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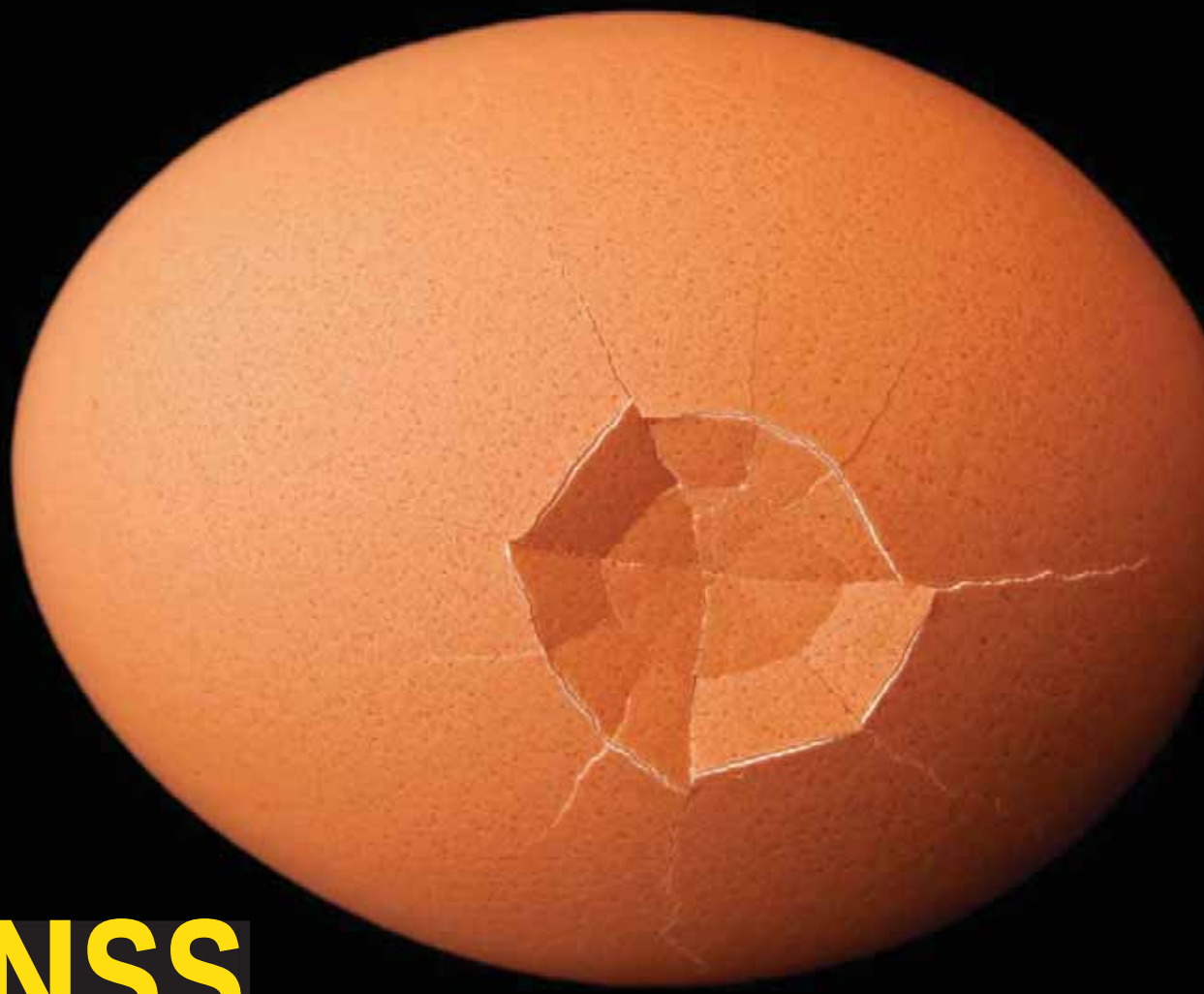

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Articles

Columns

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Bal Krishna, Editor
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Possibility or a dream?

Spatially Enabled Geovernment and Societies

Geospatial experts from different background and part of the world share their views on Spatially Enabled Government and Society (SEGS) at UNRCC-PCGIAP International Symposium organized by Department of Surveying and Mapping Malaysia during 15 – 16 February at Kuala Lumpur, Malaysia. They highlight pertinent issues, challenges and suggest way forward to achieve the goal

The ultimate challenge

Paul Cheung
Director of Global Geospatial Information Management (GGIM) Secretariat and Statistics Division, United Nations

It is important to deal with institutional, legal and common frameworks, management models, and technical standards for the building of sustainable spatial data infrastructures.

The ultimate challenge is how we can help countries develop the full potential of geospatial information and the underlying technology in order to make it accessible to, and able to be used effectively by, a broad range of users.

Sustaining the technology

Hiroshi Murakami
PhD, Director-General,Geospatial Information Department, Geospatial Information Authority of Japan (GSI)

GPS or the satellite positioning and timing technology has been deeply interwoven in various activities of the society now in Japan, ranging from vehicle (cars, airplanes, ships, trains, etc.) navigation to timing for online trading. It is anticipated that there could be insurmountable damage to the functions of the society in case GPS signals were to be disrupted indefinitely.

However, the technology currently depends totally on the operation of one country. While Russia, EU and China are developing their own GNSS, political leaders in Japan have come to an understanding that the country should be independent and self-sustained on this important technology.

A journey, not an end

Teo CheeHai
President, International Federation of Surveyors (FIG)

Spatial maturity could not be simply defined with a set of parameters. Instead, it would be more evolutionary, progressing from one stage to another. The goal posts may change and keep moving forward. In a sense, it is a journey and not an end. The important aspect is that that such a journey is shared by most if not all of the jurisdictions within the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) region. We should endeavor to engage more and more jurisdictions in this journey. It may so happen that some of the jurisdictions may progress slower than others but all are the part of this journey, striving to progress towards a spatially enabled society as that would ultimately benefit the people within these jurisdictions. If we fail to involve all these jurisdictions, particularly the small islands and developing jurisdictions in this journey, then that would be sad for humanity.

Build with the end goal in mind

Brent A Jones
PE, PLS, Global Industry Manager, Cadastre/ Survey/AEC, Esri, USA

Successful cadastral systems evolve. As societies, culture, laws, and technology evolve, so can the benefits from the system. It is important to understand full spatial enablement and begin building with the end goal in mind and build a system designed to evolve and grow.

For citizens

Datuk Prof Sr Dr Abdul Kadir Taib
Director General, Department of Survey and Mapping Malaysia

The geospatial information generated by mapping agencies like Department of Surveying and Mapping (JUPEM), Malaysia should ultimately benefit the people and society. I will consider the objective of spatially enabled governance and society has been achieved when geospatial information is not only used by the government agencies which are working in geospatial domain but also by those agencies who do not deal with geospatial data directly. However, the geospatial data should ultimately be used by the citizens. When that happens, I can say, we are Spatially Enabled Society.

Legislative interoperability

Peter M Laarakker
Advisor, Cadastre, Land Registry and Mapping Agency, The Netherlands

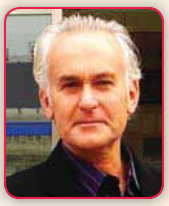
The processes of land management like land use planning, taxation and property rights registration both use ánd produce land information. One of the objectives of an NSDI is to reuse the produced information as much as possible for the other land management processes. The extent to which this is possible is depending on the laws that govern those land management processes, that all have a perspective on spatial reality but which perspectives are not necessarily the same. One can speak of legislative interoperability when all hindrances for reuse in these land management laws have been removed and concepts and definitions of spatial objects are aligned as much as possible.

We seriously risk "spatial stagnation"

Greg Scott
Group Leader, National Geographic Information, Environmental Geoscience Division, Geoscience Australia

By definition, 'spatial enablement in action' means that we (governments) must make our spatial information "actionable". That is, it must be used and leveraged beyond just for mapping. It must form the enduring fundamental authoritative spatial data layers of a nation, and do so in a way so that it is able to support evidence-based decision making for the many social, economic and environmental drivers challenges that face our Governments. It is incumbent on us doing so. Should we not do so, we seriously risk "spatial stagnation", and have a rich resource of geoinformation that remains largely untapped and with significant unrealised potential.

Technology transfer is a key



Professor William Cartwright
School of Mathematical and Geospatial Sciences, RMIT University, Australia; Chair, Joint Board of Geospatial Information Societies

Capacity building and technology transfer is a key issue for spatial and geographic information management. There is a need for a global agenda for capacity building and technology transfer for countries in the context of spatial information. This element is also central to the objectives of the Joint Board GIS member organizations in support of local, national and international spatial data management and infrastructure developments that will allow nations and their citizens to better address social, economic, and environmental issues of pressing importance.

Knowledge transfer, conducted by Joint Board of Geospatial Information Societies (JB GIS) member associations, in many instances conducted in collaboration with national member organizations, affiliates and industry, are provided to contribute to the provision of new knowledge and to foster the advancement of the discipline. In order for students to have access to relevant courses and for industry to keep abreast with developments in technology and contemporary geospatial information thinking, it is important for relevant educational courses be offered.

JB GIS is committed to supporting existing educational courses and providing specialist courses where needed. Sister organisations that form the JB GIS champion education and training. This can be in the form of traditional university and training college programmes, short courses for professional and technical members of mapping agencies and as outreach initiatives to transfer knowledge about the discipline and its contemporary practices.

These programmes can be supported by JB GIS member associations offering programmes independently, or in partnership with sister associations.

Kuala Lumpur declaration on Spatially Enabled Government & Society

We, the participants of the United Nations sponsored Permanent Committee on GIS Infrastructure for Asia and the Pacific International Symposium on Spatially Enabled Government and Society, with the theme "Towards Spatial Maturity" held at the Kuala Lumpur Convention Centre, Kuala Lumpur, Malaysia on February 15th and 16th, 2012, having met in the context of building trust to promote understanding and to enhance collaboration in the field of geospatial information and spatial enablement that addresses current national, regional and global challenges, hereby issue this ***Kuala Lumpur Declaration on Spatially Enabled Government and Society.***

Recalling Resolution 16 at the 13th United Nations Regional Cartographic Conference for Asia and the Pacific in 1994 that established the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP),

Noting Resolution 1 at the 16th United Nations Regional Cartographic Conference for Asia and the Pacific in 2003 on the importance of spatial data infrastructures in supporting sustainable development at national, regional and global levels,

Further noting Resolution 5 at the 18th United Nations Regional Cartographic Conference for Asia and the Pacific in 2009 to understand, compare and determine the state of spatially enabled government and society including levels of maturity and governance of spatial data infrastructure in the region,

Bearing in mind that the rapid development and increased demand for spatial information infrastructures in all countries in past years has made geospatial information an invaluable tool in policy planning and evidence-based decision making,

Mindful that spatial enablement, that is, the ability to add location to almost all existing information, unlocks the wealth of existing knowledge about social, economic and environmental matters, and can play a vital role in understanding and addressing the many challenges that we face in an increasingly complex and interconnected world,

Acknowledging that spatial enablement, by definition, requires information to be collected, updated, analyzed, represented, and communicated, together with information on ownership and custodianship, in a consistent manner to underpin effective delivery systems, good governance, public safety and security towards the well being of societies, the environment and economy,

Recognizing that geospatial information includes 'fundamental data' that is essential and therefore must have authority, currency, resilience and sustainability, be comprehensive, freely available, accessible and usable for informed decision-making, which immediately leads to better policies and sustainable actions, and more open, accountable, responsive and efficient governments,

Agree that spatially enabled societies and governments, recognizing that all activities and events have a geographical and temporal context, make decisions and organize their affairs through the effective and efficient use of spatial data, information and services,

Resolve to fully support the initiative of the United Nations to implement global mechanisms to foster geospatial information management among the Member States, international organizations, and the private sector, and in this regard to make every effort to:

- enhance national efforts including investments towards the managing of all information spatially and the realizing of spatially enabled governments and societies with a focus on citizens and users;
- confirm the importance of governance and legislative frameworks and the need for legislative interoperability;
- confirm the importance of authoritative and assured data and information, encourage the incorporation of volunteered information, develop enabling platforms by locating, connecting and delivering information from different scales, purposes and origins;
- confirm the importance of common geodetic reference frameworks, positioning and network infrastructures;
- avail resources to invest, manage and sustain the capture, collection and collation of fundamental data and information and to reduce duplication in these efforts;
- build and use common standards and frameworks to ensure interoperability;
- enhance institutional arrangements and stakeholder collaborations; and
- improve returns on investment through better coordination, use and reuse of data, information and systems and to enhance innovation and productivity.

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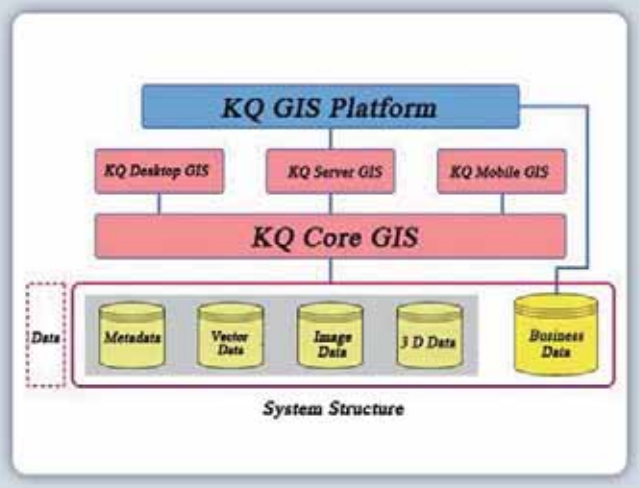

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Need for collaboration

Sr Ahmad Fauzi bin Nordin
Deputy Director General of Survey and Mapping, Malaysia

It is obvious that there are enormous benefits of a government being spatially enabled- this includes improved decision making and improved delivery mechanisms. However to realize a spatially enabled government, there needs to be much collaboration, because the effort is multi-disciplinary in nature. The Treasury need not have reservation in providing funding for data collection and maintenance works as studies have shown that there is positive return on investment (ROI) in funding those works.

Challenge is legal and institutional arrangements

Professor Woosug Cho
Department of Civil Engineering, Director, Inha Innovation Center for Engineering Education, Inha University, Korea

The key challenge in the context of spatial governance is legal and institutional arrangements which define most of national, regional and global activities in collection, dissemination, utilization as well as service of geospatial information toward a spatially enabled society.

Change in mentality

Michael Sutherland
PhD, Department of Geomatics Engineering and Land Management, University of the West Indies, St. Augustine, Trinidad & Tobago

The shift in paradigm in governance (towards spatially enabled) will happen only if there is change in mentality. The shift in mentality is really from a divisionist view of the world to a holistic, systems view of the world. We design institutions, systems, processes, databases etc. based on the way we think - our perceptions of needs. The divisionist mentality hardly makes space for sharing information in the design process because it is focused only on fulfilling of narrow mandates - on the partial view of the world. The holistic, systems thinking mentality perceives the need of the whole even in the design of parts. It is systems thinking that is the germ for the SDI concept in the spatial enablement of government and society, but SDI implementation will be stymied if all stakeholders do not share the holistic mentality - they will pose barriers to its development.

The key drivers

Fuziah binti Abu Hanifah
Director, Malaysian Centre for Geospatial Data Infrastructure (MaCGDI), Malaysia

Data policy and copyrights need to be clearly identified as driving forces in the context of geospatial information sharing.

The direction – Not to make millions but to serve millions

Keith Clifford Bell
The World Bank, East Asia Pacific Region, Washington DC, USA

I would like to refer Maslow's hierarchical theory of human needs (physical and psychological) , which dates from 1943. Through taking a Maslow optic of the eight Millennium Development Goals (MDG) provides a refreshing perspective of the links between human development needs and broader development needs including economic development. At the lowest level of Maslow, are the basic needs of people to survive - Food, Water and Shelter. Currently, more than 1 billion of the world's population or 20% live without access to safe drinking water. More than 13% of the world's population are hungry, one billion children live in poverty (or 1 in 2 children in the world) and 640 million live without adequate shelter. Poverty is the principle cause of hunger.

Much of the pitch for SEGS, is for high end economies, where people already have met the requirements of the lower levels of Maslow and indeed the MDG. We see this in the sophisticated applications of GPS enabled cell phones, in-car navigation systems and other applications that Maslow would rank at the self-actualization level of human development and enrichment - that is those trying to make millions. Only infrequently, do we see then pitch for SEGS aimed at the lowest level of Maslow - those struggling to survive - that is, those millions trying to make it. Thus as key professional and industry organizations such as FIG, GSDI and ICA continue to promote SEGS, and we see similar advocacy from PCGIAP, UNRCC and now UN GGIM, greater consideration needs to be given to the power of SEGS to help those at the low end of Maslow's hierarchy - those struggling to survive, or just make it. SEGS has enormous potential to contribute to the successful realization of the MDG.

GNSS vulnerabilities: Testing the Truth

GNSS may be based on satellites, but the solutions to widely known vulnerabilities are no longer rocket science!

Dr C S Dixon
Business Development Manager, GNSS Research & Applications Centre of Excellence (GRACE), The University of Nottingham, UK

Dr C J Hill
Principal Research Officer, Nottingham Geospatial Institute, University of Nottingham, UK

Dr M Dumville
General Manager and a Director, Nottingham Scientific Limited, UK

Dr D Lowe
Principal Navigation Engineer, Nottingham Scientific Limited, UK

A lot has been written in the open civil domain about the vulnerabilities of GPS. The GPS system, whilst proven as extremely accurate and reliable, is vulnerable to a range of threats. Headline warnings have included the US DoT Volpe report [2] from 2001, the Royal Academy of Engineering Report [3] of 2011, interruptions to GPS-based services in some regions at the last Solar maximum, and jamming analyses conducted by the General Lighthouse Authorities [4] and many others. Prof. Last and Dr. Basker [5] even warned us at the recent ENC GNSS Conference that the vulnerabilities of GPS could lead to an increase in the price of our daily bread! Despite the warning messages, GPS has generally continued to work wonderfully well. Bread prices have been as stable as supermarket profit margins and consumer budgets dictate they should be.

