ISSN 0973-2136
Vol I, Issue 2 July 2005
MONTHLY

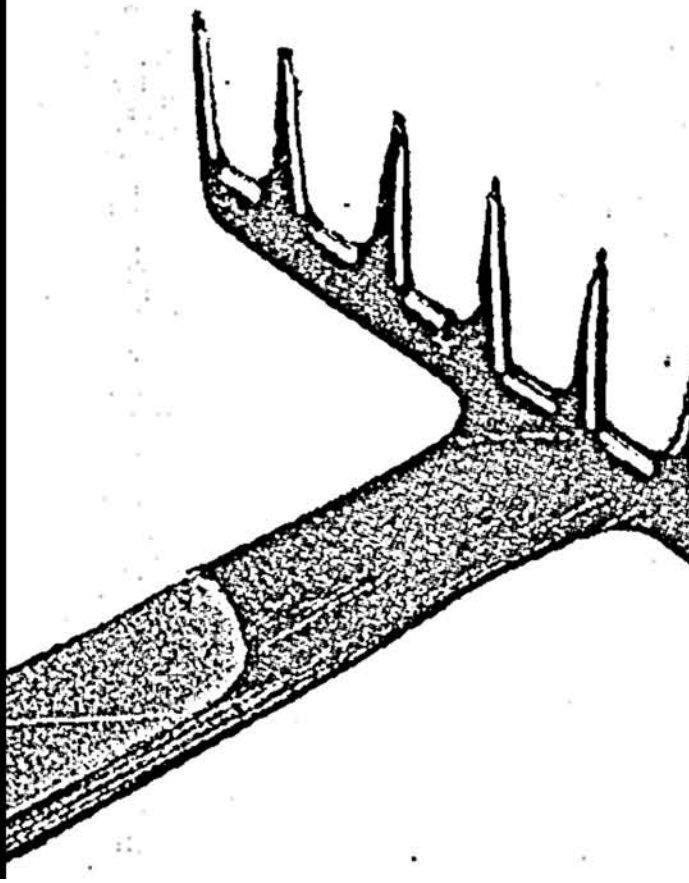
# Coordinates

POSITIONING, NAVIGATION AND BEYOND

## India's national map policy

## Hope vs Hype

## License to use GPS in India?





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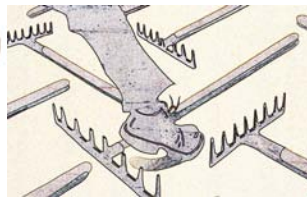
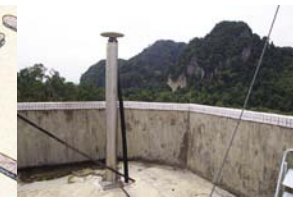
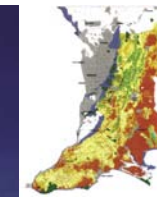
## Articles





## Columns



This issue has been made possible by the support and good wishes of the following individuals and companies Ajay Lavakare, Allan Barnes, Arjun Singh, Eugene Clark,G D Gupta, George Cho, Harumi Araki, I V Murali Krishna, J G Krishnayya, Janaki Turaga, Muneendra Kumar, N K Agrawal, Nathan Pugh, P K Garg, Shunji Murai; AAM Hatch, Aerial Services, Contex, Leica, Pixel Infotek, Trimble; and many others.

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Printed and published by Sanjay Malaviya on behalf of Centre for Geoinformation Technologies (cGIT) at A221 Mangal Apartments, Vasundhara Enclave, Delhi 110096, India. **Editor** Bal Krishna | **Owner** Centre for Geoinformation Technologies | **Designer** Sahil Fernandes | **Printer** Sonu Printer, A110 DDA Sheds, Okhla, New Delhi, India.

## Policy and policing

We were taken aback.

We were taken aback when we were told by none other than the Wireless Advisor to Government of India, that an Operating License is required from the Wireless Planning and Coordination Wing, Ministry of Communication and IT, Government of India to operate a GPS in India [*see interview on page 30*].

The Wireless Advisor was simply stating the rule, but we were worried.

Worried, because not many GPS users are aware of this rule. Worried, because we feel that the publishing of this fact may disturb the present equilibrium, and dampen the market spirit.

Regardless of whether the Government enforces the rule or not, the fact remains that it exists. And since it exists, then what is the rationale behind it? Should anything be done?

We would like to begin a debate.

A debate on the need, relevance, and importance of such a rule in the present and emergent scenario. Also, on a broader canvas of policy, practice, and policing. We would like the key stakeholders to take this exercise ahead, and make it as participative as possible.

