RNI: DELENG/2005/15153
Publication: 15th of every month
Posting: 19th /20th of every month at NDPSO

No: DL(E)-01/5079/11-13
Licensed to post without pre-payment U(E) 28/2011-13
Rs.100

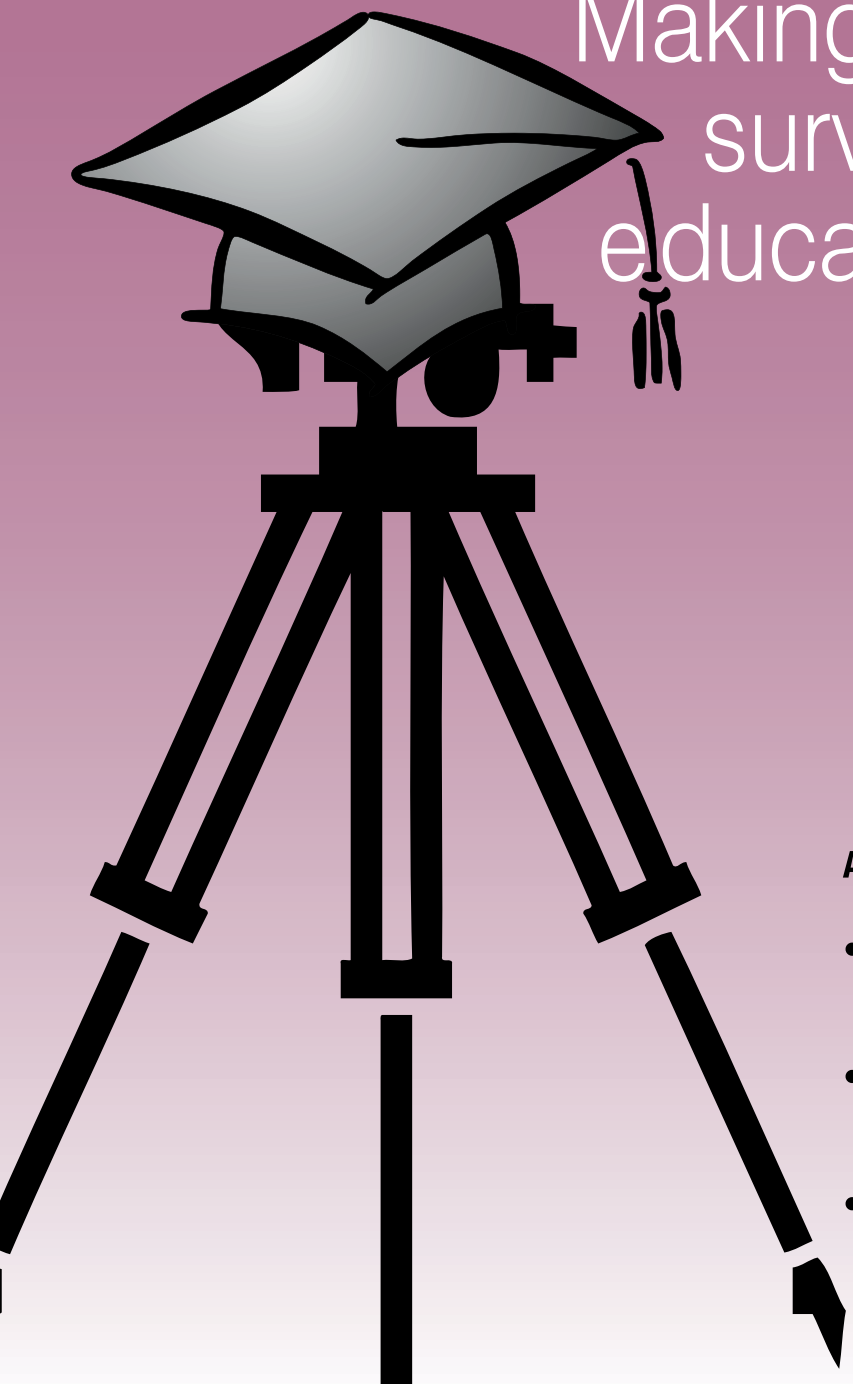
ISSN 0973-2136

www.mycoordinates.org

Coordinates

Volume VII, Issue 9, September 2011

THE MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND



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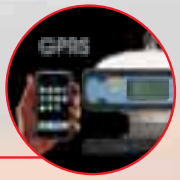

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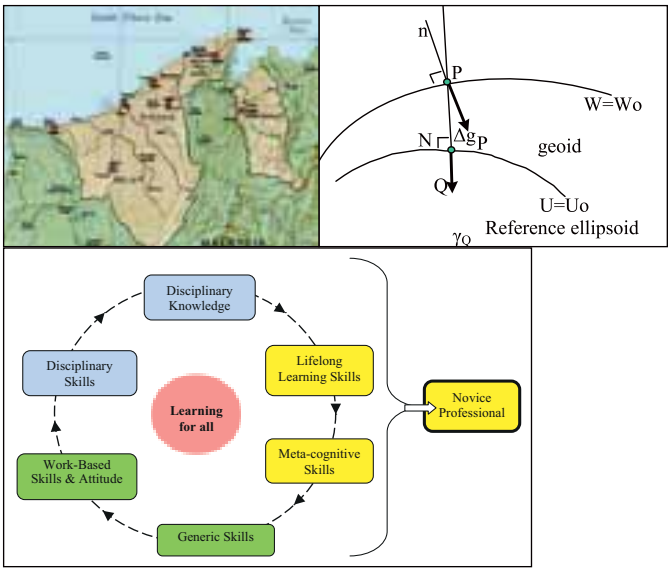

In this issue

Coordinates Volume 7, Issue 9, September 2011

Articles

Columns

This issue has been made possible by the support and good wishes of the following individuals and companies Abdullah K A, Anthony J Russo, CheeHai TEO, Dadan Ramdani, Ed Norse, Garfield Young, Ian Harper, Martin Smith, Mohammed Ali MJ, Musa T A, Omar K, Othman R, Pramod K Singh, Roger Murphy, Steven Frank, Tahir M; and CHC, ESRI, Foif, Geneq, GeoEye, HiTarget, Javad, Hemisphere GPS, Kanq Digital, Pentax, MicroSurvey, NRSC, Navcom, NovAtel, Racelogic, Riegl, Septentrio, Spirent, South, Trimble and many others.

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Web www.mycoordinates.org

Annual subscription (12 issues) [India] Rs.1,200
[Overseas] US$80

Printed and published by Sanjay Malaviya on behalf of Centre for Geoinformation Technologies at A221 Mangal Apartments, Vasundhara Enclave, Delhi 110096, India.

Editor Bal Krishna

Owner Centre for Geoinformation Technologies

Designed at Thomson Press India Ltd.

Printer Thomson Press India Ltd., B 315, Okhla Phase I, New Delhi-110020, India

This issue of Coordinates is of 60 pages, including cover

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Countries like India are an enigmatic and intriguing case.

Despite a great history and legacy,

The challenge to prepare and groom surveyors,

To meet the present day needs and demands,

Apparently, looks huge.

For educational institutes, which too are not many

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And for students, it is yet to be a promising career.

With present, far from being up to mark,

Offers little hope for the future.

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"The Obama administration believes we must protect existing GPS users from disruption of the services"

says Anthony J Russo, Director, National Coordination Office for Space-Based Positioning, Navigation, and Timing

"There are now companies whose sole line of business is manufacturing devices that purposefully and illegally cause harmful interference to GPS"

What is the mandate of National Coordination Office for Space-Based PNT?

The mandate for the National Coordination Office (NCO) is detailed in United States (U.S.) National Policy. Our primary role is to support the National Space-Based PNT Executive Committee which convenes at the Deputy Secretary level to advise and coordinate on Space-Based PNT issues affecting multiple departments and agencies. The NCO does not make decisions or create policy. Rather, we serve as the Executive Committee's Secretariat and execute tasks as directed by them. Specific responsibilities include interagency coordination, consensus development and issue resolution for all matters presented to the Executive Committee. As Director, I represent the Executive Committee on space-based PNT matters within the Government, the public sector, and with representatives of foreign governments and international organizations.

Would you like to explain the updates in US PNT policy?

President Obama's 2010 National Space Policy includes specific language related to Global Navigation Satellite Systems (GNSS). It provides an overarching goal statement calling for the United States to maintain our leadership in the service, provision, and use of GNSS. It left other elements of U.S. PNT Policy, including the structure of the Space-Based PNT Executive Committee and its Coordination Office intact. Specifically it directs the federal agencies to:

Provide continuous worldwide access to the Global Positioning System (GPS) free of direct user charges for peaceful civil uses.

Engage with our international partners to encourage GNSS compatibility and interoperability, service transparency, and market access

Continue to operate and maintain GPS to satisfy civil and national security needs consistent with our published standards. In addition, the United States may consider use of foreign PNT services to augment and strength resiliency of GPS

Invest in domestic capabilities and support international activities to detect, mitigate and increase resiliency to harmful interference to GPS. As necessary, the United States will implement redundant and backup systems or approaches to protect critical infrastructure, key resources and mission-essential functions.

What is new in GPS?

There is always something new in GPS. As I was writing this, another GPS IIF

satellite completed verification testing and is now operational. The IIF generation of satellites improves accuracy through more advanced atomic clocks. The IIF family of satellites has a longer design life than the previous generation of GPS satellites and it transmits a third civil signal. The new L5 signal is in the protected Aeronautical Radionavigation Services (ARNS) band and is more robust than L1 C/A due to its higher transmission power, wider bandwidth and longer spreading codes. When the constellation is fully populated with L5 capable satellites, it will improve performance for aviation, other safety-of-life and all civil users worldwide.

Just a few weeks ago, the Department of Defense completed the expansion of the GPS constellation into what is called the "Expandable 24" configuration. This was a two-phased operation that took 18 months to complete. The result is better geometry providing more coverage to GPS users. The new configuration increases robustness of satellite availability and overall signal in space performance.

> Although Policy is clear in the direction to have backup capabilities, it does not mandate any specific solution like Loran

In addition to continuing to modernize the satellites, we are simultaneously improving the command and control segment of GPS by replacing the legacy Operational Control Segment with the GPS Advanced Control Segment (OCX). The OCX ground system will bring more automation and will double the capacity to command and control satellites. It will be able to handle all the new civil signals coming on line with the GPS IIF and the GPS III programs.

Meanwhile we continue to expand and upgrade our GPS augmentation systems to further enhance Space-Based PNT services. For example, use of the FAA's Wide Area Augmentation Service (WAAS) has now expanded to the point that "Local Performance with Vertical Guidance" (LPV) approaches more than double the number of Instrument Landing System (ILS) approaches. WAAS-enabled LPV approaches do not require ground-based transmitters at airports and eliminate the need for critical area limitations associated with an ILS. New WAAS users are emerging at a rate of more than 1,000 per month. Meanwhile, a WAAS software upgrade in November will provide even greater resiliency to ionospheric distortions, once again improving the space-based PNT service for all of our users.

Even a successful program like GPS has its share of challenges. Recently, our analysts noticed one of our older GPS satellites, SVN-30, had a malfunctioning clock and therefore was not performing up to our published standards. We take our claim of being the world's "gold standard" seriously, so we decided to activate one of the three residual satellites we maintain as on-orbit spares to replace the malfunctioning satellite. This is exactly why we keep residual satellites on-orbit, but fortunately this is only the second time in 25 years we have had to use one of them.

It is said that GPS signals across the US are threatened by a new wireless Internet network being established by LightSquared. What is your comment on this?

This is an issue still under review by the Federal Communications Commission (FCC), an independent U.S. government agency charged with regulating commercial interstate and international communications in the 50 states, the District of Columbia and U.S. possessions. Our office has worked extensively on the GPS interference aspects of this problem with the FCC and the National Telecommunications and Information Administration (NTIA), the Executive Branch agency responsible for advising the President on telecommunications issues, and the manager of the federal government's use of spectrum. I can assure your readers the U.S. Government is carefully considering the concerns of our GPS users as they evaluate LightSquared's proposals. Mr. Genachowski, Chairman of the FCC, has promised to protect the use of GPS and also promised a fact-based, engineering approach to the evaluation.

The Obama administration believes we must protect existing GPS users from disruption of the services they depend on today and ensure innovative new GPS applications can be developed in the future. At the same time, recognizing the President's instruction to identify 500 MHz of spectrum for new mobile broadband services, we will continue our efforts at more efficient use of spectrum. Therefore, the U.S. government will participate in further testing required to establish whether there are any mitigation strategies that can enable LightSquared operation in the lower 10MHz of the Mobile Satellite Services band. We also encourage commercial entities with interests to work with LightSquared toward a possible resolution, though any proposed mitigation must be subjected to full testing. The challenge of meeting the President's goal also depends on long-term actions by Federal agencies in the area of research and development, procurement practices that encourage spectrally-efficient applications, and new policy development.

There is a thought that there is too much dependence on GPS? What is your view on the 'said back ups' like Loran?

The continuing growth of services based on the Global Positioning System presents both opportunities and risks to U.S. national, homeland, and economic security. The widespread and growing dependence on the Global Positioning System of military, civil, and commercial systems and infrastructures has made many of these systems inherently vulnerable to an unexpected interruption in positioning, navigation, and/or timing services.
For this reason, our national policy specifically calls for backup capabilities to ensure continued service for growing national, homeland and economic security

requirements, for civil requirements and to meet commercial and scientific demands.

Although Policy is clear in the direction to have backup capabilities, it does not mandate any specific solution like Loran. The Department of Transportation, in coordination with the Secretary of Homeland Security, has primary responsibility to develop, acquire, operate and maintain backup PNT capabilities for critical transportation, homeland security and other critical civil and commercial infrastructure.

The Department of Homeland Security, with input from across the Federal Government, is nearing completion of a comprehensive National Risk Assessment focused on civil GPS services, which should provide us greater insight into our dependency and our need for additional backup capabilities.

How to address the issues like jamming?

I undertook the task of addressing the proliferation of GPS jamming devices as my top priority when I took over as Director of the NCO. I took on this task because this is very serious problem that has been getting worse over the last several years. There are now companies whose sole line of business is manufacturing devices that purposefully and illegally cause harmful interference to GPS. In just in the past year, low-cost devices produced overseas have negatively impacted civil aviation, surveying, cell phones, law enforcement and other PNT services in our country. The Executive Committee has devoted significant time and attention to this issue. They have asked for new threat and risk assessments, a review of the legal regime, engagement with our international partners, new jamming test procedures and improved measures to detect, identify, locate and mitigate sources of interference. Our colleagues at the FCC have stepped up enforcement against the owners of these devices and against the companies that manufacture and sell them. We have introduced a proposal for action at the International Committee on GNSS to address this issue as it affects all GNSS systems and cuts across international borders.

With many new GNSS systems on horizon, how do you position the US GPS? Don't you think that such a GNSS race is not in the interest of the US?

I disagree with the premise of your question. We do not see any GNSS race. If there ever was such a race, it was over long ago. We recognize we are in a multi-GNSS environment today and new players will continue to emerge in the future. This is not a threat to us. In fact, it may be an opportunity as numerous studies show using signals from multiple national systems can improve availability and enhance performance of certain applications. The emergence of other GNSS services complements U.S. provision of GPS services, and does not need to be seen as competition.

While we have made great strides in areas like frequency deconfliction, additional international collaboration is still needed to fully realize mutual goals of compatibility and interoperability

We expect that people around the world will continue to want to use GPS, either by itself or in combination with other GNSS. GPS has performed outstandingly well. It has never failed to meet its promised capabilities and has exceeded them every year of its operation. We have decades of reliable performance, a complete transparency with respect to our published standards and interface control documents, supportive policies consistent across decades of political leadership, and stable, multi-year funding. We have exciting new capabilities coming on line in the next few years as we continue to modernize both our satellites and our ground stations.

US offers free GPS signals, still many countries want to have their own GNSS systems? What could be the reasons?

I think that would be a good question to ask those countries. We have made a commitment to the world to provide free GPS signals for peaceful uses to anyone that wants them. We have demonstrated over several decades our good faith in keeping that commitment. GPS has remained available and reliable for global civilian use despite U.S. involvement in multiple wars and anti-terrorism activities, even during and after the attacks of September 11, 2001. However, each nation has to make these decisions for itself based on its own strategic interests and I certainly respect that. The United States welcomes other GNSS providers and our National Policy supports using new GNSS services to augment and strengthen the resiliency of GPS, although we will always maintain our own core GPS capabilities.

What challenges you feel in international collaborations in the field of GNSS?

While we have made great strides in areas like frequency deconfliction, additional international collaboration is still needed to fully realize mutual goals of compatibility and interoperability. I also believe there is further work we can do to ensure the new providers support transparency and open market access. One of the common challenges ahead is a worldwide demand for more bandwidth and the increasing pressure on the GNSS frequency bands. In our discussions with FCC and NTIA on the LightSquared issue, we have seen how complex it can be to maximize efficiency of spectrum use, while still supporting critical GNSS services. This problem will not be unique to GPS and I expect the issue of increasing spectrum efficiency to be one that gets a lot of discussion in future multi-lateral GNSS fora. I also expect the issue of GNSS interference, both intentional and unintentional, will be a growing international issue and a common challenge for all GNSS providers.

