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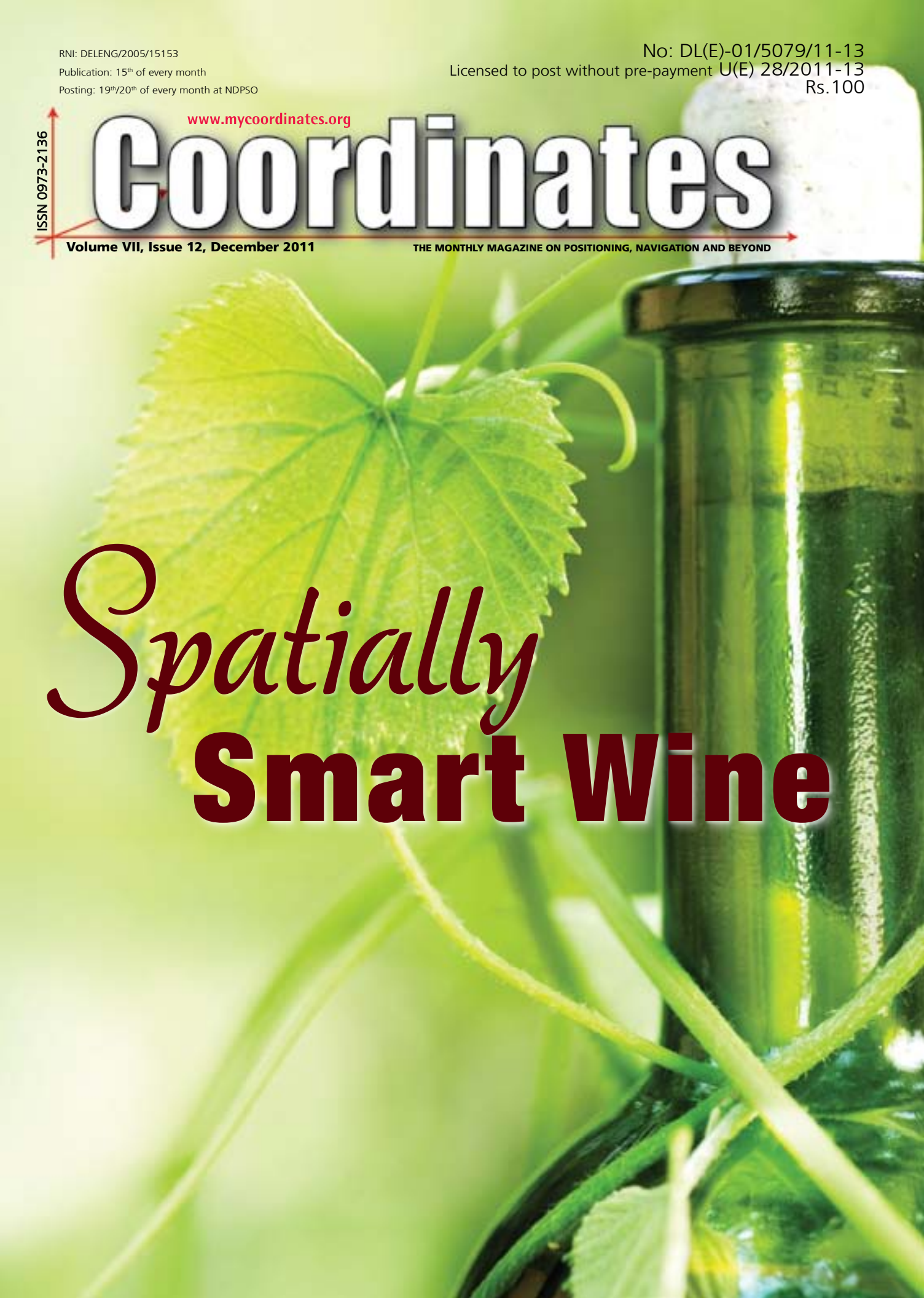
THE MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND



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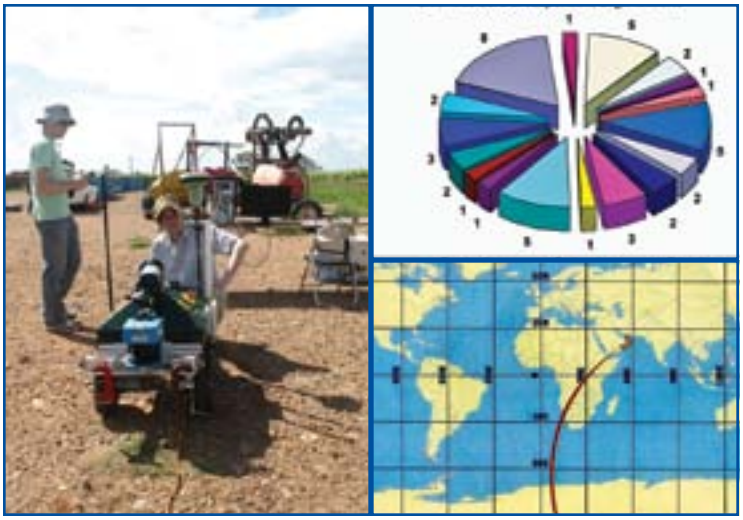

In this issue

Coordinates Volume 7, issue 12, December 2011

Articles

Columns

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An eventful year

2011 takes GNSS several steps ahead in this multi-GNSS era.

With 24 satellites in their designated orbital slots, GLONASS is fully operational.

GALILEO took a giant leap in space with the launch of two satellites.

GPS IIF satellite completed verification testing and is now operational.

China completes the construction of the basic regional navigation system.

MICHIBIKI from Japan begins providing positioning signals.

GAGAN from India took a step forward.

However, we also got caught off the guard when hit by LightSquared.

Worried and vulnerable

With a hope for a resolution sometime soon,

With also a hope that the coming year bring more success and happiness for all of us,

Coordinates wishes readers the best for year 2012.

Bal Krishna, Editor
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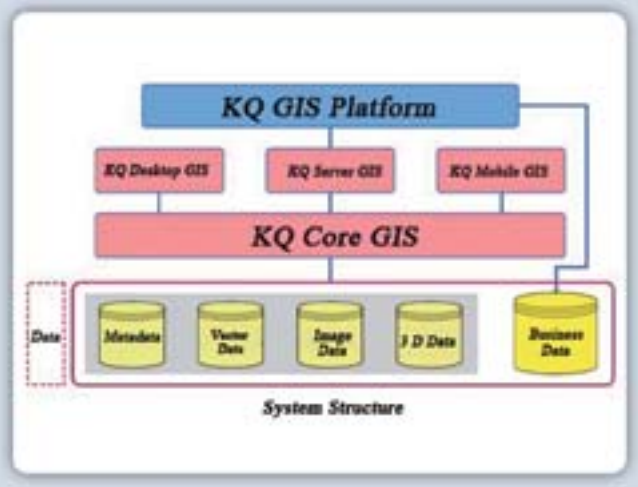

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Receiver designers should be prepared for a more complicated spectral environment

says Richard Keegan, Senior Principal Engineer, NavCom Technology, Inc., a wholly owned subsidiary of Deere & Company while sharing his views on LightSquared and GPS interference issue

What is your perspective about the present controversy involving GPS and LightSquared?

The bottom line is that the LightSquared signals interfere with GPS, and LightSquared should not be allowed to proceed until the interference problems are resolved. To understand this perspective, some background is useful. The spectrum allocated to GPS for its L1 signal is from 1559 MHz to 1591 MHZ. This spectrum is shared by other Global Navigation Satellite Systems such as the EU's Galileo, China's Compass, and shortly also by Russia's GLONASS, which uses the 1598 MHz to 1605 MHz band for its present signals. Basically, GNSS signals occupy the 1559 MHz – 1605 MHz band.

The Mobile Satellite Services (MSS) spectrum is from 1525 MHz to 1559 MHz, directly below the GPS L1 band. LightSquared has two 10 MHz bands within this spectrum, called Low 10 (1525 MHz – 1535 MHz) and High 10 (1545 MHz – 1555 MHz). They also have paired 10 MHz bands above the GPS and GLONASS frequencies at 1627 MHz – 1637 MHz and 1646 MHz – 1656 MHz. The two lower 10 MHz bands would be used for base stations (cell towers) and the upper two 10 MHz frequencies for LightSquared handsets or mobile devices.

The MSS band has for a long time been allocated by FCC rules and international agreements to low powered satellite-to-earth services. The GPS signals in the adjacent band are also low powered satellite-to-earth signals, so these bands were compatible, and GPS receivers operated properly without interference from devices in the MSS band. However, when LightSquared got conditional approval from the FCC in January 2011 to use Low 10 and High 10 for high powered terrestrial signals, it became clear that this use would interfere with GPS, and would degrade or deny GPS when a GPS receiver was near a LightSquared base station. The range of the interference depends on the type of GPS receiver, with some being more sensitive than others, but all classes of GPS receivers would be seriously affected, some at quite long ranges (15 miles or more). With a plan to roll out 40,000 base stations across the US, it became clear that LightSquared represented an extremely serious challenge to GPS usage, civilian, industrial, and military.

LightSquared is a complex issue with *political*, *technical*, and *financial* components. To address these one by one:

Political Issues

There is little question that the United States needs more wireless broadband service. Many areas are underserved, and the existing services are limited in speed and capacity. In addition, a very large proportion of these services are provided by only two companies, ATT and Verizon. So the entry of a new company into this marketplace should be welcomed if it can offer nationwide coverage, high speeds, lower costs, and competition to ATT and Verizon.

LightSquared's desires as a private company are in concert with the National Broadband Plan, established by the Obama Administration, which seeks 500 MHz of spectrum to allocate to broadband over 10 years. However, there is essentially no technically appropriate spectrum that does not have existing uses, so this is not a simple undertaking, and little has been accomplished in the first two years of this plan. LightSquared, should it be allowed to proceed, would represent a small but significant 40 MHz down payment on the 500 MHz.

Technical Issues

The political concerns might readily be resolved if they were the only problems. However, the interference with GPS is quite severe. Since GPS is an integral part of the national and global infrastructure, and deeply embedded into many everyday applications, permitting the rollout of a system that interferes with GPS is very problematic. In its grant of conditional approval to LightSquared to proceed, one of the conditions imposed by the FCC was that the interference with GPS be resolved (there is no definition of "resolved", so it means what the FCC chooses to have it mean). This has resulted in extensive interference testing and studies by many parties, including the DOD, FAA, NASA, GNSS companies, LightSquared, and others. The most significant test was conducted by the GPS Technical Working Group (TWG), which was established pursuant to the FCC's requirement to test GPS interference. The TWG results were released at the end of June 2011, and showed massive LightSquared interference with essentially all classes of GPS receivers.

The TWG testing showed multiple types of technical problems. The *definite* problems can be classified as a) overload, b) augmentation, and c) handsets. The potential problems can be classified as d) third order intermodulation and e) handset out-of-band-emissions (OOBE).

Overload – this problem stems from the closeness in frequency of the very high powered LightSquared signals to the GPS band. When a GPS receiver is near a LightSquared base station, it cannot filter out this level of power, and the LightSquared signal overloads the RF front end of the receiver.

Augmentation – many GPS receivers use augmentation signals to increase the accuracy of their navigation results. These augmentation signals are typically delivered by satellites using frequencies in the MSS band. The presence

of high power terrestrial LightSquared signals in this band prevents the reception of the low power augmentation signals, denying the use of these augmentation signals when near a LightSquared base station.

Handsets – the signals emitted by LightSquared handsets in their return bands above GLONASS interfere with GPS receivers, just as do those emitted by LightSquared base stations. Because the handset signals are of much lower power than the base station signals, the range of the interference is much less, on the order of a meter or two.

Third Order Intermodulation – if LightSquared uses both the Low 10 and High 10 bands, they will create interfering signals that fall directly into the GPS L1 band and cannot be filtered out. If only one of the two bands is used, there are no intermodulation effects.

Handset OOBE – while we know that LightSquared handsets interfere with GPS due to their communication in the return signal bands above GLONASS, the handsets are permitted under present FCC rules to emit out-of-band-interference into the GPS L1 band that is at a level high enough to seriously interfere with GPS (if they do in fact emit at the permitted levels).

Evaluating the interference effects has become more confusing as LightSquared, faced with clear evidence of serious interference to GPS, has altered their system design at least twice. The first proposed alteration was to use only Low 10 for now, with High 10 postponed (but only postponed, not abandoned). Since High 10 is closer in frequency to GPS and causes more interference than Low 10, this was a positive but insufficient step, as Low 10 still interferes with GPS to an unacceptable level. The second proposed alteration was to use only Low 10 (again, just for now) and limit aggregate power on the ground to a lower level than would otherwise be the case. This is also a welcome but also insufficient step, as interference remains, just at reduced ranges.

One of the results of studying the LightSquared interference has been to make it clear that we cannot build GPS receivers that can deal with High 10 and still function properly. The High 10 power is simply too close to filter out without severely degrading performance and greatly increasing the size and weight of receivers. Should LightSquared be allowed to eventually proceed, it must be with Low 10 alone.

While it is also clear that many existing receivers are impacted by any of the LightSquared alternatives, particularly high precision receivers used in many high value applications, whether we can build receivers that can deal with Low 10 alone without performance effects remains unsettled. We can adequately filter out Low 10, but whether this filtering will cause undesirable performance results remains to be determined.

Financial Issues

LightSquared is largely owned by a hedge fund (Harbinger Capital Partners) that has taken a huge gamble in buying a satellite company and renaming it LightSquared. They have invested heavily in LightSquared, presumably assuming that the spectrum could be converted from satellite to terrestrial spectrum.

However, there is a fairness concern with LightSquared's approach; ATT and Verizon paid billions of dollars to the US Government at auction for their terrestrial frequencies, while LightSquared, by virtue of converting satellite frequencies to terrestrial frequencies, would avoid those costs and the US Government would receive no compensation for licensing the LightSquared frequencies. The value of the LightSquared frequencies increases enormously if the spectrum is terrestrial rather than satellite spectrum (one estimate is from $2B to $10B).

