrant. There are several bills in Annapolis, USA that would require police to justify to a judge why they should be allowed to track someone with GPS technology. Police are strongly opposing these bills. *http://wjz.com*

GPS Control Software glitch

GPS Wing issued the following notice on 11 January 2010, the GPS Master Control Station loaded new operational control system software to support future GPS modernization capabilities and signals. The software has been in operational soak and the GPS Master Control Station has received a few user concerns related to the software update. The GPS Master Control Station is preparing to complete soak of the new software in preparation for final install. In support of the final install decision, the GPS Master Control Station requests that operational military and civil users provide any impacts encountered that are believed to be related to the new software or started after the 11 January 2010 install. Military or civil users please contact the GPSOC (military) or NAVCEN (civil) at the numbers listed below. Any user impacts will be presented at the decision brief for final install of the new GPS Master Control Station software.*www.navcen.uscg.gov*

ION 2010 Fellow Membership

The Institute of Navigation (ION) announced the recipients of the 2010 fellow membership. Election to fellow membership recognizes the distinguished contributions of The Institute of Navigation members to the advancement of the technology, management, practice and teaching the arts and science of navigation; and/or lifetime contributions to the Institute. *www.ion.org*

IATA submits Geodetic Survey of 4 Airports to NAMA

The report of the first phase of the World Geodetic Survey [WGS-84] of the country's Airports carried out for the Nigerian Airspace Management Agency (NAMA) by the International Air Transport Association (IATA) has been completed and submitted to the agency. The full survey reports for the Murtala Mohammed International Airport, Lagos, Mallam Aminu Kano International Airport, Kano, Nnamdi Azikiwe International Airport, Abuja and Port Harcourt International Airport as well as their GNSS Procedure design (Airspace Concept) have been submitted to the Managing Director of NAMA, Alhaji Ibrahim Auyo. *http://nigeriamasterweb.com*

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At the G-spatial EXPO, lectures, symposiums and exhibition of products and services will be held. Also opportunities for information exchange among industries, academia and administration will be provided.

The objectives of the G-spatial EXPO Exhibition are to promote the use of space-based positioning technologies and also the creation ofnew type of business utilizing geospatial information, by inviting presentation of proposals and innovative ideas from the private sector on new business, new services and further improvement of existing services.

Official website of the G-spatial EXPO : http://www.g-expo.jp/en/

Galileo update

Satellite Navigation Event

Galileo Application Days, 3-5 March, kicks off the competition with a conference and an 'Application Village', where demonstrations will occur. The annual ESNC competition, or 'Galileo Masters' as it is also known, is designed to stimulate commercial applications using Europe's satellite navigation programmes. The event is being organised by the GSA, and the Application Centre for Satellite Navigation in Oberpfaffenhofen (the 'Galileo Masters'), and is sponsored by the ESA Technology Transfer Programme. The aim is to promote the competition in conjunction with other investments the European Union and ESA make in satellite navigation research. *www.gsa.europa.eu*

OHB-System and ESA sign Galileo contract

The Director of the Galileo Programme and Navigation related activities, Mr René Oosterlinck, and the CEO of OHB-System AG, Berry Smutny, signed the contract for the development and construction of 14 Galileo satellites. These signatures implement the decision made by the European Commission to nominate OHB-System as prime contractor for the 1st 14 satellites.

With a total volume of around EUR 566 million, the contract assigns to OHB-System the function of prime contractor for 14 satellites. OHB will also be responsible to develop and assemble the satellite bus. Under the terms of a subcontract, UK based company Surrey Satellite Technology Ltd. (SSTL) will be developing and building the navigation payload and additionally supporting OHB in the final assembly of the satellites. The 14 satellites will be integrated in Bremen, with the first two scheduled for launch in late 2012. *www.ohb-technology.de*

Arianespace to launch the first ten satellites in the Galileo constellation

Jean-Yves Le Gall, Chairman and CEO of Arianespace, and René Oosterlinck, Director of the Galileo Program and Navigation-related Activities at the ESA, signed the launch contract for the first ten FOC (Full Operational Capability) satellites in Europe's planned Galileo satellite positioning system at ESTEC (European Space Research & Technology Centre) in Noordwijk, the Netherlands. The contract is managed by ESA on behalf of the European Union.

Also present at the contract signing ceremony were Matthias Ruete, Director General of the Energy and Transport Directorate General in the European Commission, and Jean-Jacques Dordain, Director General of ESA.