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LightSquared and GPS

The controversy around LightSquared and GPS has been summarized below

What is LightSquared?

LightSquared Subsidiary LLC is a company that plans to provide a wholesale, nationwide 4G-LTE wireless broadband network integrated with satellite coverage. LightSquared will combine existing mobile satellite communications services (formerly known as SkyTerra) with a ground-based wireless communications network that uses the same L-band radio spectrum as the satellites. On January 26, 2011, the Federal Communications Commission (FCC) issued an Order and Authorization giving LightSquared conditional approval to build out its ground-based wireless network (referred to as an ancillary terrestrial component, ATC) by reusing its authorized mobile satellite service (MSS) spectrum. The approval is subject to further testing and FCC review (see below).

GPS community concerns

The base stations of the LightSquared network will transmit signals in a radio band immediately adjacent to the GPS frequencies. The GPS community is concerned because testing has shown that LightSquared's ground-based transmissions overpower the relatively weak GPS signal from space. Although LightSquared will operate in its own radio band, that band is so close to the GPS signals that most GPS devices pick up the stronger LightSquared signal and become overloaded or jammed. There is also concern that the FCC may approve a technical solution to the problem that requires millions of existing GPS users to upgrade or replace their devices.

What is being done to address the concerns?

In its Order and Authorization, the FCC required that LightSquared create a working group with the GPS community "to address interference concerns regarding GPS and, further, that this [working group] process must be completed to the Commission's satisfaction before LightSquared commences offering commercial service." LightSquared committed $20 million to the working group and worked closely with the U.S. GPS Industry Council and other participants to complete interference testing.

The FCC ordered LightSquared to file monthly progress reports and a final report due June 15, 2011. On June 15, LightSquared requested and the FCC approved an extension of the deadline to July 1, 2011. They submitted their final report on June 30, 2011, along with a separate document providing their recommendation to the FCC. The FCC opened a 30-day public comment period on the report and recommendations, with a comment deadline of July 30, 2011. LightSquared cannot commence commercial operations of its terrestrial network until the FCC, "after consultation with NTIA [National Telecommunications and Information Administration], concludes that harmful interference concerns have been resolved and sends a letter to LightSquared stating that the process is complete."

Independent of the FCC-ordered study, the government's National Space-Based PNT Systems Engineering Forum (NPEF) conducted its own testing of the potential interference to military and civilian GPS users from LightSquared's terrestrial network. The NPEF completed its report on June 1, 2011; the unclassified public version was released July 6, 2011.

What is the Executive Branch position on this issue?

The government GPS community is working closely with LightSquared and the U.S. spectrum regulators to ensure that GPS users are protected from interference and unnecessary re-equipage. The U.S. Government continues to support the President's National Broadband Plan and facilitate its implementation consistent with the preservation of national and economic security.

Federal agencies have conducted extensive technical studies to understand the interference effects and seek potential mitigations. Their initial analysis is complete and was provided to the FCC through the National Telecommunications and Information Administration (NTIA). The results clearly demonstrate that implementing LightSquared's planned deployment for terrestrial operations poses a significant potential for harmful interference to GPS services.

Prior to the FCC Order and Authorization of January 2011, the National Coordination Office and multiple federal agencies expressed concern about potential GPS interference from LightSquared. On behalf of the Executive Branch, NTIA sent a letter to the FCC stating that the LightSquared proposal raised "significant interference concerns that warrant full evaluation" to ensure that federal agencies' use of GPS is not adversely impacted.

On July 6, 2011, the NTIA Administrator sent another letter to the FCC stating that, based on the government testing and analysis, his earlier concerns about GPS interference remain unresolved. He recommended that the FCC continue to withhold authorization for LightSquared to commence commercial operations. NTIA, in coordination with federal agencies, is still reviewing the LightSquared working group test results and will continue to consult with the FCC.

www.pnt.gov/interference/lightsquared/

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PlainSpeak

"Analysis carried out in Europe... has shown that transmission from LightSquared base-stations do indeed have considerable potential to cause harmful interference to [our] receivers operating in the United States." – **European Commission**

"[W]e would first like to confirm the information of the LightSquared system service deployment plan in Hawaii and Guam area to determine whether the impact to our monitoring stations would present." – **Japan Aerospace Exploration Agency**

"Without the ability to quickly, efficiently, and often in real-time, provide through GPS the accurate geospatial information private and government consumers have come to expect, not only will the costs to provide such data skyrocket, but also much of that data will be obsolete before it can be made available for its intended purpose." – **American Congress on Surveying and Mapping & The National Society of Professional Surveyors**

"[The TWG's] results greatly concern AEM as our member companies have invested billions of dollars on the research and development of equipment products dependent on an uninterrupted GPS signal... The results of the TWG's extensive study clearly demonstrate allowing LightSquared to move forward is reckless and doing so places GPS based equipment at certain risk." – **Association of Equipment Manufacturers**

"[T]he waiver granted LightSquared to deploy and operate a terrestrial network using frequencies adjacent to GPS [should] be withdrawn until sufficient testing and evaluation has been conducted with adequate assurances that precision based GPS will not be adversely impacted." – **American Association of State Highway and Transportation Officials**.

"LightSquared has utterly failed to take seriously the safety of America's aviation system, and the Commission cannot similarly engage in denial and ignore the serious threats to public safety posed by LightSquared." – **Aircraft Owners and Pilots Association & General Aviation Manufacturers Association**

"LightSquared completely ignores the fact that high precision GPS is embedded in equipment in extensive use in the aviation sector and that Low 10 MHz interference to such precision GPS will jeopardize an important part of air safety for the American flying public." – **Deere & Company**

"The bottom line is that LightSquared has been afforded an extraordinary opportunity to make the case that its proposed use of the MSS band is viable without causing harm and cost to government and private industry in excess of the benefits of its proposal... The condition set forth in the Commission's January 2011 order – that harmful interference to GPS must be resolved – has not been satisfied, and LightSquared cannot be allowed to commence operations." – **Trimble Navigation Limited**

"[N]o mechanism exists that would enable LightSquared to mitigate the harmful interference revealed by the testing program... The Commission, through proper procedures, should reject LightSquared's Recommendation, rescind the conditional waiver, and otherwise ensure that the conclusions reached from the work of the TWG and further studies/tests be codified in its rules governing ATC use in the L-band." – **Lockheed Martin Corporation**

www.saveourgps.org

Interference to GPS from LightSquared network

The Final Report of the Technical Working Group mandated by the Federal Communications Commission and conducted jointly by LightSquared and the GPS community of manufacturers and users has been filed with the FCC. It shows that LightSquared's proposed network would cause devastating interference to all kinds of GPS receivers tested including those used in Aviation, Cellular phones, General Location and Navigation (including Automotive, Public Safety, Personal and Marine Navigation), High Precision and Networks (including Agriculture, Surveying, Construction and Monitoring of Dams, Structures, Earthquakes and Volcanoes), and GPS Timing. The results show that the network would also jam LightSquared's own satellite transmissions and those of others in the same Mobile Satellite Services (MSS) band, being used in many important land and marine based industrial and safety applications.

Schlesinger, Parkinson Address FCC: Rescind LightSquared Waiver

The two co-chairs of the U.S. National Advisory Board for Space-Based Positioning, Navigation, and Timing, the Hon James R Schlesinger and Dr Bradford Parkinson, have delivered an official, strongly worded letter today to Julius Genachowski, chairman, Federal Communications Commission. The letter "formally requests that the Federal Communications Commission rescind the conditional waiver approving LightSquared terrestrial operations in the MSS radio band from 1525-1559 MHz, and instead select an appropriate band that would avoid the substantial collateral damage in its understandable quest to bring broadband to the American public."

The two writers add that "The proposal would radically change a primary space-to-earth radio band to allow high-power terrestrial broadcasts. As shown by comprehensive industry and government testing and analyses, if this proposal were allowed to proceed, it would have the unavoidable consequence of adversely impacting current and planned Federal and private sector infrastructure. The costs would be tens of billions of dollars per year. Such a loss would impact our nation's national security, international standing and have a notable economic impact. It is not an acceptable alternative to impose this burden on behalf of a single company."

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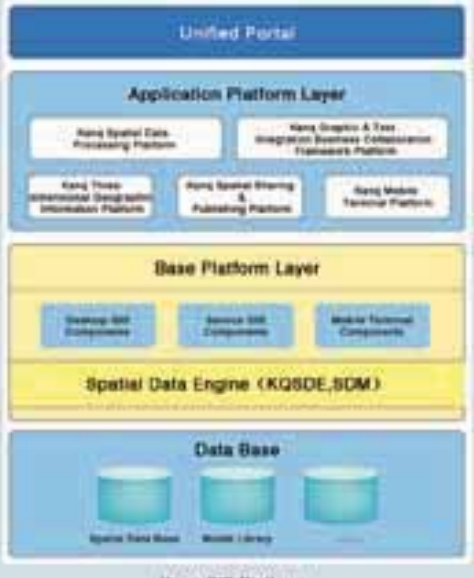

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Our accurate compact modules will allow innovators to develop applications not yet on the drawing board

says Ed Norse GNSS Portfolio Manager, Integrated Technologies, Trimble Navigation Ltd

How is Trimble getting ready with the multi-GNSS systems scenario?

Trimble understands that our customers want to purchase receivers today that will benefit from the GNSS signals planned for the future. To keep up with these ongoing changes Trimble's integrated circuit design team is constantly developing custom chips to be used in our receivers. With many divisions of Trimble utilizing this same core technology the economics of creating a new chip at frequent intervals makes more sense. The latest generation of receiver technology tracks the current Compass navigation demonstration system open service signals and Galileo open service under a license of the European Union and the European Space Agency.

Would you like to highlight some of the key features of Trimble BD910 and Trimble BD920?

Unlike any other OEM RTK receiver on the market the BD910 and BD920 are enclosed in a fully shielded metal enclosure. This design ensures the high quality GNSS signals are protected from the sources of EMI on the host platform. It also significantly reduces radiated emissions which speeds compliance certification and time to market. The RTK receivers are also extremely small allowing them to be integrated

into mobile devices such field controllers and tablets. The Trimble BD910 and BD920 were designed for easy integration and rugged dependability. Customers benefit from the Ethernet connectivity available on the board, allowing high speed data transfer and configuration via standard web browsers. USB and RS-232 are also supported. Just like other Trimble embedded technologies, easy to use software commands simplify integration and reduce development times.

How important is the power backups in portable solutions and how is it being addressed in your products?

Power consumption is a critical factor for portable solutions. The lower the power consumption the longer the device will operate on its battery supply. Changing batteries reduces productivity. The Trimble BD910 and BD920 have chosen lower power components including the main processor to minimize power consumption. Channels not in use are switched off. Lower gain antennas with lower power consumption are supported. Firmware is optimized to reduce power where possible.

What is the USP of Trimble BD982?

The BD982 is a very powerful RTK receiver for professional applications. The receiver contains two independent antenna ports. This allows RTK baselines to be computed at a 50Hz rate between the two antennas and to a remote base station. The receiver supports GPS L1/L2/L5, GLONASS L1/L2 and Galileo L1/E5 in addition to OmniSTAR VBS, XP, G2 and HP services. Single antenna GNSS systems have difficulty determining where the antenna is positioned relative to the vehicle and object of interest, especially when dynamics are low. External sensors can be used to augment this however these tend to drift when static. Heading derived from dual-antenna GNSS measurements overcomes these issues.

How competitive are the pricing of these products?

All our OEM products are available in a variety of configurations to suit the requirements of our customers. Pricing is dependent on the options selected and the volume of units purchased. We believe our pricing is very competitive.

What are the applications these modules best suited for?

The modules are suited for a variety of applications where compact size is critical. Mobile devices such field controllers and tablets benefit from both the size and full metal jacket design. Aerial and ground unmanned vehicles are shrinking in size requiring smaller navigation payloads. Just as low accuracy GPS chipsets have opened up an increasing number of new applications we predict that these centimeter accurate compact modules will allow innovators to develop applications not yet on the drawing board.

How are system integrators going to be benefitted from these new releases?

System integrators will benefit from all the features of these new products. The smaller our products are then the smaller our customers can make their products. The Trimble BD910 and 920 are solder down modules. This means integrators can design their printed circuit boards with our modules treated like other components on the board. No longer is additional standoff mounting hardware required which increases cost and size and reduces ruggedness. Communication to the board can be via Ethernet, USB or serial. The onboard web server makes evaluation and remote diagnostics significantly easier. The BD910 and 920 share a common connector and overlapping footprint which allows an integrator to design their product to handle either receiver dependent on the application.

With Brazil, Russia, India and China being seen as the fastest growing economies, how does Trimble plan to leverage on it?

Trimble views the BRIC nations (Brazil, Russia, India and Chi na) as critical markets that we need to be focused on serving. We believe that products like the BD910 and the BD920 will meet the needs of these markets by delivering the performance that the world has come to expect from Trimble GNSS receivers. By utilizing constellations such as GLONASS, Compass (Beidou-2), and Galileo which these nations have a financial, technical, and political stake in; and to allow customers in these countries to meet bid specifications that require usage of these constellations. By utilizing the SBAS systems such as GAGAN, MSAS, QZSS, along with EGNOS and WA`AS which these countries are invested in or serviced by. And, by delivering these products at a price point that we believe will be very competitive in these markets.

The challenges before surveyors and surveying

The survey profession faces many challenges as technology provides new tools to represent the spatial outcomes that have always been the select domain of the Certified Surveyor

Ian Harper
Geodata Australia Pty Ltd, Newcastle, Australia

Definition of land boundaries for the purposes of ownership (the Cadastre) or spatial definition for legal and cultural purposes is a vital part of the economic foundation of our society.

The skill of measurement is the historical foundation of the surveying domain and that flows through the definition of land boundaries based on the surveyor's intuitive interpretations of historical records, field monuments and measurements and survey computations. The surveyor undertakes a rigorous process to minimise the uncertainties in all these data sources to provide the spatial definition of an indefeasible land title to the government. Their importance to society is recognised by requiring ongoing statutory and professional qualification.

The cadastral (or property) layer which represents the real world cadastre is now the foundation of modern electronic GIS land administration databases which underpin good governance and decision making in public and private domains.

GIS has provided 'map-makers' with powerful electronic tools capable of generating plans, but originally those tools did not support the level of accuracy maintained by surveyors. Manually drafted maps were digitised to generate an electronic model of the cadastre and when accurate survey data was added, the GIS technology did not allow the preservation of that survey accuracy in the database. That has now changed.

Modern technology (GPS etc) has also introduced higher levels of accuracy in all spatial data. This has highlighted inefficiencies in many existing cartographic cadastral database technologies. The Continuously Operating Reference Station (CORS) in Australia and the MyRTKNet in Malaysia will provide centimetre accuracy to a wider range of GPS users and raise the level of position based data, further highlighting the need for an effective system to manage the underlying accurate cadastral database.

The measurement and computing technology available today has very little uncertainty in it and as such, the need for some of the old surveying skills has diminished and some of the measurement, computation and mapping role is being undertaken by a new breed of spatial professionals.

Governments are now looking for electronic solutions to provide effective survey, title and cadastral database management. Understanding all aspects of the relationship between an electronic model of the cadastre and real world cadastral definition is the key to generating practical governance within the limits of the data and the technology. This is how achievable goals can be set.

The role of the cadastral surveyor in the Torrens Title System

The role of the surveyor to physically define and make records to redefine legal and cultural boundaries has not changed since land ownership began, but the tools they use and the outcomes they generate have. Hand drafting title plans has moved to CAD and the electronic storing of images. Surveyors are now being asked to generate intelligent electronic records to populate databases that will generate the electronic model of the cadastre for administration and operations management. Title definition will be a consideration in the future where it has not already been implemented.

The Torrens system is recognised as one of the most effective registration systems because it is underpinned by the spatial integrity of rigorous title survey plans. Monuments on the ground or surveyor's measurements of various precision, age and technologies are used to define those boundaries and hard copy records of those monuments and measurements are the foundation to the cadastre.

The adoption of this type of historical data into a modern exact electronic environment is a difficult process due to:

Measurement records may be over a hundred years old and by comparison with modern tools, have poor accuracy but they still have the same legal status.