The other major financial issue concerns who should pay for the remediation required if LightSquared is allowed to proceed. Some existing GPS receivers and/or antennas will have to be replaced with LightSquared resistant models (presuming such can be built without degrading performance), and while the number of replacements strongly depends on how long a transition period is allowed, it is clear that some will have to be replaced.

The cost to replace receivers and/or antennas also depends very strongly on the application in which they are used. Replacing military and aviation equipment would be very expensive. Replacing survey, construction, agriculture, and scientific equipment would also be expensive. The cost to replace other types of receivers would be less. Who should bear this cost? The FCC precedent is that a new user that impacts existing users is responsible for the costs of remediation.

In summary, LightSquared should not be permitted to proceed until we know how GPS interference will be managed. If they are permitted to proceed, it must be under the following conditions:

- Low 10 alone and not High 10 (now or ever)
- Enough time must be allowed for the transition from existing receivers to LightSquared resistant receivers
- LightSquared should pay for the remediation that will be required

How did the whole thing go wrong?

The problem first arose when conditional approval for LightSquared was given without a full understanding of the interference problems that would result.

What the FCC is proposing to do with the MSS spectrum is re-purpose at least part of it for terrestrial use instead of satellite use. The appropriate process for this is called Notice of Proposed Rulemaking. This process would have involved extensive public comment, and the GPS interference problem would have become apparent at an earlier stage in the proceedings.

The second major problem arose because LightSquared either did not understand or ignored the extremely serious effects that their system would have on GPS. In failing to understand this problem, and insisting repeatedly that there would not be interference, or that the interference was minimal, or that it affected only a tiny minority of GPS receivers, LightSquared created a crisis in which they and government and industry and users have had to invest major resources in seeking a resolution. While it might not be consistent with LightSquared commitments to their potential business partners or investors, the process of evaluating the re-purposing of MSS spectrum should have played out over a much longer time frame.

Do you foresee any solution to the existing deadlock?

At some point, the FCC will rule further on the GPS interference issue. There is no required timeframe for a decision, and given that the National Telecommunications Information Administration (NTIA), the regulator of government spectrum, has asked for

further testing of Low 10 effects on various classes of GPS receivers, we don't expect this ruling to occur until possibly sometime in the first quarter of 2012, at the earliest.

We believe the FCC would very much like to give LightSquared Low 10, if there is a way to resolve the GPS interference issue. Note that resolve does not, to the FCC, necessarily mean that there is no interference. We believe the FCC will be inclined to allow some interference to occur – it is a question of whether the results are tolerable or intolerable. The federal agencies, particularly DOD and FAA, may play a big role in the FCC decision.

The bottom line is that it is not clear what the FCC will decide, but it would be prudent for receiver designers, even if LightSquared does not get a go-ahead, to prepare for a more complicated spectral environment in the future.

How do you see some of the suggestions made to address this issue?

A lot of suggestions have been made, some fanciful, some potentially useful. Among the potentially useful ones, from our perspective:

- Low 10 only, never High 10
- LightSquared pays for remediation for impacted existing receivers
- The time frame for receiver replacement or update is 5-10 years
- LightSquared power levels are reduced
- Augmentation signals are placed tightly against the GPS band (so that filters that include GPS can include the augmentation signals)
- The FCC OOBE limits for handsets are lowered

If FCC decides contrary to the expectations of GPS community, what is the way forward?

It seems unlikely that the FCC would authorize the use of High 10; the interference to all classes of GPS receivers is massive, and there is no way technically to filter it out without causing severe performance problems. If the FCC authorizes the use of Low 10, the responses of manufacturers and users will be to upgrade and replace receivers, obtaining the best performance that we can in this environment. If this is what the FCC decides, there will still be problems, and we will have to deal with them in the context of the FCC decision. The time frame and the allocation of costs will be the most critical issues to address.

Any lessons for GPS users abroad from this controversy?

GPS and GNSS users here and abroad should be quite concerned about this controversy, for several reasons.

- It affects the use of all GNSS in the US, not just GPS. The benefits of multiple GNSS in the US will be lost along with GPS when receivers are near LightSquared base stations.
- LightSquared would like to have a global system, not just a US system. If they can succeed in the US, it greatly strengthens their position abroad.
- Spectrum is dear; the LightSquared case is just one example of how the pressure for intensified use of the available spectrum may affect navigation. We should expect other instances of pressure on GNSS spectrum.
- We must be careful about the cumulative effects of electronic systems that raise the noise floor. While GNSS may be able to tolerate some systems, it may not be able to tolerate all such systems.
- We should strengthen the filtering and processing in GNSS receivers to prepare for an environment in the future that is not as friendly to GNSS as at present.

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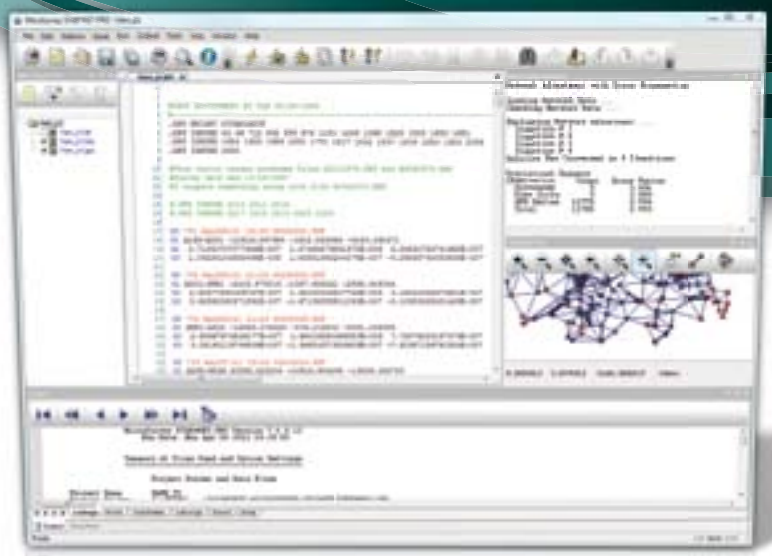

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NIIT University partners with Esri India to launch the M.Tech programme in GIS. In an interview with Coordinates, Mr Rajesh C Mathur, Vice Chairman, NIIT GIS Ltd and Dr Rajeev Shorey, President, NIIT University have discussed various aspects of this partnership

Opportunities to create unique implementation environments

Rajesh C Mathur, Vice Chairman, NIIT GIS Ltd

GIS offers great career opportunities in India and abroad. Please comment.
GIS is becoming pervasive and is finding applications across a wide range of applications across the globe. It is becoming an effective language for communication. GIS companies like Esri are leveraging the advancements in information and communication technology and implementing GIS in multiple patterns like desk top, client server, federated, Web/Cloud and Mobile. These are exciting times and GIS professionals entering the industry world over will get excellent opportunities to innovate and build unique applications which will exploit the power of this technology. We are experiencing paradigm shift in the way technology is deployed thereby creating challenging opportunities to experiment and create unique implementation environments.

What are the main challenges in GIS education?
Most academic institutions in India face tremendous challenges to keep pace with rapid advances in geospatial technology and also to meet the challenging needs of strategic nature of the geospatial technology. Often universities are reluctant to update facilities and get modern tools and systems (both hardware and software) and thus knowledge remains in old regimes and does not get enhanced with time. For example, there is hardly any university that addresses advanced concepts of Cloud GIS; Object Oriented GIS; Geo-data mining and warehousing; geo-search algorithms; legal issues in GIS and so on. Similarly universities lack facilities of modern day satellite-based positioning and navigation systems, air-borne laser terrain mapping (ALTM) system and processing software, 3D-GIS tools etc. There is a need to enhance the skills of the faculty also and to expose them to current technology trends. This impacts the quality of education and knowledge imparted to the students. This is not a good scenario as it inhibits overall and all-round developments of knowledge in wide variety of areas and has the limitation of India becoming a "labor force" as against the "knowledge force" in geospatial technology. As with any educational activity, Geospatial education too needs special attention from Government to bring in the necessary policies, programs, institutional frameworks and networks, career opportunity schemes etc. so that India can generate a large pool of geospatial expertise that can power many needs of the future.

What is the role of ESRI India in NU?
NU M.Tech GIS Programme is research driven and offered with support from Esri India. The collaboration with Esri India will help the programme to be current and industry relevant, taught by a mixed blend of NU faculty and GIS industry experts in Esri India. The collaboration with Esri India will strengthen the M. Tech GIS programme.

Do you visualize any academic – industry interface in the context of NU?
NU M.Tech GIS programme curriculum has been constructed by taking inputs from the GIS industry leaders including Esri India. Some of the leading universities and academic institutions academia also participated in the curriculum design. The initial reaction of the industry is willingness to offer internship and placements to NU M.Tech GIS students after they finish the programme. Some of the leading software development organizations along with Esri Inc are offering scholarships to the students. In times to come, I see the relationship with industry getting stronger.

Innovations will be encouraged

Dr Rajeev Shorey, President, NIIT University

"To be the leading centre of innovation and learning in emerging areas of the knowledge society" How do you plan to achieve your vision?
NU MTech GIS has been envisioned to be highly research driven. Courses in this programme will involve real life projects that has societal applications and benefits. Innovations and entrepreneurship will be encouraged to bring novel research and applications into practice.

How are your courses different from others?
The Programme is based on a unique Geospatial Technology Competency Model (GTCM) and will focus on spatial thinking, technology and applications of GIS, GPS fundamentals and techniques, Geospatial project management and field techniques, exploring geospatial nature of regions, economy, demography, occupation profile, applications of GIS for humanities, etc. The Programme will enable professionals to start a challenging and rewarding career in the rapidly emerging area of GIS. Professionals pursuing this Programme will get a comprehensive exposure to GIS components like Geospatial modeling and database, Cartography, GIS programming, Remote sensing for GIS and relevant elective courses like GIS and Urban Planning, Advanced GIS platform programming (Mobile, Web and Cloud), Geoinformatics for environment, etc. Graduates will be fully prepared for positions as GIS Project Managers, Applications Specialists, Systems Engineers and GIS Business Development Managers. They will also have the option to pursue doctoral research at NU.

What are your plans to ensure best of faculties becoming part of your initiative?
We have started a worldwide initiative to hire outstanding faculty. NU is very selective in this process. I am happy to report that we have been able to attract quality faculties from all around the world, specially United States.

Do you have scholarships to support meritorious students? Any plan for students placements too?
Scholarship All enrolled students in the founding batch will be awarded 100% scholarship from Esri Inc, California and leading corporate houses in the country. The scholarship includes full University fee waiver for the entire duration of the Programme.
Stipend During internship (in the third and fourth semester), all enrolled students will get a stipend at par with the MBA graduates from the organizations that have supported this Programme.
Placement All enrolled students in the founding batch will be placed at par with the MBA graduates in GIS organizations that have supported this Programme.

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100% scholarship. One of the many reasons you'd want to enrol for M.Tech (GIS)

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Spatially Smart Wine

Spatially Smart Wine was a project initiated by an enthusiastic group of Sydney Young Surveyors, with the support of the Institute of Surveyors New South Wales and the School of Surveying and Spatial Information Systems and the University of New South Wales. We present here the first part of the paper

Precision viticulture (PV) is styled from the zonal management paradigm of precision agriculture, where large homogeneous fields are divided into smaller units based on yield or other field characteristics which may be differentially managed (Lamb et al., 2002, Bramley, 2009, Bramley and Robert, 2003) *(Note that McBratney et al. (2005) suggest the definition of precision agriculture is continually evolving as we develop further technologies and greater awareness of agricultural processes)*. PV acknowledges the numerous spatial variations that affect grape quality and yield, including soil characteristics, pests and diseases and topography (Hall et al., 2003, Arnó et al., 2009), providing land managers with the tools to quantify and manage this variability (Proffitt, 2006). Land managers can thus 'selectively' treat areas, for example by the variable application of mulch, water, fertiliser, sprays etc.

The general process of PV is cyclical across observation, evaluation and interpretation - which informs a targeted management plan followed by ongoing observation and evaluation (Bramley et al., 2005). The benefits of PV are increased knowledge of vineyard processes, allowing for targeted improvements to yield, wine quality, reduced disease incidence and increased resilience across the vineyard (Johnson et al., 2003). Data capture undertaken as part of PV can inform mechanised operations for greater efficiency in irrigation, spraying, mulching and pruning, and selective harvesting. Decision support systems are further supported and may aid land managers when in the field (Johnson et al., 2003). PV mitigates against the growing problems of climate change (Battaglini et al., 2009, Shanmuganthan et al., 2008), food security (Gebbers and Adamchuk, 2010) and supports the growing awareness of the consumer and market demands (Delmas and Grant, 2008, Rowbottom et al., 2008, Chaoui and Sørensen, 2008).

Research into the use of autonomous machinery in vineyards is still young and presents opportunities for further development (Grift et al., 2008, Longo et al., 2010). The use of wireless sensor networks is a recent addition to PV, but not yet routinely implemented (see examples in Shi et al., 2008, Matese et al., 2009, López Riquelme et al., 2009, Morais et al., 2008). A significant limitation of current applications and research is the lack of an appropriate, multi-functional decision support system (McBratney et al., 2005, Arnó et al., 2009).

This research focuses on the contribution of surveying and spatial technologies to PV, with a focus on sensor applications for tele-operated and autonomous machinery. This paper reports the preliminary findings of a scoping fieldtrip, with an outline of technologies tested for their utility and suitability to the client's needs.

The 'Spatially Smart Wine Project'

'Spatially Smart Wine' is a joint initiative of the International Federation of Surveyors (FIG) Young

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Surveyors Network, the New South Wales Institution of Surveyors Young Surveyors Group (Australia) and the University of New South Wales Schools of Surveying and Mechatronic Engineering. The project was initiated to improve the networks and skills of young surveyors in the Sydney region, and to generally improve community understanding of surveying (see Figure 1). Additional benefits are increasing surveyors' knowledge of PV!

General details of how the project was run are reported in Fairlie and McAlister (2011). Fieldwork was undertaken at Jarrett's wines, a small to medium (300 hectare) vineyard 30km south west of Orange, NSW, Australia – approximately 300km west of Sydney. Established just over 15 years ago, the management of the vineyard now incorporates organic and biodynamic farming principles. The vineyard manager sees PV as a critical element of sustainable vineyard management.