These ten satellites will be placed in a circular orbit at an altitude of 23,000 kilometres. They will be launched in pairs starting in December 2012, using five Soyuz launchers operated from the Guiana Space Centre. The satellites will be built by the team of OHB Technology of Germany and Surrey Satellite Technology, Ltd. of the United Kingdom. *www.arianespace.com*

At a Glance

Mergers, Acquisitions and Partnerships

- Genasys signs agreement with Telefonica Int to market LBS in 13 countries of Latin America.
- Bentley acquires Enterprise Informatics, Inc and Exor Corp.
- Leica global reseller of MicroSurvey's PointCloud CAD mapping software.
- Leica HDS and INOVx to jointly develop software for converting laser scan data into intelligent plant models.
- PBBI will use Tele Atlas map data across its entire line of solutions.
- Trimble acquires Pondera Engineers LLC
- Terenzio Mariani is the primary reseller of Vexcel Imaging GmbH, in Italy.
- IDV Solutions and Competitive Innovations, LLC enters into partnership.
- GyPSii and Telmap to introduce location-based social networking
- Beijing Siwei Spatial Data Technology Co. is the first reseller for Ultracam photogrammetric products in China
- ScanEx Research & Development Centre and PCI Software, India sign reseller agreement.

Miscellaneous

- SuperPad 3 now supports German, Spanish, and Japanese also
- New Century Software and LandWorks to integrate their respective software
- 1.4 million downloads for Nokia Ovi maps
- Apple bans location-based iPhone advertisements.
- PND shipments will continue to slow, stagnating at 48 million by 2015, ABI Research.

SOUTH

http://www.southinstrument.com
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Bentley delivers 3D City GIS Software

Bentley Systems just-released V8i versions of Bentley Map, Bentley Descartes, Bentley Geospatial Server, and Bentley Geo Web Publisher further extend this portfolio to include new 3D City GIS capabilities. *www.bentley.com*

China ensures a map for every village

Chinese mapping authorities have worked out about 70,000 topographic charts and image graphics for the rural areas in the past year, as an effort to ensure each village has one map of its own. The State Bureau of Surveying and Mapping has also made more than 300 thematic maps and developed 18 GIS tailored for agriculture and rural areas. *www.chinadaily.com.cn*

Cambodia criticises Google maps

Cambodia has hit out at Google over a misleading map of the disputed Thai-Cambodia border, accusing of being "professionally irresponsible". *www.reuters.com*

Croatia launches SDI

The Republic of Croatia has simplified access to countrywide geographic data through an online geoportal, which has already proven its value as an essential component of the country's Organized Land Project, which streamlines and regulates the real property registration of land. The geoportal is modelled after the European Union's INSPIRE directive to share geographic information across Europe. *www.geo-portal.hr*

Pakistan preparing digital maps

Digital maps are being prepared of the cities and towns of Sindh province. First phase includes digital maps of Karachi, Hyderabad, Sukkur, Mirpurkhas, Khairpur, Shaheed Benazirabad and Larkana while maps of Karachi and Hyderabad have been completed from environmental point of view. *www.regionaltimes.com*

Initiative for a global mapping alliance

AND (Automotive Navigation Data - Netherlands), EMG (China) and Orion (Dubai) received has set up a foundation of a Global Digital Mapping Alliance (GDMA) based in the Netherlands. The first objective of GDMA is a feasibility study towards the needs from the market regarding an independent and neutral map data provider offering a worldwide navigable map database. *www.gdma.biz*

NZ scientists working on disaster preparedness in the Pacific

Geologists from GNS Science will spend the next six months collecting information on buildings and other infrastructure in Pacific Island countries to measure vulnerability and risk from earthquakes and cyclones in the southwest Pacific. The Asian Development Bank has contracted GNS Science to carry out the work over the next two years in association with the Pacific Disaster Centre and the Pacific Islands Applied Geoscience Commission (SOPAC), based in Fiji. *www.voxy.co.nz*

Singapore highlights Concept Plan

Minister Mah Bow Tan said Singapore's land use planning for the next 10-15 years has to take into account new trends and emerging issues. Many of these issues are complex and may involve trade-offs between different objectives. He also launched a public consultation to seek public views on shaping Singapore's physical landscape. The Urban Redevelopment Authority announced the launch of the Concept Plan 2011 (CP2011) Review Public Consultation exercise. Two focus groups have been formed to seek feedback from the public on how to provide a good quality of life for all including the elderly, grow in a sustainable way and retain our identity. The Concept Plan maps out the long term directions for Singapore's land use and transportation plans over the next 40 to 50 years. The review is carried out once every ten years and the present review is scheduled to be completed in 2011. *www.ura.gov.sg*