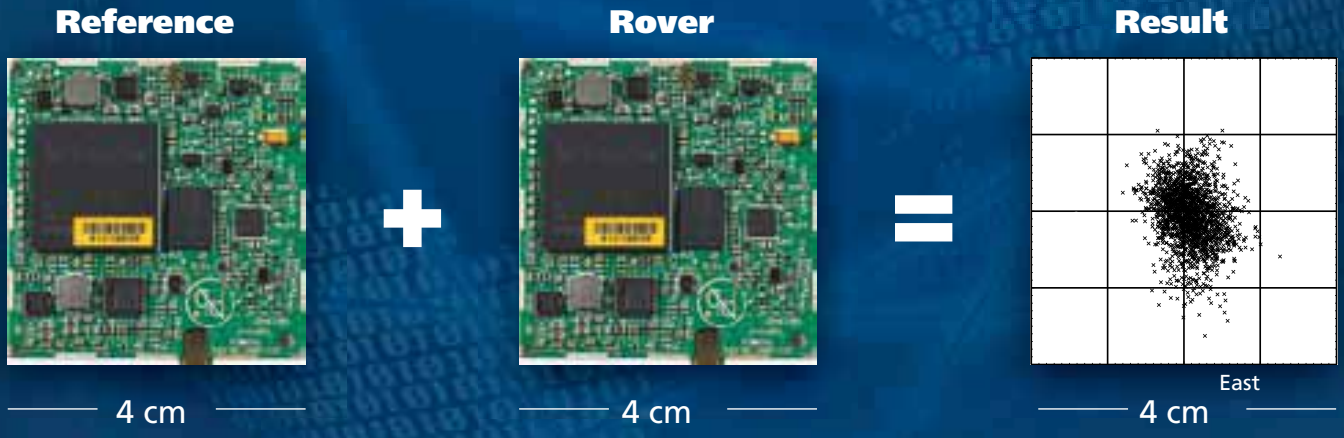
Survey plans are allowed to have a statutory level of misclose or error in them

Many plans are not accurate, even though they have been through a checking process when registered.

Historical survey practices where a surveyor would think it prudent that when they were measuring the boundary of a 100 link parcel, they would actually place the pegs 101 links apart. Under

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

the Torrens system, the original location where the peg or monument is placed defines the property corner but the title would only read 100 links. This outlines the basic edict of the Torrens system of "Monument over Measurement". That practice, which was widespread in earlier times, is based on the philosophy that if there were problems with the survey, no landowner will complain too much if they had more land than their title states. The surveyor did not consider the problems they have just caused in the electronic future.

For these and many other reasons it is impossible to fit all the title dimensions of parcels together exactly in an electronic database but surveyors through their skill, make it happen in the real world. The solution is to replicate that same survey logic in an electronic process to generate a seamless survey geometry database. There are occasional gaps and overlaps in the real world but they are a result of poor survey practice showing a lack of resolve to solve obvious plan problems in the field and offer a solution to the registration authority.

Databases are being populated data from many sources, often of unknown spatial quality and unfortunately many people utilise those databases with little recognition of that data quality. An accurate cadastre will provide a framework to position that data as close as possible to its real position.

Many lessons have been learnt in infrastructure projects that the investment in creating a cadastral database of known accuracy will overcome undectectable spatial problems in design that only come to light during the construction stage. Service authorities (water, sewer, power, telco etc) also now understand the business case efficiencies of an accurate cadastre or at least knowing the level of accuracy in operational databases. It is unfortunate that in many jurisdictions many authorities and other levels of government commit funds to build their own more accurate cadastral databases, duplicating government databases and wasting resources.

Modelling a survey database to represent a Torrens Title System

The survey data model or Numerical Cadastral Data Base (NCDB) technology is already in use and it provides any levels of data validation. Surveyors need those tools because they have always had to certify their survey outcomes, but many spatial professionals do not consider spatial quality when they should. The NCDB technology provides a tool and an intelligent data structure to efficiently manage all levels of survey measurement data (traverse & GPS) in a GIS database environment however it is important to recognise that the coordinates generated have no legal status unless legislation is in place to provide that legal status to the model.

The fact that coordinates can change over time due to tectonic movement or updating geodetic observations is another issue of governance that not many people outside the survey profession understand. The NCDB technology manages such a dynamic coordinate environment, but generally needs surveyor's skills in advising how to interpret the higher level of functionality available.

> Surveyor's skills should see them have a higher role of data management and data governance

This is the type of tool that will make surveyors relevant to the future under the current regime of governance for boundary definition, however as the efficiency of coordinates is being recognised, the database will be seen by many with an economic bent as a cost effective cadastral definition tool. It can be, but in the right hands.

The future

The rate of change in the electronic world is phenomenal. We are comfortable with email and web page technologies, but now we are under siege through 24/7 communications and the pressure to be active in personal and professional social networks. Data is also flooding in from these sources. Time and cost minimisation will be the biggest challenges in the future. Under most Torrens property legislation it may be difficult to provide the same quick boundary definition fix that database coordinates are perceived to provide, but this will happen in a coordinated future. The most efficient way to store any spatial data in an electronic environment is by coordinates, so in time legislation will provide that the coordinates of the cadastral database will become the prima facie survey evidence to define boundaries. That is already the case in some places around the world..

The database is a powerful land administration management tool but it can also suffer from many issues like the amount and type of data available and the expectation of outcomes. Technology can obviously solve this problem but at what cost. At the South East Asian Survey Congress (Kuala Lumpur June 2011) two plenary speakers addressed relevant issues. Dr Keith Clifford Bell of the World Bank related a growing trend in many developing countries where systems are being 'over-engineered' and not fit for the purpose of providing simpler or economically sustainable database solutions. The issue of utilising un-official data (crowd sourcing etc) was also raised with Professor Ian Williamson (Centre for SDI and Land Administration, University of Melbourne) outlining the need for spatially enabled AAA land information (Accurate, Authoritive, Assured) at all levels. Both survey systems and survey skills can play a role in these agendas.

The issue of 3D cadastres is now high on the spatial agenda. Numerically defining 3D objects is not a problem as the modelling tools have been around for some time. The real problem is the quantum leap in statutory governance applied to by-laws attached to the management of shared structures, services and communal areas. Trying to achieve this governance by creating a 3D mathematical model to replicate existing definition practices is not practical. The effectiveness of future electronic 3D cadastres will only be possible if a pragmatic approach to that governance is adopted. This is

a role where surveyors should be at the forefront because they understand practical measurement capabilities and the relationship to practical legal definition.

In Australia, a surveyor's options for the future are:

Traditional custodians of the cadastre and measurement professionals (Geodesists etc) – there is a considerable decline in younger people entering or staying in this area, however the survey definition role will remain for the cadastral surveyor whilst property remains the economic foundation of our society. The success of the Torrens Title system is based on a high level of governance in property survey definition however retaining that high level of rigour must be supported by legislation. The same should apply to legal title coordinates. Highlighting the importance and justifying a higher value on that role is also a key to the future health of the profession.

Higher Level Spatial Technologies – Individuals and companies have recognised the commercial opportunities in providing services in GIS, satellite & aerial imagery, 3D modelling, lidar etc. The rewards can be high but it can be a big investment and carries many associated risks. Individuals can provide specific consulting skills but these areas generally require the resources of the larger corporate entities and knowledge of the market & the economics.

Somewhere in between – Servicing both of the previous domains can add value to a surveyor's role. Surveyors are recognised for their project management skills for land development and that role should expand to a spatial data management and data validation role. A 'shaking down' of the industry is seeing many practioners having to make the business decision about which of the previous domains they wish to be involved with – stay small and service the 1st or grow into or join other firms to be part the 2nd. In the modern world servicing the middle ground is difficult economics.

In many Torrens Title systems like that in Australia, the transition from the "monument over measurement" edict has considerable historical legal and spatial definition issues that will not be resolved quickly. The legal status of the database as regulated by legislation is the underlying determinant of the database role for government but the awareness and understanding of that status is also important for all other stakeholders. The cadastral surveyor is the only profession that fully understands the connection between those issues and should play a major role in that transition.

Surveyor's skills should see them have a higher role of data management and data governance in the future but there must be recognition by government and industry that these factors are important in an efficient electronic future. Spatial data quality validation and certification of that data should be a niche for surveyors that should be marketed as critical to a risk averse and litigious future, particularly to government.

Making surveying education relevant

This paper examines how selected surveying/geomatics programmes address the issue of making their courses relevant to industry needs, student characteristics and one particular trend within higher education

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Surveying education has been 'playing' catch up with changes in the surveying/geomatics industry and some individuals are of the opinion that the lag is substantial and demands immediate attention. Not only has technology impacted the surveying industry but the modernisation brought on by information and computer technologies has considerably impacted educational methods used in surveying/geomatics programmes. This paper examines how selected surveying/geomatics programmes address the issue of making their courses relevant to industry needs, student characteristics and one particular trend within higher education. The discussion is based on empirical data from a research that involved fifteen surveying/geomatics programmes from thirteen countries. The study investigated curriculum architecture and pedagogical alternatives within the discipline and the impact these have on students' preparedness for work.

Responding to change in the geospatial industry

Though some specialised surveying operations such as cadastral surveying are still protected activities for surveyors in some countries, generally land measurement and representation are no longer seen as exclusively the domain of surveyors. The geospatial industry continues to become more and more commercialized and caters to a growing market. In some contexts this is perceived by the surveying community as a threat and in others as an opportunity. Though these perspectives need to be taken in context, there is a growing awareness within the international surveying community that changes in the geospatial industry should be viewed as an opportunity for surveyors. Surveyors are now expected to adapt their systems of measuring, computing and representing land features to ever changing technologies. Indeed, as it relates to this area of work and education the only constant is change (Enemark, 2005).

Some argue that surveyors should not limit their roles and functions to doing only the things they used to do using new methods and new tools. Contemporary surveyors are encouraged to embrace the new opportunities and use their expansive knowledge and skills to engage with or rather lead the way in the commercialized geospatial industry. Surely surveyors are best placed to provide not only reliable data and processed information, but with appropriate education and training they can also provide leadership, advice and guidance in the vast array of areas where spatial information is used.

Surveying/geomatics education

The scenario described above brings to focus questions about the systems used to educate individuals for the surveying profession. In a number of countries the training and education of surveyors have been historically rooted in a system of apprenticeship. Young men (primarily) with a proclivity for mathematics and the outdoors were seen as prime candidates

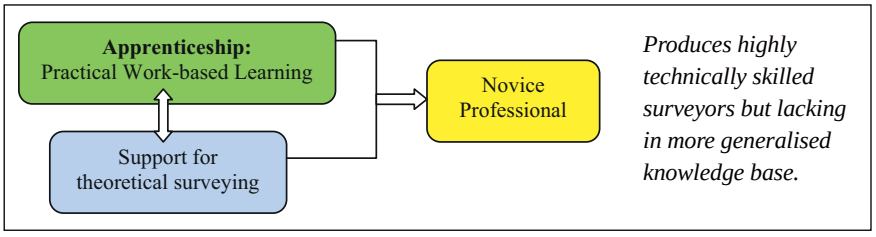

Fig 1: Apprenticeship Model

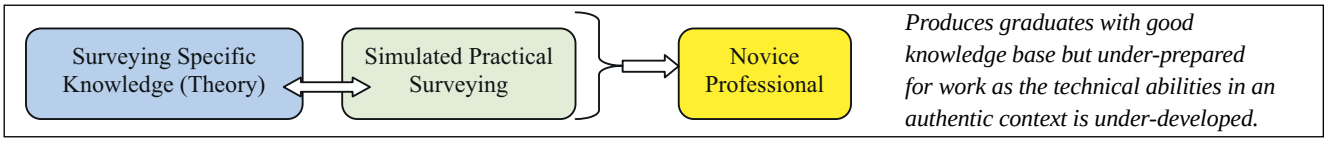

Fig 2: Traditional Education Model I

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for surveying apprenticeship. They would be trained under the supervision of a professional surveyor and through some supporting arrangement exposed to theoretical and computational aspects of the discipline. After a period of 'adequate' development in surveying knowledge and skills, the apprentice could follow a legally prescribed process to obtain a license to practice as a professional surveyor.

In a number of countries such as Britain, the military has also played an important role in the training and education of persons in surveying. Civil societies have benefitted from military trained surveyors who have worked, for example, in the primary surveys of numerous countries that were overseas territories of the former British Empire. Some of the earliest local surveyors in many of these former British colonies were apprenticed to European surveyors employed to the Directorate of Overseas Surveys (MacDonald, 1996). In Britain and other contexts, university graduates with academic degrees in fields such a geography and mathematics were also recruited to fill senior surveying positions within the civil service. With this latter group in-house training within the surveying establishment were provided since they had limited or no exposure to surveying knowledge and skills after graduation.

Formal surveying education in most of the countries looked at in the study, started in technical institutions such as the polytechnics in England and some Caribbean and African countries. These technical institutions provided vocational training offering certification to sub-degree levels (a few also offered Bachelor's degrees). They trained individuals who could follow on to become licensed surveyors. Many of these polytechnic institutions were upgraded to universities and many former sub-degree surveying courses upgraded to degree courses. Within this framework of development, surveying curricula maintained a strong focus on measurement and mapping. However, university requirements brought about a broadening of education for students in degree programmes. In many cases this meant a reduction in the concentration of specialised surveying education and an increase in general education. However, this had to be balanced with demands from professional accrediting bodies to maintain certain specialised content if the courses were to maintain a strong surveying flavour. In spite of this trend, it was found that in all 15 programmes studied, the specialised core elements remain the major components of the surveying curricula.

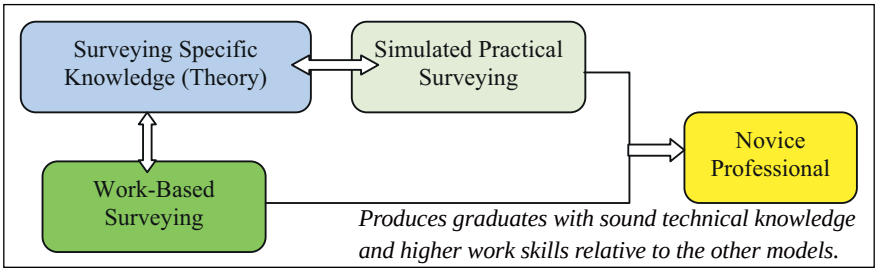

Fig 3: Traditional Education Model II

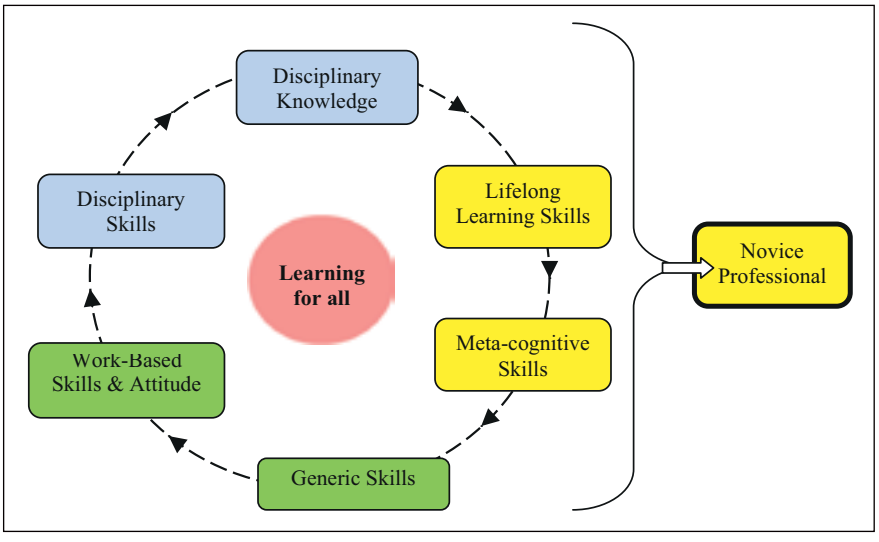

Fig 4: Contemporary Model of Surveying Education

An important difference in the educational approaches of the past and present was identified. The apprenticeship system had a primary focus on building practical competences through a process of scaffolding. This was supported by short, sometimes informally arranged sessions to teach relevant theoretical concepts. Most of the university-based courses in the study had a system that was the opposite of this educational model. They are primarily concerned with covering theoretical concepts along with simulated practical exercises that reinforce the theoretical concepts. Where work-related experience was included as part of the study, it was given secondary consideration relative to the more theoretical focus. ***Figures 1 & 2*** illustrate the two models of surveying education described above.

Work-based skills development is the aspect that differentiates *Traditional Model I* from *Traditional Model II*. In those curricula that did not include work-based experiences, this was a decision based more on resource constraints rather than on philosophical reasons. Programme leaders generally expressed that because surveying education is profession-oriented, students would benefit from industry exposure during their studies. The ability to incorporate industry experience in surveying education, though not always a viable option for universities, is generally viewed as a learning activity that enhances students' readiness for work.

The models illustrate colour-coded boxes that highlight aspects of the educational models that seek to develop: disciplinary knowledge and skills (blue); work-based learning (dark green); practical skills (light green); and professional competences (yellow). The upper levels indicate primary emphasis in the curriculum and the lower level secondary emphasis.

The study found that a contemporary model of education (***Figure 4***) is emerging based on how the surveying community perceives the modern context of the discipline. This educational model seeks to incorporate the

corpus of traditional surveying knowledge with knowledge of wider geomatics areas. Additionally, the model seeks to convey other aspects of learning that are more related to developing in students the skills to function in a dynamic world where interests and methods are in constant flux. Learning for the entire community of learners (not only the students) is at the centre of this model. With this model the disciplinary knowledge and skills may take on a generalist geomatics approach or it may offer narrow specialisations in areas such as Measurement Science, GIS, Remote Sensing, Photogrammetry, etc. Generic skills are those that are typically assumed to be developed during the normal course of knowledge growth and skills development. However, higher education programmes are now expected to explicitly incorporate systems that can develop generic transferable skills in students. Some examples of generic skills are: time management, teamwork, critical thinking and adaptability. These may be developed through increased group activities, learner-directed learning and meta-cognitive activities such as those that encourage reflection and critical thinking. Allowing students to choose surveying methods in the execution of multiple tasks and to justify their choices in the context of economy and accuracy and other specifications has been identified as one way of building critical thinking skills in surveying students.