Biodynamic viticulture rejects the use of synthetic chemical fertilisers and pesticides. Both organic and biodynamic farming practices embrace the use of natural products, but the underlying philosophy of biodynamics is the use of soil and plant 'preparations' to stimulate the soil and enhance plant health and product quality (Reeve et al., 2005). The adoption of organic and/or biodynamic farming practices is likely to increase with greater awareness of climate change and sustainability requirements (Turinek et al., 2009). The general thesis of these farming processes is sustainable agriculture, with no long term environmental damage. There remain a number of research gaps in organic and biodynamic farming practices – for example, critics cite a lack of scientific understanding and rigour within the biodynamic field (Kirchmann, 1994) . PV technology has a role to assist, for example in research on soil nutrient variability, mapping and management, weed control, and achieving dual outcomes of economic and environmental sustainability. Research is advancing with regards to robotic weeders, online systems to manage soil nutrients and crops, but commercial adoption and availability of products is limited (see Dedousis et al., 2010 for an overview of the field). The general goal of the fieldwork was the testing of survey and spatial technologies for PV, particularly taking into account client needs and fitness-for-purpose.

Figure 1: The authors at Jarrett's Vineyard

Table 1: Surveying technologies and their applications to PV. Compiled from (Keightley and Bawden, 2010, Bramley, 2009, Bramley and Robert, 2003, Lamb et al., 2002, Grote et al., 2003, Bramley et al., 2005)

Sensor/ Technology	Application	Benefits
Aerial LiDAR and Terrestrial laser scanning	Measurement of tree/vine trunk diameter Height of vegetation and topography Leaf area density and index 3D reconstruction of vegetation/objects	Carbon measurement: wood volume of perennial crops indicative of carbon storage (Keightley and Bawden, 2010) Foliage density and height for variable spray applications (Gil, 2007, Rosell et al., 2009, Rosell Polo et al., 2009)
Satellite/aerial multi- and hyper-spectral imagery	Selective harvesting Yield estimation Digital Terrain Model Soil information Crop vigour indices (such as Normalised Difference Vegetation Index (NDVI), Leaf area index (LAI))	Topography provides indication of water/soil variation (Bramley, 2009, Bramley and Robert, 2003, Lamb et al., 2002) Healthy, vigorous grapevines typically have higher reflectivities (Arnó et al., 2009). Leaf density has been shown to be linked to grape yield and quality (Lamb et al., 2002). NDVI measurements can identify downy mildew (Mazzetto et al., 2010) LAI is related to fruit ripening rate, so can be used to parameterise plant growth models and for decision support systems (Johnson, 2003). LAI can also inform spraying (Siegfried et al., 2007)
Ground Penetrating Radar (GPR)	Soil water content	Soil water content informs planting and vineyard management (Grote et al., 2003)
Tele-operated and autonomous machinery applications	Mulching, irrigation, spraying, harvesting etc.	Relieves staff workload and allows for supported decision making, such as real-time measurement and resultant variability in applications (see for example, Bramley et al., 2005)
GPS	Accurate location of position GPS data can be incorporated into maps, giving new interpretative power to generate more meaningful maps	The accessibility and low cost of GPS means that grape-growers can accurately locate themselves within their vineyard when sampling for vine growth, development and productivity (Lamb et al., 2002)
GPS- and GIS-enabled Toughbook	Data collection of location of vines posts, quality of vines, defects (destroyed vines etc), rabbit holes etc	Cost-effective and convenient for basic mapping and data collection, replacing the traditional pen and paper-based method (Koostra et al., 2003)

Note the focus of this table is on technologies traditionally associated with the geospatial and surveying professions. It does not represent an exhaustive list of sensor technologies used in precision viticulture.

Outline of this paper

In the following sections we will provide an overview of surveying technologies applicable to PV, an initial high level qualitative analysis of technologies tested, and finally an overview of the outputs and accuracies achieved in uniting the Unmanned Ground Vehicle with surveying technologies.

Application of surveying technologies to precision viticulture

PV requires much finer sampling than precision agriculture (Bramley and Janik, 2005), hence the greater need for surveying and spatial professionals to engage with this industry. Viticulture is particularly suited to spatial and surveying technologies, due to the 'fixed' nature of plantings and the perennial nature of crops (Arnó et al., 2009) and spatial analysis is critical to managing vineyard productivity and minimising risk in small scale vineyards.

Vineyard establishment in Australia will typically involve soil sampling (including type mapping, salinity measurements and moisture distribution), topographic mapping and surveyor set-out of plantings, with grape varieties located according to appropriate soil type, nutrient and moisture levels. Topographic variation is a critical driver of vineyard yield variation (see Bramley 2006, Bramley and Williams 2007), particularly in the Australian case where yield is closely linked to water supply and generally varies with topography (Bramley 2003b).

Once established there are a number of ongoing roles for spatial data and analysis. Vineyard leaf area is a key determinant of grape characteristics and wine quality and is a predictor of fruit ripening rate and instances of infestation and disease. Vineyard leaf area measurements can inform pruning procedures, shoot thinning, leaf removal and irrigation (Johnson et al., 2003). International monitoring of emissions for climate change mitigation and adaptation is further creating a role for spatial technology in the vineyard. Transient biomass (changes in biomass from year to year) provides an indication of the most productive areas of the vineyard, and monitoring of biomass may be a future requirement of climate change policy. Measurement of transient biomass year by year (i.e. following pruning) is common, but difficult and expensive – remote imaging options present much more efficient forms of measurement (Keightley and Bawden, 2010). Uniquely, Mazzetto (2010) present a ground-based mobile remote sensing lab to allow more frequent and targeted vineyard spatial analysis.

Table 1 provides an overview of sensor technologies for PV and their applications and benefits.

The paper was presented at FIG Working Week 2011, Marrakech, Morocco, 18-22 May 2011

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Land governance

This paper discusses the World Bank support for sustainable land reform, focusing on the East Asia Region, with particular emphases on initiatives in land governance, land development investment, tenure security, NSDI, e-government, land tax, spatial planning, disaster response and mitigation. Readers may recall that we have published the first and second part of the paper in October 2011 and November 2011 issue. We present here the concluding part of the paper

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The importance of good land governance to strengthen women's land rights, facilitate land-related investment, transfer land to better uses, use it as collateral, and allow effective decentralization through collection of property taxes has long been recognized. The challenges posed by recent global developments, especially urbanization, increased and more volatile food prices, and climate change have raised the profile of land and the need for countries to have appropriate land policies. However, efforts to improve country-level land governance are often frustrated by technical complexities, institutional fragmentation, vested interests, and lack of a shared vision on how to move towards good land governance and measure progress in concrete settings. Recent initiatives have recognized the important challenges this raises and the need for partners to act in a collaborative and coordinated fashion to address them. Increased awareness of the successful implementation of innovative approaches to good land governance can help to not only improve land governance itself, but can also contribute to the overall well-being of the poorest and the achievement of the MDGs.

Good governance is increasingly recognized as critical to effective development and sustainability. Specifically for the land sector governance, a fully functioning land and property system is composed of four building blocks: (a) a system of rules that defines the bundle of rights and obligations between people and assets reflecting the multiplicity and diversity of property systems around the world; (b) a system of governance; (c) a functioning market for the registration, exchange of assets; and (d) an instrument of social policy. Each of these components can be dysfunctional, operating against the poor.

Even in terms of standard indicators such as corruption, land has long been known to be one of the sectors most affected by bad governance, something that is not difficult to understand in light of the fact that land is not only a major asset but also that its values are likely to rise rapidly in many contexts of urbanization and economic development. The most authoritative survey of global corruption finds that, after the police and the court, land services are the most corrupt sector, ahead of other permits, education, health, tax authorities, or public utilities (Transparency International 2009). This survey found the levels of bribery across public sectors as follows: (a) land services, 15%; (b) police, 24%); (c) judiciary, 16%; (d) registry and permit services, 13%; (e) education, 9%; (f) health, 9%; (g) taxation, 7%; and (h) utilities, 7%.

Although individual amounts may be small, such petty corruption can add up to be large sums; in India the total amount of bribes paid annually by users of land administration services are estimated at $700 million (Transparency International India 2005), equivalent to three quarters of India's total public spending on science, technology, and environment.

The effects of weak land governance will be particularly harmful for the poor in developing countries for whom land is a primary means to generate a livelihood, a key vehicle to invest, accumulate wealth, and transfer it between generations, and key part of their identity. All over the world, land and real estate are a main component of household wealth. Because land comprises such a large share of the asset portfolio of the poor, giving secure property rights to land they already use can increase the wealth of poor people who are not able to afford the (official and unofficial) fees needed to deal with the formal system. It also implies that improved land governance has great potential to benefit the poor directly and indirectly.

Land governance assessment framework

The World Bank, in collaboration with other partners, has developed the Land Governance Assessment Framework (LGAF), a tool designed to help countries assess their policies and practices regarding land governance, setting a benchmark for comparison and monitoring of progress. It comprises a set of eighty detailed Land Governance Indicators which are ranked on a scale of pre-coded statements, from the degree of good governance to best practice. The LGAF addresses the need for guidance to diagnose and benchmark land governance, helping countries prioritize reforms, and monitor progress over time. It focuses on five broad thematic areas that have been identified as major areas for policy intervention in the land sector, viz. The legal framework, land-use planning, public land management, the availability of land-related information, and dispute resolution mechanisms. Table 2 presents a summarized version of LGAF's five thematic governance areas, comprising twenty-one index groups and eighty specific indicators (World Bank, 2010).

Initially piloting of the LGAF has been undertaken across a range of countries in different regions during 2008-09. In East Asia, Indonesia was the pilot country. If applied in a way that draws on existing expertise and broad participation

Table 2: LGAF Dimensions ordered by Thematic Areas
THEMATIC AREA 1. LEGAL AND INSTITUTIONAL FRAMEWORK
LGI-1. Recognition of a continuum of rights: The law recognizes a range of rights held by individuals as well as groups (including secondary rights as well as rights held by minorities and women).
LGI-2. Enforcement of rights: The rights recognized by law are enforced (including secondary rights as well as rights by minorities and women).
LGI-3. Mechanisms for recognition of rights: The formal definition and assignment of rights, and process of recording of rights accords with actual practice or, where it does not, provides affordable avenues for establishing such consistency in a non-discriminatory manner.
LGI-4. Restrictions on rights: Land rights are not conditional on adherence to unrealistic standards.
LGI-5. Clarity of mandates and practice: Institutional mandates concerning the regulation and management of the land sector are clearly defined, duplication of responsibilities is avoided and information is shared as needed.
LGI-6. Equity and non-discrimination in the decision-making process: Policies are formulated through a legitimate decision-making process that draws on inputs from all concerned. The legal framework is non-discriminatory and institutions to enforce property rights are equally accessible to all.
THEMATIC AREA 2. LAND USE PLANNING, MANAGEMENT, AND TAXATION
LGI-7. Transparency of land use restrictions: Changes in land use and management regulations are made in a transparent fashion and provide significant benefits for society in general rather than just for specific groups.
LGI-8. Efficiency in the land use planning process: Land use plans and regulations are justified, effectively implemented, do not drive large parts of the population into informality, and are able to cope with population growth.
LGI-9. Speed and predictability of enforcement of restricted land uses: Development permits are granted promptly and predictably.
LGI-10. Transparency of valuations: Valuations for tax purposes are based on clear principles, applied uniformly, updated regularly, and publicly accessible.
LGI-11. Collection efficiency: Resources from land and property taxes are collected and the yield from land taxes exceeds the cost of collection
THEMATIC AREA 3. MANAGEMENT OF PUBLIC LAND
LGI-12. Identification of public land and clear management: Public land ownership is justified, inventoried, under clear management responsibilities, and relevant information is publicly accessible.
LGI-13. Justification and time-efficiency of expropriation processes: The state expropriates land only for overall public interest and this is done efficiently.
LGI-14. Transparency and fairness of expropriation procedures: Expropriation procedures are clear and transparent and compensation in kind or at market values is paid fairly and expeditiously.
LGI-15. Transparent process and economic benefit: Transfer of public land to private use follows a clear, transparent, and competitive process and payments are collected and audited.
THEMATIC AREA 4. PUBLIC PROVISION OF LAND INFORMATION
LGI-16. Completeness: The land registry provides information on different private tenure categories in a way that is geographically complete and searchable by parcel as well as by right holder and can be obtained expeditiously by all interested parties.
LGI-17. Reliability: Registry information is updated, sufficient to make meaningful inferences on ownership.
LGI-18. Cost-effectiveness and sustainability: Land administration services are provided in a cost-effective manner.
LGI-19. Transparency: Fees are determined and collected in a transparent manner.
THEMATIC AREA 5. DISPUTE RESOLUTION AND CONFLICT MANAGEMENT
LGI-20. Assignment of responsibility: Responsibility for conflict management at different levels is clearly assigned, in line with actual practice, relevant bodies are competent in applicable legal matters, and decisions can be appealed against.
LGI-21. Low level of pending conflict: The share of land affected by pending conflicts is low and decreasing.

by relevant stakeholders (including governments) from the beginning, the LGAF can not only help to broaden the range of issues to be covered in such analysis but also the relevance of the resulting analysis and the credibility of resulting recommendations for policy or further study. In all of the countries studied, the LGAF was useful as a diagnostic tool to identify gaps in policy and the way in which institutions function or responsibilities between institutions are assigned. A second use of, to monitor discrete (rule-based) indicators for policy reform, follows immediately and can provide an excellent opportunity for a broad-based coalition of actors (including NGOs, the private sector, and academics) to monitor to what extent recommendations are followed through. Finally, and possibly most importantly, the LGAF points towards a number of quantitative indicators which, together with the initial diagnostic, are essential to continually monitor land governance. The fact that each of these indicators is related to one or more core areas of the land administration system suggests that collection and publication of these indicators on a regular basis, and to accommodate wide variations of these indicators over space in a way that can be easily disaggregated, should be a routine in any land administration system.