SPOT 4 operations resume

SPOT 4 satellite operations have been resumed after orbital parameters corrections after it was suspended in December 2009. An orbital manoeuvre of SPOT 4 was required due to the approach of two operational satellites SPOT 4 and SPOT 5 flying the similar sun-synchronous orbits in one and the same plane. *www.scanex.ru*

Glacier-melting debate highlights importance of satellites

The Global Climate Observing System (GCOS) has called for the systematic monitoring of glaciers by satellites in support of the UN Framework Convention on Climate Change. In 2007, ESA started the GlobGlacier project as a major effort to develop and apply existing methodologies to monitor glaciers and contribute to a global glacier inventory using satellite observations. GlobGlacier, part of ESA's 'Data User Element', is adding about 20,000 of the estimated 160,000 glaciers worldwide to this inventory to allow their histories to be adequately tracked. The inventory combines information on glacier outlines based on archived satellite data from the Landsat Thematic Mapper (TM) and the Enhanced Thematic Mapper Plus (ETM+) instruments with topographic information from the Shuttle Radar Topography Mission and the Global Digital Elevation Model (GDEM) from ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer). *www.esa.int*

RS technology for Indian Forests

The Ministry of Environment & Forests, India has approved National Forestry Information Network and IT for fire monitoring under an action plan to enhance forestry science. The National Forestry Information Network would be established using remote sensing, GIS and MIS. All land based forestry interventions will be geo-mapped and monitored on a time scale, and will be put in the public domain. IT for fire monitoring is a programme to use satellite data for early transmission of fire signals to the

mobile phones/ PDA's of field officers is being undertaken. *http://pib.nic.in*

Ukraine to launch 11 satellites

Ukraine to form groups of remote Earth-sensing satellites consisting of 11 spacecraft in orbit by 2030, according to National Space Agency of Ukraine. The groups will consist of space vehicles with optical sensors and space vehicles with radio frequency sensors. Ukraine is preparing a launch of Sich-2 earth observation satellite to orbit this year. *www.kyivpost.com*

CBERS-3 go ahead

Brazil and China shall launch the fourth China Brazil Environmental Remote Sensing (CBERS) satellite in 2011. At the initial phase (1988-2003), two satellites, CBERS-1 and CBERS-2, were sent into space. China was responsible for 70 percent of the first series of satellites. The construction of CBERS-3 and 4 will be shared equally. *Xinhua*

Flight-testing of cryogenic stage of GSLV in April

Indian Space Research Organisation Chairman K. Radhakrishnan said the flight- testing of the indigenous cryogenic stage of the GSLV D3 would be conducted in April. The vehicle would carry GAST-4, a communication satellite. "Though we had several GSLV flights, we were using the Russian cryogenic stages," he said. *http://beta.thehindu.com*

ERDAS adds support for WorldView-2

ERDAS announced support for WorldView-2 satellite products. Using ERDAS IMAGINE and LPS 2010, GEOINT and military analysts, state and local governments, civil organizations, first responders, and non-governmental organizations can now transform WorldView-2 imagery into timely, relevant and accurate geospatial intelligence. *www.erdas.com*

ISO gives car industry new interface

As the car navigation industry has grown so has incompatibility between navigation systems and the databases that store important location information. Additionally, there is a need to more easily develop navigation system applications. ISO is contributing solutions to those issues with an International Standard for a navigation system application programming interface (API). ISO 17267:2009, intelligent transport systems – Navigation systems – API, will help facilitate the interoperability between navigation systems and map databases by providing an interface that will make information accessible and retrievable as well as assist developers of navigation systems. The new standard describes what data may be retrieved from a database, defines the interface for access and specifies a set of navigation function calls. *www.iso.org*

Maploader to the Wisepilot platform

Appello Systems introduced Maploader - a service which enables the user to pre-load high quality maps to the mobile phone and always have them available, regardless of connectivity. Wisepilot Maploader enables to load maps in batches of country by country. *www.appello.se*