Relevance of educational methods

Considering students' expectations and their changed characteristics

Student Expectations

Students' motivation for accessing higher education courses is primarily associated with career aspirations. Surveying students expect their university education to prepare them for work in the surveying industry and also to help in their preparation for professional certification. This fact has been overwhelmingly acknowledged by surveying students, programme leaders, academics and representatives of professional accrediting bodies interviewed in the study. The degree to which universities prepare students for the profession is a product of a number of factors. The knowledge content of the course is one of the more obvious factors as well as the degree to which students are able to apply theoretical concepts to practical situations. However, the link between pedagogical approaches and learning is less frequently acknowledged. Certain approaches are better at promoting certain types of learning than do others. If, for example, students are expected to have a holistic appreciation of a particular surveying method, they should be able to engage with the theoretical concepts, the skills required for applying theory to practice, and the affective aspects of negotiating the problem in a relevant context. In other words, concepts are not taught as abstract ideas that are joined with related concepts and activities after graduation. Rather, the learning of theoretical concepts occurs in a setting where related activities are linked. This kind of learning arrangement is described by Kolb (1995) as experiential learning. In this context students are able to make meanings of the teaching and learning experiences.

The study found that sometimes experiential learning is hindered by lack of resources. For example, where three-dimensional laser scanning is presented in theory but the expensive equipment is not available for demonstration and hands-on applications to real surveying situations. Two universities in the study have demonstrated how 'virtual' experiences can be employed as an effective alternative. This refers to the use of multimedia, animation, video conferencing and other live links that allow students to at least see how concepts can be applied in real situations.

Student Characteristics

Educational literature has identified changes in the characteristics of individuals who access higher education. It speaks of the emergence of students with characteristics vastly different from past realties. Students born in the late 1980s and onward have been referred to as *Net Generation Learners* (NGL) by Oblinger & Oblinger (2005) and as *New Millennium Learners* by Pedró (2006). These descriptors define the first generation of children to grow up surrounded by

Surveying Education

There is the continuing need to raise the next generation of professionals that is not only educated and competent but also agile and able to respond responsibly to the growing demands from humanity. Humanity is facing a series of challenges ranging from adequate food and shelter; environmental degradation, natural disasters and climate change; growing income chasm and economic crises. The profession cannot just measure but also need to manage, to mitigate, to meaningfully deploy its sciences and technologies, its knowledge and practices for the betterment of humanity so that the profession remains relevant. Against this backdrop, surveying educators have the unenviable task of educating and shaping our next generation of professionals.

However, there is always a gap between education and practise. This gap can be better addressed when the educators and the practitioners within the profession turn to each other for input and guidance particularly over things such as curriculum. The teaching institutions and the industry have to engage and work with each other to address this gap. This is happening and this gap also appears to be lessening with time as industry steps up to provide appropriate practical exposure, as new technologies that are being deployed is also being introduced to teaching institutions at faster and faster rates.

FIG Commission 2 (Professional Education) within its current four-year work plan is also addressing this challenge and this gap. Within the Commission, we are encouraging research, discussions and debates, for instance, on means to improve the delivery of surveying education, on components within a surveying curriculum that will keep the next generation of professionals relevant. Together with FIG Commission 1 (Professional Practice) in particular, and FIG's other eight Commissions, we are considering and identifying what is and what it takes to bring forth the next generation of surveying professionals that is not only well educated and competent but also agile and able, professionals armed with sciences and technologies, knowledge and best practices, responsibly extending the usefulness of surveying for the benefit of society, environment and economy, next door to everywhere.

Surveying curriculum and programmes that are keeping abreast with current realities and challenges of the time, as well as the demands on and the needs of the profession are addressing this issue better and better.

CheeHai TEO
President, FIG

Prof. Dr. Steven Frank
Chair, FIG Commission 2 (Professional Education)

digital media, with most of their activities dealing with peer-to-peer communication and knowledge management mediated by these technologies (Pedro, 2006). These students are considered to be particularly adept with computers, creative with technology, highly skilled at multitasking, find interactivity engaging, and have a preference for experiential, hands-on learning. How true are these descriptions of modern surveying students? How do we engage this breed of students?

Observations of teaching and learning activities within Surveying/Geomatics courses strongly suggested that contemporary surveying students bear many features of the NGL. For example, in lectures students were observed connecting with friends via online social networking tools, surfing the internet to look up new concepts being presented and using their personal computers to read the notes from the lecture and to augment them. Computer technology seemed indispensible to the surveying students. There was some evidence that pedagogical approaches were informed by a desire to engage these student characteristics. The technology in many cases was integrally linked to the study programme. This was evident within the classroom setting as well as in laboratories and in field exercises. Surveying students in several contexts were clearly oriented to the technology as part of their education as well as tools useful for instruction.

While the use of technology within surveying education programmes appears to have growing support within universities, a bigger challenge appears to be finding effective ways of conveying to students competencies for lifelong learning. While surveying students need to be supported in their learning, they also need to be encouraged to be actively engaged in seeking the knowledge and skills that will support ongoing learning. This is important because many things that surveying students learn in today's classrooms may be obsolete by the time they graduate. Thus, surveying students must be encouraged and supported in developing critical thinking skills, the skills to be able to deconstruct a problem and follow unpredictable paths to finding materials and tools to aid them in coming to decisions related to authentic surveying problems. Whether this is done through case study learning, group-based learning, project-based learning, problem-based learning, or other methods, the critical thing is that the education needs to be oriented towards learning and not teaching. Within this modern educational paradigm, all stakeholders in the educational framework are learners (as illustrated in Figure 4).

Conclusion

Our study gives consideration to the nature of the systems used to train and educate individuals for the modern surveying profession. How relevant are they to the modern context? Who are the individuals who typically access surveying courses or rather to whom do surveying courses appeal? The answers to these questions are fundamental to the development of surveying/geomatics education programmes. These are issues of relevance. Relevance of practice to societal needs, relevance of education to practice and relevance of educational methods to students needs and to industry needs. Exploring these issues involves: (1) an understanding of the nature of the profession in its modern context and also foresight into the likely path it will take in the near future; (2) an understanding of the characteristics of modern day school leavers and higher education students; and (3) an understanding of the teaching and learning strategies employed by a responsive and responsible higher education sector.

There is no doubt that the geospatial industry has changed. It has become far more commercialized than it was a few decades ago. Increasingly non-surveying organizations are making inroads into the geospatial market, grasping the opportunities that this modern context offers. The modus operandi of surveyors has also changed (more so in some countries than others). We can foresee that those countries that are lagging in the technologies will eventually see wide-scale modernization of the surveying processes. We believe that two things are crucial for moving forward for the community of surveyors and surveying educators: (1) surveyors need not only to adapt their operations to the changing technologies but also tap into new opportunities that their skills-set clearly makes them ideal for; and (2) universities and other educational institutions that offer surveying courses need to orient the education towards learning for all in a community of learners involving all stakeholders. The curriculum structure and pedagogical approaches employed must begin to manifest a degree of flexibility that allows for changes to ensure relevance. If our educational efforts were to have a focus on learning rather than teaching, then we would be more inclined to try new methods and to adjust methods depending on our evaluation of students' needs and the needs of industry. As a surveying community we can only respond to contemporary demands if our orientations and our educational programmes are relevant to the times.

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Acknowledgements

The authors would like to thank students and staff in the fifteen universities and members of the surveying profession who participated in the study. Thanks also to the Commonwealth Scholarship Commission for funding the research.

The paper was presented at FIG Working Week 2001, Morocco, 18-22 May 2011

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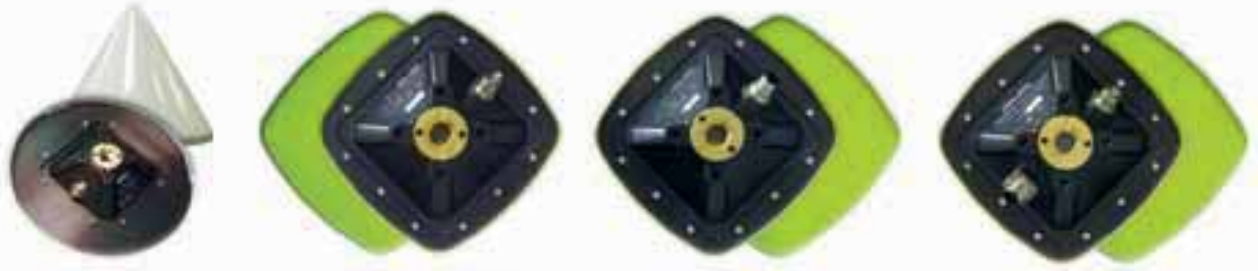

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Example 2: 1-PPS output + Event Marker + GSM Antenna

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

Front panel connectors:

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

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

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

Back panel connectors:

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

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

SIGMA

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- Charger
- Modem
- GSM
- Bluetooth

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

Front panel connectors:

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

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

Back panel connectors:

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

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

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GrAnt-G3T
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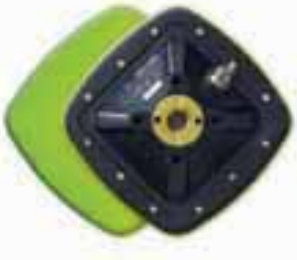

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0.6 kg

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AirAnt

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

120x74x44.5 mm,
0.32 kg

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

TriAnt

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

128x128x55 mm,
0.47 kg

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

RingAnt-G3T

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

RingAnt-DM

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

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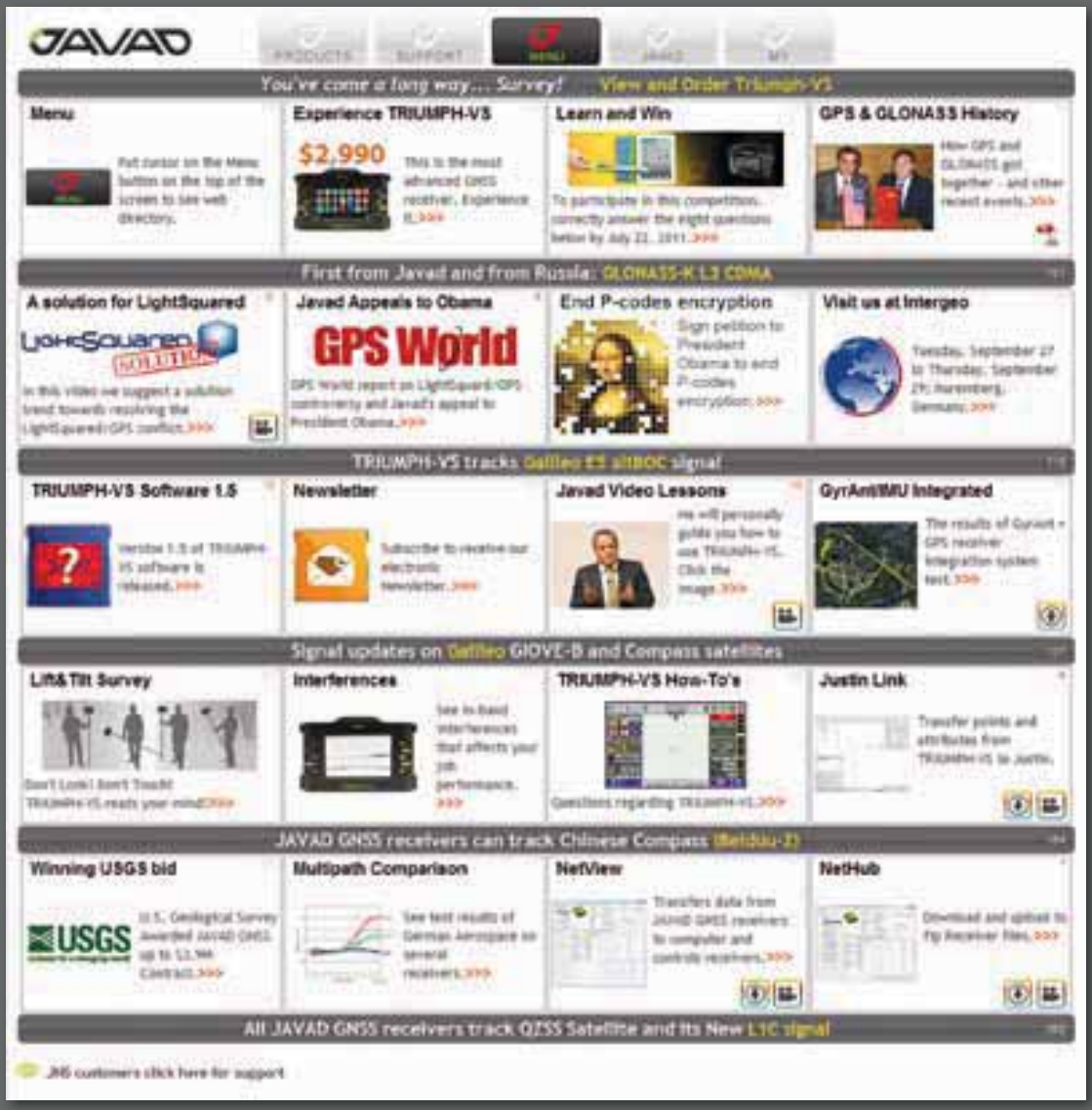

The realization of geocentric datum for Brunei Darussalam 2009

The implementation of GDBD2009 will further encourage the use of GNSS/GPS positioning technology

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The Survey Department of Brunei Darussalam, with the collaboration of the Universiti Teknologi Malaysia (UTM), has carried out a study on the establishment of a new geodetic framework for the country. A new geocentric datum for Brunei Darussalam 2009 (GDBD2009) was established using GPS space geodetic technology based on the ITRF2005 reference frame. The GDBD2009 is related to ITRF2005 through the inclusion of the 8 GPS stations of the Brunei Darussalam Zero Order Network and have been processed together with more than fifty IGS stations around the world. The realization of GDBD2009 requires the determination of a new datum transformation and map projection scheme. A new set of transformation parameters to be use in converting from the existing local datum to the new GDBD2009 has been computed. The implication of this new datum on the existing cadastral and mapping practices, various GPS non-mapping applications, and the GIS/LIS related applications are taken into consideration.

History of the Local Geodetic Reference System in Brunei

The initial survey of Brunei Darussalam was originally conducted in the period of 1934 to 1937 (Bridges, 1937), as part of the primary triangulation of British Borneo. In 1947, readjustment of this triangulation (including Sabah & Sarawak) was undertaken by the Directorate of Colonial Surveys to establish a local geodetic reference system known as Borneo Triangulation 1948 (BT48). This reference system had its origin at Bukit Timbalai and uses the Modified Everest as the reference ellipsoid.

In 1968, the BT48 was further strengthen through a readjustment procedure consisting of the Borneo West Coast Triangulation of Brunei Darussalam and Sabah (1930-1942), Borneo East Coast Triangulation of Sarawak, the extension of the West Coast Triangulation of Sabah (1955-1960) and several Doppler points (1961-1968) (Majid et. al, 2003). The readjustment was performed based on Modified Everest as the reference ellipsoid, with the same origin and semi major axis of the ellipsoid as used in the BT48 solution. This local geodetic reference system was later known as the Borneo Triangulation 1968 (BT68). However, this BT68 datum was not being adopted in Brunei Darussalam (Abu, 1998).

A Global Positioning System (GPS) network in Brunei Darussalam was established in 1992 using Wild Macrometers WM101GPS receivers and was then replaced with Wild System 200 receivers in 1994. A major GPS campaign covering Brunei Darussalam was undertaken in 1994 and 1995. During the period between 2002 and 2003, another GPS campaign was carried out on 17 stations which include some primary and secondary triangulation

Fig 1: Primary (14) and Secondary (5) Triangulation Stations.

stations (see Figure 1) and new GPS monuments (Morgan, 2004). The main objectives of this campaign are (a) to establish a new GPS network, (b) to analyze the existing geodetic network and, (c) to obtain transformation parameters between WGS84 and BT48.

The Need of a Geocentric Datum

In the era of satellite-based positioning, where points anywhere on or near the Earth are determined in a continuous basis with the use of Global Navigation Satellite System (GNSS), in particular the Global Positioning System (GPS), the application of this space-based technique is preferred. Brunei Darussalam requires a coordinate system compatible with GPS in order to support high-precision positioning system, national mapping and navigation applications. These requirements cannot be effectively met by the existing BT48 datum.

The adoption of a geocentric datum will support various geo-economics activities in Brunei Darussalam, being a nation that benefits from extensive oil and gas resources, as well as from the agriculture, forestry, tourist and banking sectors. Moreover, the implementation of the geocentric datum will provide an efficient exchange of spatial data between many data themes and to ensure that an integrated national geographic data infrastructure can be realized.

Adoption of ITRF2005 in Brunei Darussalam

Currently, there are eight (8) GNSS Continuously Operating Reference Station (CORS) included in the Brunei Darussalam Zero Order Network (see Figure 2). Each CORS is equipped with a GPS receiver, antenna, and electrical power supply and communication link providing 24 hours Real-Time Kinematic (RTK) data to GNSS/GPS users in Brunei Darussalam. The physical structure of these stations is shown in Figure 3.