GPS (or to use the generic term that encompasses GLONASS, Galileo, and Beidou as well, GNSS) is global. The systems provide hundreds of millions of users around the World with a very cheap mechanism to do nearly anything that involves positioning and timing. The enormous benefits of Global Navigation Satellite System (GNSS) are compounded by the tiny price tags associated with buying and running user equipment, and there have been no catastrophes to date! Inexorably, GNSS has become embedded in transport systems (land, air, and sea), timing systems, communications systems, banking, emergency services, route finders, tolling systems, and many, many more. As a society we are already arguably critically dependent on GPS (and to a lesser, but growing, extent on the other GNSSs).

The question is, do we need to wait for a catastrophe before we take action to protect ourselves against known vulnerabilities of systems based on GNSS? The threats are not theoretical ones, but have been witnessed "in the wild". They have been recorded, quantified, written about, recreated in the laboratory and examined quite extensively in some cases. So can we afford to continue ignoring their impact on an increasing range of applications and services that are fundamental to modern life?

This paper is based on a presentation [1] given to the European Navigation Conference ENC GNSS 2011, held in London in November 2011. We present an overview of threats and vulnerabilities of GNSS systems in general and with a focus at application level across a spectrum of domains. We highlight some of the important countermeasures that are already available on the market, but which are not ubiquitously used. We argue that those responsible for the procurement of equipment and services (including state and private organisations) need to devote effort to quantifying the real threats that their systems will face operationally in order to ensure that procured equipment will be effective in operation. Vulnerabilities are illuminated by results from our experiments during the Defence Science & Technology Laboratory (DSTL) live jamming trials conducted in summer 2011 as part of project VULCANO. We argue that testing of equipment, applications, and services must be conducted against test specifications aligned with the equipment's performance specifications,

and should include robustness to operational threats and vulnerabilities.

Vulnerabilities and threats

Despite the good performance of GPS, there are more than a few GNSS vulnerabilities and threats. Categorisation into unintentional and intentional is sometimes done to aid understanding. Unintentional disruptions include natural phenomena such as high levels of ionospheric disturbance and solar flares, as well as man-made phenomena including system errors (satellite or signal), and unwanted radio frequency transmissions (TV, microwave communications, radar, ...). Intentional disruptions are where a user is deprived of GNSS services deliberately. These include jamming / interference, and spoofing.

The unintentional threats are an ongoing concern. They should not, however, be considered to be stable threats simply because they're unintentional. The imminent "Solar Maximum" makes the situation worse, since increased levels of solar radiation will lead to increased disturbance of Earth's ionosphere, to increased electron count and variability, and to scintillations that degrade and disrupt GNSS signals. As we write this article, NASA have reported (19th January 2012) that a potent solar flare has unleashed the biggest radiation storm since 2005 that could disrupt some satellite communications and no doubt GPS too in the polar regions. Judging from the impact seen at the last Solar Maximum around 2000, GNSS services will certainly be disrupted again by the imminent maximum. GNSS receivers will lose lock on the signals they're tracking, resulting in outages of tens of minutes or a few hours. Oil and gas exploration services suffered the main impact in 2000. They were the only "sophisticated" users in the worst affected areas around the equator and tropics. There will be many more users in a great array of application fields this time.

The other major change in unintentional threats to GNSS is the pressure on shared use of a finite radio spectrum. Communications and broadcast services march ever onwards supporting our societal growth, and with the growth in modern multi-media communications there is an ever-increasing demand for bandwidth / spectrum. "Light-Squared" is the latest, but by no means the only communications service to cause a problem to GNSS receivers. And of course, GNSS Systems, when operating on the same frequencies as each other, interfere to some extent with one another's signals. As more systems and satellites enter the fray, the background interference worsens.

Illustration of Regions most susceptible to Ionospheric Disturbance and Scintillation

GPS Jammer – one of many available on the internet

The threat of intentional disruptions to GNSS services is also growing. GPS is used to track both valuable cargoes and tagged offenders. It's used in tracking devices that thwart car thieves. It's used in some countries to measure the journeys of road vehicles in order that drivers can be billed for their motoring miles. These innovations unfortunately give criminals an incentive to interfere with GPS services: a professional car thief can continue about his business of stealing Ferraris by using a combined GPS / GSM jammer to block the car's anti-theft system from knowing and reporting where the vehicle is. This criminal incentive, combined with the inherent innovation of humanity, has led to a substantial business for making and distributing GPS jammers. They can be bought online, or one can build one's own from plans published on the internet!

Countermeasures

There is a vast array of countermeasures available. Here we say a few words about some of them:

System-Level Countermeasures
(generally these countermeasures are "out of scope" for users of GNSS Systems and applicable only to the Systems' designers. There is however a notable exception: Systems bought with taxpayers money should deliver services that meet the needs of those taxpayers – if you perceive that System providers are not doing all they could to make your GNSS robust, then lobby them and the organisations that fund them to do better! RIN is one good rallying point for such activity.)

- Multiple signals mean that if one

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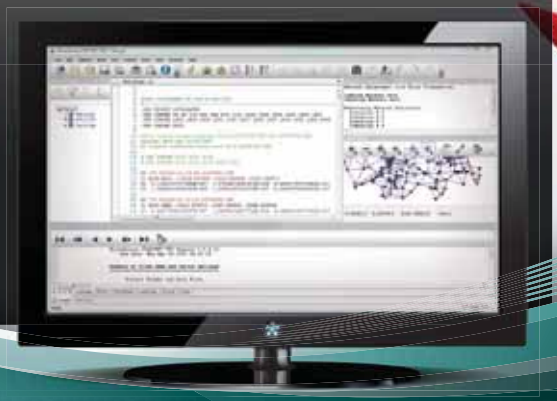

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signal is degraded then appropriately equipped users can use another instead.
- Signals themselves can be transmitted at a higher power; spot beams can be used to increase incident power over a limited region. This will of course increase the impact of mutual interference to other systems.
- Signal encryption / decryption and authentication of signals and data all make spoofing more difficult.

Countermeasures based on Receiver Antennas
- Choke ring antennas block (or at least decrease) incident power at low elevations. This reduces or eliminates the impact of any interference from low elevations as well as improving performance by reducing multipath. Such antennas may weigh several kilos and measure 40cm across, so they, like many countermeasures, are more appropriate for some applications than others;
- Gain optimised antennas can do the same as can CRPA (Controlled Reception Pattern Antenna (often colloquially referred to as an anti-jamming antenna)) (null-steering, etc.) antennas although this technology is only widely available to the military.

Receiver-based Countermeasures
- Multi-system and particularly also multiple-frequency use grants a level of robustness, unless interferers also cover multiple frequencies.
- Radio-Frequency Front-End (RFFE) checks can identify interference. This can be used to alert users to a problem in order that its impact can be mitigated at application level or user level.
- Monitoring and filtering of interference can eliminate or mitigate its effect, and / or detect its presence at receiver level.

Terminal / Application-Level Countermeasures
- Hybridisation & Redundancy in simple terms means combining the GNSS navigation part with other sensors such as an Inertial Measurement Unit (IMU), compass or odometer. In the event of GNSS problems, the second (dissimilar) system takes over as the primary navigation means.
- Secure interfaces and tamper-proof hardware reduce the risk of physical tampering, which may be the major threat for some applications (automotive anti-theft units, fishery units that track vessels to ensure no-fishing zones are respected).

Back-office Countermeasures
- Prediction – direct comparison of predicted measurements (and predicted course) with reported measurements / course can be carried out in a back-office to indicate GNSS or other problems that may warrant action or investigation.
- Integration of GNSS data with other data sets can again be used either in back-office or a mobile application to identify problems.

Contingency Plans can also be excellent counters to GNSS threats. They are often economic and simple to implement, albeit with a degraded service level compared with that when GNSS is fully operational. The key point is to plan ahead so that they can be implemented when needed!
- Wait until service resumes. In the event of a GNSS problem, do you really need to do that operation right now, or could you wait for a few minutes or hours, or go to another location?
- Abandon mission. Potentially a serious decision to make, but this may be the only safe option in some cases.
- Proceed using what we used before we had GPS (e.g. using visual navigation cues / using voice reporting of police officer locations / voice reporting of truck fleet location, etc.)
- Use alternative techniques or routes.

Application vulnerabilities

It can be very constructive to consider the consequence of GNSS system or application vulnerabilities in terms that are meaningful to particular users. The table below gives a simple summary for several domains of operation that were considered during the VULCANO study. It lists the consequence of vulnerabilities against three major categories – safety, economic impact, and environmental impact. Enormous complexity and depth of analysis can of course be

	Consequence		
Domain	**Safety**	**Economic**	**Environmental**
Maritime	Vessel and passenger safety may be compromised	Delays; Loss of services	Pollution (e.g. in the event of accident); Risk of damage to property
Road	Secondary effects (high reliance on Satnav systems from many road users and fleet operators)	Loss of revenue RUC (Road User Charging); Erosion of Public confidence Suboptimal routing/ re-routing of fleets	Pollution from suboptimal routing
Timing	Loss of CNI (Critical National Infrastructure) systems dependent on GNSS	Loss of Systems dependent on GNSS	Secondary effects
Emergency services	Personnel safety may be compromised if personnel locations and movements cannot be tracked	Operations may be able to continue but may be more costly	Typically none
Other (applicable to many domains)	Generally none	Downtime of services dependent on GNSS may lead to loss of revenue or to loss of productivity	Typically only secondary?

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pursued in this type of analysis, but our simple summary gives at least a feel for some of the major factors.

Failures – Results from field trials

During Summer 2011, NSL and The University of Nottingham seized the opportunities offered by the Technology Strategy Board-supported VULCANO project and by DSTL's GPS jamming trials at Sennybridge, to examine what actually happens to real navigation equipment in real operational situations of interference. A wide selection of equipment was tested including:

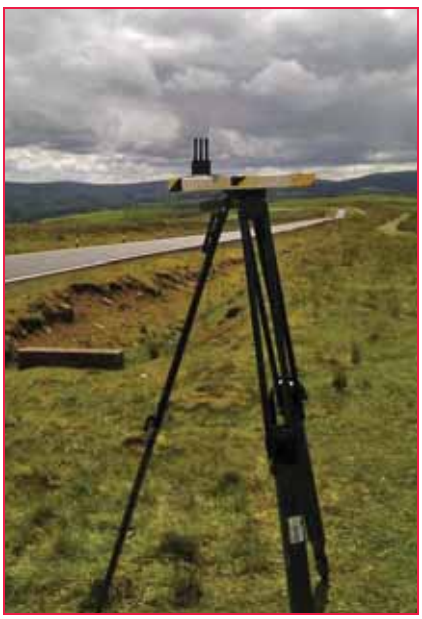
- Consumer grade
- Commercial grade
- Professional grade
- Augmented (inertial, Micro Electro Mechanical Systems (MEMS),...)
- GLONASS receivers
- And eLORAN

We had some interesting findings, some of which were presented at the ENC GNSS conference in Autumn 2011. After the presentation, one questioner asked me *"what did you see that was unexpected?"* Unfortunately, my questioner had missed the point. What I might expect as a navigation expert of a quarter century standing when I go to GNSS jamming trials is one thing. Surprisingly enough that will not be the same thing as the expectations of the poor fellow going about his daily business, relying (perhaps even unknowingly) on GPS, and not thinking nor indeed even knowing about jamming at all. Most of the population are not navigation experts. Most believe that jamming is something that Auntie Katie does when she isn't marmalading!

In the relatively controlled environment of the wet and windy Welsh hills, with the relatively friendly DSTL jamming set-up, what we saw is what you, dear reader, could experience with your GPS equipment out in the real world when you're using GPS to (a) guide your private plane or (b) wondering what's happened to the high-value cargo you thought you were tracking in your armoured car, or (c) whatever real-World application you have. Suddenly interference or jamming or high levels of ionospheric disturbance will cause the same effects we saw, but in a situation where you're not expecting it. If you have no countermeasures and no fall-back, you might suffer extreme consequences resulting from your loss! Indeed, you might not even notice there's a problem because there's a very high probability that your current-generation GNSS equipment will not report it to you! At the very least, you might notice when you've lost your way, run aground or can't find your armoured car on the map.

Amongst other things our equipment suffered the problems shown in the table below. The impact at receiver level is listed, along with likely impact

Receiver Impact	User Impact
Loss of accuracy Noisy position solution "wanders" around real location	User (generally) slightly off course
Spurious position information (errors) Jumps in position Big and small jumps seen	User uncertainty, Loss of confidence in equipment
Loss of signal No position	User is lost, ... but knows it!
Hazardous Misleading Information (HMI) Credible such that "reasonableness checks" fail to identify problem	User is lost, ... and doesn't know!



One of the Jammers

Nottingham Geospatial Institute's Trials vehicle

at user level. The user level impact is often the more meaningful one for anyone who isn't a GNSS equipment designer, but is of course dependent on what impact is suffered at receiver level. User Impact is also highly application specific. Position jumps may be annoying to surveyors and have to be post-processed out as outliers. The same position jumps could also lead autopilot equipment to alter course, which could be rather more serious.

Jamming test (lower power) – Vehicle drove along the road, suffering a loss of satellites (and position) close to the jammer. The coloured line shows the recorded track with colour indicating the number of satellites tracked. As we continued away from the jammer satellites were recovered and navigation regained.

Testing robustness

If we need systems based on GNSS that are robust against threats & vulnerabilities, then we need to specify what they must be robust against – i.e. a threat specification is needed. And then we need to prove that the systems are robust against it!

The partners in the VULCANO project, NSL and GRACE, proposed a GNSS vulnerabilities Test Methodology covering specification and recording of vulnerability testing. It included:

- Test regime
- Equipment under test
- Mode (acquisition, re-acquisition, and tracking behaviour may be very different)

Jamming test (higher power) – vehicle drove along the road and almost immediately suffered impacts from the jamming. Position was reported off-road by 10's of metres (the vehicle never left the road); at other times no position was available.

- Conditions to test (specification)
- Test Equipment
  - Jammer types, powers, characteristics, other threats, ...
- Monitor equipment
- Test Process (Specific steps)
- Outcome
  - Expected
  - Observed
- Findings, Conclusions, Recommendations

The Test equipment is obviously rather specialised. Simulators and live jammers along with anechoic test environments are all part of the paraphernalia. Much of this equipment already exists in military circles; less exists outside those circles. GRACE, with its mandate to support GNSS testing in the UK is developing test types, procedures, resources and success criteria as well as tools required to assess GNSS vulnerabilities, and highlighting the need for test specifications for operationally realistic threat scenarios. This is the latest part of the story of industrial and institutional efforts to define UK needs for GNSS Testing (acknowledging efforts from organisations and individual participants in UKSpace, Intellect, and the Digital Systems KTN, as well as the 2011 Royal Academy of Engineering Report on GNSS Reliance & Vulnerabilities).

Conclusions

GNSS vulnerabilities are many and varied and include natural and man-made threats. Some are getting worse (imminent solar maximum, spectrum demand, low-price jammers coupled with incentives to use them). The impacts can be serious on a huge array of user applications. Do we really need to wait for a catastrophe before taking action against GNSS vulnerabilities?

Many countermeasures already exist. Their effectiveness against threats is variable – some are effective against one threat but not another. Some countermeasures are more applicable to certain applications than to others due to factors such as cost, size, weight, and form factor. Countermeasures will of course be more effective where users mandate their inclusion in GNSS products; if users are complacent then we can only assume that suppliers will be too, since they have little incentive for action.

In our opinion users need to assess the vulnerabilities of their applications, and need to create procurement specifications that specify actual operational needs, including robustness. End Users may need to engage specialist support to ensure that new equipment is not only cost-effective but operationally effective too! To support this, threat analyses, including characterisation of both unintentional and intentional threats needs to be published in order that they can be protected against.

Test Procedures should be standardised, and should include testing against defined threats, in order to prove that equipment does what is needed under realistic operational conditions. Test Equipment and Test Beds also need to be developed and better coordinated. The ongoing activity examining UK's needs for GNSS Test Facilities must take account of the needs of GNSS vulnerabilities testing, including both equipment-level testing and application-level testing.

It's all solvable. Major portions are already solved. GNSS may be based on satellites, but the solutions to widely known vulnerabilities are no longer rocket science!

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Acknowledgements

This paper is based on a presentation given at the European Navigation Conference ENC GNSS 2011, held in London in November and December 2011. The experimental work reported here was carried out by staff from two partner organisations working together in the VULCANO Project. The industrial leaders were Nottingham Scientific Limited and the academic partners were from the University of Nottingham, and specifically from the GNSS Research and Applications Centre of Excellence (GRACE) and the Nottingham Geospatial Institute (NGI). Project VULCANO was supported by the Technology Strategy Board as part of their competition "Feasibility Studies for Innovation in Space". The field tests of GNSS equipment were conducted as part of the Jamming Exercises run by DSTL at Sennybridge during summer 2011.