Verizon Mobile Broadband Devices

Acoording to Verizon Wireless businesses can now use select Mobile Broadband PC cards and USB modems with a variety of third-party LBS applications for navigation, in-vehicle tracking, geo-fencing and more. Location-Enabled Mobile Broadband uses the device's built-in GPS receiver to enable portable computing devices, such as laptops, to communicate relevant location information directly to the user or business. *www.verizonwireless.com*

Globe introduces GPS tracking system

The Globe Business GPS Tracker is a business solution that will give entrepreneurs, especially those in the delivery business, the ability to monitor their vehicles in real-time using the GPS. Entrepreneurs are able to monitor and know the exact location of their trucks and cargo en route to their destinations. *www.globe.com.ph*

Turkey Yellow Pages deal with NAVTEQ

Turkey Yellow Pages has signed a 5 year strategic partnership with NAVTEQ and Nokia Global Mapping Platforms who will providing comprehensive and categorised Turkish based business listing information and POI's. This local search company will be the sole reseller of 2 new location based mapping and navigation advertising products (offered by NAVTEQ and Ovi Maps) as well. *www.pr.com*

Geometry releases GIS for the iPhone

Geometry iGIS is a GIS application to deliver GIS functionality to the iPhone and iPod Touch. It allows iPhone owners to load, view and add their own data over the Google Map background that is available on all iPhones. *www.geometryit.com*

IGN transfer PND business to Medion

French governmental map maker Institut Géographique National (IGN) has selected Medion to use its "IGN Evadeo" brand. Medion is taking over the PND sales in France under the IGN Evadeo brand with hybrid products made both for in-car navigation and hiking which are ruggedized and waterproof (rated IPX4 or IPX7). *www.ign.fr*

GPS Mobiles to drives sales

The GPS market is witnessing a steady growth on the back of increasing usage in vehicle navigation, fleet management, asset tracking,consumer GPS markets etc. As per the newly updated research report "World GPS Market Forecast to 2013", the worldwide shipments of GPS devices is projected to grow at a CAGR of over 20% and GPS-enabled mobile handsets at 25% between 2010 and 2013. *www.rncos.com*

u-blox acquires patents for low-power real-time GPS

u-blox has purchased 15 patents and patent applications from UK-based Air Semiconductor Ltd. The patents expand the company's technology portfolio of low-power GPS solutions. *www.u-blox.com*

Rockwell Collins tracks military signal

Rockwell Collins has achieved live satellite M Code tracking with its new GPS receiver for the Modernized User Equipment (MUE) program. The MUE receiver card development program is developing the military user equipment portion of the next-generation GPS system that incorporates a new military signal and security architecture. It offers enhanced integrity, exclusivity and improved anti-jam capabilities. M Code, which stands for Military Code, is a key element in the modernization of military GPS. While it is transmitted on the same L1 and L2 frequencies used by the legacy P(Y) Code, it will significantly improve the security of military GPS. *www.rockwellcollins.com*

Leica Zeno GIS handhelds & software

Leica Zeno GIS offers professionals multi-functional and easiest GNSS/GIS solution with superior performance. It provides a one-click automated workflow between the field and office. It provides a color graphic display in portrait format and a numeric keypad. Leica Zeno 15 comes with a full QWERTY keyboard and a display in landscape format. The Field software is an OEM version of ESRI ArcPad 8 and also provides a full range of functions to easily control the integrated GNSS receiver and to manage the data collection process such as GNSS raw data logging, easy handling of GNSS real-time configurations, feature accuracy management etc *www.leica-geosystems.com*

ECIL contract for Rockwell Collins

Rockwell Collins was awarded a contract for Electronic Counter-Counter Measure (ECCM) radio modules by Electronics Corporation of India Ltd. The component hardware card sets will be integrated into ground-based UHF for Defence use. The contract also includes GPS hand-held receivers. *www.rockwellcollins.com*

Timble News

EZ-Sync™ solution is a wireless data transfer capability that provides enhanced information management for growers and agribusinesses. It is compatible with Trimble® Juno™ SC or Trimble Nomad™ 800XC. This makes it possible to wirelessly send GPS maps such as soil sampling, field scouting, and boundary maps from the field to the office.

4D Control software is the core of Trimble monitoring solutions that combines GNSS and optical technologies for real-time deformation monitoring applications like monitoring dams, bridges, buildings, pipeline etc.