A geocentric datum for Brunei Darussalam could be realized by connecting a set of the Zero Order Network stations into the global reference system such as International Terrestrial Reference System (ITRS) - a system implemented by International Terrestrial Reference Frames (ITRF) from the combination of space Geodesy techniques (including GPS observations). Since 1988, there are 11 realizations of the ITRS with the latest called ITRF2005 being adopted for this project.

The approach is to establish GPS baselines between Brunei's CORS and the global network of GNSS stations of International GNSS Services (IGS). For this purpose, GPS data from Brunei's CORS observed between 17th May 2009 and 2nd June 2009 were processed together with more than fifty IGS stations around the world. The Bernese multi-GNSS analysis software 5.0 (Dach et. al, 2009) was used for the data processing.

Minimally constraints adjustment using free network solution was performed to adjust the daily solution. This process allows for the internal reliability test and outliers detection. Figures 4 depicts the combined daily repeatability of 3-dimensional stations coordinates for the Brunei's CORS. RMS of residuals is between 2.78 to 3.73mm, 3.50 to 6.27mm and 4.89 to 10.15mm for northing, easting and height components respectively. These results indicate the internal accuracy of the Brunei's CORS from the free network adjustment is between 2 to 7mm and 4 to 10mm for the horizontal and vertical components, respectively.

The Helmert 3D transformation was used for the Brunei ITRF realization using the previous results of the free network adjustment and the known IGS station coordinates. The realization of ITRF was fixed at 25 May 2009 (about mid-year) or 2009.45. It was found that the range of coordinate residuals is

Fig 2: Location of Brunei's GNSS CORS

Parameter	Value
Ellipsoid	GRS 80
Semi-Major axis, a	6378137.000 Meter
Flattening, 1/f	298.2572221
Latitude of Center of the Projection, f_c	4° 00' 00" N
Longitude of Center of the Projection, l_c	115° 00' 00" E
Rectified to Skew Grid, g_o	$\sin^{-1}$ (0.8)
Azimuth of Central Line, a_c	53° 18' 56.91582"
Scale factor, k_c	0.99984
False Origin (Easting)	Nil
False Origin (Northing)	Nil

Table 1: The New Geocentric RSO Projection Parameters

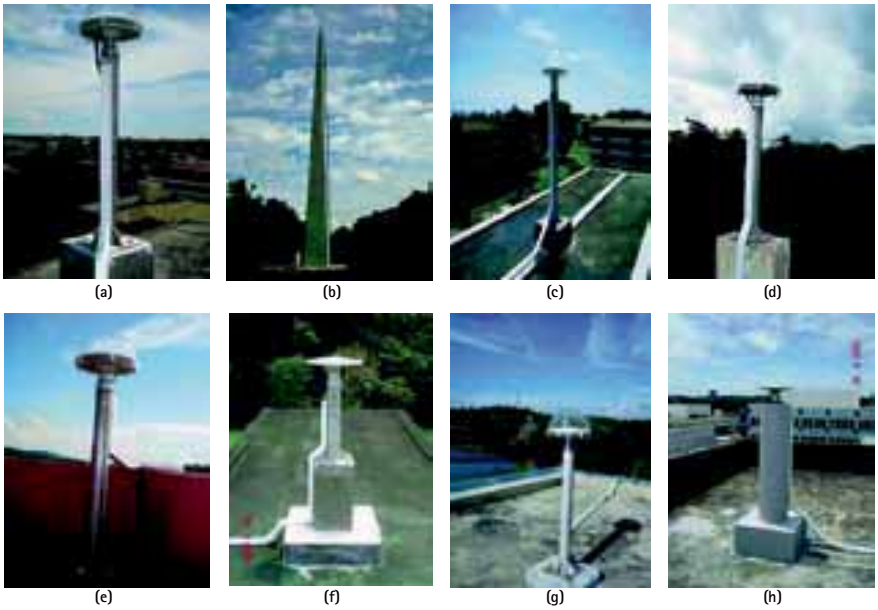

Fig 3: The Eight (8) GNSS CORS that form the Zero Order Network of Brunei Darussalam: (a) KBEL (b) LABI (c) MURA (d) LAMU (e) LIAN (f) TEMB (g) TUTO and (h) UKUR.

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between 7 to 12 mm and 11 to 16 mm for horizontal and vertical, respectively. The RMS of fitting is 5.6 mm, 5.1 mm and 6.3 mm for the northing, easting and height components respectively.

Determination of Brunei datum transformation

Once the adoption of ITRF2005 has been completed, the next task is to define the relationship between the local geodetic system BT48 and the newly established geocentric datum of Brunei Darussalam 2009 (GDBD2009). For this reason, the old primary and secondary triangulations of BT48 stations (see Figure 1) need to be revisited. These triangulation stations are to be observed using GPS technique in order to tie with the GDBD2009 reference frame.

The most challenging task was to arrange an expedition to visit all of these stations (except for station B09, see Figure 1) since they were remotely located on the mountainous area in the Borneo tropical rain forest. A GPS campaign was conducted in January and March 2009. Snapshot of the location of these triangulation stations are given in Figure 5.

During the GPS campaign, data was collected over 48 hours duration at each station. The GPS data was processed using similar procedures as discussed in Section 2.0. The only difference is that the station coordinates of Brunei's CORS in GDBD2009 reference frame were held fixed. Result from this network adjustment has shown that the RMS fitting is between 0.5 to 4mm and 2-10mm for the horizontal and vertical, respectively.

The next step is to adopt the Bursa-Wolf model to derive a single set of seven transformation parameters between the GDBD2009 and BT48 using coordinates of common points. Figure 6 shows the derivation flow of this transformation procedure. Basically, the transformation procedure requires an ellipsoidal height from each station, and this creates a problem since there are only a few stations of BT48 with the height information. In addition, the existing height values are provided in 'Mean-Sea' Level (MSL), which probably was updated by the local authority using a local vertical datum.

To overcome the above problem, a 'reverse' height computation strategy was implemented. There are three (3) computation steps involve in this strategy, which can be summarized as follow:

Step 1: Computation of homogenous BT48 station orthometric height (H_{BT48})

As the common point's coordinates are available in the GDBD2009 reference frame, the derivation of the geoid height (N_{EGM08}) of each station from the global Earth Geopotential Model 2008(EGM08) grid can be carried out. Since the ellipsoidal height ($h_{GDBD2009}$) is available, the computation of H_{BT48} for each station is given by,

$$H_{BT48} = h_{GDBD2009} - N_{EGM08} \quad (1)$$

Step 2: Computation of BT48 station geoid height (N_{BT48})

To compute the N_{BT48} value, a multiple regression equation produced by the U.S. Defense Mapping Agency (DMA) – 'local geoid height on Timbalai 1948 datum' (see DMA, 1987) has been employed. The regression equation is given by,

$$N_{BT48} = -1.703 - 6.806.U - 7.143.V + 18.663\,U^3 + 23.300.UV^3 - 13.211.U^5 - 10.642.U^4V - 1.909.V5 - 36.586.U^3V^5 - 28.381.U^3V^7 \quad (2)$$

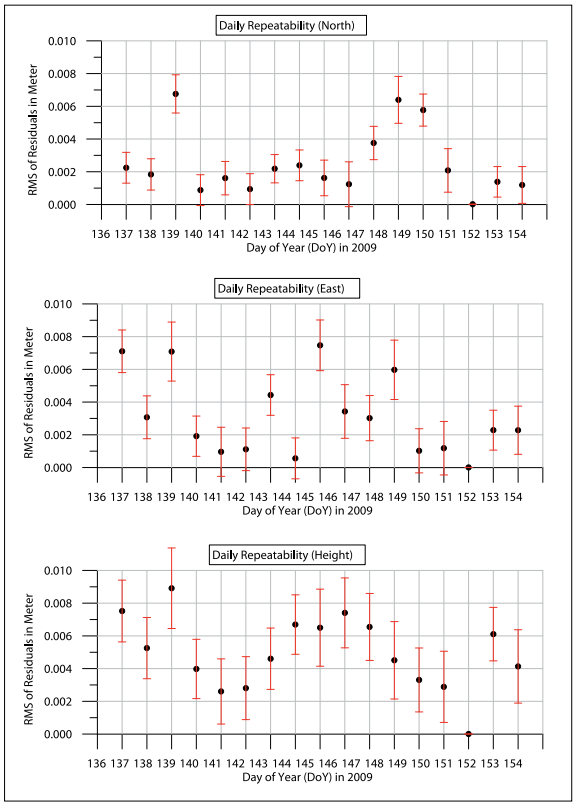

Fig 4: Combined Daily Repeatability

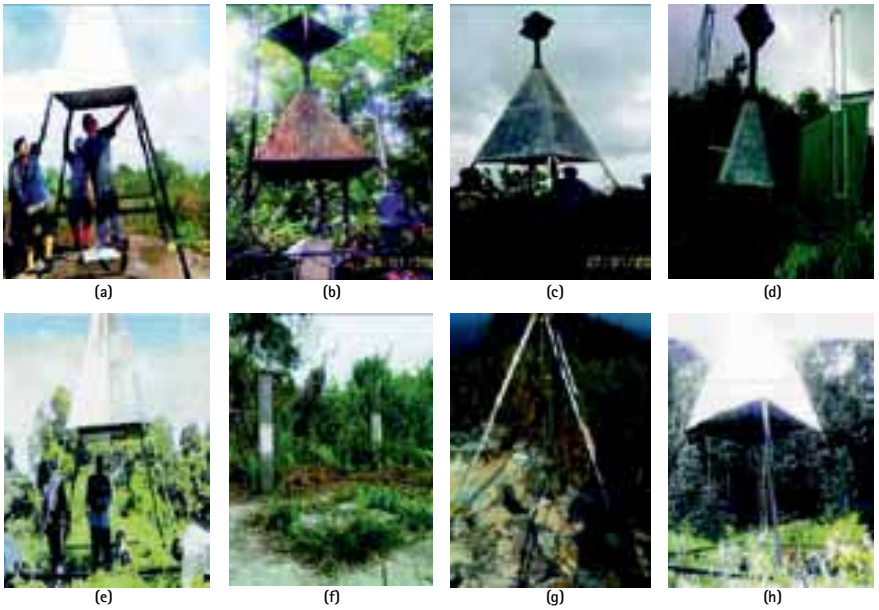

Fig 5: Some of the Primary Triangulation Stations: (a) Bukit Agok; (b) Bukit Telingan; (c) Bukit Tunggulian; (d) Bukit Bedawan; (e) Bukit Sagan A; (f) Bukit Miri; (g) Bukit Lambir and, (h) Bukit Bub Rumah.

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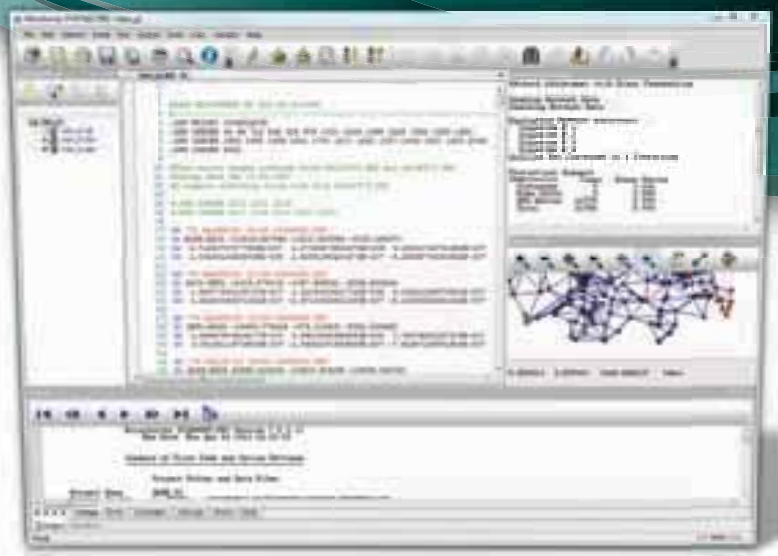

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where,

$U = K (\phi - 4)$
$V = K (\lambda - 114)$
$K = 0.20943951$
ϕ = latitude of station in BT48
λ = longitude of station in BT48

Step 3: Computation of BT48 station ellipsoidal (hBT48)

Using the computed values in Step 1 and Step 2, the value of h_{BT48} for each station can be deduced as,

$$h_{BT48} = H_{BT48} - N_{BT48} \quad (3)$$

Two iteration adjustment steps were carried out for the derivation of the transformation parameters. Result from the 1st iteration has shown that the scale factor between GDBD2009 and BT48 is -7.297ppm with 0.584 standard error of unit weight. However, the residuals plot for the common points has shown that station B039 (Ulu Tutong) exhibit the largest residuals in all three coordinates' components (see Figure 7). Excluding the station B039 in the 2nd iteration has drastically improved the solution (see Figure 8). The residuals computed form this iteration is less than 0.5 meter with a standard error of unit weight of 0.240. Furthermore, the result has shown that the 'reverse' height computation strategies works satisfactorily and it is rather interesting that the divergence of the old BT48 and GDBD2009 is much more less than anticipated.

A new set of transformation parameters from GDBD2009 to BT48 consisting of shift component (Dx, Dy, Dz), rotation (Rx, Ry, Rz) and scale is given in the Technical Manual of GDBD2009 (SDBD, 2009) available at Brunei Survey Department.

The Brunei geocentric RSO projection

For many years, Brunei Darussalam has been using the Borneo Rectified Skew Orthomorphic (RSO) projection for the country rectangular coordinates system to serve the national cadastral and topographic mapping. The RSO projection is in many ways equivalent to Hotine Oblique Mercator (HOM) (Hotine, 1947; Snyder, 1987), which conformally maps an ellipsoid onto an oblique cylindrical projection with a line of constant scales skewed at an angle to the meridian; except that the defining parameters are different. These parameters are latitude, longitude and scale factor of the center of the projection, azimuth of the central line, skew azimuth, false northing and easting.

Since the GDBD2009 has been realized in Brunei Darussalam with GRS80 as the reference ellipsoid, the RSO projection parameters related to this reference ellipsoid need to be redefined. Accordingly, the new geocentric RSO projection parameters for Brunei Darussalam are listed in Table 1.

Implications

The newly established GDBD2009 may bring some implications to issues relating to GPS positioning, cadastral surveying and topographic mapping, navigation applications in land, maritime and aviation, and socio-economy.

The widespread use of GPS has further highlighted the need to adopt a geocentric datum in this country. Position determination using various GPS techniques has been increasingly being practiced for various surveying related applications. The existing GPS network in Brunei Darussalam will certainly provide better control for GPS positioning activities carried out by various mapping related agencies. Real time application of GPS positioning technology, especially in RTK GPS, will give an option for either real time or post-processing modes of positioning.

The old RSO projection for cadastral mapping was based on the BT48 system referenced to the Modified Everest ellipsoid while the corresponding reference ellipsoid for the geocentric GDBD2009 is the GRS80. With the GDBD2009 datum, geodetic coordinates of a point determined using GPS by cadastral surveyor can now be projected directly to their related geocentric RSO plane coordinate values without converting first to BT48 system. Moreover, by reducing the step of the coordinate transformation will reduce any defect caused by imperfection in the value of the defining parameters being used.

Figure 9 shows the flow chart that allows various coordinate systems to be converted from one system to another. The old RSO can be converted to BT48 and to GDBD2009 by using the Bursa-Wolf 7 parameter transformation and vice-versa. RSO projection is now viable between Geocentric RSO coordinates and GDBD2009 coordinates. Consequently, it allows the conversion between BT48 and WGS84 (using 3-parameter) and from WGS84 to BT48 (using Bursa-Wolf 7-parameter method or Molodensky-Badekas 10-parameter method) to be performed.

Application of satellite positioning technology in maritime navigation has been practiced by commercial ships and

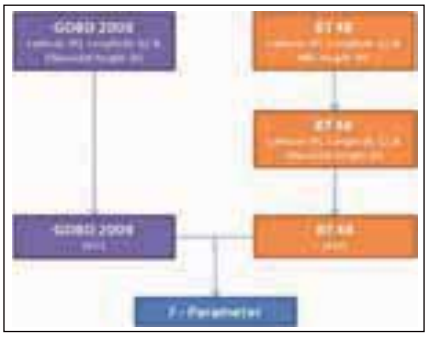

Fig 6: The Bursa-Wolf 7 Parameters Transformation Derivation Flow

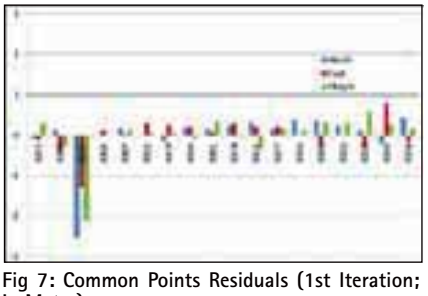

Fig 7: Common Points Residuals (1st Iteration; in Meter)

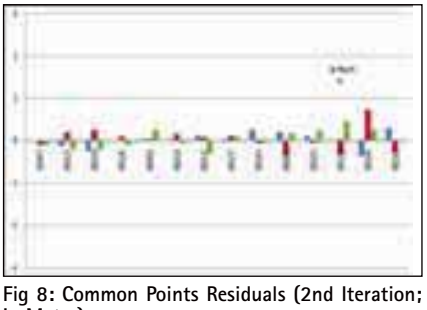

Fig 8: Common Points Residuals (2nd Iteration; in Meter)

liners, the NAVY and port authorities. Intelligent Transportation System (ITS), which integrates GPS positioning technology, ICT and electronic technology, has been widely used in modern transportation system. For example, an autonomous ITS system requires the integration of GPS positioning equipments with electronics chart in a vessel enabling the system to give effective travel direction since its position is always shown on the chart. Other such applications are in the aviation and fleet management.