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The realization of [the] geocentric datum for Brunei Darussalam 2009

Readers may recall that we published a paper "The realization of [the] geocentric datum for Brunei Darussalam 2009" in September 2011 issue of Coordinates. We have received a comment on this paper from Kazimierz Becek and Adam Lyszkowicz. We shared this comment with Survey Department, Ministry of Development, Brunei Darussalam for their response. We publish here both, the comment and the response

Dr Kazimierz Becek
Universiti Brunei Darussalam, Brunei Darussalam

Dr Adam Lyszkowicz
University Warmia & Mazury, Poland

Introduction

Replacing the horizontal datum of a country is a complicated and difficult project. The decision to embark on such a "revolutionary" move should only be taken after in-depth studies to identify compelling reasons for such replacement. Here, we comment on the article by Tahir *et al.* published in the September 2011 issue of *Coordinates*. In this article, the authors discussed some aspects of the replacement of the horizontal datum of Brunei Darussalam–Timbalai 1948 with a geocentric datum known as the Geocentric Datum of Brunei Darussalam 2009 (GDBD2009). The article also outlines the selected map projection, Rectified Skew Orthomorphic (RSO).

Survey Department responds:
We are fully obliged and thankful to the comments and critics from Becek et al concerning the publication of the article titled "The Realization of Geocentric Datum for Brunei Darussalam 2009" in Coordinates, Sept 2011.

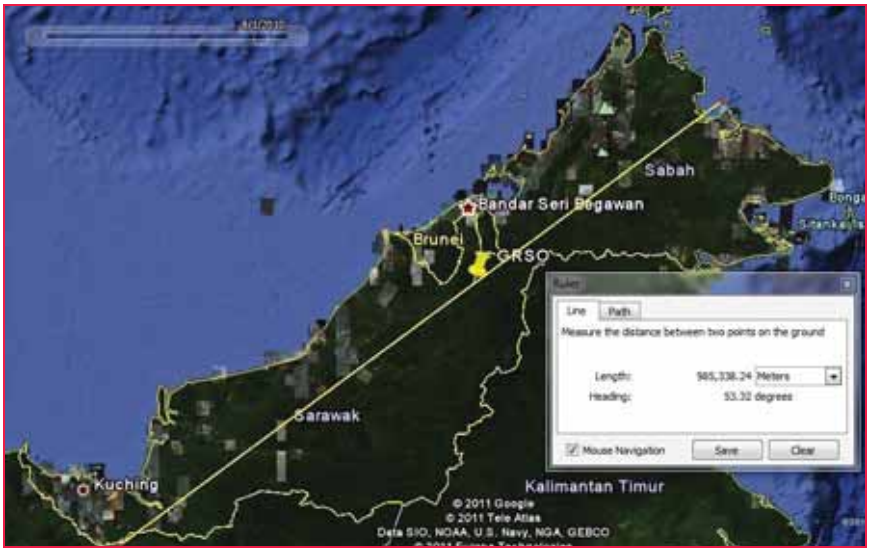

Figure 1. Brunei Darussalam and the Malaysian provinces of Sarawak and Sabah are located in the North-western section of Borneo. The yellow pin indicates the origin of the BRSO projection (N4o, E115o), which is coincidental with the origin of the "geocentric RSO." The yellow line running diagonally across the picture marks the central line of both the BRSO and the geocentric RSO projections (azimuth 53o 18' 56.91582"), and it passes through the origin of the projection. While the central line of the projections appears to be optimal for Sarawak and Sabah, it does not seem favourable to the territory of Brunei Darussalam. Source: Background image, Google Earth®; the pin and the central line – own work

When a country should change its geodetic datum?

The relatively recent developments in GNSS technology have dramatically changed the *modi operandi* of geodesy and the surveying profession to an extent that, wherever possible, GNSS has replaced traditional surveying methods, including traversing and triangulation. The widespread adoption of the GNSS technology which uses the geocentric datum promotes replacing local datums with a geocentric datum similar to the datum used by the GNSS systems. Already in 1990, FIG has been recommended this datum migration by countries around the world. Soon after, in 1991, the maritime nations associated with the International Hydrographic Organisation (IHO) have recommended the production of future navigational charts on a geocentric datum. This move was followed by the International Civil Aviation Authority

Figure 2. The approximate geometric centre of the territory of Brunei Darussalam is marked with a white spot in the centre of the picture. The radius of the white circle containing the entire territory of Brunei Darussalam, including the coastal waters, is approximately 80 km. The yellow pin indicates the centre of the BRSO/GRSO projection (N4o, E115o). The yellow line represents the central line of both projections. Source: Own work; background image, Google Earth®

(ICAO), which decided to conduct its operations in relations to a geocentric datum. In 1994, at the United Nations Regional Cartographic Conference for Asia and the Pacific, participants resolved to adopt a geocentric datum as soon as possible. This conference also established the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) to develop a common datum in the region. Some of PCGIAP member countries have already adopted geocentric datums. According to the EPSG database, until December 2011, over 80 countries have already adopted a geocentric datum. Among of them, since 2009, is Brunei Darussalam.

Survey Department responds:
At least Mr Becek is aware of the present development in geodesy.

It is expected that this trend will continue in the future, despite all the efforts required, and despite an increase in positioning errors caused by the usually larger separation between geoid and the geocentric ellipsoid (plumb line deflection).

Survey Department responds:
The above statement is true in the conventional geodesy where we were measuring terrestrial data (angle, EDM distant, etc) which need to be reduced on to the ellipsoid for computation of coordinates. The bigger the separation between geoid and ellipsoid leads to bigger error in coordinate determination. Therefore a best-fit ellipsoid was critically needed for geodetic datum realization in view of providing a platform for accurate national mapping.

In the present space geodetic era, we do not employ old geodetic data reduction concept since we are able to determine accurate 3D coordinates or 3D vector from space geodetic measurements (satellite to receivers range derived from either code or phase measurements). The 3D Cartesian Coordinates derived from GPS, for instant, can be split into the latitude and longitude, representing the horizontal component, and into the ellipsoidal height representing the geometrical height above the ellipsoid of reference, without any lost of accuracy.

Some comments on the selected map projection

In the article, Tahir *et al.* (2011) stated the following to justify the adoption of the same map projection as the previous one, i.e. the RSO projection: "*For many years, Brunei Darussalam has been using the Borneo Rectified Skew Orthomorphic (BRSO) projection for the country…*"

The RSO map projection was adopted in 1948 long before Brunei gained its independence, i.e., when the country, together with Sarawak and Sabah, was still under British rule. Figure 1 provides basic information on the RSO projection, including the centre of the projection (4o N, 115o E) and the central line of the projection, which passes through the central point at the azimuth 53o 18' 56.91582." This type of map projection was adopted to optimally map the oblique shape of the then area of interest (Sarawak, Brunei and Sabah). Since then, Brunei Darussalam has managed its geodetic needs on its own. The country would be expected to select a projection that best suits its current territorial area and shape. Figure 2 shows that the shape of the country resembles a circle. There is, therefore, no reason to use

the RSO projection, especially with the central line and the point of origin of the projection outside of its territory. By adopting the RSO projection with these parameters, Brunei is overlooking the fact that the scale along the central line is the true one.

Given current trends in geoscience and the shape of the country, including its offshore water areas, it would appear that it would be more suitable to use one of the many variations of the transverse Mercator projection, including the UTM Zone 50. The latter is also the most GNNS-friendly solution.

A note on the terminology

Since 1948, the official name of the geodetic datum used in Brunei, Sarawak and Sabah is Timbalai 1948. This name continues to be used in Brunei after the country regained its independence. On all topographic and other maps produced in Brunei, this name is used to refer to the geodetic datum. In addition, Timbalai 1948 is used on the Navy Charts produced by the British Admiralty. Software manufacturers, including ESRI and ERDAS, refer to the datum used in Brunei as the Timbalai 1948 datum. This name is also listed in the EPSG database. Yet, for unclear reasons, Tahir *et al.* (2011) refer to the Brunei geodetic datum as the Borneo Triangulation 1948 or BT48. It is unclear as to why the Survey Department of Brunei Darussalam supports this inconsistency in the terminology. History provides plenty of examples that these types of inconsistencies are frequent sources of confusion in the geodetic, surveying and mapping communities.

Conclusion

1. Based on the above, the Survey Department should be congratulated for the bold reform of the geodetic datum through the adoption of the geocentric datum – GDBD2009.

Survey Department responds:
The move to geocentric datum has been thoroughly strategized and implemented according to the international standard and has taken into consideration all technical as well as legal aspects. So it is rather unwise to say that this reform is a BOLD reform.

2. Confusion may arise from the statement that "*With GDBD2009, geodetic coordinates of a point determined in WGS84 using GPS could be directly projected to their related geocentric RSO plane coordinate values* [without the need transforming them to GDBD2009 first – added by the Authors]." This simply implies that GDBD2009 datum is not necessary, because the WGS84 coordinates may be directly projected to the "geocentric" RSO.

Survey Department responds:
Application of satellite positioning technology in maritime navigation has been practiced by commercial ships and liners, the NAVY and port authorities. Intelligent Transportation System (ITS), which integrates GPS positioning technology, ICT and electronic technology, has been widely used in modern transportation system. For example, an autonomous ITS system requires the integration of GPS positioning equipments with electronics chart in a vessel enabling the system to give effective travel direction since its position is always shown on the chart. Other such applications are in the aviation and fleet management. GDBD2009 will provide better coordinate system infrastructure compatible with GPS positioning technology implemented for navigation applications. With GDBD2009, geodetic coordinates of a point determined in WGS84 using GPS could be directly projected to their related geocentric RSO plane coordinate values.

This is an advantage that will spur the use of GPS for navigation applications in this country.

From geodesist point of view, there is nothing wrong with the statements. GDBD2009 is the realization of ITRF2005 which is consistent with WGS84 at cm level, in other words WGS84 = GDBD2009 at cm level of accuracy. The third paragraph in the article purposely discussed about GPS applications in navigation with coordinate's accuracy of a few meters is sufficient.

3. The RSO map projection for Brunei Darussalam is not an appropriate one because the mapped territory (onshore and offshore) has a circular shape (does not have any prevailing direction). The RSO projection is used for mapping territories which are extended in a particular direction such as the East Malaysian states of Sarawak and Sabah taken together.

Survey Department responds:
It is true when you are given the task to design a surveying and mapping system for a new country where the only consideration is to select the best map projection as normally described in the text book.

4. The parameters of the "geocentric" RSO are not optimal for Brunei because the central line of the projection (the distortion-free line) does not pass through the territory of the country at all.

Survey Department responds:
Cadastral system in Brunei use RSO projection for alienation of land parcel. The Certified Plan (CP) for the land parcel is a legal document as well as the information in it (bearings and distances). Changing to the other map projection or major modification of the existing projection parameter i.e. central line, false origin etc will also change the coordinate's convergence, the shape and size of an area, and;

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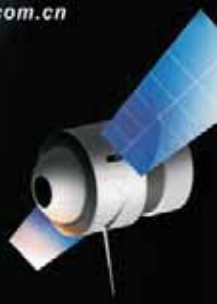

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a) Survey Department of Brunei Darussalam need to call back hundred of thousand of CPs for correction of bearings, distances and area size. This has to be done by court order.

b) Changing the size and shape of an area will upset the owners and it might end up in court battle.

Maintaining the existing map projection is the best solutions for the largest users of Continuously Operating Reference Stations (CORS) in Brunei.

5. To avoid confusion, the well-established name of the disposed Brunei geodetic datum - Timbalai 1948, should be used, rather than its alias (BT48).

Survey Department responds: Please do not mix-up between Timbalai 1948 and BT48. Timbalai 1948 (East Malaysia and Brunei) and Kertau 1948 (West Malaysia) is the official names used by DoD (Department of Defence or previously known as Directorate of Colonial Surveys).

Both coordinates systems used Molodensky 3-Parameters transformation to transform BT68 and MRT68 to NSZWC, WGS72 and WGS84 system using numbers of Doppler stations in Malaysia. On the other hand, BT48 and BT68 is the official names for Borneo Triangulation, a network covered Sabah, Labuan, Brunei and Sarawak. Any derivation of transformation parameter (3, 4 or 7) to or from BT48/68 shall maintain the triangulation network name's in order to differentiate with DoD's 3-Parameters Timbalai 1948.

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SNIPPETS

At a Glance

- Valley Air Photos purchases second UltraCamX
- Webtech Wireless announces release of Quadrant Manager
- TomTom launches GO 2050 and Via range of PNDs in Indonesia
- Sygic GPS App reaches 5 million downloads
- New T8 Mini telematics unit from Trakm8
- Rolta releases Rolta Geomatica™ 2012
- RMSI joins Google's Authorized Reseller program
- The Muscat Electricity Distribution Company introduces mobile GIS solution device
- mapIT pens distribution deal with deCarta
- SuperGeo provides GIS training to Kuwait Ministry of Public Works
- Central Informatics Organisation Bahrain signs MoU with Esri
- Trimble reports strong growth in 2011
- Applanix releases POSPac MMS 5.4 Service Pack 2
- Yotta DCL, UK wins £2.27m surveying contract
- Rx Networks announces multi-mode GPS/GLONASS 14-day extended ephemeris assistance solution
- u-blox UMTS/HSPA+ wireless module
- TomTom India sets up map making facility in Pune
- Archaeological Survey of India seeks Surveyor General's help to protect heritage sites
- Massachusetts Institute of Technology's Computer Science and Artificial Intelligence Laboratory developed a new system that allows robots to build and continuously update a 3D map of their environment
- Esri UK to supply cloud-based GIS services to public sector
- NASA map reveals height of earth's forests
- Centre for Wind Energy to develop solar atlas for India
- Security concerns keep power lines off Japan's topo maps

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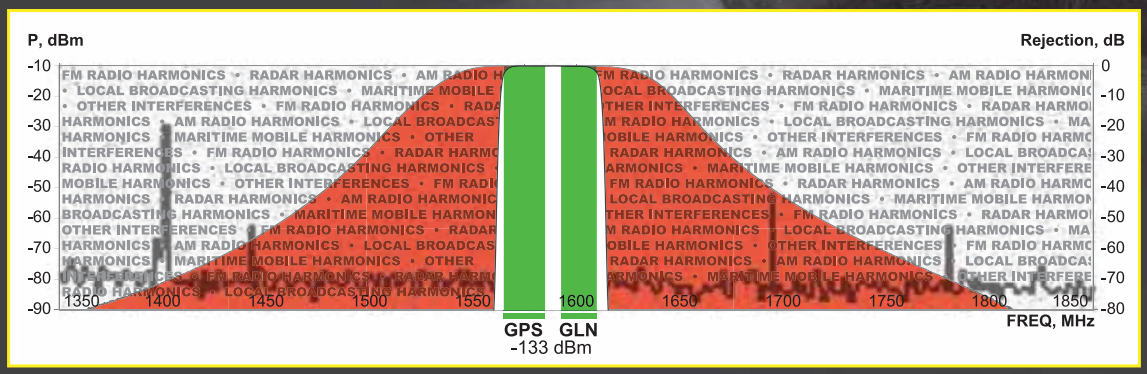
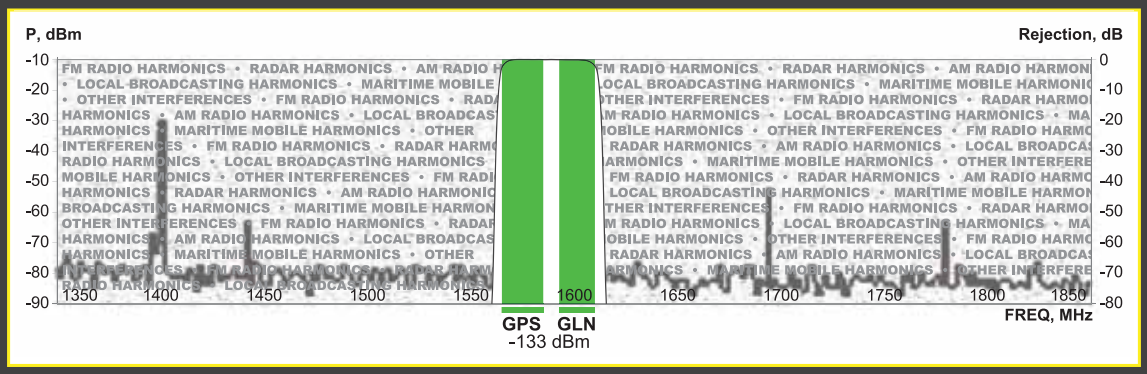


It invites more white noise and other unwanted signals in and degrades performance (with or without LightSquared).

They say they cannot build anything better!

This filter is good



It brings every drop of GNSS signals in undisturbed, protects against unwanted white noise and other interference, and provides better performance.

They say they cannot build this, it is too difficult!

Controller for Field Applications

VICTOR-VS

We complete our receivers with an ultra-rugged Windows CE controller for Field Applications. VICTOR-VS is powerful, waterproof, shockproof and versatile.

- **Loaded with Revolutionary Software**
- **4.3-inch display of 800x480 pixels**
- **Two 24+ hours rechargeable batteries**
- **Integrated camera 3 Mpixels**
- **Rugged, lightweight**

TRIUMPH-VS

Revolutionary new GNSS complex that combines high performance 216-channel GNSS receiver, all-frequency GNSS antenna, and a modern featured handheld.

- Complete RTK rover unit

TRIUMPH-NT

- Where you don't need internal GNSS antenna

Same as TRIUMPH-VS but without internal GNSS antenna, inclinometers, compass and cameras.