Sustainability of land administration systems

For the investment in a land administration project to be considered successful, it should be expected that the developments by the end of donor engagement are sustainable. Sustainability has many elements including: (a) capacity; (b) budget; (c) good governance, transparency and accountability; (d) security of land records from loss, destruction and fraud; (e) reliable and consistent delivery of services which are accessible, government commitment and public confidence; to name but a few.

There should be sufficient capacity in the public sector and hopefully also private sector. Land administration agencies should have sufficient recurrent budget to maintain their operations and have access to additional investment budgets to undertake the necessary developments and improvements to maintain their efficiency and effectiveness. Whilst in many developed countries there are examples of land administration agencies which are self-funded, from land registration and other fees they collect, it should never be forgotten that it has taken a very long time to achieve such a status, and much longer than the duration of on one or more phases of land administration project implementation.

The Thailand land titling program is one example of a successful program that has long been sustained after the donor support had finished in 2002. The Thai Department of Lands (DoL) has continued to implement the program, under government funding. A technical review undertaken by the World Bank in August 2009, noted that the land registration in Thailand now generates around ten times its operating costs per annum through fees collected for land transactions and enquiries, although DoL remains an on-budget agency and all revenue is returned to the Treasury. In Thailand, the majority of all land transfers are generally completed in less than three hours.

Concluding remarks

Land-related issues will continue to be high priority areas of engagement by the World Bank as evidenced by the continuing concerns of food security, climate change, disaster mitigation and response, poverty alleviation, growing urbanization, carbon, conflict, human rights and so. That land is now more clearly seen as a cross-sectoral issue, may see an increasing trend of dealing with land issues under a broader project or program agenda. ICT, and specifically geospatial information technologies, will increasingly be on the critical path of the support provided by the World Bank. The importance of the cadastre, in its broadest sense, and its governance, remains paramount in almost all development interventions. It therefore follows that investment in land administration systems should explicitly see the development of the NSDI and spatial enablement of the government as part of overall reform, which facilitates an expanded agenda that includes land governance, social development, sustainable management of natural resources and the environment, disaster prevention, climate change, carbon monitoring and so forth. However, such investments need to be calibrated for the specific country requirements, including capacity and sustainability.

For land-related professionals, especially surveyors and spatial information scientists, it is essential that their engagement in land administration, and governance reform, is based on the prudent and balanced application of new technologies and appropriate levels of spatial accuracies. Over-engineered data bases, requiring unnecessary data fields and unnecessary high levels of spatial accuracy, are costly to develop and maintain. These professionals must also recognize the broader social, cultural, political, economic and financial factors that shape the cadastres and NSDIs. The focus of thinking and investment should be on good governance and completeness, reliability, fitness-for-use and cost-effectiveness of land-related data rather than spatial accuracy. The International Federation of Surveyors (FIG) has a very prominent role to play at both global and regional levels in shaping the thinking of land professionals to ensure sound investment in modern technologies.

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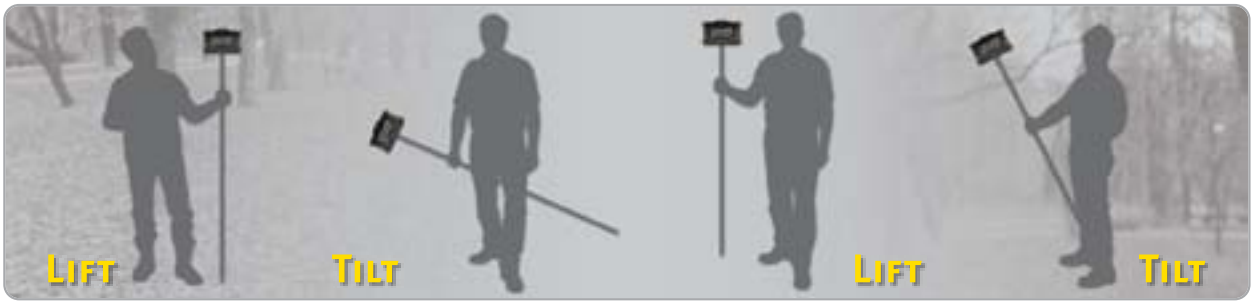

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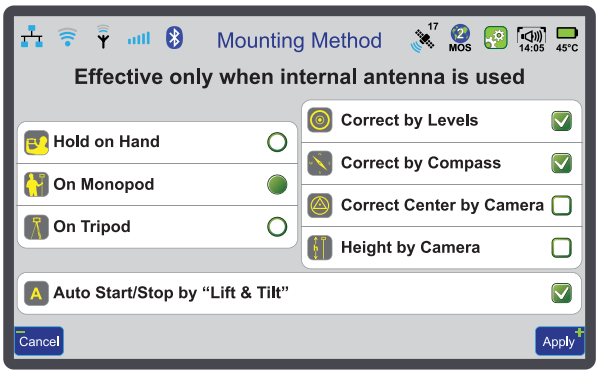

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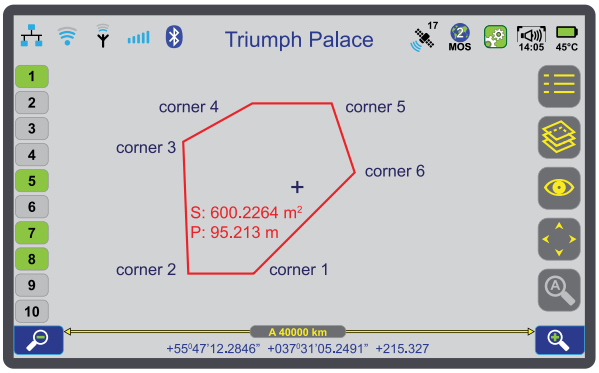

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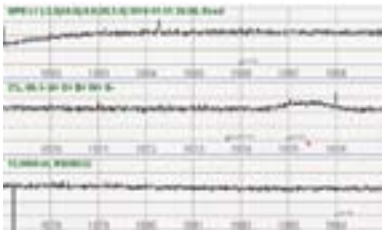

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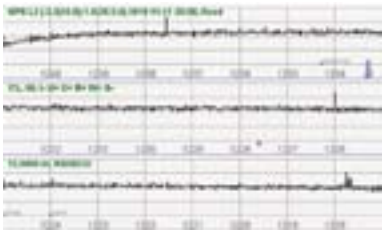

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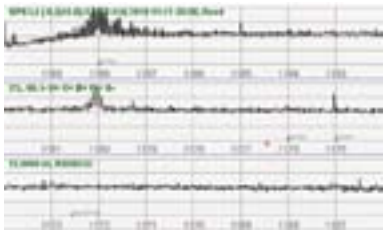
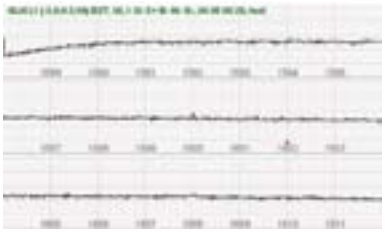


GLONASS L1



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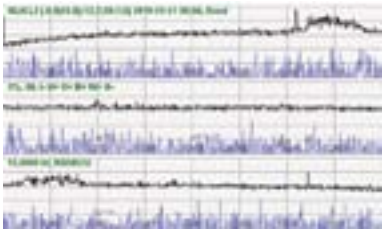

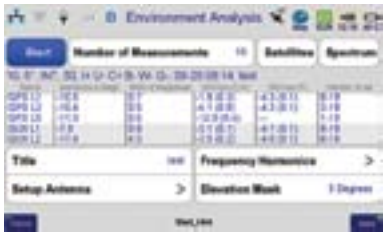

Center of the Band

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“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.

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"The NGIS and NSDI complement each other"

says Dr R Sivakumar, CEO NSDI & Head NRDMS Division, Department of Science & Technology, Government of India

What are the achievements of NSDI?

The most important achievement of the National Spatial Data Infrastructure (NSDI) has been bringing together many agencies to work for a cause. It had not been easy and it took more than ten years to reach at this stage. In addition, we were involved in the standards development activities of NSDI for Metadata (2005/2009) and National Spatial Data Exchange Standards (NSDE-2003). NSDI is seen as Standards organization and Bureau of Indian Standards (BIS) is in the process of constituting a mirror committee for ISO TC 211 with NSDI as anchor. We also initiated efforts for development of Content Standard. India GeoPortal, today, provides metadata of many agencies and offers OGC compliant services such as WMS, WFS, WCS and WMTS. WMS offered by SOI and NRSC together provide topographical data of 1:50,000 scale and satellite images in an interoperable manner. GSI and FSI will also provide WMS very soon. This is a step towards realizing our vision of making the geospatial data available and accessible by creating a policy environment, evolving standards and developing the necessary tools and technologies through a process of consensus building. We do organize annual conferences to keep the discussion and momentum alive. The NSDI secretariat has been actively involved in evolving National Map Policy, Remote Sensing Data Policy and in drafting National Data Sharing and Accessibility Policy(NDSAP). There were initiative taken by other organizations as a result of our activities, for example; the Geological Survey of India Portal and some state portals like in Karnataka. District Geo-portals were also conceptualized and demonstrated. A number of research projects have been undertaken besides establishing centres of excellence at IITs/ Universities. NSDI has also prepared data models and procedures for mapping on 1:10,000 scale. NSDI is now embarking on creating a States Geospatial Data Council (SGDC) to establish SDIs in all states. NSDI has also developed a number of tools such as conversion tool for Everest to WGS 84, Ontology etc. Consultancy Development Centre (CDC) of Department of Scientific and Industrial Research (DSIR) carried out a detailed study on the expectations of stakeholders and the aspiration of NSDI and its agencies as shareholders. This aspiration documents is just released and has set our agenda for 2020 while carrying out a detailed SWOT analysis. We are now working towards migrating from e -Governance to G- Governance.

Would you like to highlight the findings of aspiration document?

The society needs products and not data alone. It is the time for the NSDI to migrate from 'data domain' of enabling infrastructure to 'product domain' of a performing infrastructure. The report suggests that in geospatial product space, the NSDI will have to evolve workable and synergizing relationships between itself, BIS, data generators, geospatial product developers, hardware manufacturers, cell phone and smart phone manufacturers, communication service providers in addition to the users.

What NSDI could not achieve?

Let us understand the challenges first. The worst part of the NSDI initiative was that it was being mistaken as the Department of Science and Technology (DST) project. The other challenges were empowerment of authority and mandate, human resources and support from the industry. NSDI made an attempt two years ago to develop a Geospatial Decision Support System (Geo DSS) and had to give up due to inadequate response. We should also look at small investments made in NSDI and the outcome which is far disproportionate as NSDI is, today, seen as gateway for spatial data in India.

How do you see the initiative regarding National GIS? What structure you propose between NSDI and NGIS?

The National GIS (NGIS) and NSDI complement each other. NSDI could be an enabling mechanism for providing standards, interoperability, research and capacity building and INGO could provide the national GIS platform for crucial Geo DSS applications based on national GIS Data Asset for governance, enterprise and citizen services. The INGO could have the flexibility and efficiency of private sector while the NSDI could provide the rigors and authenticity of the Governmental processes. In my personal view, INGO board could be the part of NSDC with CEO of INGO working under an autonomous organization. In my view, INGO evolved from NSDI and National GIS will be a non starter without NSDI.

What according to you should be the NGIS mandate?

The NGIS should focus on providing solutions. It should seriously deliberate on Geo DSS as users would like to have the solutions for problems at hand rather than data, hardware and software. We need to develop Spatial Information Processing (SIP) Models to provide automated responses to user queries, both through cell phone and web in local language. Thus there is a need to have a Geo ICT solution for spatial data similar to the Apps of iPAD. In NSDI experience, organizations were reluctant to even share their metadata. If NGIS has to focus on applications and services, these data would play a key role. To avail these data may itself be a challenge.

Based on your NSDI experience, what technology platform should be used by NGIS for cost-effective implementation and optimum value for users?

It is premature to suggest a technology platform though there were suggestions to use 'geo clouds'. The data providers need to get reassured about data security. At the user level, we need to explore the open source as it would not be possible to replicate the software licenses in large numbers. In any case, the ISO/TC 211 and OGC compliant products, services and solutions should be the main requirement to ensure interoperability.

User requirements analysis for the development of NSDI

This paper elaborates SDI situation in the Sultanate of Oman from an organisational perspective

Ahmed Hamood Mohammed Al-Wardi
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The economic and social development in the Sultanate of Oman during and after 1970 became the basis of assessment and planning to identify priorities of national development. For this, the role of geographic data to support sound decision-making has been considered important to support development programmes. Thus, the framework of dataset or the fundamental data in the Sultanate needs to clearly identify what constitutes the basic data used and produced by the government and private institutions.

The framework is a collaborative effort to create a common source of basic geographic data that are commonly used as a base dataset upon which other datasets can be placed (Phillips et al., 1999). It is a foundation on which organisations can build by adding commonly referred to datasets or a sufficient reference for most geo-located datasets (Luzet et al., 2000).

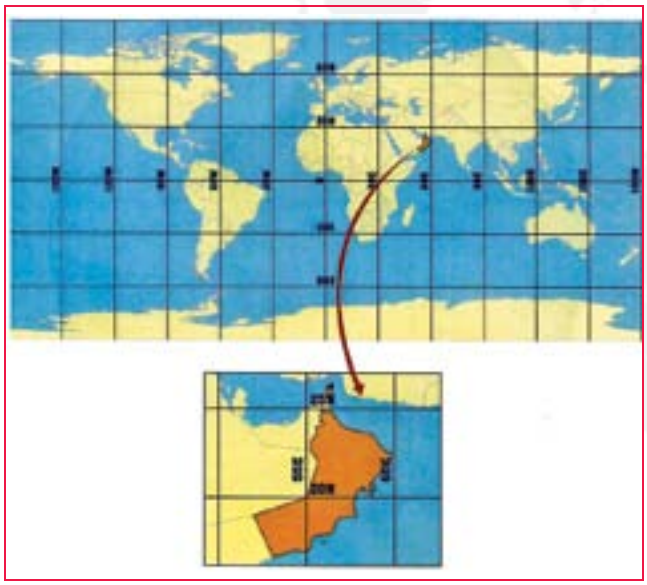

Figure 1: Indicates the location of the Sultanate of Oman on the world map (MD,1996).