GDBD2009 will provide better coordinate system infrastructure compatible with GPS positioning technology implemented for navigation applications. With GDBD2009, geodetic coordinates of a point determined in WGS84 using GPS could be directly projected to their related geocentric RSO plane coordinate values. This is an advantage that will spur the use of GPS for navigation applications in this country.

The adoption of GDBD2009 will accommodate the integration of spatial datasets and consequently, will provide better data sharing, handling and management. The GDBD2009 provides coordinates that are appropriate for applications at all levels (local and international) and allows the easy integration with other information technologies. By using the GDBD2009, it will minimize confusion for all users and provide maximum accuracy where high precision is required.

Conclusions

In implementing GDBD2009, matters related to datum transformations and map projections have been considered. The new Geocentric Datum for Brunei Darussalam or GDBD2009 has been successfully established using the GPS technology, and by adopting the ITRF2005 at epoch 2009.45 and GRS80 as the reference ellipsoid. The GDBD2009 is connected to ITRF2005 by the inclusion of over fifty (50) International GNSS Service (IGS) sites in the precise baselines processing and network adjustment of GPS stations of the Brunei's CORS. Accuracy estimate for the stations in the network that define GDBD2009 is found to be in the order of 0.5-4mm and 2-10mm for the horizontal and vertical components, respectively.

With GDBD2009, geodetic coordinates of a point determined using GPS by a cadastral surveyor can now be projected directly to their related geocentric RSO plane coordinate values without converting first to BT48 system. A new set of geocentric RSO projection parameters for Brunei Darussalam has been defined. With the establishment of GDBD2009, data migration will become so imminent now and will definitely lead to all maps either large or small scale to be revised or reproduced. Future issues relating to height modernization in Brunei Darussalam will have to be addressed. Thus, a homogeneous height value for Brunei Darussalam can be implemented nation wide.

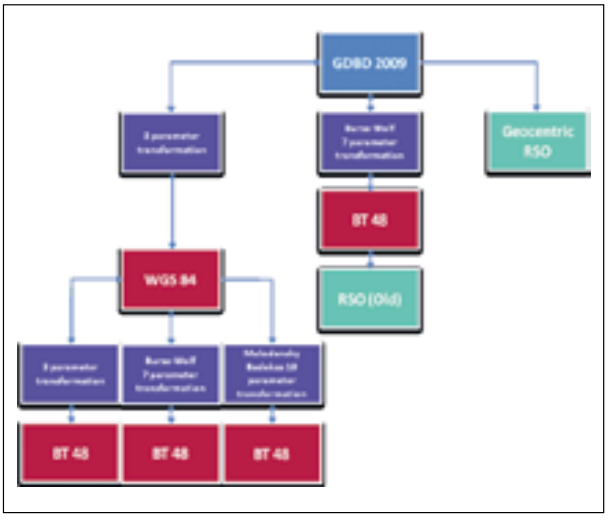

Fig 9: Flow of Datum Transformation & Geocentric RSO Projection, and Relationship with GDBD2009.

The implementation of GDBD2009 will further encourage the use of GNSS/GPS positioning technology by various mapping related agencies in this country. Definitely, government department and non-government organization as well as the public will benefit in many ways from GDBD2009, the new geocentric datum of Brunei Darussalam.

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GPS applications on cellular phone with geoid addition to height

The use of GPS in mobile phones became a common and can be used for survey purposes GCP

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Location Base Services (LBS) is service mechanisms that provides information about the location and take advantage of the location. Global Positioning System (GPS) is one of Devices that inform the position. Mobile phone GPS has the advantage because they can be used also as a means of communication and the completeness of the camera (photo and video) resolution good enough to take photos that have coordinates ((Geo) tagging photo) and can be sent directly to the office for more information .

GPS has higher accuracy than cell phones. Accuracy of GPS ranges from 5 to 30 meters, whereas for cellular phone a level of accuracy varies from 500 meters to 20 meters. The Information of position using a mobile can be used if it does not require a high degree of accuracy.

For programming in the manufacture of software that runs on mobile phones in this study used the Java Micro Edition (J2ME) which can produce a good application and flexible and can be run on other mobile devices like mobile phones, personal digital assistants (PDAs), and printers. Java ME includes flexible use interface, powerful security, network protocols contained in devices, and support for network applications can be downloaded dynamically. Java ME-based application can be used in many devices, and increase the original capacity of each device. For the purposes of use in location-based programming in Java Specification Request provided J2ME (JSR) 179

JSR 179

Java Specification Request (JSR) 179 has been created by the Java Community Process (JCP) to support location-based programming that has been connected in the Connected Limited Device Configuration (CLDC). Implementation of JSR 179 can be done in several positioning methods such as (Qusay, H. Mahmoud, 2004):

- Using a cellular phone network. Cell ID can be used to identify the Base Transceiver Station (BTS). A mobile phone has the accuracy of 2 to 20 kilometer radius. Another technique may have the accuracy of 150 meters.
- Using satellite. GPS is one of the techniques used this technology. In order to use this method the user must use a GPS receiver. Accuracy of this method to reach 4 to 40 meters.
- Using short-range position beacons. This method is used for areas that are not too large. This method may use Bluetooth technology.

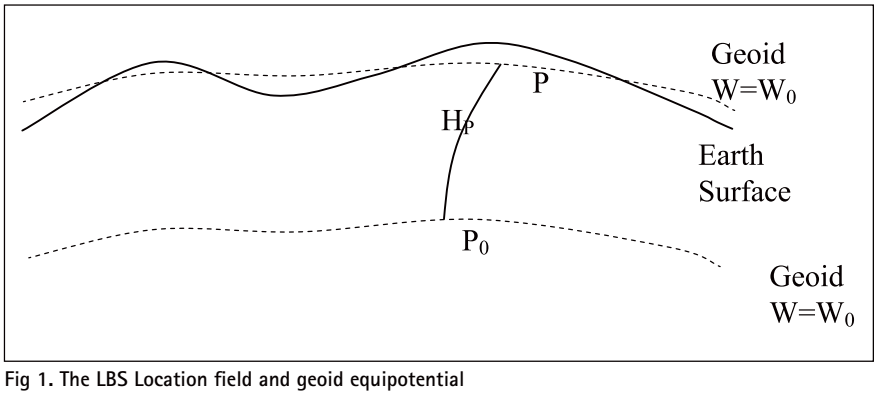

Fig 1. The LBS Location field and geoid equipotential

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API Location (JSR 179) in J2ME has optional package javax.microedition. location that has the ability to generate information on the position of equipment. Location API produces physical location information that can be used for landmarks that can be saved.

JSR 179 requires Connected Device Configuration (CDC) or the Connected Limited Device Configuration (CLDC) version 1.1. But CLDC not adequate, because it cannot perform floating-point calculations are used to represent coordinates and other measurements.

The methods are used depend on the types of devices. Applications can be requested to provide a variety of characteristics, such as minimum degree of accuracy. Class Abstract Location generates location. Each object produces the coordinates, speed and time stamp.

The coordinates are represented respectively by two classes:

- A Coordinate object shows a point latitude and longitude in degrees, and altitude in meters.
- A Qualified Coordinates object contains latitude, longitude and altitude and also shows the level of accuracy is represented in the area radius.

API Location J2ME provides a source of location information. Because there is security for accessing this method is provided SecurityException if there was no information to the desired position.

High

GPS height is used ellipsoid high, to turn it into orthometric high required geoid undulation. In general from the GPS satellite positioning with accuracy in mind that the horizontal position components (λ, φ) is more rigorous than the vertical position (h), approximately 3-4 times more accurate (Prijatna, 1997).

Orthometric height of a point on the surface of the earth can be defined as the geometric distance between that point on the surface of the earth with her partner point on the geoid surface and measured along the plumb line (referring to the projection Pizzetti; Heiskanen and Moritz (1967), p. 180).

$$H_P = \frac{C_P}{\bar{g}_P} \quad (1)$$

with HP is a high orthometric at point P, Cp = WP - W0 is the potential at point P and the average gravity along the plumb line in point P (fig1).

Geoid height can be defined as the distance from the reference ellipsoid to geoid surface as measured along the ellipsoid normal. There are several methods to get the geoid height rates among geometric method and gravimetric method. In the geometric method of geoid height is calculated from a combination of altitude data of the satellite position with altitude measurement from leveling, whereas the gravimetric method, geoid height computed from terrestrial gravity data and global geopotential model (coefficients of potential global gravity). Stokes in 1849 has published geoid calculation equation. For the purpose of calculating the geoid height and gravity anomaly data needed throughout the Earth's surface with a continuous density (read: very tight). With this equation allowed calculation of geoid height based on gravity data. The Stokes equation (Hofmann-Wellenhof and Moritz 2006) are as follows:

$$N(P) = \frac{\delta GM}{R\gamma} - \frac{\Delta W_0}{\gamma} + \frac{R}{4\pi\gamma}\int_{\lambda=0}^{2\pi}\int_{-\pi/2}^{\pi/2} St\left(\Psi_{PQ}\Delta g(Q)\cos\varphi_Q\, d\varphi_Q d\lambda_Q\right) \quad (2)$$

where: N (P): geoid height at point P, ΔW: The difference between the potential at the surface of the geoid (W_0) and the potential on the reference ellipsoid that used (U_0), δGM: GM difference (gravity constant x period) are not known between real and model earth ellipsoid, P: calculations point, Q: data gravity anomaly point Δg(Q): the gravity anomaly at point Q, St (ψ_{PQ}): Stokes function with ψ is the spherical distance from point P and Q, R: , average radius of the earth, γ: average normal gravity on the ellipsoid and λ, φ: latitude and longitude coordinates.

For the determination of Geoid (N) developed strategies to overcome them, by combining the global geoid models, N_L (to calculate the long waves signals of the geoid) and local geoid model results from local data in the vicinity of the calculations, Ns (to calculate the short wave signals of the geoid). So the calculation of geoid become N = NL + Ns (Khafid, 2000)

Of the three height (orthometric height, ellipsoidal height and geoid height/undulation) there can be expressed by equation

$$h = H + N \quad (3)$$

Where H is the orthometric height, h is the ellipsoid height and N is the geoid height.

The combination of various data types used to create a global potential coefficient model becomes better. Yet the gravity field can be modeled with observation data are still limited. To obtain a more detailed or better model of the global potential coefficient is needed the data from the satellite trajectory analysis combined with all the data closely related to the potential gravity of the earth, (Rapp, 1992).

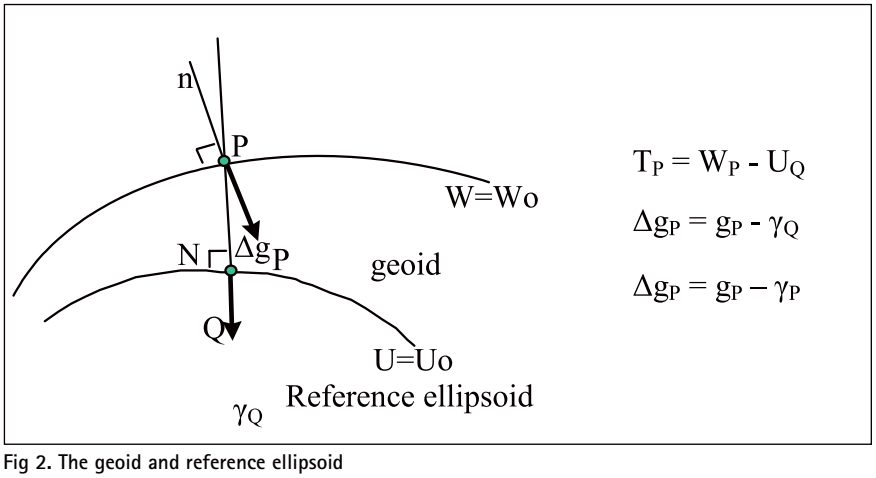

Fig 2. The geoid and reference ellipsoid

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Potential at a point P with coordinates geocentric radius r, geocentric latitude and longitude respectively φ and λ can be presented as follows (Hofmann-Wellenhof and Moritz 2006):

$$T(r,\varphi,\lambda) = \frac{GM}{r}\left[1 + \sum_{n=2}^{\infty}\left(\frac{a}{r}\right)^n \sum_{m=0}^{n} (\Delta C_{nm}\cos m\lambda + \Delta C_{nm}\sin m\lambda) P_{nm}\sin\varphi\right] \quad (4)$$

Where GM: geocentric gravitational constant, a: half the long axis of: geocentric ellipsoid, r: distance to the center of the earth, φ: latitude coordinate of the geocentric ball, λ: longitude coordinate of the geocentric ball, ΔC_{nm}, ΔS_{nm}: is the difference between harmonic coefficient and coefficient fully normalized geopotential ball and P_{nm}: The Legendre function of The first fully associated and normalized type.

Geoid is the equipotential surface closest to the average sea level. Geoid height, N is defined as the distance between the surface of the geoid and reference ellipsoid. According to equation Brun, geoid undulation defined as, (Hofmann-Wellenhof and Moritz 2006):

$$N_0 = \frac{T_P - (W_0 - U_0)}{\gamma_P} \quad (5)$$

where γ_p is normal gravity at point P. T_p is a disturbance potential, W_0 is the potential at the geoid and U_0 is the potential in ellipsoid.

Or geoid height can also be written by (Hofmann-Wellenhof and Moritz 2006):

$$N_P^L = N_0 + \frac{GM}{r_P\gamma_P}\sum_{n=2}^{\infty}\left(\frac{a}{r}\right)^n \sum_{m=0}^{n} (\Delta C_{nm}\cos m\lambda + \Delta C_{nm}\sin m\lambda) P_{nm}\sin\varphi \quad (6)$$

$$N_0 = \frac{GM - GM_0}{r_P\gamma_P} - \frac{W_0 - U_0}{\gamma_P} \quad (7)$$

where N_0 is usually ignored in practice, especially in terms of regional geoid height computation. The ignored N_0 based on assumptions that GM =GM_0 and $W_0 = U_0$, or if No ≠ 0 errors caused only a refractive error that can be eliminated with relativism the calculation of geoid height to a reference point in the calculation.

For points on the mainland, the calculation by equation (6) is less precise (Rapp, 1994). More accurate equation is as follows (Hofmann-Wellenhof and Moritz 2006):

$$N_P = N_0 + \frac{GM}{r_P\gamma_P}\sum_{n=2}^{\infty}\left(\frac{a}{r}\right)^n \sum_{m=0}^{n} (\Delta C_{nm}\cos m\lambda + \Delta C_{nm}\sin m\lambda) P_{nm}\sin\varphi + \frac{\Delta g_B}{\gamma} H \quad (8)$$

Where ΔG_B is the gravity anomaly Bouguer and H is orthometric height. The Bouguer correction term in equation (9) is significant, especially for Mountain areas.

Geoid height calculation is done by using equation (8) to find the N_L. To calculate the geoid height at a point in the data is needed the geodetic coordinates (latitude, longitude) and a global geopotential model.

To enter a correction on the geoid height is the GPS application program on the mobile phone needs a special approach because of the memory on the mobile phone is very limited. For this purpose geoid height can be searched by using the approach by way of linear interpolation.

High geoid calculated using equation (8) for specific areas with sufficient area so as not to burden the memory of the mobile phone. The linear interpolation equation is:

$$y = y_a + (y_b - y_a)\frac{(x - x_a)}{(x_b - x_a)} \quad (9)$$

Thus for the geoid height interpolation equation becomes:

$$N = N_0\left(1 - \frac{\theta - \theta_0}{\Delta\theta}\right)\left(1 - \frac{\lambda - \lambda_0}{\Delta\lambda}\right) + N_1\left(1 - \frac{\theta - \theta_1}{\Delta\theta}\right)\left(1 - \frac{\lambda - \lambda_1}{\Delta\lambda}\right) + N_2\left(1 - \frac{\theta - \theta_2}{\Delta\theta}\right)\left(1 - \frac{\lambda - \lambda_2}{\Delta\lambda}\right) + N_3\left(1 - \frac{\theta - \theta_3}{\Delta\theta}\right)\left(1 - \frac{\lambda - \lambda_3}{\Delta\lambda}\right) \quad (10)$$

Where N_0, N_1, N_2, N_3 is the geoid height at the position (θ_0, λ_0), (θ_1, λ_1), (θ_2, λ_2), (θ_3, λ_3) and Δθ, Δλ is the difference in distance on the grid.