VICTOR-VS

- 4.3-inch display of 800x480 pixels
- Integrated camera 3 Mpixels

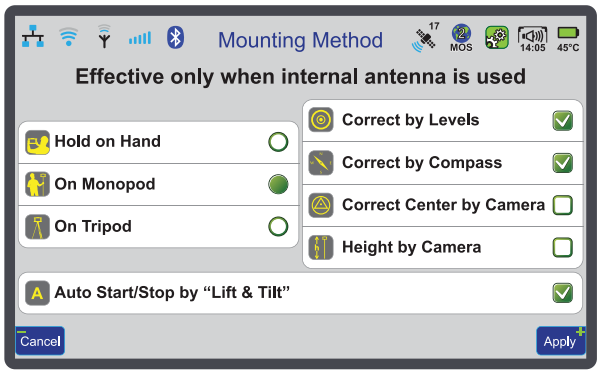
VICTOR-VS is powerful, waterproof, shockproof and versatile controller for Field Applications.

Don't Look! Don't Touch! ... Survey with Lift&Tilt

It seems TRIUMPH-VS reads your mind! Many sensors, intelligence, and innovations inside TRIUMPH-VS bring this new revolution to surveyors.

You don't need to look. You don't need to touch.

First, put TRIUMPH-VS in "Lift & Tilt" mode.



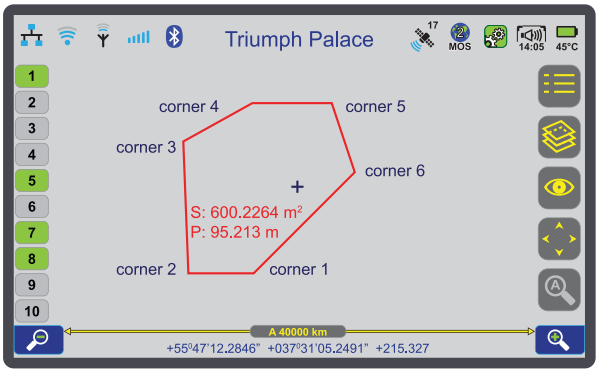
- Then, go to the survey mark, lift TRIUMPH-VS to near vertical (better than 5 degrees). Survey will start automatically and sensors continuously compensate for leveling offsets. Audio tones keep you informed of the survey progress. You can use a headset if you are in noisy area. You can also take notes by talking to TRIUMPH-VS.

- When you are happy with the survey result, just tilt the TRIUMPH-VS (more than 15°) and walk to the next point. TRIUMPH-VS will close files automatically.

- Then go to your next point. Lift it up and do again as you did in the previous survey point: Do Nothing! Just lift it up to near vertical.

- When you are happy again, tilt it again, and walk to the next point. Points and file names will auto-increment. You can over-write names if you like.

- If you are doing a parcel survey (for example) after the last parcel point, push "Parcel End" and see the parcel map, parcel area and parcel perimeter instantly.



See who jams your GPS/GNSS

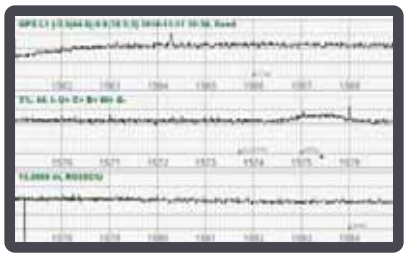
TRIUMPH-VS

shows interferences in all GNSS bands
Including LightSquared possible interferences

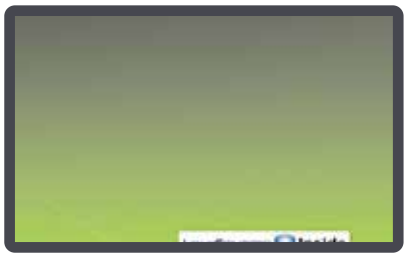
Your GNSS receiver sometimes does not track satellites? Sometimes RTK solutions get stuck in “Float”, or take longer to converge to “Fixed”? You may have interferences in one or more of your GNSS bands. In addition to harmonics of signals like local TV and radio stations, now there are $10 GNSS jammers on the market that interfere with GNSS signals as well!

The GNSS interference analyzer feature of TRIUMPH-VS does much more than a generic $30,000 spectrum analyzer. TRIUMPH-VS shows interferences by analyzing signals before RF and after digital sections and quantifies how much interference is in your neighborhood. See the reverse side for more detail.

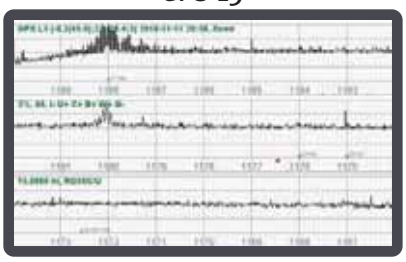
GPS L1



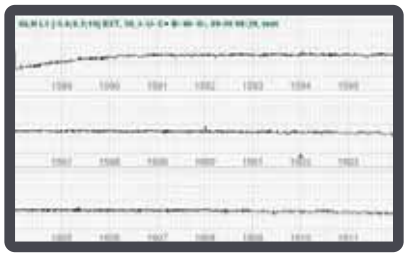
GPS L2



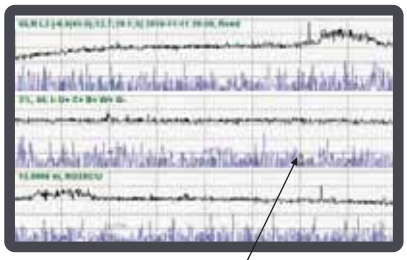
GPS L5

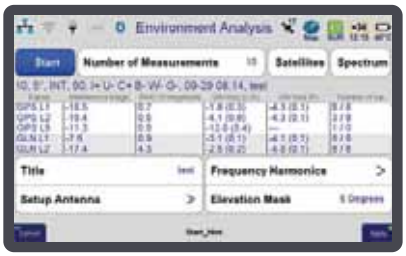


GLONASS L1



GLONASS L2





Center of the Band

TRIUMPH-VS not only scans the GNSS bands and shows the shape and frequencies of the interferences, but it also quantifies the magnitude of the interferences in two distinct and complementary ways: a) by analyzing the analog signal and determining the “Interference Magnitude”, and b) by analyzing the S/N (Signal-to-Noise ratio) of all satellites’ signals after they are digitized and processed (after code and carrier correlations) and determining the “Satellites S/N loss” due to interferences.

“Interference Magnitude” is determined by analyzing the amount of gain that we can apply to the GNSS signal before digitizing it. The more interference there is, the less we can amplify the signal to avoid saturation. We can determine the “Interference Magnitude” by comparing the actual amplification magnitude with our nominal amplification magnitude (when no interference exists).

“Satellites S/N loss” is determined by comparing the actual measured S/N of each satellite (for each of its signals) with its nominal S/N at that elevation angle and then averaging all such deviations for all satellite signals.

TRIUMPH-VS not only analyzes and shows interferences, it also has In-Band Interference Rejection option that removes in-band interferences.

Try TRIUMPH-VS and Compare!

First visit www.javad.com and view our 21 GNSS Video Lessons (total of about 4.4 hours). It will be a good learning experience, even if you do not proceed with the following offer:

- To experience the **TRIUMPH-VS**, pay **$2,990** and receive one complete system with all accessories for RTN/VRS RTK, or RTK using your own base station (like a TRIUMPH-1 or another TRIUMPH-VS).

- Experience it for one month. To purchase it, send us three additional monthly payments of $2,990. Or send it back for a full refund.

Visit our dealer near you or www.javad.com

Limited time offer and subject to credit approval.

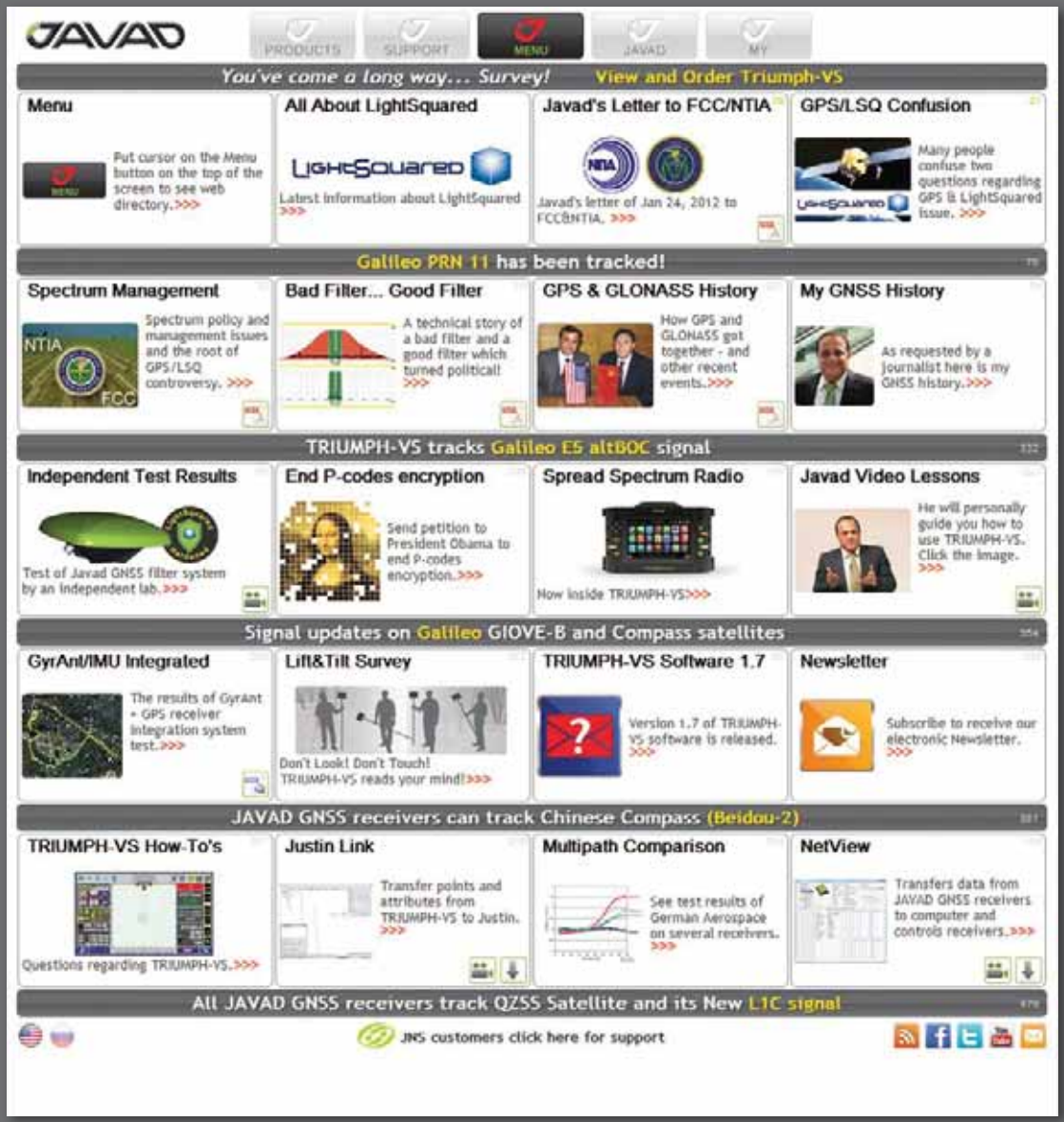
Complete RTK rover unit

TRIUMPH-VS

3 Products Packaged in One!

1. High precision all-frequencies GNSS Antenna GPS+GLONASS+Galileo
2. Revolutionary, compact, 216-channel GNSS Receiver
3. Breakthrough, wide-screen, high-resolution handheld controller

For the latest GNSS news and technical information visit www.javad.com



Applications relying on position, velocity and timing information will grow

says Dr Guenter Heinrichs, Head of Customer Applications, Business Development, IFEN GmbH

IFEN is pushing the boundary in satellite navigation'– How would you explain this?

Founded in 1998, IFEN is recognised as a forerunner in several satellite navigation technologies and respected for defining industry standards.

IFEN was the first company in Europe to work on ground based integrity monitoring. Starting out with research and development in 1999 for regional augmentation system EGNOS V1, IFEN is currently providing maintenance to the current SoL certified EGNOS V2 for the integrity check. Furthermore, IFEN will continue to make major contributions to the ongoing definition of the next generation EGNOS V3.

Since 2000 IFEN has been heavily involved in the design and implementation of Galileo global integrity. Of special remark, IFEN invented the new concept of Memory Codes in 2003, used today for Galileo E1 and E6 signals. Additionally IFEN is the only European provider of the verification receivers for the Galileo payload test system and the provider of the Galileo UERE monitoring facility. What's more the worldwide first Galileo test range GATE in Berchtesgaden, Germany was designed and developed by IFEN, acting since 2010 also as system operator of GATE.

IFEN also offers a comprehensive range of outstanding GNSS test solutions for the commercial market, focusing on flexible multi-GNSS and multi-frequency RF signal generators with leading-edge support for up to nine RF frequencies and 108 signal channels and also offers flexible and customizable multi-GNSS and multi-frequency test receivers.

These important milestones represent our company vision, which is to push past all the boundaries of today's technology standards to deliver unrivalled excellence in satellite navigation for all working results, products or services. Our ambitions are challenging but pushing the boundary is our 'self image'.

What could be the key drivers for navigation market?

With respect to the navigation market, today we are living in exciting and challenging times. The key drivers for the navigation market today and in future are in our opinion twofold. They are application based on one hand and technology driven on the other.

Application based means that the number of applications relying on position, velocity and timing (PVT) information will grow permanently in future. Many applications are already using this information today, predominantly derived from worldwide available satellite navigation systems. The growing number of applications demanding such PVT information even under challenging environmental conditions, such as in inner cities, in urban canyons or indoors, will in future also affect and most likely change the technical requirements of the user equipment (GNSS receivers or more generally GNSS positioning sensors).Furthermore, at minimum this will influence the usage requirements of the global satellite navigation systems.

From a technology point of view, the navigation market starts changing already today from the usage of a single satellite navigation system, primarily GPS, towards the usage of multiple satellite navigation systems, called multi-GNSSs (Global Navigation Satellite Systems). Examples are the combined use of GPS and GLONASS already today in the consumer market (e.g. in smart phones and for car navigation) and the usage of multi-GNSS (e.g. GPS + GLONASS + Galileo + SBAS + QZSS), combined with multi-frequency, in the professional market. Additionally in the future it is foreseeable that the use of dual-frequency equipment in the consumer market will also be in demand.

Last but not least, both of these key drivers for the navigation market will at the end of the day also affect the testing requirements for GNSS receivers and positioning sensors and finally the testing needs for GNSS based applications. IFEN will be prepared for this future challenge by providing a complete portfolio of leading-edge GNSS test solutions.

Would you like to tell us something about your joint venture with 'WORK Microwave' in the context of NavX®–GNSS test solution?

IFEN's primary commercial products line 'NavX® - GNSS Test Solutions' is designed to provide the users with a complete range of integrated navigation test products and services unique on the market, which surpass the performance of standard satellite navigation. To be able to do justice to this

claim, we were very glad that we could find with WORK Microwave, a leading European manufacturer of advanced satellite communications equipment, a reliable partner who has in-depth expertise in RF design and manufacturing.

Based on IFEN's outstanding satellite navigation and GNSS signal design know-how and experience, gathered in the frame of its participation in the European EGNOS and Galileo programs, IFEN decided in 2005 to step into the commercial GNSS RF signal simulator market. For this venture RF expertise was essential for the market success and this was the reason for the birth of our partnership with WORK Microwave, which to this day has been a very successful partnership, supported greatly by the local proximity of both partners in Germany.

Today, IFEN produces its NavX®-NCS (Navigation Constellation Simulator) range of commercial multi-GNSS RF signal simulators in partnership with WORK Microwave for already nearly six years.

With the NavX®-NCS series, we provide the first GNSS RF signal generators in the world capable of simulating GPS, Galileo, GLONASS, QZSS and SBAS simultaneously in a single chassis. They are the only GNSS simulators in the market today offering both flexibility and scalability with full multi-constellation and multi-frequency capability. The NavX®-NCS series of GNSS RF signal generators offered by IFEN in partnership with WORK Microwave therefore sets a"new standard" for GNSS RF signal simulation.

GATE closes the gap between laboratory based constellation simulations and the real-world Galileo system. Please elaborate?

The development of products, services and applications is a key factor for the commercial success of a satellite navigation system. This was the basic thought behind the idea of setting up an open-air test infrastructure also for Galileo. A similar approach has already been followed by GPS with the setting up of the initial YUMA test bed decades ago in the late 1970's.

The initial idea the development and setting up of the **Ga**lileo **T**est and Development **E**nvironment – GATE is based on, is related to the problem that by the natural physical restrictions of the laboratory based constellation simulators limits are set to the realistic simulation of multipath and interference effects. Yet it is these effects caused by environmental conditions, such as for inner cities, for urban canyons or for indoor scenarios, and deteriorating the GNSS signals that are becoming more and more the dominant navigation errors. Especially in the case when the more dominant ionospheric error can significantly be reduced by using multi-frequency GNSS receivers.

With GATE, a unique outdoor open-air test range is available for the emerging Galileo and GPS satellite navigation market, enabling tests under realistic environmental signal effects and dynamic conditions, including multipath and interference effects. Consisting today of eight virtual „Galileo satellites" located on top of several mountains around the GATE test area in Berchtesgaden (Germany), a well suited topology is available to support different testing scenarios. With full control over the eight GATE "Galileo satellites", feared events can be simulated enabling also the evaluation of new user integrity (RAIM) algorithmic concepts and implementations. GATE therefore closes the gap between laboratory based constellation simulations and the real-world Galileo system, with its 18 satellites IOC constellation planned to be available in 2014.