In the national level, common spatial data are mostly defended through national agreements on content, known as "framework" or "fundamental" data (Nebert D. *et al*, 2004) these agreements leveraging individual geographic data in purport and quality so can be exchanged and used.

In Oman, there have been discussions and interactions for last many years to enrich this aspect with achievements. Still, there is no consensus in views or whatsoever about framework datasets which would give importance to the geographical datasets to be as value to the government agencies and to private sector companies to achieve their needs. To run an NSDI, the critical points considered to be must are - to have the proper identification of datasets which have different national importance; activation of specific standards; and identification of priorities and commitments among the organizations working in the field of GIS. Therefore, the common datasets for the Sultanate are those data which are used with great popularity by the various members of the GIS community to meet their various needs. Certainly, there is a need to identify the datasets required by the widespread users and also a need to find out whether these datasets meet the expectations of those who use them. There is also a need to know the productive enterprises and the extent of duplication with others. With these objectives, this study is structured to clarify these aspects, identify and prioritize the framework datasets through the study elements that is embedded with questionnaire, interview and review of the data valuable in order to identify the fundamental data to represent the foundation stone for a wide range of activities and applications. To reach the goal by determining the specific aspects of the datasets available in the Sultanate, which is seen as more applicable for large segment of users and help in the discovery of any framework datasets, priority should be given to this integration in Oman NSDI.

Sultanate of Oman at a glance

The Sultanate of Oman occupies the south-eastern tip of the Arabian Peninsula between latitude 16° 40′ and 26° 20′ north

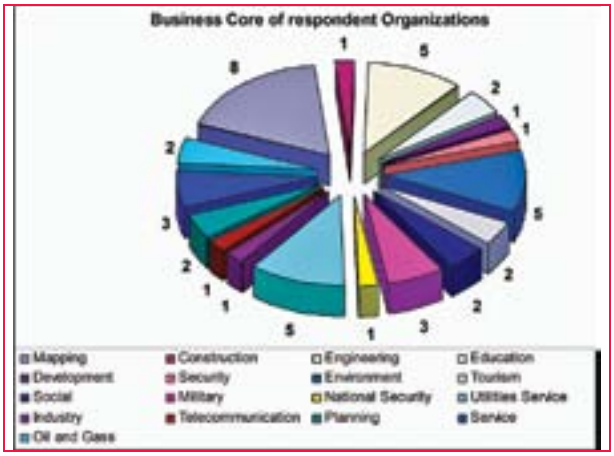

Figure 2: The number of institutions involved in the study and their business core

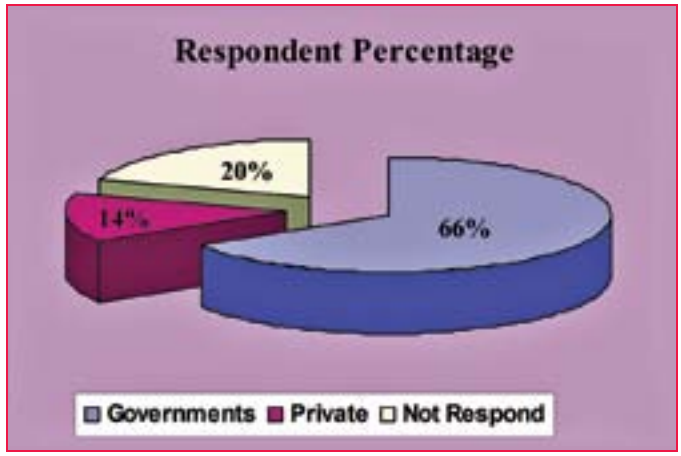

Figure 3: Respondent percentage

and longitudes 51° 50′ and 59° 40′ east. It is bordered to the west by the United Arab Emirates and the Kingdom of Saudi Arabia and the South by the Republic of Yemen, the Strait of Hormuze to the North and Arabian Sea to the East.

The Sultanate occupies a total area of 309,500 km² which includes different terrains that vary from plain to highland and mountains. The coastal plain overlooking the sea of Oman and the Arabian Sea forms the most important plain of Oman. This area amounts to 3% of the total landmass while the mountains make up 15% of the total area. Sand and desert cover the greatest area and represents approximately 82% of the total area; most of it the Empty Quarter (MD, 1996).

Spatial data evaluation methods

One of the fundamental starting points for developing NSDI in the Sultanate is to clearly understand, identify and describe the user requirement. The study explores, develops and evaluates specific spatial data which will be suitable to be the core of NSDI dataset. Questionnaire, interview and data review are the important elements of this study. These elements give a clear picture about the situation of spatial data activities of the Sultanate of Oman. The study elements are targeted to GIS organisations in all development sectors in the Sultanate, whether they are producers or users of the geo-spatial data. The business core of these organisations, as illustrated in figure 2 indicates that the mapping sector leads due to its significant impact on geospatial data production in the Sultanate by eight institutions, followed by engineering sector, environment and utilities services by three institutions for each. The third happens to be the military and services followed by the rest of other sectors.

The main message coming out of these organisations is that there are diverse opinions about NSDI and types of fundamental geospatial datasets. However, there is a general agreement on essentiality to adopt the government NSDI technology.

Questionnaire contents

The questionnaire has been designed carefully to cover all the study aspects. It is conducted in four parts in quantitative manner as mentioned below:

- **Part A:** Awareness of the existence and benefits of National Spatial Data Infrastructure (NSDI).
- **Part B:** Identifying data producers, data users, and their activities
- **Part C:** Availability, accessibility, applicability and usability of data
- **Part D:** Approvals, policies, regulations, laws pertaining to the creation of national base maps, creation of national spatial databases, spatial planning, human resource management.

Questionnaire respondents

The intention of this survey was to incorporate views from users in different sectors. The questionnaire was distributed to 35 organizations working in the field of GIS including government and private sectors. 28 organizations

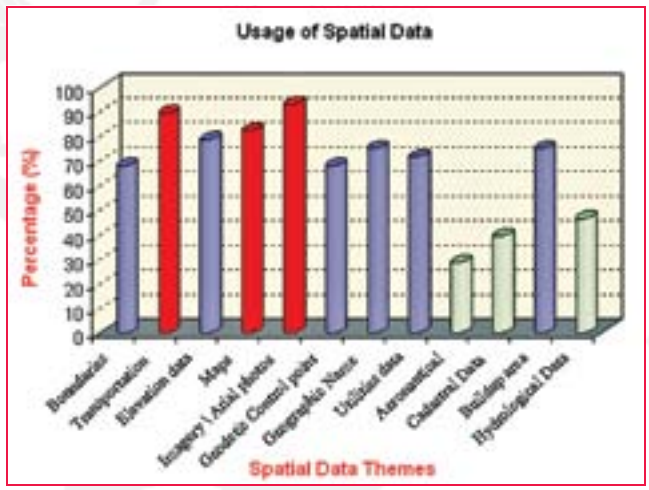

Figure 4: Percentage of used spatial data in the Sultanate according to the questionnaire outcome.

responded the feedback questionnaire. The respondent percentages from government department and private sectors are illustrated in Figure 3.

Spatial data usage

The information of spatial data usage which brought by the questionnaire was analysed. The findings are mentioned in table 1 and figure 4. The outcome of the analysis indicates spatial data interests i.e. images / aerial photo, transportation data and maps constitute around 80%. Geographic place names, build up area and elevation data come second with almost 70%. Utilities, geodetic control points and administrative boundaries also have relatively high percentage of usage at 60% level. The less percentage usages, below 42%, are hydrological data, cadastral and aeronautical information which apparently interested to a few agencies.

Fundamental datasets

The user need assessment as resulted from this study suggested the fundamental datasets for the Sultanate of Oman. This data is a group of basic information for the data that can not be derived from other information, which represent the phenomena as location, objects, or important subjects to understand the environmental, social benefits and economic levels of regional and sub-national and local communities. Taking into account the essential needs users from different sectors and the relevant technical specifications such as the quality, continuity and accuracy.

On basis of the definition and the criteria mentioned above, the fundamental datasets for the Sultanate of Oman have been chosen as following:

- Transportation
- Boundaries information
- Geodetic Control Network
- Utilities and services
- Imagery \ Arial photos
- Elevation data
- Maps
- Cadastral data
- Hydrography

Table 1: Spatial data themes used in the Sultanate of Oman's Organizations

Organization \ Data Sets	Boundaries	Transportation	Elevation data	Maps	Imagery \ Arial photos	Geodetic Control point	Geographic place Name	Utilities data	Aeronautical	Cadastral Data	Buildup area	Hydrological Data
MONE	◆	◆	◆	◆	◆	-	◆	◆	-	-	◆	-
MOTC	-	◆	-	-	-	-	-	-	-	-	-	-
MOD-NSA	◆	◆	◆	◆	◆	◆	◆	◆	◆	-	◆	◆
MOD-HNO	◆	-	◆	◆	◆	◆	◆	-	-	-	◆	◆
MOD-MWS	-	◆	◆	◆	◆	◆	◆	◆	-	◆	◆	-
MOI Table	◆	◆	-	◆	◆	◆	◆	-	-	-	◆	-
MECA	◆	◆	◆	◆	◆	-	◆	-	-	-	◆	-
MORM&WR	◆	◆	◆	◆	◆	-	-	◆	-	-	-	◆
MOH	◆	◆	-	-	◆	◆	-	◆	-	◆	◆	-
MOHR	◆	◆	-	◆	◆	-	-	◆	-	-	◆	-
MOAG	◆	◆	◆	◆	◆	-	◆	-	-	-	◆	◆
MM	-	◆	◆	◆	◆	◆	◆	◆	-	◆	◆	◆
DM	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
SCTP	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
SQU- COA	◆	◆	◆	◆	◆	◆	◆	◆	-	-	◆	-
SQU-RSC	-	◆	◆	◆	◆	◆	-	-	-	-	◆	-
PDO	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Omantel	◆	◆	◆	◆	◆	◆	◆	◆	-	◆	◆	-
DGMAN	◆	-	◆	◆	◆	◆	◆	-	◆	-	◆	◆
FUGRO	-	◆	◆	◆	◆	◆	◆	◆	-	-	-	-
Weatherford	◆	◆	◆	-	◆	◆	◆	◆	◆	-	-	◆
Haya	-	◆	◆	◆	◆	◆	◆	◆	-	◆	◆	-
CMI&C	-	◆	◆	◆	-	-	-	-	-	-	-	-
SIPC	-	◆	◆	-	◆	◆	-	◆	-	-	-	-
MZEC	◆	◆	-	-	◆	-	◆	◆	-	◆	◆	-
WSDH	-	-	-	◆	◆	-	◆	◆	-	-	-	◆
NIT	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
MGS	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆

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Issues impeding NSDI development

Several issues have been highlighted according to organizations perspective, which considered impeding the NSDI development. Table 2 and figure 5 indicate that more than 65 % of the respondents have chosen policies as the major issue impeding the NSDI development. Authorization and budgets come second (42%) and third (40%) correspondingly. 30-19 % of the respondents consider standards, security, shortage of technology, awareness of NSDI and skill of experience as issues that are affecting the development of the NSDI. The less aspectual types are training which come less than 10% of the total 23 responses while 5 responses have been excluded due to lack of information.

Metadata circulation

The current situation on the production and circulation of metadata information needs to be evaluated in the coming years. Although the results of the survey indicate there is growing interest by creating metadata by almost half of the respondents, the largest percentage (57%) of firms do not own or have traded metadata while (70%) from the rest whom have metadata do not use and follow international well known standards. This finding reflects negatively on the integration of geographical data and therefore will not bring the principles of participation. The questionnaire also indicated that there is a positive sign that the majority of the respondents who don't use metadata realize the importance of such data and that they are in interested in activating it in the near future.

Standards usage

Standards are one of the foundations upon which the NSDI can be built and a mainstay in the integration of geographic data in order to achieve subscription principle among the members. Figure 6 illustrates the majority of respondents up to (62%) using the standards that correspond with their requirements and meet their needs. This certainly reflects the quality of the product, but to achieve the benefits of standards among the members, it must serve the purpose of integration and data exchange. The result, unfortunately, is disappointing. The study has shown that only 35% of users have used uniform standards while the rest are using their own standards. Furthermore, more than 65% of the organisations do not have any membership or linkages, whether internal or external standards organisations. The weak linkage between institutions and absence of a body or centre

Table 2: The major issues that impede developing NSDI in the Sultanate.