The Geoid Height for the GPS application in the mobile phone uses EGM 2008 (Pavlis, NK. et al. 2008)

Conclusions and suggestions

Use of JAVA ME is so much easier in making software for mobile phones. JSR 179, which is one of the applets in Java ME-based programming that helps position.

The use of GPS in mobile phones became a common and can be used for survey purposes GCP. Geoid Height is needed for the height usage information on the GPS height. For this purpose geoid height can be searched by using the approach by way of linear interpolation.

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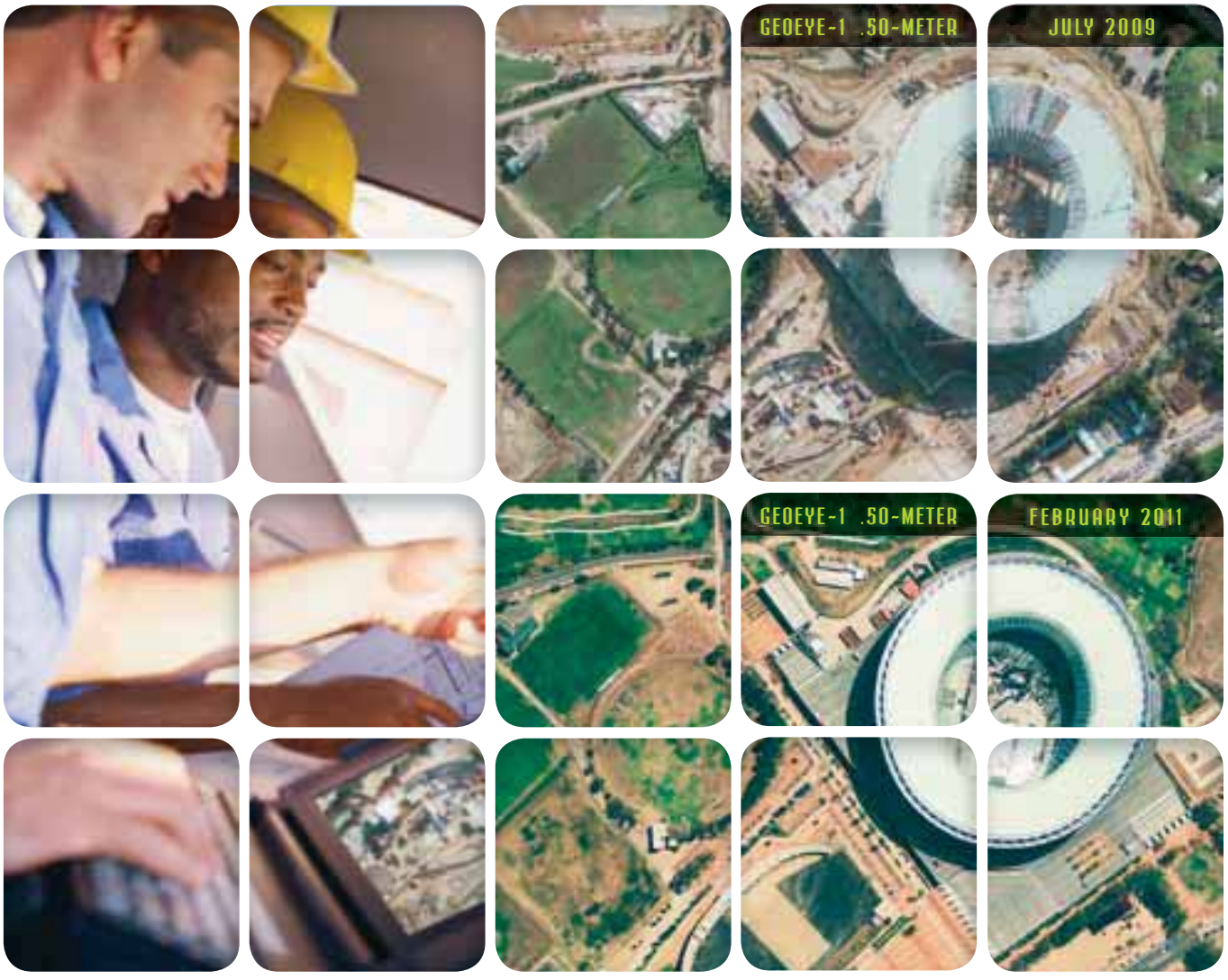

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Design of NGIS: one size fits all type

The vision document of National GIS gives an impression that governance is what government does

Pramod K Singh

Associate Professor, Institute of Rural Management Anand, India

National Data Sharing and Accessibility Policy (NDSAP) is announced by the Department of Science and Technology (DST), Government of India in May 2011. This is certainly a bold step in terms of providing the information proactively as Indians have a constitutional backup for the right to information through the Right to Information Act 2005. The NDSAP talks about sharable data and non-sharable data (negative list). The negative list is that which includes the data that is not sharable and would not be available on the public domain. Section 8 and 9 of the Right to Information Act, 2005, the Information Technology Act, 2000, and Right to Privacy upheld by the Honourable Supreme Court of India in its various judgments, will be the guiding factors preparing the negative list. The metadata of the sharable data will be available on a portal (www.data.gov.in). The NDSAP also talks about open access, registered access, and restricted access of data. It proposes for a state-of-the-art data warehouse with online analytical processing (OLAP). The main features of data warehouse would include user-friendly interface, dynamic/ pull down menus, search based report, secured web access, bulletin board, complete metadata, and parametric and dynamic report in exportable format. The NDSAP mentions some of the current legal framework available in the country. It also mentions the responsibilities of data owners/data generators/ data controllers. It recognizes that the current methods of storing data are as diverse as the disciplines that generate it. Hence it calls for development of institutional repositories, and data centers with specific infrastructure to enable all users to access and use it.

However, the NDSAP fails to talk about metadata standards, data content standards, copyright issues, data pricing issues, mode of payment, participation of various stakeholders, etc. Indian organizations have historically acted in a compartmentalized manner with limited sharing of data or applications not only for citizens and the private sector, but also for other government agencies. What if, some departments do not share any data? The policy is silent about that. There has to be a law for data sharing.

Initiatives for National Spatial Data Infrastructure (NSDI) started in the year 2000. After a decade, even the entire metadata does not exist at the NSDI portal so far. Hence there has to be a clear cut timeline for preparing metadata of both spatial and non-spatial data. Metadata standards for spatial data (NSDI metadata ver. 2.0) do exist today. However, the metadata standards for diverse sets of non-spatial data need to be developed in a time bound manner. Along with the metadata standards, data content standards should also be developed for both the spatial and non-spatial data. This is certainly a mammoth task, which requires participation of a large number of stakeholders.

We do not have copyright framework for even a spatial data, which is an integral part of NSDI. Copyright frameworks for both spatial and non-spatial data also need to be developed in a time bound manner. There is a need for pricing policy for both spatial and non-spatial data. Data generators may recover only a marginal cost from the data users. Users from government departments, R&D institutions, academia, and CSOs involved in development should be provided all kinds of data either free of cost or at a nominal cost.

Planning Commission has constituted a National GIS Interim Core Group (ICG) for the establishment of National GIS (NGIS), which released a draft vision document ver 1.0 in June 2011. The vision document envisions that the NGIS will be a GIS system of systems— a seamless cloud computing and networking infrastructure. Essentially it's a technologically sound cloud GIS infrastructure consisting of a network of data servers, security services, cloud management protocols, disaster recovery and business process continuity system. The vision document proposes a GIS enabled decision support system for governance, enterprise and citizens. However, ICG has extremely poor appreciation of governance. Governance comprises the mechanisms, processes, and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations, and mediate their differences (UNDP, 1997). Governance is a process of multi-stakeholder involvement, multiple interest resolution (Stewart 2003). The vision document gives an impression that governance is what government does. Governance, in fact, has a much broader canvass than government and envisages the roles of all stakeholders: the state, private sector, civil society, and citizens at large.

The vision document proposes that the NGIS will be implemented by Indian National GIS Organization (INGO) — an organization with a lot of agility but top-down style of functioning. The proposed arrangement of NGIS functioning may facilitate revenue generation of the private sector, and functioning by the government departments, but unlikely to facilitate a healthy governance process where all the stakeholders— government, private sector, academia, Panchayati Raj Institutions (PRIs), civil society organizations (CSO), and citizens could actively participate.

At this point of time, two policies— National Map Policy (NMP) and Remote Sensing Data Policy (RSDP) exist for access of Survey of India's topographical sheets and remote sensing data respectively. NMP mandates the SOI to decide issues of liberalizing access of spatial data to users. Other spatial data creating organizations have to abide by the instructions of SOI. NMP does not mention the role of other spatial information generators explicitly. Other spatial data products and services do not fall under NMP. According to section 2 (b) of RSDP, the authority to acquire and disseminate all satellite remote sensing data in India—both from Indian and foreign satellites is vested with the NRSC. Even after promulgating two policies, NMP and RSDP, all the spatial products and services are not covered. A handful of government departments have privileged access to spatial information while others have no access. Even NDSAP is unable to address this issue. Hope the provisions of NDSAP will be modified to overrule this information asymmetry. Besides,

India needs to have an integrated information policy incorporating all the data products and services—spatial and non-spatial. The vision document of NGIS also mentions that the access to and use of any available GIS contents must be governed by 'use principle' rather than any limiting principle. Hope NGIS succeeds in this endeavor.

Today planning and developmental activities are no more the domain of government agencies alone. Increasingly it has been felt that PRIs, CSOs, and other community based organizations (CBOs) are very effective in implementation of development projects owing to their wide reach and proximity to the end beneficiaries (Singh, 2005). The current arrangement of NGIS may facilitate planning process by the Planning Commission and State Planning Boards, but unlikely to facilitate planning process by PRIs, CSOs, and CBOs. Instead of the proposed design of National GIS, it would have been an interoperable system of systems, which could have leveraged standards and local best practices with emphasis on local data needs and local practices along with data integration at state, regional and ultimately at national levels. There is a need for strong MIS to be built over spatial domain, with all the data entry should take place at transaction points.

The draft vision document of NGIS proposes that administrative boundaries should be available as foundation dataset. Up-to-date, standard, and accurate geo-referenced administrative boundaries, road networks, and landuse/ landcover should be made available free of cost in the public domain. Other foundation dataset like drainage and DEM may be priced.

There is a need for a facilitating agency, which may safeguard the interests of all the stakeholders. The facilitating agency may create a level playing field for different data generating agencies, and provide and appellate facility to any of stakeholders, especially the users.

The overall design of NGIS seems to be top-down, supply driven, data-centric, techno-centric, and 'one size fits all' type. Instead, it should be bottom up, citizen-centric, demand driven, information centric, and customized. Since ICG is still in a process of evolving NGIS, hope it would address some of the concerns raised above.

China to launch civil survey satellite

China will put into space a high-definition civil survey satellite, the first of its kind in the country, at the end of this year. The satellite, ZY 3, will be launched from the Taiyuan Satellite Launch Center in north Shanxi Province. The satellite will help the mapping efforts in the country's western regions where geographic information is difficult to collect and update due to limits of equipment and technology. *Xinhua*

1,145 satellites to be launched

Euroconsult, a research and analyst firm specialising in the satellite and space sectors, forecasted that approximately 1,145 satellites will be built for launch during the next ten years (2011-2020), 51 percent more satellites than the previous decade. These projections came from Euroconsult's just-released Satellites to be Built & Launched by 2020, World Market Survey. According to the report (now in its 14th edition), revenues from the manufacture and launch of these 1,145 satellites will be worth USD 196 billion worldwide, of which 70 percent can be attributed to government demand. *Euroconsult*

3D video transmission live from space

Half a century after humankind entered outer space, an ESA-developed camera produced live-streaming 3D images for the first time in the history of space travel – showing the International Space Station like never before. On 6 August, NASA astronaut Ron Garan operated the Erasmus Recording Binocular (ERB-2) camera to open a new window on the ISS through stereoscopic eyes, in high-definition quality. As Flight Engineer for Expedition 28 and a video blogger himself, Garan set up the futuristic-looking camera in Europe's Columbus laboratory.

Damage assessment of US tornadoes

Within days after devastating tornadoes struck Alabama and Missouri, the damage experts at ImageCat and New Light Technologies produced a rapid building damage assessment database to estimate losses from the event. This work was done through the use of high-resolution pre- and post- event NOAA aerial photography, Google Earth satellite imagery and engineering expertise. *GISuser.com*

Pakistan expands RS satellite network

Pakistan is considering working with China, Japan and Europe to expand its network of RS satellites for use in environment monitoring and natural resource surveys. Recently, Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) announced to launch six homemade, high-resolution RS satellites by 2014. In addition, on August 11, Pakistan launched a communication satellite Paksat-IR from the Xichang Satellite Launch Centre in Sichuan province of China. *SciDev.net*

Ukraine launches RS satellite Sich-2

Ukraine launched a remote sensing satellite Sich-2 from the Yasny launch base in the Orenburg Region, Russia. The Ukrainian satellite was carried by Dnepr along with the American satellites AprizeSat-5 and AprizeSat-6, Italy's EduSat, Nigeria's NigeriaSat-X and NigeriaSat-2, and Turkey's RASAT. *www.nasaspaceflight.com*

Flood Hazard Zonation Maps by NRSC

In addition to the flood response services through Decision Support Centre (DSC), NRSC/ISRO has taken up development of Flood Hazard Zonation Maps using satellite data towards Disaster Risk Reduction, under ISRO-DMS Programme. Towards this, as a first step, NRSC has generated Flood Hazard Zonation Maps for Assam state based on 10 years of satellite data. With the support of Editorial Board consisting of NDMA, CWC, IMD, ASDMA and others, NRSC / ISRO has initiated the task of development of Flood Hazard Atlas for Assam State. This is the first time in the country to have a flood hazard atlas with much detail. Similar efforts are on the way for other states like Bihar, Orissa, etc.

USGS develops GIS data framework for Afghanistan

The US Geological Survey (USGS) developed an integrated GIS data framework for Afghanistan. It aims to provide the fundamental databases and current, state-of-the-art maps to support natural resource assessment programmes and to aid in restoring Afghan geosciences ministries to operational status. Working in cooperation with the Afghanistan Geological Survey (AGS), Afghanistan Ministry of Mines and Industries (MMI), and Afghanistan Geology and Cartography Head Office (AGCHO), participants in USGS' Geospatial Infrastructure Development Project collected, compiled and digitised existing geologic, topographic and remote sensing data. They used them to produce geologic, cartographic and satellite image map sets of the entire country. *http://afghanistan.cr.usgs.*

UniStrong holds 40% GIS market share in China

Beijing UniStrong Science & Technology Co. Ltd. holds approximately 40 percent GIS market share in China, according to a report by Orient Securities Company Ltd. In next five years, the company is poised to do the business of approximately 100 billion yuan (USD 15.6 billion), China Daily reported. *China Daily*

'Streetwise' South Korea drops Japanese Legacy

After decades of confusion, South Korea has ditched its traditional address system and adopted one based on named streets and consecutively numbered buildings. Traditional addresses, in use since 1910, identify specific land lots. The address of a typical Seoul house is: Seoul City, a gu (ward), a dong (neighbourhood) and the number of the lot on which it stands. The system — adopted during the Japanese colonial occupation — has proved a boon to makers of satellite navigation systems, but mystifying for many others. Invitations to social or business events routinely include a map. *www.taipeitimes.com*

China maps Brahmaputra, Indus

Chinese scientists have completed a first of its kind study to pinpoint the sources of the Brahmaputra and Indus rivers using satellite images. Researchers from the Chinese Academy of Sciences (CAS) used remote-sensing satellite images and data from several expeditions to the Tibetan plateau to map the sources of the Brahmaputra, Indus, Salween and Irrawaddy rivers. The CAS study has mapped the river's length at 3,848 km, while earlier studies had estimated its length at 2,900-3,350 km. It also measured its drainage area at 712,035 sq km, with earlier estimates ranging from 520,000 sq km to 1.73 million sqkm. *www.thehindu.com*

Atlas to reveal reasons of poverty

CHF International, a nonprofit organisation, is developing an urban poverty atlas as part of a programme called Slum Communities Achieving Livable Environments with Urban Partners (SCALE-UP). CHF's goal in mapping slums is to provide a more complete picture of why poverty exists in certain areas and how conditions can be improved. It focuses on three cities in India—Bangalore, Nagpur and Pune—as well as three in Ghana—its capital Accra and its twin port cities Sekondi and Takoradi. Some mapping work has also begun in Haiti.