How do you see your association with IRNSS?

In our opinion the Indian Regional Navigation Satellite System (IRNSS) will be in future an essential component of the worldwide satellite navigation infrastructure and will therefore play an important role for India and for Asia as well. In this context, IFEN is proud that the IRNSS payload system engineering group of the Space Applications Centre (SAC) in Ahmedabad, India, has selected IFEN's multi-constellation and multi-frequency GNSS RF simulator NavX®-NCS Professional in 2011 for their R&D and testing activities in the frame of the ongoing IRNSS programme.

The decision of the Space Application Centre for our GNSS RF Navigation Constellation Simulator NavX®-NCS as a reference in the official IRNSS space program of the Indian government represents another milestone for our 'NavX® - GNSS Test Solutions' products and perfectly matches to IFEN's mission of pushing the boundary in satellite navigation.

What is your preparation for a muti-GNSS scenario?

We have recognized very early on that the future with satellite navigation will lie in multi-GNSS applications. We have walked along this path consistently from the beginning. This is not only reflected in our extensive satellite navigation expertise but also found in the philosophy of all of our products. Today IFEN is known for its outstanding multi-GNSS satellite navigation know-how offered to customers for services and due to its multi-GNSS technology portfolio, IFEN is already positioned as a provider of leading-edge multi-GNSS test solutions for the commercial market

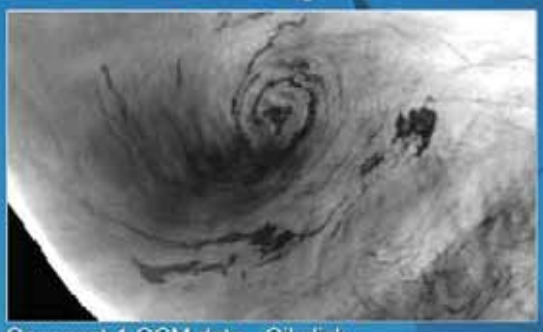
Our Vision – The future is multi-GNSS – The future is now! Our Mission – 'Pushing the Boundary' in multi-GNSS functionality and performance.

What are other application areas your product is suitable for other than GNSS?

IFEN's commercial products line 'NavX® - GNSS Test Solutions' is primarily addressing the consumer and professional application areas. For the consumer application area we are focusing with our NavX®-NCS series of GNSS RF signal generators especially on the automotive, personal navigation, mobile phone, chipset manufacturer, and telecommunications market segments. Within the professional application area we are mainly addressing with our NavX®-NCS series of GNSS RF signal generators the professional receiver manufacturer, precision agriculture, civil engineering, civil aviation, space, defence and scientific market segments.

Bhuvan Gateway to Indian Earth Observation

Oceansat-2 OCM data - Fog over North India



Oceansat-1 OCM data - Oil slick

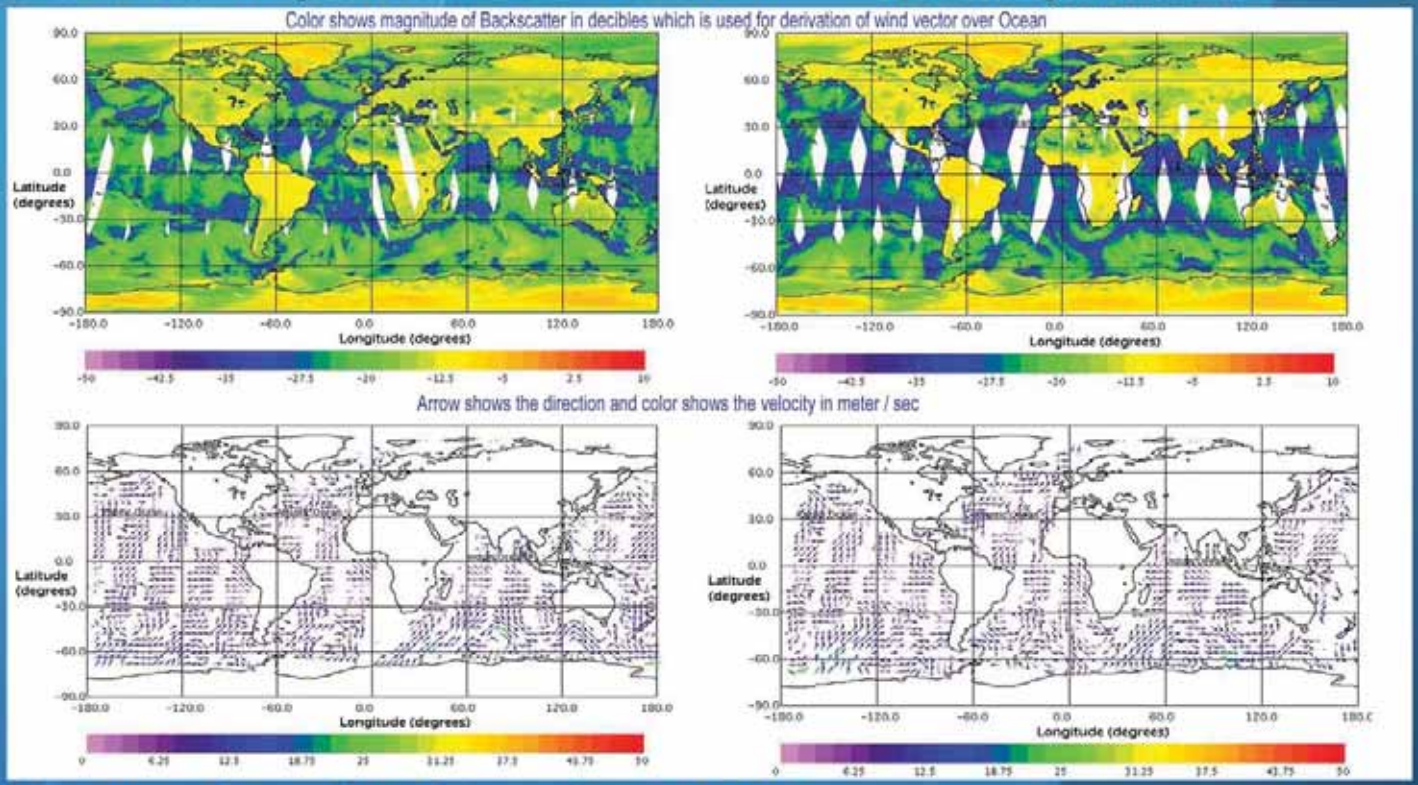
Features

- Time Series Visualisation
- Services - Land, Ocean, Weather, Disaster etc.,
- Pocket Bhuvan
- Multi-Lingual Bhuvan
- Online Discussion Forum
- Free Downloads - Carto DEM, AWiFS, LISS III

www.bhuvan.nrsc.gov.in

Potential Fishing Zone Information

Global Wind Vector Images of Oceansat-2 Scatterometer Data



National Remote Sensing Centre, Balanagar, Hyderabad-500037 www.nrsc.gov.in sales@nrsc.gov.in

Too Fast, Too Furious

Was Haste the Undoing of LightSquared in the GPS-Broadband Controversy?

Gavin Schrock, PLS
Administrator,
Washington State
Reference Network
Seattle Public
Utilities, USA

> "He who sows hurry reaps indigestion"
>
> *– Robert Louis Stevenson*

Innovation, progress, and responsible actions

Innovation and progress are essential, and an imperative, but only if bourn of responsible actions. A recent battle between two of the pillars of innovation and progress; satellite-based positioning, and wireless communications represent such high stakes that some have been driven to advocate for irresponsible actions to support or rationalize their respective positions.

Despite recent regulatory and financial blows to the broadband startup LightSquared, the battle roils on between the GPS industry and this wireless industry aspirant, both with substantial financial interests in the outcome. No expense has been spared by the foes, with lobbying, public relations posturing, and mutual accusations of influence pedaling and muckraking reminiscent of political campaigns. For all of the technical, legal, political, and emotional arguments for and against, a key segment of stakeholders is almost exclusively left out of deliberations; the end users of GPS. These end users range from those who rely directly on GPS for industry, safety, and national security, to those who may not even be aware of how much GPS affects their lives and livelihoods, and the very taxpayers who funded the GPS constellation and entrust the U.S. government with managing not only this valuable amenity, but the radio spectrum in which it operates. It is also these very end users that would bear the greatest burdens if this matter is not resolved with due care.

Critical GPS infrastructure and aviation safety were cited by the US government in its recent decision to all but halt the controversial LightSquared broadband plan

An excellent summary *[http://mycoordinates.org/it-cannot-go-on-forever%E2%80%A6-we-have-to-find-a-solution/]* of the technical considerations in this controversy and call for solutions by Dr Durk van Willigen appears in the January 2012 Coordinates. Dr Van Williegn's call for resolution serves as a great starting point from which to look back and examine the conflicting motivations in play, and how they might reveal common ground for future equitable resolutions – this issue will rise again. The tale begins with grand ideals, but flaws and challenges were to be revealed; and many believe that these issues should have been thought out and resolved long before and plan came up for approval. Everything Dr Van Willigen proposes is worthy of open dialogue and actionable items, but only if the interests of the end users and practicalities of implementation are duly considered.

This collision of two uses of public radio spectrum; that of satellite global positioning, and that of high speed wireless data began, arguably with noble intentions. The hunger for more wireless capacity is driven not only by consumer uses, and as some may characterize an

almost addiction to streaming media, but also that a boost in capacity has been characterized by some as a panacea for lackluster economies. You will find very few, even among those opposing the specific wireless plan in question, that are actually opposed to expanded wireless capacity; but there are dramatically differing views on just how much should be sacrificed to achieve this goal – a case of *"Do not do unto others as you expect they should do unto you. Their tastes may not be the same" George Bernard Shaw*

Intentions and actions – Both noble and ignoble

Calls for adding 500MHz of additional wireless capacity have come from a broad range of interests, including a specific initiative from White House *[www.whitehouse.gov/the-press-office/2011/02/10/president-obama-details-plan-win-future-through-expanded-wireless-access]*. The goal is laudable, and the Federal Communications Commission (FCC) *[www.fcc.gov]* that oversees the public radio spectrum would be tasked with identifying underutilized spectrum and fostering initiatives to activate the same. It is perhaps a great disservice to this ambitious initiative that one of the first proposed plans to seek enhanced wireless would become so mired in controversy and more so that this specific plan represents only about 6% of the original 500MHz sought. The wireless startup, LightSquared sought approval from the FCC in 2010 to offer terrestrial wireless services in spectrum it acquired from a satellite communications company it purchased in 2010, as an adjunct to existing satellite services. This idea of a dual-use system has been explored for many years, and more than one wireless company are pursuing the same, but in different spectrum.

The plan was sure to spark controversy as the spectrum in question is adjacent to the L-Band in which GPS operates; which many view as critical infrastructure. The spectrum that LightSquared would propose for this ambitious plan is in what is known as Mobile Satellite Spectrum

> There are so many outstanding issues resulting in this current battle to have done a great disservice to the end users of GPS, the users of wireless broadband, LightSquared and its investors, and the international standing of the U.S. with regards to Global Positioning Systems

(MSS). Many elements of the MSS bands were established by the FCC and international treaties, through such bodies as the International Telecommunications Union (ITU) *[http://www.itu.int/pub/R-HDB-41]*, as reserved for low power satellite transmissions. GPS, adjacent to the subject MSS band has, without restriction for three decades used a "wide-band" approach, as many satellite based applications do, to get the most out of the weak signals; namely looking into the traditionally "quiet" adjacent MSS band for as much GPS signal as possible. Three decades of innovation, based on this completely unrestricted approach, have enabled feats of exemplary engineering; taking rough positioning capabilities of uncorrected GPS from precisions expressed in meters, to that of millimeters - even in real time. The economic value that GPS has yielded has been estimated to range in the hundreds of billions of dollars (USD), and likely much more worldwide – unprecedented when you consider that GPS is free and was originally designed for defense purposes.

In January of 2011 the FCC granted a waiver *[http://transition.fcc.gov/Daily_Releases/Daily_Business/2011/db0126/DA-11-133A1.pdf]* to LightSquared to begin terrestrial transmissions from as many as 40,000 towers for an Ancillary Terrestrial Component (ATC), as part of the proposed dual-mode plan. The waiver had strict conditions though, and in an explicit acknowledgement of the incumbent and valued uses of GPS, the FCC would not allow commencement of transmissions unless the potential interference (that the very powerful terrestrial transmissions would pose for the much weaker GPS signals) were resolved. At first glance the proposal had immediate appeal; a private company willing to invest billions into a new source of wireless bandwidth. But many recognized immediately the potential for conflict that such a dramatic imbalance of signals strengths would pose, and were puzzled as to how and why the waiver had ever been granted when such interference seemed inevitable. Those concerns were just the beginning…

The GPS industry immediately expressed concerns, and a broad coalition *[http://www.saveourgps.org/]* of not only GPS manufacturers but public and private interests who may rely greatly on GPS was formed. The FCC ordered tests to be overseen jointly by both LightSquared and the GPS Industry Council. The first round of tests, those focused on the upper portion of the proposed LightSquared spectrum, completed in mid-2011, showed substantial interference across all types of GPS devices examined, these undisputed results published in a 1,000 page final report *[http://saveourgps.org/interference-studies.aspx]*. If indeed there was verifiable interference hazards to GPS from the original plan, such news did not serve to settle the issue, but instead spurred a war of words and actions, both noble and ignoble. The heated exchanges only served to further marginalize the concerns of the end users; the costs, monetarily, and in lost productivity, safety, and security would be mainly levied upon the end users if the plan were to be approved.

Arguments, both in opposition and support, the likes of which one would have never imagined would be aired with regards to something as ubiquitous to commerce, safety, and security as is GPS,

began to take on tones which hindered reasonable examination of any possible solutions. As the technical failures of the plan, evidenced by the first round of the tests, became more obvious, some supporters began fashioning a straw man of GPS; issuing charges of "unlicensed uses" and spectral "poaching". In the absence of any formal legal findings or proceedings to support such statements, these accusations and characterizations could be utilized quite effectively in the court of public opinion. These tactics may have swayed the opinions of some, but for the public entities charged with judging the issue of whether the conditions of the waiver had been met, such accusations may have simply been brushed aside as (to borrow from Milton) "obtruding false rules pranked in reason's garb". In the end, the reasons stated for the FCC proposal to vacate the waiver, essentially halting the plan in its tracks, had little to do with any of the posturing, but instead of the disruption that would befall the current unrestricted uses of GPS; primarily the public safety risks.

Assessing assertions and assumptions

The controversy also inspired not only the federal agencies charged with evaluating the plan, but even average end users to more closely research and scrutinize arguments for and against the plan. Once it was established that yes, there would be interference as many had predicted, then some tried to weigh the purported value of the proposed wireless plan against the expected disruptions to GPS. How much would be an acceptable loss? And how much could actually be gained? Positioning and communications are completely different in nature and value, and no one who relies heavily on one or the other could be expected to completely reconcile some sort of trade-off equation; but supporters of each side did try. Some of these contested points stand out:

A spectrum crisis has been offered as rationale for dramatic spectral moves: Nearly anyone with a mobile phone has experienced at some time or another overloaded services, there is most certainly a flood of new mobile data users. But how much does this represent the "traffic jam" within the spectrum and system of a specific carrier and how much does it represent a shortage across all spectrum? Some have even suggested that the crisis *[http://gigaom.com/broadband/is-the-spectrum-crisis-a-myth/]* is contrived or exaggerated to boost rapid adoption of such plans. One may not agree with such skeptical views, but before such potentially disruptive plans are considered, would it not be prudent to have a full and independent examination of just how much spectrum is being underutilized, or may be idle, or "sat on" by current licensees? If there is as many hold, a pending crisis that has not otherwise been brought about by mismanagement of existing spectrum, then why should GPS users be singled out as those who have to "take the bullet" to solve the crisis?

> It is almost tragic for both broadband and GPS that this episode came to this end. Whatever the outcome, or fate of LightSquared, the dialogue into solutions and alternatives should continue.

The proposed plan has appealing aspects; the idea of a wholesale wireless data provider service, with a potential to bring down prices. There were also those who concluded that the proposed services would not ultimately be as unique and ubiquitous *[http://tmfassociates.com/blog/2011/12/07/theres-no-there-there/]* as some would like them to believe. Documents recently released through Freedom of Information requests have even indicated that the pricing for the data may not have been as much of a bargain as originally asserted. Many asked the question: Was the plan so compelling or different from existing wireless services, or other plans under way that do not pose a potential hazard to GPS?

Following the initial damaging tests, a revision to the original plan was offered; to begin transmission in the lower portion of the spectrum in question. This offered potential for possible solutions, and the FCCC ordered more tests. Many manufacturers began developing engineering solutions as a contingency if the plan were to be approved, though conventional wisdom held that there would not be enough time to plan for all contingencies. Most manufacturers were careful to remain sensitive to the end users and not trumpet such moves, as it would be the end users that would ultimately have to pay them for whatever solutions they might come up with. There is a big difference between developing solutions in response to, or in anticipation of a potential hazard, and the open advocacy for the rapid precipitation of the hazard –there were some, though few, in even the GPS industry and related academia that would to do just that. The argument most supporters of the plan offer is "this is just the price of progress" – others would balk at what would appear to be cavalier disregard for the finances, livelihoods, safety, and security of others. Even if the motivations of the supporters may have come from pure intention, it can be viewed by end users as self serving and perhaps exploitive of the situation. One can only speculate on motivations, but it does not look good.