TS835 Mechanical Total Station enables contractors to increase point layout productivity and accuracy while reducing rework and project expenses. It offers 5-second accuracy and a fast, long-range EDM with precision optics. *www.trimble.com*

Quadrifilar Antenna for precision GPS L1/L2 Band

Maxtena's dual band L1/L2 quadrifilar antenna, the M1227HCT22A uses Advanced Helicore™ Technology to achieve greater than +2.5dBic performance in both GPS L1 and L2 bands for "dual-frequency" Precision GPS applications. It has axial ratio typically 0.5 dB, upper-hemisphere efficiency >40%, and high-linearity LNA. *www.maxtena.com*

Broadcom's new GPS Receiver Solution for Mobile Devices Sets

Broadcom Corporation single-chip GPS solution for mobile devices sets new standards in performance and low power consumption with state-of-the-art sensitivity and navigation performance. *www.broadcom.com*

Ashtech introduces ProFlex™ Lite

Ashtech ProFlex Lite is a GNSS sensor that allows OEMs and system integrators to easily integrate RTK positioning into their applications. It is a positioning solution that delivers enhanced real-time precision ranging from sub-meter down to centimetre level. It is scalable and available in a variety of configurations from L1 GPS+GLONASS+SBAS up to L1/L2 GPS+GLONASS+SBAS. *www.ashtech.com*

New FARO Scene Software

FARO Scene 4.7 is the latest version of its scan processing software for its Laser Scanner. It features more efficient point cloud handling and visualization due to the new 64 bit architecture which extends the usable memory. The new Web-Share functionality is natively built into it and requires no additional software to publish the scan data on the web. *www.faro.com*

Topcon FC-250

The FC-250 has the operating system power of the latest Windows Mobile® Version 6.5. The PC performance with 806MHz processor and 256MB SDRAM is designed to significantly speed up data collection in the field. It also has a built-in Bluetooth® modem and wireless LAN capability as standard features. *www.topcon.eu*

Sokkia new series Total Stations

Sokkia 50RX reflectorless total stations are the high-temperature models and are newly added for use in the heat of up to +60°C (+140°F) without compromising the lowest operating temperature of -20°C (-4°F). The IP66 protection shuts out powder dust, sand, mud, snow, dripping water, or driving rain. The range is extended to 400m (1,310ft.). Also the variation of measurement time

due to different ranges and object types are reduced by 30% to increase total measurement speed. *www.sokkia.com*

Tests of BlueSky Positioning's A-GPS technology

EMT has completed its initial field testing of BlueSky Positioning's A-GPS technology. The tests were conducted using both GPRS and USSD (Unstructured Supplementary Services Data) for retrieving assistance data in a live 3G network. EMT Estonia is the first network operator to test a USSD connection for assistance data, allowing BlueSky Positioning's A-GPS solution to be used with ordinary mobile phones, even if the model does not support GPRS. *www.blueskypositioning.com*

Blom awarded NOK 20 million contract in Mongolia

Blom has been awarded a consultancy services contract in Mongolia by the Millennium Challenge Account - Mongolia (MCA-M), as part of the Property Rights Project. Blom will provide full business analysis and recommendations on improving registration information technology systems, processes and procedures; develop management tools and guidance documents; digitize registry data; develop interconnection of 13 separate offices; incorporate property registry processes and information into IT systems; establish data flow connections between property rights data and the National Land Information System; and cooperate with architectural design firm, monitoring and evaluation contractor and IT and equipment provider. *www.blomasa.com*

Tallysman Wireless launches new GPS

Tallysman Wireless TW120 GPS Inline Amplifier is an industrial-grade low-noise, low-power amplifier with 25dB gain, the TW120 is specially designed to tightly filter and boost weak GPS L1 signals, while maintaining low antenna noise figures. *www.tallysman.com*

MicroSurvey releases PointCloud CAD

PointCloud CAD 2010 is a CAD, Surveying, and Point Cloud system. It includes the same rendering engine that is used in products like 3DStudio, Solidworks, Pro Engineer, and Microstation. It lets you analyze, edit, and build compelling surfaces, drawings, and animations with ease. *www.microsurvey.com*

Septentrio AsteRx3 Product Series

Septentrio AsteRx3™ product series is designed for integration in precision positioning, navigation, and automation applications such as land and maritime survey, machine control, UAV payloads, amongst others. To support these applications an embedded suite of algorithms called GNSS+™, which provides users with tools for achieving the benefits of simultaneously receiving all modernized GNSS signals as soon as they are made available. *www.Septentrio.com*