Agencies	Standards	Security	Authority	Shortage of Technology	Awareness of NSDI	Budgets	Policies	Skill and Experience	Training	Other
MONE	—	—	—	—	—	—	✓	—	—	—
MOTCM_DGMAN	—	—	—	—	—	—	—	—	—	—
MOTCM_DGT	—	—	✓	✓	—	✓	—	—	—	—
MOH	—	—	✓	✓	—	✓	—	—	—	—
MH	—	—	✓	—	—	—	✓	—	—	—
MECA	—	—	✓	—	—	✓	✓	—	—	—
MORM & WR	—	—	✓	—	—	✓	✓	—	—	—
MAG	—	—	—	—	—	—	✓	—	—	—
SCTP	✓	✓	—	—	✓	—	—	—	—	—
MOD_NSA	✓	—	—	—	—	—	✓	—	—	—
MOD-MWS	✓	—	—	—	—	—	✓	—	—	—
MOD_ONHO	—	—	—	—	—	—	✓	—	—	—
MM	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DHM	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SQU_COA	—	✓	✓	—	—	—	—	✓	—	—
SQU_RSC	✓	—	✓	—	—	—	—	✓	—	—
NTIC	—	—	✓	—	—	—	✓	—	—	—
PDO	—	—	—	—	✓		✓	—	—	—
Omantel	✓	—	—	—		✓	✓	—	—	—
FUGRO	—	—	—	—	✓	✓	—	—	—	—
Weatherford	—	—	—	—	—	—	—	—	—	—
Haya	—	—	—		—	—	—	—	—	—
CMI&C	—	—	—	—	—	—	—	—	—	—
SIPC	—	—	—	—	—	✓	—	—	—	—
MZEC	—	—	—	—	—	—	✓	—	—	—
WSDH	—	✓	—	—	—	—	✓	✓	—	—
MGS	—	—	—	—	—	—	—	—	—	—
Rhta Oman	—	—	—	—	—	—	—	—	—	—

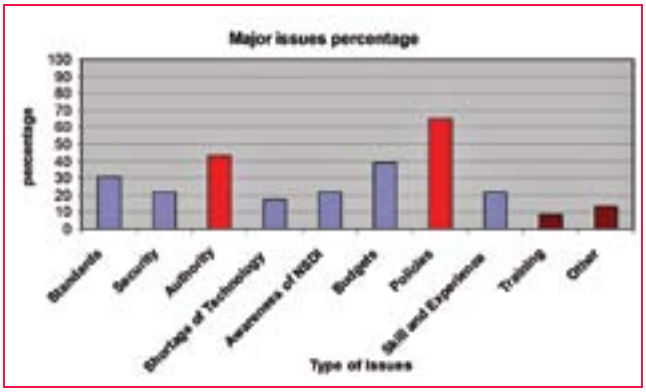

Figure 5: Illustrates the major issues percentage

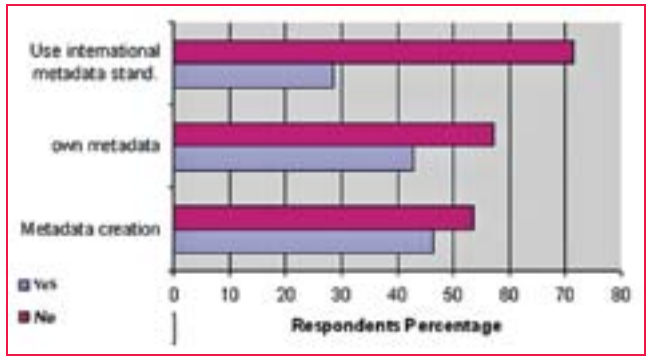

Figure 6: Represents the metadata activist between respondents

that concern the standards application between the institutions of the Sultanate can be the reason for such an outcome.

Accessibility and applicability of geospatial data

The availability of digital geographic data is the important foundation to activate NSDI technique. The availability of this data in the current nature does not necessarily mean, their compatibility with this technique, unless it is compatible with the user's needs in the Sultanate, in terms of technical specifications for this data. Modern technology has enabled easier and highly precise spatial data acquisition, therefore, it is important to evaluate how far these organizations have achieved in this context. The study elements give observations about the digital geographic data in the Sultanate. Figure 7 shows many of the semantic tasks which require decision-makers knowledge while developing of NSDI. It is observed that 64% of respondents of the questionnaire, have access to geographic data, consistent with projected maps and right scale and format. But these data only cover the needs of 50% of the users. While the same percentage (50%) show the volubility of the accuracy required. For this, the Sultanate's geographical data need to be restructured, consistent with the acquisition of multi-use geographic data. The access to geographic data is an important part to achieve the principle of multi-users for multi applications under the framework of agreements of mutual benefit between actors. Given the state of institutions that covered by the questionnaire, the availability of these conventions is almost non-existent (less than 10%), which negatively reflects in the proportion of means that allows users access to digital geographic data, that does not exceed 20%. Although, it does indicate that more that 70% of the organizations have staff skill capable to interact positively in the availability and use of geographic data.

Distribution, participation and existence of agreements for the integration and data exchange are the main problems being faced by the geo-spatial activities in Oman. It is clear that the majority (75%) of the institutions are facing problems in achieving the subscription (figure 8), and this is due to the many reasons such as the maturity of government initiatives to provide comprehensive with accuracy and calibration required, and understanding the nature of geographical data in terms of specifications compatible with the integration and multi-use. For this, reliance on individual initiative and individual use is prominent in more than (50%) of the institutions included in the study which suggests the need for halting the flow of funds and the depletion of the effort to achieve the objectives of individual limited.

Conclusion

The paper elaborates the geospatial data situation in the Sultanate of Oman by reviewing questionnaire results. The fundamental geospatial data which uses mostly in government and private institutions was specified to be the backbone of Oman NSDI. The paper also explains the most important points concerning the nature and accuracy of these data, and the availability of the user's needs which are compatible with sustainable development in the Sultanate. The results indicate there are many issues concerning geo spatial data in the Sultanate that need to be evaluated and resolved before initiating the NSDI. The issues being considered as most important obstacles facing the establishment NSDI are essential development of standards for data acquisitions and all producers must comply them for data integration. In addition, the associated legislation to coordinate the participation and finding executants for data access whether individually or collectively is also required. On metadata use, the study shows clearly that producers interest does not exceed third of the institutions included in the study while the double of this percentage do not use geographic data standards. For this, the integration of these data among themselves for many applications most certainly is another obstacle that affects data sharing and distribution.

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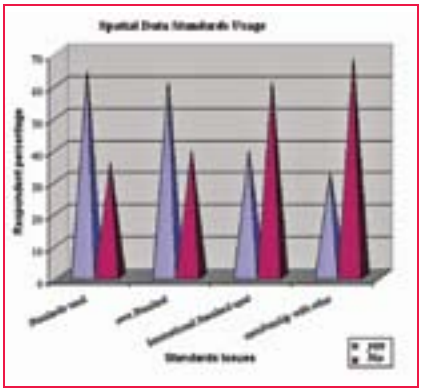

Figure 7: Standards usage situation

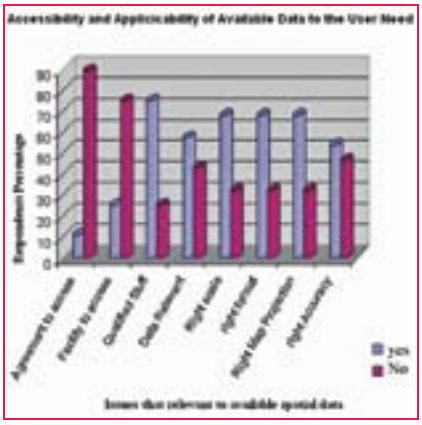

Figure 8: Shows accessibility and applicability of available data in Oman

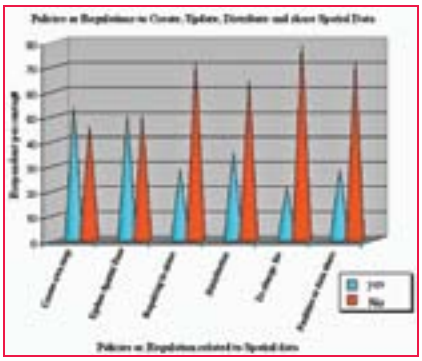

Figure 9: Illustrates the policies related spatial data

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Beyond Spatial Enablement

4th Land Administration Forum for the Asia and Pacific Region, Melbourne 5-7 October 2011

Over 650 years of experience in spatial information management, land administration and spatial enablement were percolated into 22 presentations offering a raft of initiatives and insights across the world corresponding with the theme of the forum, "Beyond Spatial Enablement'- Land Administration to support Spatially Enabled Government"

The Centre for SDI and Land Administration (CSDILA), The University of Melbourne was delighted to be part of a design and successfully conduct the 4th UN Land Administration Forum for Asia and the Pacific. The committee, led by and Prof Abbas Rajabifard (GSDI President and Director of CSDILA) and Mr Greg Scott (Chair, Permanent Committee on GIS Infrastructure for Asia and the Pacific- PCGIAP Working Group on Spatially Enabled Government) organised a world-class Forum, attended by 110 participants from different countries, including representatives from the United Nations, the World Bank, Europe, Australian federal and state government and spatial industry, and a number of major international related spatial organisations.

This event was jointly organized by the PCGIAP, Centre for SDI and Land Administration (CSDILA), The University of Melbourne, with support from the Australian Government through Geoscience Australia, GSDI Association, FIG, ICA and other Australian federal and state organizations including Victorian Spatial Council, Land Victoria (DSE), Murray Darling Basin Authority (MDBA) and Surveying & Spatial Sciences Institute (SSSI). The event has also been supported by the media partners including Coordinates, GIM International and Land Mark Magazine. The Forum was preceded by a day of collaborative workshops by CSDILA in the areas of national land infrastructure, spatial metadata automation and 3D property management. The event aimed to provide a forum for sharing trends, strategies and a vision for a spatially enabled future with additional themes in mapping, spatial information, SDI and land administration strategies to facilitate spatially enabled government.

The keynote addresses highlighted the emergence of location as the fourth driver in decision-making, the role of the cadastre and land administration in spatial enablement, the continued need for good land governance to facilitate spatially enabled government to build capacity for addressing the global agenda and lastly, the primacy of a spatially enabled government in achieving sustainable development.

From local government organisations to international institutions like the World Bank reported the myriad initiatives currently occurring around the world to realise spatial enablement activities. The worldwide challenges were also examined and new initiatives that the UN and member countries are implementing in support of spatially enabled government and society were considered. It was observed that the realisation of spatial enablement was still being impacted by the existence and perpetuation of data silos both within and between organisations making the discovery, access, use and sharing of spatial data still a significant challenge.

In considering emerging trends for future direction, many different aspects were discussed. Key to these were participation trends especially pertaining to users, location as the fourth element of decision-making, the need to differentiate between high accuracy data (the new concept of AAA information) and other data (including crowd-sourced), evolving standards, growing awareness for open access to data, a focus on service delivery and finally, a caution that the move to achieve spatial enablement could result in spatial dependency. These various elements will provide the basis for the development of new strategies to provide the foundation for future international activities by participants in line with the objectives of GSDI and FIG and the MoU arrangements that currently exist with these organisations, as well as fostering collaborations with global organisations like ICA and the ISPRS.

Alongside the forum, the CSDILA also celebrated its 10 year anniversary celebrations. For more information about the Forum (including presentations) and its outcomes, visit: http://csdila.unimelb.edu.au/BeyondSpatialEnablement/programme.html.

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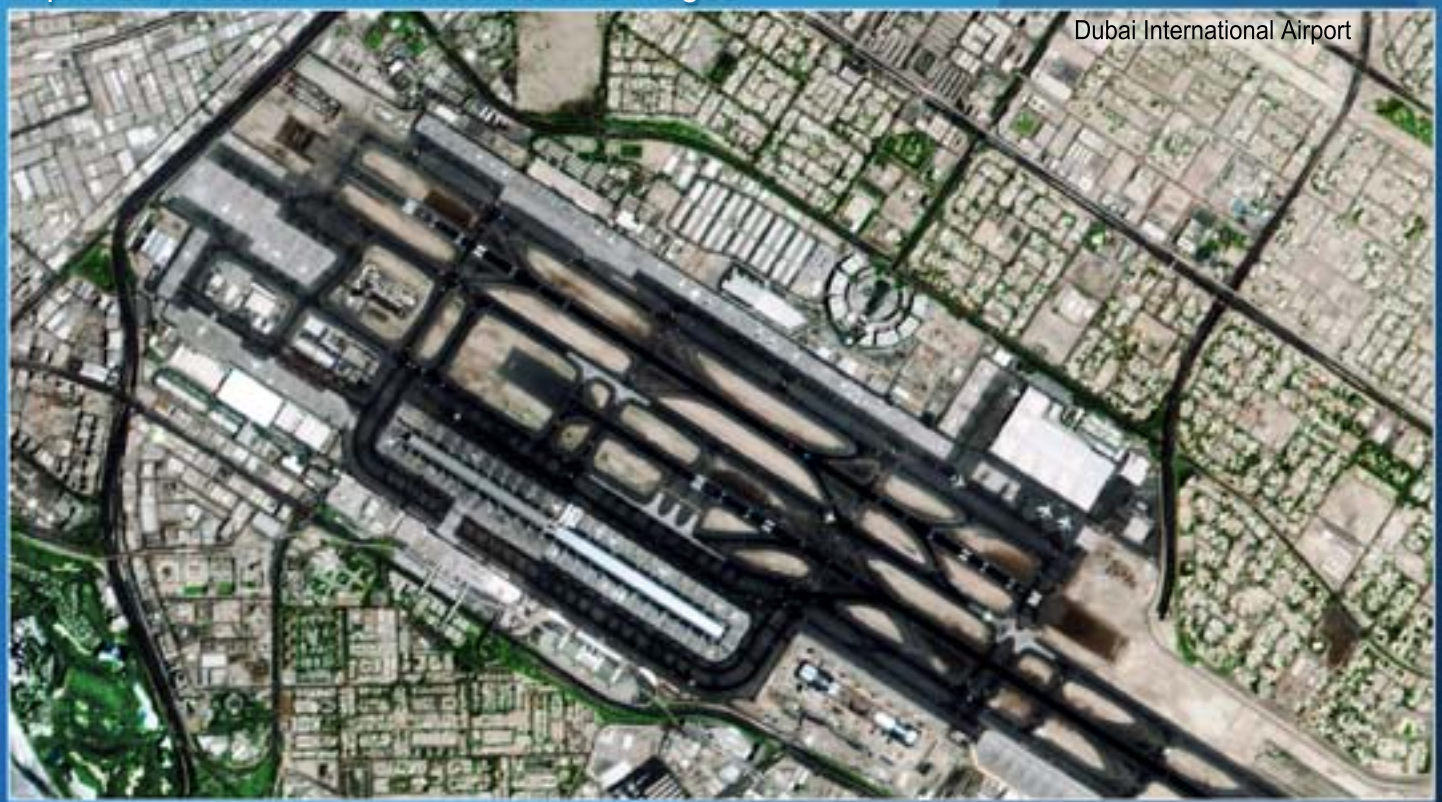

Dubai International Airport

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

GLONASS constellation update

On November 30, the GLONASS-K1 satellite, GLONASS 701(K), which had been using broadcast almanac slot 3 and transmitting on frequency channel -5 while undergoing flight tests, ceased transmissions on its assigned channel and was removed from the almanac.GLONASS 744, launched with the other Block 44 satellites on 4 November 2011 and which achieved its orbital slot 3 in Plane 1 a few days ago, was activated and is transmitting on frequency channel 5. It is currently set unhealthy in both the almanac and the ephemeris while undergoing further commissioning.GLONASS 743 and 745 are still moving towards their designated orbit slots. It is not clear if they will immediately replace the satellites currently in those slots or be held in reserve until needed.According to the Roscosmos Information-Analytical Centre, GLONASS 746, launched, is destined for orbit slot 17 in Plane 3. This is the current location of GLONASS 714, the oldest currently functioning satellite in Plane 3, launched on December 25, 2005. Based on NORAD/ JSpOC tracking, GLONASS 746 is still drifting towards slot 17 and at its current speed will reach the slot in a few weeks.