Subsequent tests of the interim compromise to start with the lower portion of the spectrum were reported to show that there was still a risk of interference for a hundreds of thousands of general navigation devices, including critical systems used for civil aviation ground collision avoidance. These tests, while disputed by LightSquared, were the driver for the significant February 14th, 2012 letter from the National Telecommunications and Information Administration (NTIA), the federal agency directly advising the FCC on the LightSquared issue. The letter [http://www.ntia.doc.gov/fcc-filing/2012/ntia-lightsquared-recommendation-fcc] from NTIA chief Lawrence Strickling to FCC Chairman Julius Genachowski concludes

"at this time that there are no mitigation strategies that both solve the interference issues and provide LightSquared with an adequate commercial network deployment". As expected, concerns for civil aviation and national security held the greatest weight in deliberations. The NTIA also recommended a long period of study of these issues and spectral policy change proposals, with a longer transition period added for any negotiated changes. The FCC released a statement almost immediately, stating that it plans to vacate the waiver; because of the impacts on GNSS.

Answers posing more questions

LightSquared continues to publicly refute the conclusions of the NTIA and FCC, and with so much at stake right in at least demanding scrutiny of the process, seeking clarification of some allegedly conflicting past FCC policies, and pressing for serious consideration of possible solutions, but there is a lot left to be desired in the sometimes inflammatory manner in which they have done so. One such move came, perhaps in anticipation of the PNT finding, in the form of a new petition from LightSquared to the FCC for a declaratory ruling on whether GPS users should be entitled to protections for the type of current "wide band" usage with respects to the adjacent MSS band. The FCC, as standard process dictates, has opened a public comment period on the matter *[http://www.fcc.gov/document/pleading-cycle-lightsquared-petition-declaratory-ruling*. It is to be noted that the FCC carefully separated this current petition from consideration of the original waiver, which it now seeks to rescind, along with some earlier related authorizations related to disputed ancillary terrestrial service provisions.

All of the posturing a politics has left the end users only further disenfranchised and questioning the process. While others might argue that the "ball glanced off the wicket", the end users want solid findings; unless they see "dislodged bales", then no out can be scored (apologies for U.S. readers for the cricket analogy; perhaps it should be that the end users "wished to see the instant replay"). End users were left in an untenable situation, not knowing whether they must replace or upgrade their equipment, and if subsequent legal moves could bring about more rounds of spectral changes. Users are told that perhaps engineering solutions could enable both increased wireless capacity in the MSS band without harming GPS, but no one offered how this might be done without tremendous potential impacts to production, finances, safety and security. Even if such solutions were readily available (and thus far only solutions for a narrow range of equipment, and spectrum have been tested, though not yet by any of the officiating bodies) an implementation plan both in physical practicalities and needed policy changes has not been offered by any parties.

Supporters of the plan are promoting the idea of "receiver standards", as have

proponents of other unrelated initiatives in the past. This would be completely unprecedented as the FCC is not in business of receiver standards, and it has been generally concluded that the FCC may not have specific authority [http://www.fhhlaw.com/resources/TelecomLaw/2003/may/0503tl_10.pdf] to enforce such standards. Federal agencies and GPS supporters are seeking establishment of "protection criteria"; the NTIA and FCC have indicated that both may be explored. Such a tangle of ideas; but the road to solution that would be simpler than we might think, though it might not be satisfactory for all parties, it may have been solution that does the least amount of harm – if only this solution had been explored before this ill fated plan were put in motion…

Time, money, and engineering can fix anything?

When it comes to issues of protecting public interests in technological challenges, it is often said that time, money, and engineering can fix anything. But only with the right balance of all three.

There has been some promising progress on engineering solutions; but so far these prototypes have only addressed a very narrow class of GPS receivers, and only for the less volatile lower section of the spectrum in question. The upper section, that had proven universally damaging in the earlier joint tests, had not formally been taken off the table as it is unlikely that the plan could find profitability with lower band alone. Such modest successes, while demonstrating that solutions may someday be viable, were construed by some as being an answer to all concerns. The NTIA and FCC, and especially civil aviation (for which no solutions had been offered to date) did not accept such a premise.

The FCC is in the business of both protecting the public's interests in the spectrum that the public owns. One misconception is that a company "owns" spectrum, not so, they hold a license for spectrum for a specific use, with strict conditions attached - the public owns the spectrum. The FCC must promote and enable the most efficient uses possible of the public spectrum. The same is too said of the multiple agencies that oversee and manage GPS, but positioning is not the direct realm of the FCC. There has to be synchronicity between these two realms; positioning and communications policies. And that major changes in either; whether they are backed up by nuanced policy and laws, or evidenced by generally accepted usage – effective management of these amenities should require that all outstanding issues be solved before a potentially disruptive plan was waivered. That there are so many outstanding issues resulting in this current battle to have done a great disservice to the end users of GPS, the users of wireless broadband, LightSquared and its investors, and the international standing of the U.S. with regards to Global Positioning Systems.

The solution may lay in the middle ground between what many view as a recklessly hasty plan, and adherence to the status quo of current GPS capabilities and solutions. Engineering solutions are certainly worth pursuing, and with such potential for profitable ventures serving hungry broadband markets, it would certainly be worth investments in such engineering. Time though, is the wild card in the equation.

Time Heals

With enough of a transition time, spanning standard replacements cycles for equipment, the end users could be spared paying the whole bill themselves. Civil Aviation and the FAA could have time to develop and certify new equipment and continue with development of the NextGen of air traffic systems. The improvements to satellite navigation constellations, like GPS, Glonass, Compass, and Galileo could have time to reach maturity, and users could take advantage of those enhancements. There are precedents for allowing sufficient transition time to phase in potentially disruptive changes brought on by policy and technological progress; the transition to Digital TV in the U.S, was one overseen by the FCC, and the optional sunset of the P(Y) code of the GPS constellation *[https://www.federalregister.gov/articles/2008/09/23/E8-22197/preservation-of-continuity-for-semi-codeless-gps-applications]* by U.S. positioning authorities was announced in 2008, giving a full 12 years for the users and manufacturers of codeless and semi-codeless GPS solutions to plan for the possible change.

Of course LightSquared could not be faulted for at least attempting rapid adoption; they had investors and deadlines… but a longer term plan could have also been a "win". Valuable spectrum could be money in the bank, much in the same way as an offshore lease awaiting the development of safe deep water drilling technologies can be a great addition to a corporate portfolio. But they would have had to be patient.

This matter is not only of concern to the GPS users of the U.S. That such a precedent for retasking of satellite spectrum and potential harm to GPS had even been considered has both puzzled and frightened the international positioning community and policy makers. Yes, the world may be increasingly dependent on wireless communications, but this is also becoming a world increasing dependent on positioning and spatial technologies to boost economic activity, manage resources and assets, and protect the property and safety of the public. Both are needed, but not one at the expense of another.

Ironically, it is the fate of this plan that is rapidly changing in the days following the FCC proposal to all but halt it. There are defecting inventors, lawsuits, talk of bankruptcy or spectrum swaps, defaulted payments, and more – by the time this goes to print, there could be completely different players involved. It is almost tragic for both broadband and GPS that this episode came to this end. Whatever the outcome, or fate of LightSquared, the dialogue into solutions and alternatives should continue. But this must include all stakeholders. It was difficult to foster such conversations when there is a kind of spectral gun being held to the head of the end users. But despite this, a solution for the future, with enough time to implement is not out of the realm of possibility...

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Cloud services are transforming the remote sensing industry

Brian Rohde
Senior Product Manager, DigitalGlobe

As satellite imagery becomes increasingly ubiquitous, the mechanisms to deliver and disseminate this data have become critically important to both the consumers and providers. Aligning these dissemination tools with cloud hosting and computing is a natural fit and provides significant opportunities to make remote sensing data more accessible.

Customers who utilize satellite imagery products are able monitor any place in the world from the convenience of their office or home. Not only does this significantly improve overall inefficiencies for governments and organizations by reducing or eliminating the need for regular on-site visits, but it allows customers to access content within hours of acquisition. From defense to commercial interests, this timeliness allows for rapid and informed decision making related to ground-based information.

To appreciate these advantages of timely delivery of satellite imagery, imagine the following scenario. In a world without internet accessibility, 11 am local time, the Mount Pinatubo Volcano suddenly erupts. A few minutes later, DigitalGlobe instructs its constellation of satellites to collect images based on its monitoring of world events and, at noon local time, collects the first image of the event. Having received orders from humanitarian and relief organizations, DigitalGlobe produces the imagery, burns it to DVDs and sends it that afternoon to Manila via overnight delivery. The DVD is held in Tokyo because all flights to Manila are canceled due to poor visibility caused by an ash cloud pervading much of the Philippines. Two days later, humanitarian relief organizations receive the DVD, which was finally delivered from Tokyo to Manila via ship.

Fortunately, we no longer live in a world restricted to physical delivery. Rather, as was the case with the recent tsunami and subsequent nuclear disaster in Japan one year ago, sharing and dissemination of information occurred within minutes of the disaster. In this real-world example, DigitalGlobe collected imagery of the Fukushima Daiichi plant just minutes before and after the first explosion, and made that imagery available online within hours of the event.

In order ensure that users can effectively access content they need, when and where they need it, providers such as DigitalGlobe have utilized web and the cloud-based services to deliver content to users around the world. These new dissemination frameworks provide dramatic reductions for customers' total cost of ownership. Now, rather than investing in a datacenter or waiting for physical media to be delivered, and then struggling with how to share data among users who may not be in physical proximity, customers can simply make a request to a web service hosted on the cloud, which will respond with the image product within seconds. No longer must a customer rely on its own infrastructure to share the data, or build its own datacenter to manage the petabytes of content requested from commercial remote sensing providers like DigitalGlobe each year. Instead, customers may access the content on demand- when they need it, where they need it. Because the imagery is available through web services that are hosted in the cloud, users around the world can instantly access recent, relevant imagery, from anywhere that they can connect to the internet.

By making the imagery product once and disseminating it through cloud-based web services, providers such as DigitalGlobe leverage the cloud to fulfill multiple customer commitments at once. By computing in the cloud, imagery is processed in real-time, exactly in accordance with each customer's request. Image customization, including formatting, mosaicking, projection and layering, can all be completed within seconds.

At the foundation of DigitalGlobe's cloud-based remote sensing web service are OGC open standards. Only by having a well-adopted, uniform set of services and protocols, can customers expect to integrate services to existing geospatial applications, or can providers expect to address customer integrations en masse. Indeed, these open standards allow for a single web service to be natively interoperable with hundreds of geospatial applications. Web services can be hosted in industry-standard cloud platforms directly, or can be "Image as a Service" solutions, where pixels are hosted on the cloud and referenced by web services at the customer or provider's environment.

Just as the banking industry has leveraged technologies and practices to make online access secure, so, too have remote sensing providers. By implementing rigorous authentication and authorization procedures, and encrypting requests and responses, customers can be assured that their activities, information and imagery are secure.

Cloud services are transforming the remote sensing industry as they continue to evolve together. While the Cloud will be a significant part of this future, look for clear skies ahead.

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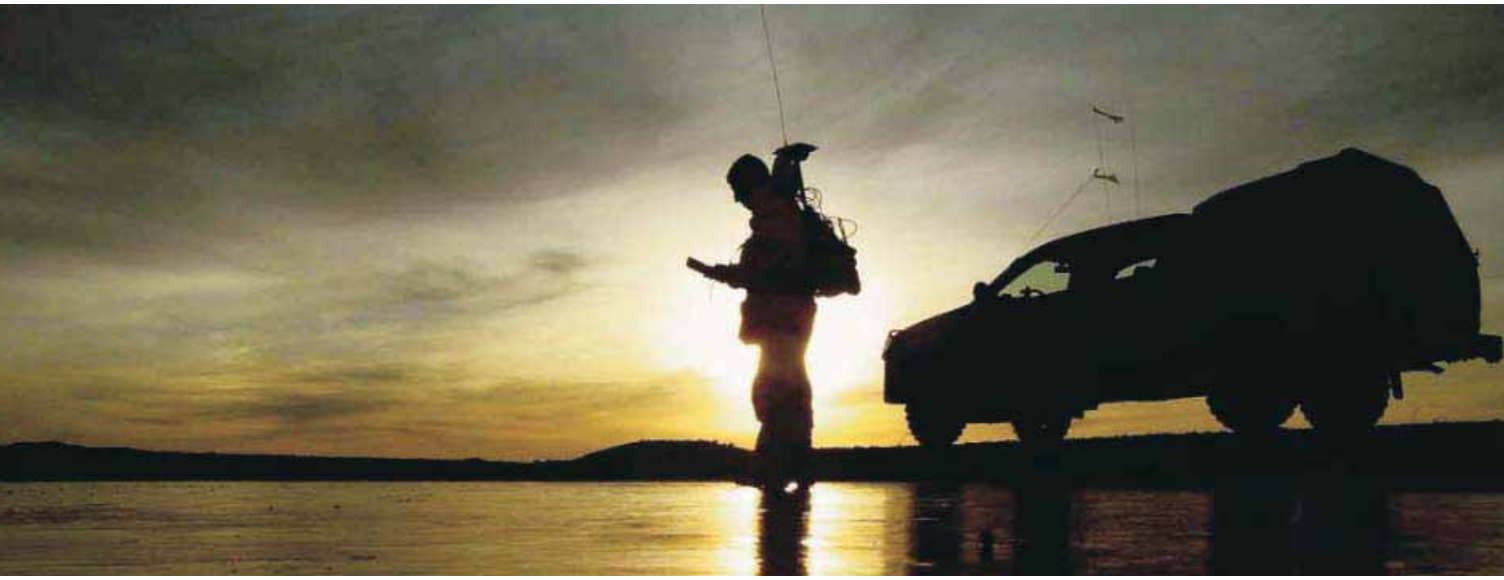

The University of Nottingham Ningbo China invites applications for the MSc in Engineering Surveying and Geodesy(full-time: one year; part-time: two to three years) and PhD opportunities in the research areas of Space Geodesy and Engineering Surveying.

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Stipends are available for students to pursuit PhD in UNNC. Research projects can be in, but not limit to, the areas of GNSS for deformation monitoring, GNSS data processing algorithms, GNSS error modelling, GNSS for position, velocity and time determination, sensor integration (GNSS, INS, UWB, etc.). Students may be co-supervised by professors in The University of Nottingham in UK.

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Trimble cloud-based solution for the transport and logistics

Trimble® trako Visual Cargo is a new cloud-based solution provides on-road supply chain visibility to enhance efficiency for the transport and logistics industry in India. With standard, easy-to-use application process interfaces (API), shippers can seamlessly integrate Visual Cargo with its ERP/TMS system and vehicle location data from the Trimble trako Fleet Management solution to provide trip-based tracking of goods, transit schedule, route and safety compliance. *www.trimble.com*

New rugged Trimble Juno series

Trimble introduced new generation of GNSS devices for GIS field applications—the Trimble Juno 3B and 3D handhelds. It provides a complete, integrated package of positioning, imaging and communications for flexibility. The Juno 3B has an integrated GPS, a 5 MP autofocus camera and Windows Mobile software. The Juno 3D includes all of the features of the Juno 3B plus 3G wireless technology. *www.trimble.com*

Spectracom new signal generator for in-line GNSS product testing

Spectracom has announced the GSG-52 RF Signal Generator, a new offering in its line of GPS constellation simulators. It is designed for in-line product testing of navigation-fix and positioning functions of integrated GPS or other GNSS receivers. A user can configure scenarios on-the-fly without the need for an external PC and re-compilation phase. *www.spectracomcorp.com*

Hemisphere GPS and Carlson Software establish strategic alliance

Hemisphere GPS and Carlson Software have announced a strategic alliance, which will provide a roadmap for new, integrated solutions for land survey, mapping, construction, mining and other key machine control markets. This alliance is part of Hemisphere GPS's recent formation of their survey and construction group, where the two companies will combine their expertise to develop intuitive and powerful GNSS-based solutions that improve the efficiency and performance in several applications including data collection, land development design and earth moving. *www.hemispheregps.com*

Topcon Introduces the PN-A5 GNSS Antenna

Topcon Positioning Systems (TPS) has announced the new PN-A5 GNSS antenna that combines the company's TA-5 full spectrum GNSS antenna element with a newly designed semi-hemispherical convex impedance ground plane. This unique ground plane design provides improved multipath mitigation and a significant increase in ability to track signals from satellites located near to the horizon, according to company sources.