$4 Million for High-Tech Mapping Programme

The Government of New Zealand will give $1 million a year over the next four years for the High-tech mapping of country's forests, pastures, rivers and cities that will result from a research programme using satellite technology, geospatial mapping techniques and advanced computing power. *beehive.govt.nz*

Japan to map radioactive contaminated farmlands

The Japanese Government will soon draw up a radioactive substance concentration map for farmlands. The government will also conduct a study on contaminated debris as part of measures to deal with radioactive material released from the crippled Fukushima Daiichi nuclear power plant. According to measures compiled, the Ministry of Agriculture, Forestry and Fisheries will analyse farm land at about 500 sites mainly in Fukushima Prefecture, where the wrecked nuclear plant is located, and draw up a radioactive material concentration map by the end of this month. *Mainichi Japan*

GSI rolls out hyperspectral mapping

Geological Survey of India (GSI) rolled out hyperspectral mapping and heliborne geophysical surveys will be taken up soon, announced S. Vijay Kumar, Secretary Mines, Government of India. Kumar made this announcement during Central Geological Programming Board (CGPB) meeting and exhibition. *Press Information Bureau*

Indian state maps schools on GIS

Manipur, an Indian state, successfully mapped schools located in remote areas on GIS, according to the Ministry of Human Resource Development, Government of India (GOI). The GIS mapping got technical support from Mission of Geo-Spatial Application center, an agency of the GOI. With this map, Manipur has become the first state in India which has mapped every school on GIS. *E-Pao*

India to conduct undersea survey

The Government of India shall conduct oceanic survey in the country's territorial waters, including parts of the Bay of Bengal, Gulf of Cambay and Andaman Sea, to look for prospects of under-sea mineral resources and natural gas, according to Ministry of Earth Sciences Secretary Shailesh Nayak. The Ministry is taking up this initiative along with the Geological Survey of India and the Goa-based National Antarctic and Ocean Research Centre. The survey will study 90,000 sqkms of sea floor till 2014. *Economic Times*

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Galileo update

Brussels Celebratory Launch Events

The launch of the two operational Galileo IOV (In-Orbit Validation) satellites on 20 October is a first in the history of the European Union. It is a moment to celebrate this unique and ambitious European collaboration.

The European Commission is organising a celebratory event in Brussels. Details to be confirmed shortly.

The event will comprise direct re-transmission of the launch, an exhibition on European Commission activities in space and an opportunity to meet the Galileo engineers behind the programme. Other forms of entertainment such as live music will also be provided. *http://ec.europa.eu/enterprise/policies/satnav/galileo/satellite-launches/index_en.htm*

Logica to secure the Galileo satellite navigation programme

Logica has announced the signing of two new contracts for the European Galileo satellite navigation Full Operational Capability (FOC) programme. The contracts with the two ground system prime contractors, whose respective contracts with the European Space Agency (ESA) under a programme of and funded by the European Union were signed at the Paris Air Show in Le Bourget on 22 June 2011. A €42 million contract is for elements of the Ground Mission Segment (GMS). Working with Thales Alenia Space France, Logica will have security responsibility for GMS, plus provision of the new Galileo Security Facility and encryption Key Management Facilities. The Galileo Security Facility will act as the security control centre for the complete Galileo system and will be installed at the two Galileo Security Monitoring Centres planned for France and the UK.

New Hope for European GNSS Downstream Industry Development

Galileo Services Association welcomes with enthusiasm the European Parliament Resolution of 7 June 2011 on "Transport applications of Global Navigation Satellite Systems – short- and medium term EU policy". With the dedicated budget being exhausted, 2010 would have been the year of the last FP7 call for GNSS – thereby effectively removing Europe's opportunity to continue boosting downstream industry and taking advantage of the momentum created by the large investment made in Galileo. However, after more than one year of committed lobby campaign, hope is reborn among European GNSS downstream Research and Innovati on actors when reading the recent resolution of the European Parliament.

Among the decisive statements raised in the resolution the European Parliament reminds that "the commercial transport applications of GNSS and Galileo represent a growing global market which should be secured as far as is possible for the economic benefit of European industry and for the creation of skilled jobs" and, more widely, that "investment in this sector has implications for all EU policies, and whereas its expansion and implementation will have a direct impact on the realisation of the EU 2020 Strategy and from the point of view of developing the potential of the European market in GNSS applications and services so as to create jobs and enhance Europe's competitiveness."

50th Space Wing gains control of newest GPS Satellite

The 50th Space Wing's 2nd Space Operations Squadron accepted command and control of the second GPS Block IIF satellite. The Space and Missile Systems Center's GPS Directorate, located at Los Angeles Air Force Base, remained in control of the satellite during a 30-day on-orbit checkout period before the hand-off to 2 SOPS. The next-generation GPS IIF satellites built by Boeing will provide improved accuracy through advanced atomic clocks, a longer design life than legacy GPS satellites, and a new third civil signal, L5 that will eventually benefit commercial aviation and safety-of-life applications. *www.gpsworld.com*

Air Force to replace GPS satellite

A failing GPS satellite is being replaced with a spare satellite currently in orbit. The Air Force said that the satellite's clock began malfunctioning in May. The backup satellite was switched on in June and functioned well. The Air Force says it will be tested over the next week before it is returned to active status. The backup satellite was decommissioned in 2009 to make room for a newer model.

ProconGPS, Inc. files suit

ProconGPS has filed a patent infringement lawsuit in a California Federal Court against Star Sensor, Skypatrol LLC and others. The complaint is related to U.S. patents 6,249,217 B1 & 6,025,774 and involves an innovative system that applies GPStechnology, cellular networks, and information systems to monitor loan status for a default condition on a vehicle and to enable tracking to aid the confiscation and repossession process for dealers and finance companies.

Glonass-M launch delayed

The launch of Glonass-M navigation satellite has been postponed for an additional equipment check, announced Russia's Space Forces commander, Gen.

Oleg Ostapenko. He said, “Presumably, satellite will be launched in early September.” The launch of the satellite was scheduled for August 26, 2011 from the Plesetsk Space Center in northern Russia by Soyuz-2.1B carrier rocket. *RIA Novosti*

Toucans wearing GPS backpacks help study seed dispersal

Nutmeg-loving toucans wearing GPS transmitters recently helped a team of scientists at the Smithsonian Tropical Research Institute in Panama address an age-old problem in plant ecology: accurately estimating seed dispersal. The tracking data revealed what scientists have long suspected, that toucans are excellent seed dispersers, particularly in the morning, and for the first time enabled researchers to create a map of the relative patterns and distances that toucans distribute the seeds of a nutmeg tree. *http://smithsonianscience.org*

Software improves accuracy of GPS

Researchers at the Ohio State University in the US developed a software to fix GPS errors. According to the initial test, the software enabled centimetre-scale GPS positioning – including altitude – as often as 97 percent of the time. Researchers claimed the software will help to improve the vertical accuracy of measurements in potentially hazardous regions at high altitudes, such as areas of soft, loose land that may be prone to landslides. They also claim that their software could be used to measure how quickly glaciers at high altitudes are melting. *Ohio State University*

LINZ broadcasts real-time GNSS data

Land Information New Zealand (LINZ) started publicly broadcasting real-time GNSS data. The data is streamed free-of-charge from 39 CORS throughout the country. This includes 34 LINZ PositioNZ stations and 5 stations which are part of the GeoNet project run by GNS Science. Users can connect to a data stream in the field using their GNSS receiver and a cellular connection. This enables RTK positioning to be carried out, without the need to set up a separate base station. *Landonline*

TRIUMPH-VS v1.6 released by JAVAD.

Javad has released Version 1.6 of TRIUMPH-VS software. Its new features include Polish language support and Action button debounce. It has also improved Map screen performance, Languages support, Point coordinates input, Fixed Base Station action, Solution RMSes display in Action screen, US Survey units (feet) support, Device temperature monitoring and UHF Setup.

Trimble Introduces new Compact OEM GNSS Modules

Trimble has introduced the Trimble® BD910 and BD920 modules to its GNSS OEM portfolio. These small modules feature centimeter-level, Real-Time Kinematic (RTK) positioning capabilities that are ideal for high-precision and control applications. Both the modules are designed to allow OEMs and system integrators to easily add centimeter-level positioning to specialized or custom hardware solutions. *www.trimble.com*

Trimble introduces TerraSync – GIS Data Collection Software

TerraSync software is used by utilities, public sector, natural resources, and many other organizations worldwide as a key component of enterprise GIS data collection and asset management projects. The latest release focuses on updates requested by users to address their changing needs. *www.trimble.com.*

Pairing SPAN™ GNSS/INS technology with MEMS sensors solves manyIntegrator problems

NovAtel Inc has announced the addition of four Micro Electromechanical Systems (MEMS) Inertial Measurement Units (IMUs) to its SPAN™ line of GNSS/INS products: the HG1900 and HG1930 IMUs from Honeywell International Inc. and the LandMark™ 20 and LandMark™ 40 IMUs from Gladiator Technologies Inc. These additions significantly expands the range of cost, size and power options available for size and weight concerned applications requiring high performance position, velocity and attitude data. *www.novatel.com*

Leica announces enhancement in FCMS v3.34

Leica Geosystems announced version 3.34 of its Flight & Sensor Control Management System (FCMS). New productive features such as automatic generation of bitmaps from DTM data have been added to it. FCMS 3.34 provides easy and automated operation of the recently released Leica ALS70 high-performance Airborne LiDAR system as well as of the new Leica RCD30 medium format camera.

Leica Cyclone 7.2 released

New Leica Cyclone v7.2 software improves office processing and use of rich "as-built" point cloud data. Several innovations in Leica Cyclone 7.2 address key market needs and trends in the processing and use of rich, as-built point cloud data from laser scanning/High-Definition Surveying™. *www.leica-geosystems.com*

Hexagon expands presence in South America

Hexagon acquired all shares in the Brazilian software and services provider SISGRAPH. SISGRAPH has been providing custom made Intergraph solutions to Latin America since 1980. It provides sales, consulting, implementation and training services for all Intergraph products in Latin America. *www.hexagon.com*

Raytheon wins U.S. Navy Contract

Raytheon Company has received a $32.2 million contract from the US Navy for Global Positioning, Navigation and Timing Service (''GPNTS'') program. The program is designed to replace the current Navigation Sensor System Interface and support mission-critical real-time positioning, navigation, and timing data services. To carry out the contract, Raytheon has partnered with Argon ST that provides systems and sensors for the command, control, communications, computers, combat systems, intelligence, surveillance and reconnaissance markets. *www.zacks.com*

Magellan Announces Trade-in Offer for GIS eXplorist Pro 10

Magellan GPS has announced a promotion that allows customers in the US and Canada to trade in any GIS data collection device in exchange for $75 off a new Magellan GIS eXplorist Pro 10 device — a rugged, waterproof, handheld GPS device that runs Windows Mobile 6.5 for high-accuracy GIS data collection.

CHC X91 GNSS receiver supports Christchurch earthquake relief

In September 2010 and February 2011 two major earthquakes struck, just a few kilometers from the Christchurch central city in New Zealand creating utter devastation in the central city and eastern suburbs. CHC X91 GNSS receiver was deployed by the Paterson Pitts Group survey team on two key projects to go a small way toward enabling decisions on the nature and form of Christchurch's rebuild to be planned. When undertaking decisions of this magnitude, it is essential to have data of a high quality. *www.chcnav.com*

Blue Marble Desktop v2.3 features new metadata editor tool

Blue Marble Geographics has announced to now offer support for metadata within the Blue Marble Desktop v2.3. It will allow users to create or update FGDC compliant metadata for files that are processed through the Blue Marble Desktop. This new feature will allow for the seamless integration of metadata into existing workflows which will help users to share geographic data across their complete enterprise while retaining data integrity throughout the entire lifecycle. *Blue Marble Geographics*

Dr Cymru Welsh Water deploys Bentley's ProjectWise

Dŵr Cymru Welsh Water is deploying Bentley's ProjectWise project team collaboration platform to improve its work sharing, better manage all engineering content, better leverage its existing hydraulic models for its water and wastewater networks, and reduce costs. *www.bentley.com*

MicroSurvey® Releases FieldGenius®

MicroSurvey has announced a major version update to MicroSurvey FieldGenius. It now supports more devices than ever, under a wider variety of hardware configurations – high definition, standard definition, tablet-style, portrait or landscape oriented. Also, FieldGenius users retain their freedom of choice when it comes to hardware; no proprietary tethering between the software, the data collector and the total station or GPS receiver. *Microsurvey.com*

Australian Defence Department's 'Secret Weapon' Maps Human Terrain

Sophisticated mapping technology which plots socio-cultural information is equipping Australia's military force to make better informed decisions while deployed on operations overseas. Underpinned with technology from Esri Australia, 'Human Terrain' maps display the human geography of an area using dozens of different categories such as ethnicity, religion and language. The technology supports key military decisions in peacekeeping, conflict, humanitarian assistance and disaster relief operations. *Esri Australia*

U.S. Army Increases Geospatial-Intelligence for Warfighters with SOCET GXP

The U.S. Army signed a multi-year agreement to add more than 500 new licenses of BAE Systems' comprehensive geospatial-intelligence analysis software, SOCET GXP®. As the Army consolidates legacy hardware and software systems into the Distributed Common Ground System – Army (DCGS-A) enterprise, imagery and geospatial analysis tools must meet wide-ranging technical requirements to provide relevant and timely geospatial intelligence to the warfighter. SOCET GXP v3.2 is optimized for handling large data sets and many layers of information derived from various sensors and geodatabases. Users exploit the data through collaborative video analysis and other tools, helping the Army visualize the battle space.

Pythagoras BVBA partners up with i-Bangla.

Pythagoras BVBA has partnered with i-Bangla. This company is located in Dhaka, Bangladesh and will take care of sales of Pythagoras in the SAARC region. Pythagoras is a standalone CAD program that focuses on markets concerning surveying, constructing, engineering etc.

France investigates Apple's location-based tracking services

The issue over location-based tracking has been plaguing Apple for a while now. The Cupertino-based company along with Google were questioned by the government over privacy concerns with location-based tracking. A federal lawsuit was also filed against Apple several months ago and not too long ago Apple recently settled a similar lawsuit in South Korea by paying a $3,000 fine and an additional $1,000 to a South Korean user, who seemed to take an issue with the tracking. Led by France's Commission Nationale de L'Informatique et des Liberts (CNIL), the CNIL will be conducting their own investigation and wants to learn how Apple encrypts the data that they collect. Given that the CNIL has sued Google for over €100,000, the sum that Apple might have to pay, should the CNIL take issue with the tracking services, will be substantially more than $4,000. *http://www.ubergizmo.com*

Jiepang Partners with Nokia to promote NFC check-ins

China's leading location-based social app, Jiepang is teaming up with Nokia to promote NFC check-ins, a faster and verified way to "check in" and share locations with friends using a special Jiepang app preloaded on the newly launched Nokia smartphones: Nokia 600, Nokia 700 and Nokia 701, which are NFC-enabled and run the latest operating system Symbian Belle. *jiepang.com*

u-blox GSM module verified eCall and ERA Glonass

u-blox and Rohde & Schwarz have successfully concluded tests of u-blox' LEON GSM modem for eCall / ERA Glonass readiness. eCall and ERA Glonass are a EU and Russian initiatives to capitalize on GSM and GPS technologies for vehicle emergency response service. The projects are independently led by the European Commission and the Russian government to provide rapid assistance to motorists involved in a collision anywhere in the European Union and Russia. *www.u-blox.com*

September 2011

Geospatial Defence & Intelligence Asia Pacific
27 - 30 September
Kuala Lumpur, Malaysia
www.geospatialdefenceasia.com

October 2011

ACRS 2011
3-7 October
Taipei, Taiwan
www.acrs2011.org.tw

AfricaGIS 2011
10-14 October
Cairo, Egypt
www.eis-africa.org/EIS-Africa

4th Land Administration Forum for the Asia and Pacific Region – Beyond Spatial Enablement
5 - 7 October 2011
Melbourne, Australia
www.csdila.unimelb.edu.au

November 2011

The 3rd Asia Oceania Regional Workshop on GNSS
1 - 2 November
Jeju Island, Korea
www.multignss.asia/workshop.html

Joint International Symposium on Deformation Monitoring
2- 4 November 2011
Hong Kong, China
JISDM.2011@polyu.edu.hk

IMTA Global Conference & Trade Show
10-11 November
Bangkok, Thailand
www.imtamaps.org

2011 Precise Time and Time Interval Systems and Applications Meeting
14-17 November
Long Beach, California USA
www.pttimeeting.org

Regional Geographic Conference – UGI 2011
14-18 November
Santiago, Chile
www.ugi2011.cl

Esri Asia Pacific User Conference
15 - 16 November, 2011
Seoul, Korea
www.esri.com/events/asia-pacific/index.html

spatial@Gov – Positioning Australia
15 – 17 November
Canberra, Australia
www.cebit.com.au/spatial

International Symposium on GPS & GNSS
15-17 November
Sydney, Australia
www.ignss.org

LBS 2011
21 - 23 November 2011
Vienna, Austria
http://lbs2011.org/

Surveying & Spatial Sciences Conference 2011
21 – 25 November
Wellington, New Zealand
www.sssc2011.com

Best Practices for Risk Reduction and Rapid Response Mapping
22 – 25 November
Beijing, China
www.unoosa.org

ENC 2011
29 November-1 December
London, UK
www.enc2011.org

ELMF 2011
29 – 30 November
Salzburg, Austria
www.lidarmap.org/ELMF/

December 2011

GNSS Signals 2011
8 - 9 December
Toulouse , France
http://www.cborg.info

United Nations International Meeting on GNSS
12 - 16 December 2011
Vienna, Austria

May 2012

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

June 2012

Hexagon 2012
4 - 7 June
Las Vegas, USA

August 2012

The XXII Congress of the ISPRS
25 August - 1 September 2012
Melbourne, Australia
www.isprs.org

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