Aftek's Integrated Device Controller

Aftek launched its touch-screen enabled GPS / GRPS / WiFi / GSM enabled Integrated Device Controller (IDC) which offers seamless integration with a variety of peripheral devices, such as taxi fare meter, receipt printer, credit card payment terminal, smart card reader for automated fare collection and more. *www.aftek.com*

Infoterra launches interactive 3D city mapping service

Infoterra launched Skape, a 3D city mapping service designed for architects, planners, local authorities and surveyors. It enables users to manipulate urban landscapes online by combining high resolution 3D textured city models with 2D mapping and terrain data. With Skape, new buildings can be imported into a city and viewed in context with their surroundings, whilst existing buildings can be instantly removed and replaced. *www.infoterra.co.uk*

First responders using DeLorme GIS Software

As many as 500 responders and relief workers in Haiti are now using GIS software, GPS receivers and crucial map data provided by DeLorme. A combination of DeLorme XMap mapping software, Earthmate PN-Series GPS devices and DeLorme Digital Map Data for Haiti have proven invaluable to a variety of first responding organisations during the early phase of the earthquake recovery efforts. *www.delorme.com*

India News

GIS blueprint to combat Maoist
The Indian government want to use an integrated GIS synchronised with GPS in the battle against Maoist. *http://timesofindia.indiatimes.com*

GIS based applications in e-Panchayat
e-Governance Project for Panchayati Raj institutions (e-Panchayat) in India includes decentralised database and planning, budgeting and accounting, implementation and monitoring of central and state sector schemes, citizen-centric services, unique codes to Panchayats and Individuals and essential GIS based applications. Under this project, Internet connectivity will be provided to all 236,000 panchayats in the country across 31 states and Union Territories. The project will focus on three activities—identification of information and services needs of all stakeholders, process re-engineering and preparation of Detailed Project Report (DPR) for Mission Mode Project (MMP). *www.igovernment.in*

Haryana selected for SIS-DP project
Haryana in India is selected under the major remote sensing and GIS application project entitled 'Space-based Information Support for Decentralised Planning' (SIS-DP) of ISRO. The project would provide ICT enabled geospatial platform involving local bodies to carry out developmental activities under the Panchayati Raj in a decentralised, fast and transparent manner. The project would include thematic mapping of the state on 1:10 K scale.*http://timesofindia.indiatimes.com*

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www.geosiberia.sibfair.ru

ASPRS 2010
26-30 April
San Diego, CA, USA
www.asprs.org/SanDiego2010

May 2010

TIDES 2010
20-21 May
Taipei, Taiwan, R.O.C.
derc@mail.pccu.edu.tw

International Conference on Integrated Navigation Systems
31 May - 02 June 2010
Saint Petersburg, Russia
http://www.elektropribor.spb.ru

June 2010

Toulouse Space Show 2010
8 - 11 June
Toulouse, France
contact@toulousespaceshow.eu
www.toulousespaceshow.eu

IMTA Asia Pacific Conf. & Trade Show
18 - 19 June
Melbourne, Australia
www.maptrade.org/events

GEA'2010
22 -24th June
Cracow, Poland
jacek@gea.com.pl
http://gea.com.pl/targieng.php

July 2010

ISPRS Centenary celebrations
4 July
Vienna, Austria
www.isprs100vienna.org

ESRI International User Conference
12–16 July
San Diego, USA
www.esri.com

September 2010

IPIN 2010
September 15-17, 2010
ETH Zurich, Campus Science City
(Hoenggerberg), Switzerland
www.geometh.ethz.ch/ipin/

ION GNSS 2010
21-24 September
Portland, Oregon, USA
www.ion.org

G-Spatial Expo
19 - 21 September
Yokohama, Japan
g-expo@jsurvey.jp
www.g-expo.jp/en/

International Astronautical Congress 2010
27 Sep - 01 Oct
Prague Czech Republic
iac2010@guarant.cz
www.iac2010.cz/en

October 2010

INTERGEO
5 - 7 October
Cologne, Germany
www.intergeo.de

GSDI-12 World Conference
19-22 October
Singapore
www.gsdi.org

GEOINT 2010
25-28 Oct
Nashville, Tennessee, USA
http://geoint2010.com

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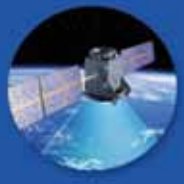

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