Breakthrough in automatic analysis of aerial images

GTA Geoinformatik GmbH has presented a prototype of a new tridicon® software version, that enables the detection of 3D objects like buildings without the need for 2D vector data (e. g. building outlines). The only source material that needs to be available for the automatic 3D object reconstruction are stereo aerial images. A development which will revolutionize the production of 3D geo-data worldwide. *www.tridicon.de*

Enhanced NavX®-NCS Professional GNSS Simulator

IFEN is in partnership with WORK Microwave has announced an enhanced version of its NavX®-NCS Professional, a multi-frequency simulator, which is optimized for research and development of GNSS safety and professional applications. The NavX®-NCS range of simulators also includes the NavX®-NCS Essential, a multi-GNSS version which is designed for system integration and production testing of mass market applications, including automotive sat-nav, mobile phone apps, chip-sets, and handheld personal navigation devices (PNDs). *www.ifen.com*

SXPad by Geneq is an affordable, rugged handheld computer

Geneq Inc. has announced the SXPad, a full-featured, affordable, rugged handheld computer for GPS/GIS data collection that is built for mobile GIS users in applications ranging from ederal/State/Local government, water/electric/gas utilities, and transportation to mining, agriculture, and forestry. With its waterproof seal and surviving one meter drops to concrete, the SXPad is built tough to survive outdoors. *www.sxbluegps.com*

Spirent expands leadership in Testing E911 and LBS for LTE Networks

Recognizing the increase in LBS momentum and the need for improved positioning performance on mobile devices, Spirent Communications has expanded its LBS LTE test solution to support LTE Positioning Protocol (LPP) and Observed Time Difference of Arrival (OTDOA). These latest enhancements are critical for meeting E911 requirements on LTE networks. *www.spirent.com*

Leica Digicat 600i and 650i

Leica Geosystems has announced the latest editions to their cable locator family, the Leica Digicat 600i and 650i series, accompanied with Logicat software, set to revolutionize underground cable location. It makes locating underground cables and pipes a simple and efficient task, increasing the operator's productivity and their profitability. The Digicat 650i offers the user all the features and functionally as the Digicat 600i with the added benefit of service depth indication. *www.leica-geosystems.com*

OS selects Leica Viva GS15 GNSS receivers

Leica Geosystems Ltd has been awarded the contract to supply over two hundred survey grade Leica Viva GS15 GNSS receivers to Ordnance Survey, UK. The contract also

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Galileo update

SSTL-OHB System consortium to build a further eight Galileo FOC satellites

European Commission Vice President Antonio Tajani has announced that the consortium led by OHB System AG and Surrey Satellite Technology Ltd (SSTL) will build a further eight satellites for Galileo.The new contract will see SSTL continuing its role as payload prime, assembling, integrating and testing the navigation payloads in the UK, whilst OHB System, as the prime contractor, builds the eight satellite platforms and executes the final integration of all the satellites in Germany. The SSTL-OHB partnership is already building fourteen satellites for the Galileo programme and will draw on its heritage and experience to produce the additional satellites to demanding schedules. *www.sstl.co.uk*

New satellites and launchers ensure Galileo start in 2014

With the signature of further contracts for satellites and launchers, Galileo is firmly on track for the provision of improved satellite navigation services to citizens in 2014. In total, 3 contracts were signed: with OHB System AG (DE) comprising 8 satellites for €250 million, with Arianespace (FR) for a booking option of up to 3 launches using Ariane 5 (€30 million), with Astrium SAS (FR) to enable the current Ariane 5 launcher to carry 4 Galileo programme satellites per launch into orbit for €30 million. *www.defpro.com*

Galileo satellite named after Cyprus schoolgirl

Adrianna Cyprus will be the name of a Galileo satellite, set to be sent to space in the coming years. The satellite was named after Adrianna Yiallourou, a 10-year-old pupil at the Ayios Anargyros primary school in Larnaca, who won a national drawing competition depicting her interpretation of space. *www.cyprus-mail.com*

UK government boosts space industry

The UK government granted GBP 2.5 million fund to enable around 22 British companies to develop commercial products and services using space technology or satellite data. The fund has been granted by the UK Space Agency, the Technology Strategy Board and the South East England Development Agency. This financial aid will support around twenty-eight fast-track research and development projects. These projects will cover a broad range of growth opportunities, ranging from novel propulsion for cubesats; through technology to exploit the Galileo (a navigation satellite system); to techniques for crop monitoring from space. The investment forms part of the UK Space Agency's National Space Technology Programme (NSTP), which will see government investment of GBP 10 million to help UK industry exploit growth opportunities in the space sector and improve the UK's space technology capabilities. *Space Travel*

includes the supply of over two hundred Leica DISTO D8 handheld distance meters, plus options for multiple reflectorless Total Stations. Leica Geosystems

NIS GLONASS and Siemens to gather toll from trucks

The federal grid operator NIS GLONASS and German company Siemens have signed a memorandum on strategic partnership on creation in Russia the electronic system of charging tolls from cargo transport for damage, done to highways. Earlier both companies became participants of a multilateral agreement on cooperation in development of similar system in Belorussia, Siemens said. *www.marchmontcapital.com*

First Z/I Imaging DMC II Camera sold in India

IIC Technologies is the first Indian company to purchase the DMC II digital sensor, introducing the latest digital imaging technology to the Indian Mapping Market. IIC provides a full range of end-to-end geospatial solutions to the Aviation, Defense, Government, Infrastructure, Marine, Oil & Gas, Transportation, Heritage and Utility sectors. Designed specifically as a photogrammetric mapping camera, the DMC II offers a rigid square frame and a fixed pixel geometry in a single pixel array that result in very high-quality geometric resolution. All DMC systems collect four-band multispectral (Red, Green, Blue, Near IR) and black-and-white panchromatic imagery. *www.ziimaging.com/en/zi-dmc-ii-camera-series_20.htm*

CS-10000 Aerial Digital Camera by Optech

Optech has released its new CS-10000 camera. With its unique and patented features, it embodies the latest advances in photogrammetric technology. It introduces many new features while retaining proven technologies such as the original True FMC (Forward Motion Compensation). It offers a field-replaceable shutter and interchangeable lenses to allow even greater operational efficiency. *www.Optec.com*

Skyworks ramps GPS/GNSS Solutions for Samsung

Skyworks Solutions, Inc is ramping GPS and GNSS solutions for Samsung Electronics Co. Ltd. The Company's newest devices, which integrate a low-noise amplifier with filtering specifically designed for GPS/GNSS receiver applications, are the smallest solutions in the market requiring no external components. *www.skyworksinc.com*

CalAmp's four new addition to its wireless devices for MRM

CalAmp Corp has recently introduced the addition of four new GPRS and HSPA wireless communications products for Mobile Resource Management (MRM) applications. This new Location Messaging Unit (LMU) and Trailer Tracking Unit (TTU) products will provide GPS tracking and cellular-based wireless communications capabilities to 12-volt and 24-volt vehicles. *http://investor.calamp.com*

Real time info for Agricultural company using GPS enabled devices

Marketing & Sales team of Krishidhan Seeds, an agricultural research driven company, will use 3G-enabled Android 2.3 Tablets to help cater farmers and agriculture fraternity. It provides real time and instant solutions and information on the availability, supply status dispatch details and also provide instant information on urgent stock requirements to the retailers. *http://techcircle.vccircle.com*

Indian Government to track mobile users'

Government of India (GoI) has made certain amendments in telecom operators' licences. As per the amendments, from May 31, 2012, all telecom operators in India would have to provide the Department of Telecommunications (DoT) real-time details of users' locations in latitudes and longitudes. Initially, operators will provide real-time locations of some specific mobile phone numbers, provided by the GOI. But within three years, service providers will have to provide information on locations of all users. The information will have some margin of error at first. But by 2013, at least 60 per cent of the calls in urban areas would have to be accurately tracked when made 100 metres away from the nearest cell tower. By 2014, the government will seek to increase the proportion to 75 per cent in cities and 50 per cent in suburban and rural areas. *Indian Express*

GPS L1/L2 antenna for high-precision heavy-duty tracking applications

PCTEL, Inc., has announced its GPS L1/L2 ruggedized antenna designed for reliable performance in high-precision, heavy-duty GNSS tracking applications. The new antenna offers GPS L1 and GPS L2 satellite reception and performance in a low profile mechanical package. *http://investor.pctel.com*

Interface for Fleet Director and TruckMate by Teletrac

Teletrac has announced the availability of an interface between its Fleet Director™ GPS & vehicle tracking solutions and TruckMate®, an enterprise transportation software solution from TMW Systems. The interface provides customers using both systems with seamless and reliable 2-way communications between dispatchers and drivers, along with real-time GPS-based location, motion and mileage data. *www.teletrac.net*

Accord Technology completes full suite advanced GPS

Accord Technology LLC was recently authorized TSO-C145c for their latest receiver, sensor in the NexNav™ product family, theNexNav™ MAXGPS WAAS Class Beta-1, -2, -3. This successful GPS development is a key solution in a series of Accord Technology's affordable civil aviation GPS receivers and sensor. Available as circuit card receivers (CCA) for avionics OEM hosting or as line replaceable sensor units (LRU) for aircraft installations, MAX is affordable and meets the latest standards, worldwide.

3-axis gyroscope for automotive apps by STM

STMicroelectronics has introduced 3-axis digital-output gyroscope that meets the industry-standard qualification for automotive integrated circuits (AEC-Q100). ST's newest angular-rate sensor aims to add positioning accuracy and stability to a wide range of automotive applications, including in-dash navigation, telematics and vehicle tolling systems. Accurate measurements of angular-motion detection with ST's automotive-qualified gyroscopes will significantly enhance dead-reckoning and/or map-matching capabilities in car navigation and telematics applications. *www.st.com*

Sylectus web-based dashboard for fleet management

SylectDash™ is a web-based dashboard solution that allows real-time access to mission critical information to improve fleet management. Leveraging this powerful "anytime, anywhere" toolset, customers can access fleet information to make timely business decisions. www.*qualcomm.com*

Surveillance and Tracking apps by GIPL

Gujarat Info Petro Ltd. (GIPL), an Indian IT company, developed an application for smart phone. It aims to help in surveillance and tracking especially in sectors like forest and agriculture. It will also help in conservation of endangered species of Asiatic lions in Gir and other flora- fauna found in forests of Gujarat state, India. *Economic Times*

Nokia alleged of intellectual property violation

A Thai software company - Globetech Ltd, a subsidiary of IT conglomerate CDG Group – filed a lawsuit against Nokia at the Intellectual Property and International Trade Court. The company claimed that Nokia's Ovi map violated intellectual property right. It used Globetech's digital map data without permission. *www.nationmultimedia.com*

GNSS User Meet organized by ISRO

Indian Space Research Organisation organized A Global Navigation Satellite System (GNSS) User Meet on February 23, 2012at ISRO Satellite Centre, Bangalore. Dr.T.K.Alex, Member, Space Commission and Director, ISRO Satellite Centre (ISAC) inaugurated the meet. Shri.E.K.Bharat Bhushan, Director General, DGCA and over 250 delegates from government, industry, and academia participated in the meet. An overview of GAGAN and IRNSS navigation projects was presented by Shri.A.S.Ganeshan, Project Director, Navigation Systems.

Eminent experts in satellite based navigation presented their experiences and expertise on utilising the navigation signals for precise positioning and civil aviation and several other services during technical session. On the other hand panel discussion with the theme "Opportunities and Challenges in utilising navigation signals over Indian region" was chaired by Shri. S K Shiva Kumar, Associate Director, ISAC with members from academia, industry and ISRO participating in it. *www.isro.org*

$12 billion for Glonass

Russia may spend almost $12 bn on its Glonass satellite navigation system in 2012-2020. Kommersant space agency Roscosmos and economics ministry had agreed on a draft development program for the Glonass project, and it had already been submitted for government's approval. *www.prokerala.com*

Russia to launch two Glonass Satellites in 2012

"We are planning to carry out two Glonass satellites this year," said Roscosmos head Vladimir Popovkin. There is a group of 31 Glonass satellite in the orbit in which 24 are providing global coverage. 4 satellites are in reserve and one is undergoing trials. *http://en.ria.ru*

GLONASS Northwest to Help maintaining safe navigation

780-th Navigational Hardware Repair Plant started to equip light-optical devices mounted on sea buoys, coastal beacons and lighthouses with special GLONASS-based modules. Mainly, this innovation is called to improve reliability of navigational aids and maintain safety of seafaring. The project will be implemented with technical support of GLONASS Northwest. JSC 780-th Navigational Hardware Repair Plant is subordinated to Russian Defense Ministry and engaged in development, production, and service maintenance of navigational facilities providing safe seafaring. *http://navaltoday.com*

Researcher turns inaccuracy of GPS into a tool to predict quake

GPS users often complain about some inaccuracy in the device. A researcher at the Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat, India, turned that inaccuracy into a tool to predict earthquakes. The researcher, Sheetal Karia, supported her findings by studying the data from three earthquakes in different parts of the world in the last three years. As part of her study, Karia developed a model to predict an earthquake. The study established that underground tectonic plate activities that lead to a quake create an electromagnetic field. The field also affects the atmosphere overground which is scaled through variation in GPS data. It studies TEC variations obtained using GPS measurements and electron density observations by the detection of electro-magnetic emissions transmitted from earthquake regions. *www.timesofindia.com*

Beidou navigation payload launched by Chinese rocket

China launched another satellite for the Beidou space-based navigation network, continuing the system's expansion after it began trial service in December. A Long March 3C rocket lifted off from the Xichang space base in southwest China's Sichuan province. The 18-story launcher, boosted by twin strap-on engines, flew east from Xichang and deployed the Beidou payload in an oval-shaped geosynchronous transfer orbit stretching more than 22,300 miles above Earth at its furthest point. *www.spaceflightnow.com*

Scientists using surveying equipment to monitor whales

The teams of scientists are working out of Western Australia on the project, which will focus on the humpback and blue whales that use the coast and sea around South Western Australia for migrating, resting and, in some cases, calving. Dr Kent, Deputy Director at the Centre for Marine Science and Technology (CMST) at Curtin University in Perth, said that they will use a range of platforms to track the whales like land-based monitoring and theodolite tracking, boat-based behavioural, and photo-identification surveys, and passive acoustic recording of cetacean song and vocalisations. *www.surveyequipment.com*

Congress OKs FAA bill allowing drones in US, GPS air traffic control

After five years of legislative struggling, 23 stopgap measures and a two-week shutdown of the Federal Aviation Administration, USA, Congress finally has passed a bill aimed at prodding the nation's aviation system into a new high-tech era in which satellites are central to air traffic control and piloted planes share the skies with unmanned drones. The bill, which passed the Senate speeds

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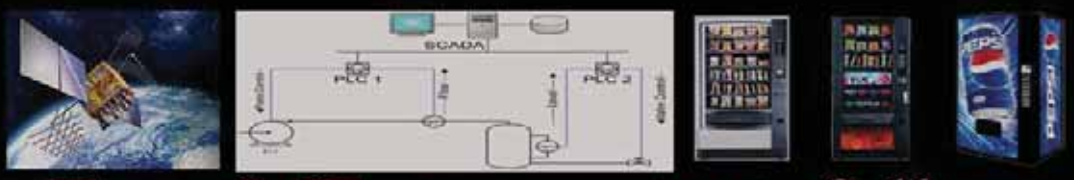

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FCC Statement on Lightsquared and GPS

"LightSquared's proposal to provide ground-based mobile service offered the potential to unleash new spectrum for mobile broadband and enhance competition. The Commission clearly stated from the outset that harmful interference to GPS would not be permitted. This is why the Conditional Waiver Order issued by the Commission's International Bureau prohibited LightSquared from beginning commercial operations unless harmful interference issues were resolved.

"NTIA, the federal agency that coordinates spectrum uses for the military and other federal government entities, has now concluded that there is no practical way to mitigate potential interference at this time. Consequently, the Commission will not lift the prohibition on LightSquared. The International Bureau of the Commission is proposing to (1) vacate the Conditional Waiver Order, and (2) suspend indefinitely LightSquared's Ancillary Terrestrial Component authority to an extent consistent with the NTIA letter. *FCC*

LightSquared broadband plan questioned by GPS experts

A DOT official's testimony in a House Aviation Subcommittee hearing called LightSquared's data plan completely incompatible with GPS. The House Subcommittee on Aviation, which is part of the Committee on Transportation and Infrastructure of the U.S. House of Representatives, held hearings Feb. 8 regarding the critical nature of GPS to aviation in the US, and the issues raised LightSquared's plans to implement a broadband data service on frequency band adjacent to the country's GPS signal. The hearing was intended to determine whether legislation is required to protect GPS from interference by LightSquared or similar uses that could prevent GPS receivers from working properly. "LightSquared's proposals are fundamentally incompatible with GPS use," said John Porcari, deputy secretary of the U.S. Department of Transportation. During his testimony, Porcari said that LightSquared's original and its many revised plans all adversely affect GPS, and that researchers have not been able to find a way to mitigate the interference. *www.eweek.com*

the nation's switch from radar to an air traffic control system based on GPS technology. *www.chicagotribune.com*

Norway to expand Arctic seabed surveying

Norway intends to expand surveys of a previously disputed area in the Arctic offshore region bordering Russian waters ahead of potential oil exploration. The country's seismic survey program began with boundary waters of the Barents Sea and will now move north, to an area east of the Svalbard archipelego, Prime Minister Jens Stoltenberg said. *www.reuters.com*

GPS uses cameras instead of satellites

Australian researchers have developed a GPS based not on satellites, but camera systems and database algorithms. Dr Michael Milford from Queensland University of Technology's Science and Engineering Faculty claims his research would make navigating a far cheaper and simpler task. The approach to visual navigation algorithms, which has been dubbed SeqSLAM (Sequence Simultaneous Localisation and Mapping), uses local best match and sequence recognition components to lock in locations. SeqSLAM uses the assumption that you are already in a specific location and tests that assumption over and over again. Milford said the 'revolution' of visual-based navigation came about when Google took photos of almost every street in the world for their Street View project. *www.theengineer.co.uk*

GPS court ruling leaves US phone tracking unclear

A US Supreme Court decision requiring a warrant to place a GPS device on the car of a criminal suspect leaves unresolved the bigger issue of police tracking using mobile phones, legal experts say. The top US court ruled 9-0 recently that police violated the rights of a suspected drug dealer when they placed a GPS, tracking device on his vehicle without a warrant and followed his movements. But privacy activists and legal analysts are watching for guidance on the far more ubiquitous practice of law enforcement tracking using cellphones. This can be done using a phone's GPS or by "triangulation" using cell towers, and can also be done with certain tablet or laptop computers. *www.google.com*

GPS tracking without a warrant goes to Ohio Supreme Court

The Ohio Supreme Court will review an Appeals Court reversal of a Columbus man's conviction for breaking into a home near Baltimore. Fairfield County Prosecutor Gregg Marx had asked the Ohio Supreme Court to review the 2-to-1 decision by the Court of Appeals that evidence obtained from the GPS device, which was installed without a warrant or court order, should be suppressed. Marx maintained that the appeals court ruling "would severely hinder the ability of law enforcement to use technology when conducting criminal investigations."