Global GPS market to reach USD 26.67

The worldwide GPS market is expected to reach USD 26.67 billion by 2016 at a CAGR of 23.7 percent from 2011 to 2016, according to a new market research report by MarketsandMarkets. GPS application market is diversified into large number of segments. Even the automotive devices are heading towards maturity in North America and Europe; but it has a large scope in the APAC region; of which China and India will be taking the lead in the near future. The emerging markets like African and Arab countries will also seek the positive growth, the report said. *www.marketsandmarkets.com*

Map-aided dead reckoning navigation system GPS

According to research carried out by Tampere University of Technology in Finland, it is possible to improve the positioning accuracy and reliability of navigation systems by using digital road maps in addition to the main navigation system. For maximum reliability, a high performance gyroscope is needed. *www.vti.fi/en*

GPS enabled fire ready app in Australia

The Country Fire Authority of Victoria have come up with the application for the iPhone, Blackberry and Android smart phone platforms which is called as "fireReady" apps.It updates with the information on bushfire warnings, current fires and Fire Danger Ratings for the state of Victoria.Users can automatically locate themselves using GPS and see any fire activity in their area. Along with this they can push notifications alert users of new bushfire warnings and planned burns. *www.abc.net.au*

Police use of GPS questioned by U.S. Supreme Court

U.S. Supreme Court justices raised the specter of George Orwell's novel "1984" as they questioned whether police officers should have unbridled freedom to place GPS devices on cars to track criminal suspects.Hearing arguments in Washington, the court voiced concern that the pervasive government surveillance envisioned by Orwell might become reality, as the justices debated whether police need a warrant before using GPS. The hour-long session produced no clear answer, other than a consensus that the decision could have far-reaching implications.The high court case concerns Antoine Jones, whom police in Washington tracked for more than a month in 2005 using a GPS device secretly placed on his Jeep Grand Cherokee. *www.businessweek.com*

GPS group seeks partial ban on LightSquared

A group of GPS vendors and users has asked the U.S. Federal Communications Commission to permanently block LightSquared from using the upper band of its licensed radio spectrum for a cellular data network.LightSquared wants to build an LTE (Long-Term Evolution) network using frequencies near the band used by GPS. The FCC has said it can only do so if interference between the two systems is resolved. After tests showed strong interference in the upper 10MHz band of LightSquared's frequencies, the carrier said it would start by operating on a lower band, which is also 10MHz wide. However, it holds out hope of using the upper band in the future.In a filing (PDF) to the FCC, the Coalition to Save Our GPS asked the agency to immediate. *www.pcworld.com*

Faulty GPS units showed fire trucks in New York harbor

The Bloomberg administration spent millions of dollars to put custom-made GPS tracking units in fire and garbage trucks, only to have vehicles inexplicably show up on computer screens as if they had sunk to the bottom of Long Island Sound or New York Harbor, the city comptroller has found. Faulty devices, inaccurate locations, needless features and prices to make a vendor blush — as much as $56,000 for a single unit in a sanitation truck — characterized the two projects, according to two audits released. The Bloomberg administration acknowledged that it had mismanaged its major information-technology projects and vowed to improve oversight. *www.nytimes.com*

Coal India will be using GPS to stop hijaking

Coal India Ltd (CIL) will use GPS to prevent shipment's hijacking and amid a shortage that has hit supplies to thermal power projects across the country. This is being started by the government to curb theft in transit. The industry has had little success over the years in tackling organized crime in mining areas. *www.livemint.com*

Telstra inks deal with Navman Wireless in Australia

Navman Wireless has signed a deal with Telstra in Australia under which its GPS fleet management solution will be available to all Telstra customers on a monthly fee basis. *http://computerworld.co.nz*

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TS650 Basic series Total Station with R300/R500 EDM
TS680 Power series Total Station with R300/R500 EDM
TS680 Ultra series Total Station with R800/R1000 EDM
TS810 Power series Total Station with R500 EDM
TS810 Ultra series Total Station with R800/R1000 EDM

F50

GTA1010

DS03

TS810 Ultra series

TS650 basic series

TS680 Power series

TS680 Ultra series

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u-blox expands Automotive Dead Reckoning GPS receivers

u-blox has announced two new products equipped with Automotive Dead Reckoning (ADR) technology. The NEO-6V GPS module and UBX-G6010-SA-DR single-chip deliver drop-in, self calibrating GPS Dead Reckoning performance for high precision vehicle navigation systems. ADR enables highly accurate positioning in areas of weak or no GPS satellite reception such as within tunnels and park houses. *www.u-blox.com*

DRC gets Web-based mining cadastre system

Spatial Dimension announced that a beta version of the Democratic Republic of Congo's online mining cadastre portal has recently gone live. The portal can be accessed at http://www.flexicadastre.com/drcmapportal/. The beta site enables users to view the DRC's mining cadastre data in a simple mapping interface as well as to search tenements by company name and identify on the map. *www.spatialdimension.com*

'Toolkits' bring EGNOS accuracy and integrity to smart phones

The European Commission has introduced free, downloadable and ready-to-use Toolkits to help anyone develop enhanced location and timing applications that harness the power of Europe's EGNOS satellite-based augmentation system. The new EGNOS Toolkit provides an easy and effective way to harness EGNOS corrections in smart phone devices by clearly explaining what is needed and providing all the necessary files and resources. *www.egnos-portal.eu*

TomTom users capture the road network

TomTom's community of drivers has collected and shared over 5,000,000,000,000 (5 trillion) anonymous travel since 2006. The travel data points cover over 140 billion kms, which equals driving each and every road in our markets 3,000 times. This information delivers deep insights into actual driving behaviour and is the key ingredient for smarter routing (IQ Routes) and traffic prediction. *www.tomtom.com*

Navteq named Ford Motor company's exclusive map provider

Navteq has been selected by Ford Motor Company to be their exclusive map supplier for the SYNC MyFord Touch. The agreement positions NAVTEQ as the map data provider for the SYNC with MyFord Touch SD-card based navigation system in North America, South America, Middle East, Russia and Europe. *www.navteq.com*

FleetViewOnline 3.11 SSAS: Transas Marine

FleetViewOnline 3.11 offers its users three alternatives for electronic charts presentation; Transas Marine proven TX-97 charts with worldwide coverage, OpenSteetMaps land charts and any charts provided by Web Map Service. Web Map Service allows to load and display georeferenced images that are generated by a map server using data from GIS database, for example charts from 3rd-party providers, weather forecasts, satellite images, images of industrial zones, and other. *www.transas.com*

Fleetgenie, a mobile workforce and fleet management system

FleetGenie announced a new mobile workforce and fleet management system incorporating vehicle tracking, route optimisation and mobile device management has been launched. It enables any organisation with a mobile workforce and fleet operation to benefit from advanced routing, embedded satellite navigation, tracking and workflow management technology, which could save them up to 30 per cent on fleet running costs. *www.fleetgenie.co.uk*

Voice navigation in Blackberry Traffic 3.0 Beta

Version 3.0 of BlackBerry Traffic navigation app via the BlackBerry Beta Zone consumer trial program has added a new turn-by-turn voice guidance option enabling hands-free navigation. Consumers can now use this voice guidance feature to communicate instructions through their smartphone's Bluetooth connection or by using their vehicle's speakers. *www.hindustantimes.com*

MapmyIndia brings ShowNearby free smartphone app to India

MapmyIndia has joined Singapore-based ShowNearby to bring Android, BlackBerry and iOS apps that allows to find points of interest in your neighbourhood. This free app will guide the user to the nearest petrol station or restaurant. *http://thenextweb.com/in*

Smartphone app as biometric & location tagged, time keeper

ExakTime has added biometrics, equipment tracking and French support to its PocketClock®/GPS mobile time clock, transforming the software into versatile mobile time tracking app for iPhone, iPad, Android, BlackBerry and Windows Mobile Smartphones and Tablets. *www.exaktime.com*

iOnRoad augmented driving app for Android

Picitup, launched iOnRoad, a visual radar app that warns drivers of potential collisions. It improves driving in real-time using the power of advanced smartphones. The app uses the smartphone's native camera and sensors to detect vehicles in front of the vehicle, alerting drivers when they are in danger. *www.ionroad.com*

3D mapping from C3 Tech bought over by Apple

Swedish startup C3 Technologies has been bought over by Apple. C3 Technologies calculates the terrain and buildings directly from aerial images. The approach takes into account the positions and angles of the cameras that took aerial images in order to give each pixel its geographical position with high accuracy.The precision of the maps comes from the the recently declassified missile targeting technology by Saab, a well-known Swedish aerospace company. *www.fastcompany.com*

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3D, GPS and plot to print capabilities for AutoCAD WS

Autodesk, Inc has announced several new features to be added to the next release of AutoCAD WS, a free* web and mobile application that enables users to view, edit and share AutoCAD projects across desktop, web and mobile devices. AutoCAD WS users will have access to 3D interactive features, including the ability to work with 3D drawings on mobile devices. *www.autodesk.com*

Geospatial tool to help diabetic patients

The Bristol-Myers Squibb Foundation in the US as part of its national diabetes initiative, Together on Diabetes, awarded USD 6.2 million grant to the Center for Geospatial Medicine at U-M's School of Natural Resources and Environment, the Duke University Medical Center and the Durham County Health Department in the US. The grant aims to improve health outcomes and quality of life for people living with type 2 diabetes. During the planning phase, the coalition is employing geospatial mapping, which takes information related to disease and health care and fits it to the physical map of a community, allowing researchers to visualise complex relationships among the locations of diabetes patients, patterns of health care and available social resources. *www.healthcanal.com*

Maps show broader swath of radiation in Japan

The Ministry of Education, Culture, Sports, Science and Technology in Japan released updated soil radiation maps. The maps show broader swath of Japan than previous releases, covering six new prefectures. The newly included prefectures are Iwate, Yamanashi, Nagano, Shizuoka, Gifu, and Toyama. *www.mdn.mainichi.jp*

Abu Dhabi UPC unveils mobile GIS software

The Abu Dhabi Urban Planning Council (UPC) unveiled two new GIS software, GeoPlanner Version 2 and GeoPad. GeoPlanner Version 2 is an updated addition of the Council's hugely successful GeoPlanner technology while the second, GeoPad, comprises state-of-the-art planning software especially for use on the iPad. Through such GIS products, the UPC aims to employ the latest, ground-breaking technology to facilitate the urban planning process in the Emirate of Abu Dhabi. *www.zawya.com*

Mapping app to trace floods in Thailand

The Information and Communication Technology Ministry, Thailand, introduced an online mapping application to let users find any location in the country and its flood status. Called the Thai Crisis Planner & Reporter, the application was developed with Chulalongkorn University. It can be accessed at http://thaicrisis.chula.ac.th. The application can provide floodwater details and water levels for all 50 districts of Bangkok. *www.bangkokpost.com*

FAO-Italy project seeks to solve problems in Nile Basin

Under the information products for Nile Basin Water Resource Management project, the Food and Agriculture Organization (FAO) consolidated spatial information on water and agriculture in the region, a forecast of the region's future food requirements, a survey of the types of farming systems practiced along the Nile and an analysis of possible future scenarios for water management and agriculture development. Under the FAO-Italy project, a wealth of GIS data on water, land and agriculture was acquired. Better data permitted the creation of the Nile Decision Support Tool (Nile-DST) — software that models the entire Nile system and allows planners to assess the trade-offs and consequences of different possible development scenarios. *www.starafrica.com*

Blue Marble Geographics Acquires Global Mapper LLC of Parker, CO

Blue Marble Geographics have acquired Global Mapper LLC of Parker, CO. Both the companies share the same common goal of offering powerful user friendly GIS software to all types of users. *http://www.bluemarblegeo.com*

PSMSL launches interactive map of sea level changes

The UK's Permanent Service for Mean Sea Level (PSMSL) launched an interactive map that allows users to explore changes in sea level worldwide over five decades. The PSMSL, operated by the National Oceanography Centre under the auspices of the International Council for Science, is the global databank for sea-level change information. It was established in 1933. The Anomalies Map, generated from a worldwide network of tide gauges, demonstrates how sea level varies from year to year when compared with the long-term average at a particular site, calculated over the period from 1960 to 1990. *www.physorg.com*

NOAA's NCS II begins production with Esri Nautical Solution

The National Oceanic and Atmospheric Administration (NOAA) have implemented a new nautical charting system based on Esri GIS technology to produce more navigational products than ever before without increasing its budget or personnel needs. The new system, NCS II allows NOAA to centralize the management of hydrographic data for US coastal waters. *www.esri.com*

Bentley acquires FormSys

Bentley Systems, has announced the acquisition of FormSys, based in Perth, Australia. This software development company has a proven, twenty-year track record in 3D design, analysis, and construction software for structural engineering, offshore engineering, and naval architecture. The acquisition will expand Bentley's SACS offerings for the design and analysis of floating structures, further extending the company's reach in the offshore energy market. *www.bentley.com*

NRSC to set up data station in Antarctica

National Remote Sensing Centre of India will set up a remote sensing ground station in the continent of Antarctica. Once the Antarctica ground station is operational, it will boost the remote sensing data transmitted by Indian Remote Sensing (IRS) satellites. The data will be helpful during natural calamities like earthquakes, tsunamis and floods, besides providing regular data terrain. According to NRSC sources, the proposed ground station in Antarctica will receive data around 10 to 12 orbits per day from different IRS satellites. *www.deccanchronicle.com*

Japan, Vietnam sign deal for two radar imaging satellites

Vietnam will buy a pair of Japanese-designed Earth observing radar satellites under a just-finalized deal representing Japan's first export of a remote sensing satellite system. The satellites will be based on Japan's new ASNARO — Advanced Satellite with New System Architecture for Observation — remote sensing platform, whose development was spurred by a shift in government space policy that places more emphasis on practical and commercial applications. *www.spacenews.com*

China launches remote-sensing satellite

China has successfully launched the remote-sensing satellite Yaogan XII recently.It will be used to conduct scientific experiments, carry out surveys on land resources, estimate crop yield and help with natural disaster-reduction and prevention. *www.bbc.com*

Satellite project prompts new Israel-Turkey crisis

Israel is trying to persuade Turkey not sell satellite images of its territory to Palestinians or other countries which could germinate new crisis between the nations. According to a report, Turkey's Göktürk electro-optical satellite project will enable the country to acquire high-resolution images for military intelligence in Europe, the Caucasus and the Middle East and help it fight Kurdish rebels. *www.todayszaman.com*

Malaysian RS satellite is off target

Malaysia's Auditor-General reported that the RazakSAT, a Malaysian remote sensing satellite, is off-target. The satellite, worth MYR 142million (MYR: Malaysian Ringgit), was supposed to image Sungai Buloh and Subang but it deviated 37 km from its original target.According to the report, the Malaysia Remote Sensing Agency (ARSM) had made the corrections by Astronautic Technology (M) Sdn Bhd (ATSB), RazakSAT's developer. But, it was not visible in the review performed on December 31, 2010. *http://thestar.com.my*

Galileo update

Europe signals new way forward for Galileo satellite navigation

The European Commission has proposed a new framework for the financing and governance of Galileo and EGNOS (GPS signal augmentation) for the period 2014-2020.