Z/I Software version 6.4 released

Z/I Imaging has announced the release of its Z/I Software version 6.4. Z/I Sensor Software includes a suite of products for the DMC and DMC II camera families for raw image data post processing, distributed processing, digital image enhancement, in-field data copy and real time image quality control. It has a new licensing system embedded based on the Leica Geosystems licensing server. *www.ziimaging.com*

Satellite-based Monitoring with Go Monitor

Astrium Services' GEO-Information team has now taken satellite-based monitoring to a new level. Based on cutting- edge satellite imagery, standard and advanced image analysis, processing and interpretation, the new service Go Monitor provides high-quality change information for any area of interest worldwide on a reliable and cost-effective basis. *https://go-monitor.com*

Satellite images expose water theft in Australia

Satellite imagery revealed how much water is being stolen from the Murray-Darling Basin by floodplain harvesting. South Australian irrigators have long complained about the practice, which upstream water authorities have struggled to stop because it requires monitoring over vast distances. A Murray Darling Basin Authority (MDBA) spokeswoman said in an interview, "Diversions such as floodplain harvesting are difficult to measure". South Australian (SA) irrigators and environmentalists throughout the basin considered the harvesting to be theft, made possible when Queensland and NSW farmers bulldoze channels that divert water off to dams or spill out into paddocks. "There is a well established principle that if you cannot measure it, you cannot manage it," she added. *Weeklytimesnow*

e-GEOS to provide maps for emergency management

e-GEOS, an Italian company, bagged two contracts from the European Commission (EC) to provide satellite data and maps for emergency management. These contracts are part of the GMES (Global Monitoring for Environment and Security) programme. The EC will be able to make pre- and post-event maps of any area in the world available within a few hours of the emergency arising, thereby facilitating the organisation of aid operations. *e-Geos*

DLR to develop tool to track space debris accurately

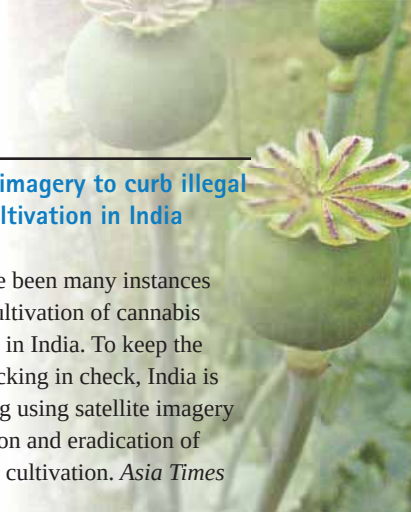
Researchers at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) are developing an optical observation system with a powerful laser. Pulses from the laser can detect particles only a few centimetres in diameter and allow determination of their orbits. The concept was tested for the first time in January 2012, in collaboration with the Laser Station in the Austrian city of Graz. The laser station in Graz is a part of the Space Research Institute of the Austrian Academy of Sciences and the laser beam it sent up into space was able to detect more than 20 different launcher components at distances of 500 to 1800 kilometres. *DLR*

Swiss 'janitor satellite' to clean space junk

Scientists at the Swiss Federal Institute for Technology in Lausanne are considering launching "janitor satellite," - CleanSpace One, designed to clean up space debris. It will costs approximately USD 11 million to build, but the Institute claims it will be worth it. It is pertinent to mention here that the year 2011 was full of reports that space debris was re-entering the atmosphere and raining down on earth. *Washington Post*

US to spend USD 50 mn on aerial photography

The US Department of Homeland Security (DHS) is considering spending up to USD 50 million to hire as many as four contractors to provide "aerial remote sensing" services. The services will include taking photos from airborne sensors of homeland security missions and emergency incidents, processing those images and disseminating them throughout the department. *www.gsnmagazine.com*



Satellite imagery to curb illegal opium cultivation in India

There have been many instances of illicit cultivation of cannabis and poppy in India. To keep the drug trafficking in check, India is considering using satellite imagery for detection and eradication of such illicit cultivation. *Asia Times*

EU Parliament supports GMES within financial framework

The European Parliament voted on the future of GMES in a resolution that strongly supports the programme being funded within the multiyear financial framework (MFF) and for it to be operational from 2014. *ESA*

Expert proposes better use of satellites for disaster MGMT

Norihiro Sakamoto proposed a plan to make better use of existing satellites so that they could make quicker tsunami forecasts. This would involve using a quasi-zenith satellite system, whereby a satellite is always located near Japan's zenith, so that there is a continuous link with offshore tsunami observation devices. Norihiro Sakamoto, the former head of technology at the Society of Japanese Aerospace Companies, currently serves as a researcher for the Tokyo Foundation and has been advocating development of a "real-time warning system" for tsunami. *www.yomiuri.co.jp*

Iran launches small earth-observation satellite

The Iranian Space Agency (ISA) launched the small earth-observation satellite, 'Navid-e Elm-o Sana'at' (Promise of Science and Industry), marking the country's first successful mission since a failed attempt in space last year. It was launched, using a Safir 1-B rocket, according to a translation of a statement posted to the agency's Farsi-language website. Safir means "Ambassador" in Farsi. *www.csmonitor.com*

Google fined for unfair competition

In a ruling the Paris court upheld an unfair competition complaint lodged by Bottin Cartographes against Google France and its parent company Google Inc. for providing free web mapping services to some businesses. The French company provides the same services for a fee and claimed the Google strategy was aimed at undercutting competitors by temporarily swallowing the full cost until it gains control of the market. *Economic Times*

India may spend USD 1 billion to map aquifers

In the next five years, India is considering spending as much as USD 1 billion to map aquifers, or large underground reservoirs. With the help of this project the Indian government aims to avert a water crisis in the South Asian country, where agriculture accounts for 20 percent of the USD 1.7 trillion economy, according to a member of the Planning Commission, India, Mihir Shah. According to a study by the NASA, India lost 109 cubic kilometers of groundwater because of indiscriminate use during 2002-2008. *Bloomberg*

Northern Ireland's DARD plans £9m GIS contract

The Department of Agriculture and Rural Development (DARD) in Northern Ireland is setting up a £9m contract for an enterprise-wide GIS. It is aimed at correcting shortcomings in the existing GIS and its Land Parcel Information System function, which have been in place since December 2004. The department said the system is also intended to meet a range of requirements for itself and its executive agencies. *www.guardian.co.uk*

New system allows robots to map their environment

Researchers at Massachusetts Institute of Technology's (MIT) Computer Science and Artificial Intelligence Laboratory (CSAIL) developed a new system that allows robots to build and continuously update a 3D map of their environment. The new approach is based on a technique called Simultaneous Localization and Mapping (SLAM). As the robot travels through an unexplored area, the Kinect sensor's visible-light video camera and infrared depth sensor scan the surroundings, building up a 3-D model of the walls of the room and the objects within it. Then, when the robot passes through the same area again, the system compares the features of the new image it has created - including details such as the edges of walls, for example - with all the previous images it has taken until it finds a match. The system is also expected to help blind people by allowing them to make their way unaided through crowded buildings such as hospitals and shopping malls. *Space Daily*

Intergraph to aid Russia in infectious disease management

Russian State Research Center for Applied Microbiology and Biotechnology (SRCAMB) in Obolensk, Russia, selected ERDAS IMAGINE and ERDAS APOLLO to help support its spatial-temporal approach for processing data related to infectious diseases and conduct risk analysis of biologically hazardous objects. *Intergraph*

Blue Marble GeoCore 2012

Blue Marble Geographics has released GeoCore 2012, the all-in-one data conversion developer toolkit for geospatial data. It features GeoCalc 6.5, GeoTransform 6.2, and GeoTranslate 5.2. If desired, the latest versions of these software development kits are also available for individual purchase. *www.bluemarblegeo.com*

DOHA Australia announces tender for 'Toilet Map'

The Department of Health and Ageing (DOHA), Australia, announced a tender for a new hosting and geospatial data management provider for its nationwide public 'Toilet Map' service, designed to help users find the closest public restroom. "The National Public Toilet Map Website identifies the location of many publicly accessible toilet facilities in Australian urban and rural areas, and along major travel routes. *www.zdnet.com.au*

SOB to complete topo map of Bangladesh by 2016

Survey of Bangladesh (SOB) will complete detailed digital topography map of Bangladesh by 2016, according to the Director of SOB, Colonel Mahmudun Nabi. He claimed that this is the first time a digital topographic map is being done to provide 'accurate and detailed' information on Bangladesh. *bdnews24.com*

Malaysia soon to table National Geospatial Bill

With an aim to make geospatial technology an essential decision making tool by 2020, for all public and private bodies in Malaysia, the National Geospatial Bill is being formulated, according to Natural Resources and Environment Minister Datuk Seri Douglas Uggah Embas. He said the proposed Act would provide the legal framework for the development of a spatially-enabled government and society. *BERNAMA*

FORM IV

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April 2012

6th International Satellite Navigation Forum
17-18 April, 2012
Moscow, Russia
http://eng.glonass-forum.ru/

Interexpo Geo-Siberia
17-19 April, 2012
Novosibirsk, Russia
http://itcsib.ru/event/4-INTEREKSPO_GEO-SIBIR

Europeon Navigation Conference 2012
23-25 April
Gdansk, Poland
www.enc2012.org

2012 European Frequency and Time Forum
23-26 April
Gothenburg, Sweden
www.eftf2012.org

Land and Poverty
April 23–26, 2012
Washington, D.C., USA
http://landandpoverty.com/

Geo Siberia
25-27 April
Novosibirsk, Russia
www.biztradeshows.com

The Seventh National GIS Symposium in Saudi Arabia
29 April – 1 May
Dammam, Saudi Arabia
www.saudigis.org

May 2012

FIG Working Week 2012
6-10 May
Rome, Italy
www.fig.net

2nd International conference and exhibition on mapping and spatial information (ICMSI2012)
8-10 May
Tehran, Iran
http://conf.ncc.org.ir

Global Geospatial Joint Conference 2012
14-17 May
Quebee City, Canada
www.gsdi.org/gsdiconf/gsdi13

Geospatial Intelligence Middle East
15 - 18, May
Abu Dhabi, United Arab Emirates
www.geospatialdefence.com

6th GNSS Vulnerabilities and Solutions Conference
21-24 May
Baska, Croatia
www.rin.org.uk

MundoGEO#Connect 2012
29-31 May Sao Paulo, Brazil
http://mundogeoconnect.com/2012/en/

The 3rd China Satellite Navigation Conference
15-19 May 2012
Guangzhou, China
www.beidou.org

June 2012

Hexagon 2012
4-7 June
Las Vegas, USA
www.hexagonconference.com

The International Summer School on Mobile Mapping Technology 2012
11 – 15 June
Tainan, Taiwan
http://conf.ncku.edu.tw/mmt2013/intro01.htm

20th International Conference on GeoInformatics
15-17 June
Hong Kong
http://old.nabble.com

Toulouse Space Show
25-28 June
Toulouse, France
www.toulousespaceshow.eu/tss12/en/

July 2012

ESRI International User Conference 2012
23-27 July
San Diego, USA
www.esri.com

August 2012

The XXII Congress of the ISPRS
25 August-1 September
Melbourne, Australia
www.isprs.org

September 2012

ION GNSS 2012
September 17-21, 2012
Nashville, Tennessee, USA
www.ion.org

October 2012

INTERGEO 2012
9-11 October
Hanover, Germany
www.intergeo.de/en

November 2012

Trimble Dimensions User Conference
November 5-7
Las Vegas, USA
http://www.trimbledimensions.com/

2012 International Conference on Indoor Positioning and Indoor Navigation (IPIN)
13-15 November
Sydney, Australia
www.surveying.unsw.edu.au/ipin2012

Bharat Oman Refineries Limited employs Bentley's ProjectWise

Bharat Oman Refineries Limited has implemented ProjectWise, Bentley's collaboration and work-sharing platform, to facilitate the design, construction, and ongoing capacity expansion of its recently commissioned 6 million metric ton refinery in Bina, Madhya Pradesh, India. *www.bentley.com*

Open access to 3D Bangkok map

The Bangkok Metropolitan Administration's (BMA) City Planning Department drew up a 3D city planning map. The 3D city map of traffic routes and infrastructure systems is available to the public at http://3d-cpd.bangkok.go.th. Thin Hongthong, chief of the department's Geographic Information Division, said that the digital map is set at a ratio of 1:500 and is based on the latest 2006 Greater Bangkok city plan. Bangkok Post

Nepal surveys hydropower potential using LiDAR

The Nepal Electricity Authority (NEA) commissioned LiDAR-based surveying for six reservoir type projects in the country. This is the first time that the hydropower is being surveyed using LiDAR technology. The Ministry of Forests and Soil Conservation, Nepal, has already used this technology to map the forest area of the country and the data received by using this technology is being processed. *www.thehimalayantimes.com*

Esri Chief Scientist Receives Honors

Esri chief scientist Dawn J. Wright, PhD, has received the Association of American Geographers (AAG) Presidential Achievement Award. Presented at the AAG annual meeting on February 28, 2012, the award recognizes Wright's outstanding work as a scientist, researcher, author, and advocate for marine conservation and for her contributions to geographic science.

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Pampering pedestrians

Kuala Lumpur is a not a new city to me. I had been there several times in last ten years. However, every visit adds new images and new perspectives and leaves me with a feel that too much is yet to be explored. When this time I visited Kuala Lumpur to attend UNRCC – PCGIAP International Symposium on Spatially Enabled Government and Society organized by Department of Surveying and Mapping Malaysia, I decided to stay at a famous street Bukit Bintang that is very popular among tourists as I understood that the place is near to Kuala Lumpur Convention Center (KLCC), the venue of the conference.

In the morning, when I had to go to KLCC, I decided to use the technology and available tools to find out how to reach KLCC from Bukit Bintang. I utilized Google maps and followed the route suggested by them (see the map). It took longer than what I had anticipated. Somehow, I had the feel that there could be some better or alternative ways to reach KLCC. In the evening, while returning, to find an alternative way I thought why not to apply Indian formula. Being an Indian, I have never shied away using this formula as it works so well.

And the formula is, forget maps; just ask someone around. I asked a security personal at the Convention Center how to reach Bukit Bintang. He paused for a while and suggested me to go outside and take the foot over bridge. I did that, and what I experienced, was simply great.

In fact, it was not simply a foot over bridge to cross the road. Instead, it was a fully air-conditioned walkway that connects two most happening and popular locations of the city – the Kuala Lumpur City Center and Bukit Bintang. As I kept walking into this 5 meter wide elevated walkway, I was getting more and more impressed as I realized the length of the walkway should be more than 500 meters with several exits and entry points.

Too impressed, I tried to find out more information about that. I went through the report at *http://thestar.com.my/news/story.asp?file=/2012/2/20/nation/10737764&sec=nation* which mentioned that it was inaugurated in January 2012 only by the Prime Minister of Malaysia Datuk Seri Najib Tun Razak. It also mentioned that the walkway was a RM100 million project financed by Petronas as part of its social contribution programme. It was a part of the Comprehensive Pedestrian Network joint initiative between the Economic Transformation Programme's (ETP) Greater Kuala Lumpur National Key Economic Area (NKEA) and the Government Transformation Programme (GTP)'s Urban Public Transport which aims to improve the experience of commuting by providing better connectivity between the various public transport services.

In the conference during the day, in the presentation by Ahmad Fauzi bin Nordin, Deputy Director General of Survey and Mapping, Malaysia, there was a mention of Government Transformation Programme where six National Key Results Areas (NKRAs) were identified. One of the focuses highlighted was Improving Urban Public Transport. The other areas were education, rural basic infrastructure, low-income households, crime and corruption. That moment, I did not realise that the programme had components that also keep pedestrians in mind in such a manner.

Next day, when I was going to KLCC, I was approached by a taxi driver, if I needed a taxi. I saw the crawling taxis at Bukit Bintang street and looked the other way. The way which was more tempting and pampering. It was Bukit Bintang KLCC walkway.

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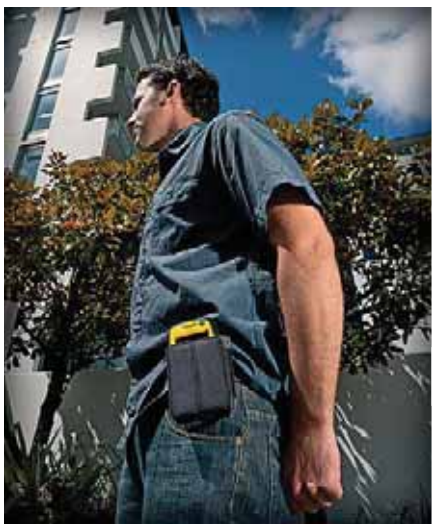

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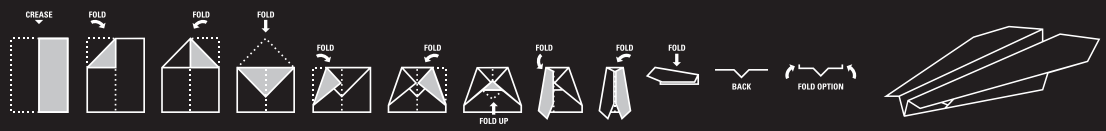

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