The Commission proposes to earmark €7 billion to guarantee the completion of the EU satellite navigation infrastructure and to ensure the exploitation of the systems until 2020, such as the operations of the space and terrestrial infrastructures, the necessary replenishment/replacement activities, certification procedures, and notably the provision of services. *www.airtrafficmanagement.net*

Galileo satellites well into early orbit preparation phase

The first two Galileo satellites launched on 21 October are well into their early orbit preparation phase, spearheading the deployment of a global navigation satellite system essential to the success of the more advanced stages of the Single European Sky.

The two satellites and the complex ground support network integral to their operation are now entering the system's first validation phase, known as Galileo in-orbit validation (GIOVE). During this first phase, two more Galileo satellites will be launched in mid-2012 to join the two experimental satellites - GIOVE-A and GIOVE-B - in orbit.

The IOV is the first step in a staggered process leading to full operational capability, planned for 2019, when the complete 30-satellite constellation and a set of remote terrestrial stations distributed worldwide will start to deliver super-accurate navigation and timing co-ordination services to both aviation and surface users. *www.flightglobal.com*

Taiwan wins European Satellite Navigation Competition and ushers in new era of telematics industry

The European Satellite Navigation Competition (ESNC) 2011 announced on November 18 the Industrial Technology Research Institute (ITRI) was the champion for the GNSS Living Lab Award for its creative Geo-coupon Application. A total of 23 countries have participated hosting different regional preliminaries of the creative contest for satellite positioning applications initiated by the European Union. Under guidance of the Department of Industrial Technology of the Ministry of Economic Affairs (MOEA) for innovation award and prototyping award, ITRI joined and became one of the hosting nations. This year, ITRI strove to host with the topic of "connected vehicle" and solicited entries around the world and the number of teams applied and entries received topped other regional contests. *www.marketwatch.com*

WORK Microwave and IFEN combine forces on multi-GNSS simulation

WORK Microwave has announced that the company's joint venture with IFEN has produced a new model for the well known NavX®-GNSS test solution product family. With its flexible licensing capability, the new product is a future-proof investment for the coming multi-GNSS era. The key technology advancement in the NavX®-NCS Essential is driven by the powerful BLACK JACK simulation engine, which lies at the heart of the NavX®-NCS Essential. The engine allows simultaneous simulation of GPS, GLONASS, SBAS, and Galileo satellites covering all operating GNSS systems on the L1 RF frequency band all-in-one-box. *www.work-microwave.de*

Pacific Crest introduces new advanced data link for field Communications

Pacific Crest, a Trimble company, has introduced the new ADL Uplink, an advanced, high-speed, wireless data link that extends the range and improves the reliability of Internet-based RTK corrections. The ADL Uplink provides high accuracy and application flexibility with more features and options than previously offered by Pacific Crest professional-grade radio links. The ADL Uplink joins the rapidly growing line of Advanced Data Link (ADL) products that include: the ADL Vantage Pro, a 35-Watt programmable UHF radio; the ADL Vantage, a 4-Watt programmable UHF radio for survey applications; the ADL Sentry, a 4-Watt radio for remote sensing and monitoring environments; the ADL Foundation, a transceiver OEM board; and the ADL RXO, a receive-only OEM board. *www.PacificCrest.com*

NovAtel launches GNSS Iono Scintillation and TEC Monitor receiver

NovAtel Inc. has introduced its GPStation-6 GNSS Ionospheric Scintillation and TEC Monitor (GISTM) receiver designed for ionospheric monitoring and space weather applications. It integrates NovAtel's powerful OEM628 measurement engine with a high-quality, low phase-noise, oven-controlled crystal

oscillator (OCXO). The receiver provides robust signal tracking, ionospheric scintillation, and TEC measurements for all current and upcoming GPS, GLONASS, Galileo, and Compass/BeiDou satellite signals. *www.novatel.com*

Topcon telematics upgrades Acme fleet

Acme Lift Co, has upgraded its fleet of large platforms and telehandlers with a telematics system from Topcon Positioning Systems Inc. Acme Lift, based in Mesa near Phoenix, has fitted its machines with compact, second-generation Topcon Tierra devices, which gather machine locations, operating hours and engine information, sift raw machine data and provide immediate alerts and useful reports. *www.acemelift.co*

Hemisphere GPS expands OEM agreement with Navico

Hemisphere GPS expanded its multi-year OEM agreement with Navico Inc., the world's largest marine electronics company. It is supplying Navico with the industry's smallest (42 cm) GPS compass, which will be privately branded Simrad HS70. The compass will be sold with Navico's AP70, AP35 and AP50 autopilots for pleasure boats, yachts and commercial vessels. *www.hemispheregps.com*

GPS Mapping Software by Eye4Software

Eye4Software's latest version of their GPS Mapping Software, GPS Mapping Studio version 4.1, has been released. It displays the current position on digital maps in real time. This can record all movements to a file for later analysis or for instance, to keep track of the covered survey area. The software can also be used to import- and export, view, edit and convert maps. *www.eye4software.com*

Recon instruments partners with SMTC

SMTC Corporation have been awarded the manufacturing contract from Recon Instruments to manufacture the world's first GPS and sensor-enabled Micro Optics Displays for alpine goggles. Recon Instruments' Micro Optic Displays ("MOD") provides real-time information on speed, jump airtime, GPS location, distance travelled, temperature, and altitude, while also boasting a run counter and chrono/tracker feature. MOD Live includes all the features of MOD but possesses additional functions utilizing its Android operating system and Bluetooth capabilities. *www.smtc.com*

Intermap and AIR Worldwide agreement

Intermap has entered into an agreement with AIR Worldwide to provide high-resolution elevation data to be used in the development of new catastrophe models for select European countries. AIR Worldwide will integrate Intermap's NEXTMap database with AIR's cutting edge catastrophe modeling capabilities, to develop high-resolution inland flood models for European countries. *www.intermap.com*

Networkfleet announces 5000 series

Networkfleet has launched Networkfleet 5000 Series of fleet tracking hardware. Compatible with light, medium and heavy duty vehicles, it offers 24/7 visibility into fleet assets, enabling fleet managers to easily locate vehicles in real time and monitor specific vehicle data such as mileage, speed, fuel consumption, and diagnostic trouble codes to improve operations and reduce costs. *www.marketwatch.com*

GPS enabled 4S Visilog from Four Soft

Four Soft , a leader in software solutions for logistics and transportation industry has announced the launch of GPS enabled 4S Visilog®. This new feature integrates the GPS benefits like truck movement reporting, etc. to the logistics control visibility mechanism of 4S VisiLog®. *www.four-soft.com*

DAT/EM Systems Software in Ethiopia

The Ethiopian Ministry of Urban Development & Construction, Urban Development Capacity Building Office (UDCBO) has recently completed the sale and installation of 29 SUMMIT Evolution workstations

Leica News

Ethiopia water survey uses Leica

A group of British surveyors have undertaken a feasibility study for a major net irrigation project in Ethiopia. Leica Geosystems surveying equipment were used to see how the irrigation infrastructure at the headwaters of the Blue Nile can be developed to harness the river's potential and establish a sustainable irrigation system. The surveyors, from British consultancy company, Halcrow, mapped the river catchment areas of Megech, Upper Beles and Negeso rivers using Leica GPS1200 and Leica GPS900 surveying systems.

Leica SmartWorx Viva v4.0for Viva TPS and GNSS

Leica SmartWorx Viva version 4.0 onboard software is packed with exciting new features to make data collection and stakeout even simpler and even more productive. It also supports the high-accurate Leica Viva GS25 GNSS surveying receiver, the Leica CGR10 &15 radio modems, and the Leica Exchange data transfer service.

Leica Cyclone v7.3.2

It fully supports the recently released ASTM E57 standard for 3D Imaging data exchange, which includes 3D laser scanning systems. This capability facilitates direct import and export of laser scan "as-built" data and related digital imagery from different types of laser scanning systems into and between different types of point cloud processing software. www.leica-geosystems.com

from DAT/EM Systems International through its representative Corporate Computer Center (3C PLC). In conjunction with the World Bank, the Ethiopian UDCBO office shall support their base map preparation for 150 towns throughout Ethiopia using DAT/EM Systems offerings.

Extension of OmniSTAR network with new Astana station

OmniSTAR has announced addition of a new reference station in Astana (Kazakhstan) to the worldwide OmniSTAR network. This station is up and running and is performing well, and improves high-accuracy positioning services within the Central-Asian region (Kazakhstan, Southern-Russia) for a wide variety of onshore applications like Agriculture, Survey, Seismic, etc. Continuous R&D and network infrastructure investments ensure superior accuracy and reliability of OmniSTAR services. *www.omnistar.nl*

CARIS offers free trial of its latest INSPIRE compliant software

With the latest release of Spatial Fusion Enterprise v5.6 CARIS is pleased to offer a free trial of its web mapping software to experience firsthand its capabilities. It has now implemented the latest View and Feature Download Services in line with the Infrastructure for Spatial Information in Europe (INSPIRE) directive. The objective of this release is to provide hydrographic charting agencies with the software tools needed to share their data interoperably.

TW5210 GPS Smart Antenna/ Receiver by Tallysman Wireless

The TW5210 by Tallysman Wireless is a professional grade integrated GPS smart antenna/receiver. It features the STMicroelectronics STA8058 Teseo™ WAAS, EGNOS and MSAS enabled GPS L1 receiver IC, low noise amplifier stage, a tight out-of-band SAW filter to reject interference, and a perfectly tuned antenna element for maximum GPS signal reception, even in dense urban-canyon environments where multipath interference is prevalent. *http://www.tallysman.com*

MARK YOUR CALENDAR

December 2011

NSDI 11
21-23 December
Bangalore, India
www.nsdiindia.gov.in

January 2012

2012 Israel Navigation Workshop and Exhibition
9 January
Netanya, Israel
www.technion.ac.il/~iaac/home.html

International LiDAR Mapping Forum
23-25 January
Denver, Co, USA
www.lidarmap.org

ION International Technical Meeting
30 Jan-1 Feb
California, United States (USA)
http://ion.org/meetings

February 2012

RIEGL LiDAR 2012 International Airborne and Mobile User Conference
28 Feb-1 March
Orlando, USA
www.riegl.com

Mobile World Congress 2012
27 Feb-1 March
Barcelona, Spain
www.mobileworldcongress.com

March 2012

Munich Satellite Navigation Summit 2012
13-15 March
Munich, Germany
www.munich-satellite-navigation-summit.org

ASPRS Annual Conference
19-23 March
Sacramento, California, USA
www.asprs.org

April 2012

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

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

May 2012

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

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

2nd International conference and exhibition on mapping and spatial information (ICMSI2012)
15-17 May
Tehran, Iran
http://conf.ncc.org.ir

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
May 2012
Goangzhou, China
www.beidou.org

June 2012

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

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

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 (Tutorials & CGSIC: September 17-18)
Nashville Convention Centre, Nashville, Tennessee, USA
www.ion.org

October 2012

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

November 2012

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

GPS, GLONASS, GALILEO[1], COMPASS

Four Constellations in Four cm

Now, embedding centimeter-level RTK positioning in your GNSS OEM application has never been easier. Trimble BD910 and BD920 modules are specifically designed for applications requiring high accuracy in a compact package. These receivers take advantage of the expanding GNSS signals, with flexible interfacing via Ethernet, USB or RS232 to speed integration times. They also feature an innovative full metal jacket design to protect from harmful electromagnetic interference.

Learn more about our portfolio at www.trimble.com/gnss-inertial

BD910

L1 GPS, GLONASS, Galileo, Compass, 220 Channels

BD920

L1/L2 GPS, GLONASS, E1 Galileo, 220 Channels

Trimble®

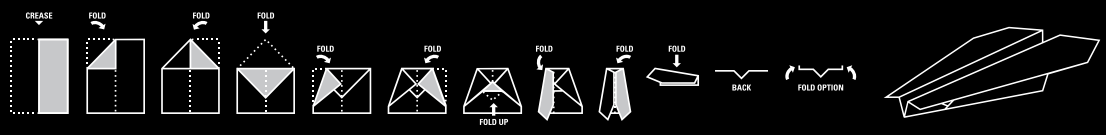
[1] Developed under a License of the European Union and the European Space Agency

Take it for a test flight.

actual size

New SPAN-MEMS, small enough for any unmanned air or ground vehicle.

Our new SPAN products combine GNSS technology with a range of MEMS inertial measurement unit options to provide continuously available position, velocity and attitude – even when GNSS signals are blocked by barriers such as trees, canyons or buildings. It's ideal for UAVs or UGVs, tracking and mapping, or anyplace else you'd like to soar over the competition. To help imagine what it is like to hold the power of SPAN-MEMS in your hand, fold this page according to the instructions. Or, to integrate the real card into your own design, call you-know-who. Just remember, MEMS the word. For more info, visit novatel.com/span-mems.



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