A debate that should result in a better understanding and implications of such rules. A debate that should create an atmosphere for the evolution of a more relevant and friendly policy ambience for the growth of positioning and navigation technologies in India.

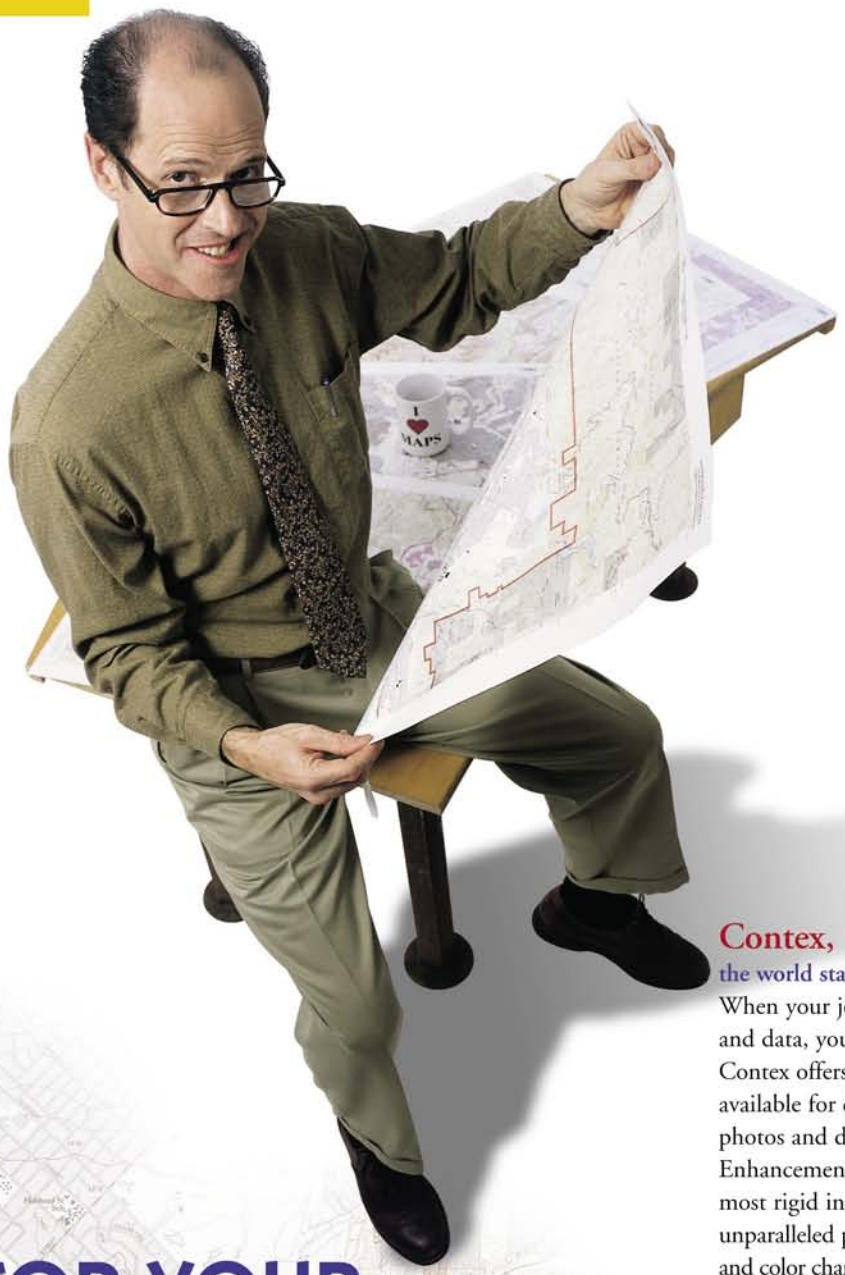
We understand that the continuance of such a policy scenario may put at stake a lot. At stake is the entire GPS industry. At stake is the wider public, which increasingly uses the end products of GPS technology in its daily life. And what about developmental projects?

On our side, we would like to make a plea. A plea to all those to whom this technology matters. A plea to those who are concerned with the growth of GPS technology in India.

A plea to re-examine the relevance of such a law in present day and emerging scenario.

We need a way out.

**Bal Krishna, Editor**
**bal@mycoordinates.org**



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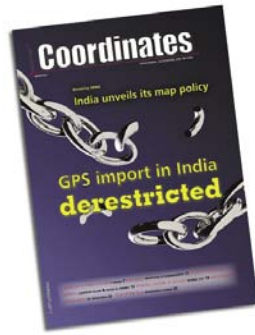
SCANNING TECHNOLOGY

Congratulations on a strong inaugural effort. In particular, I found your comments on India's delisting of GPS from restricted import items to be very interesting, as well as the interview with Prof. Ramamurthy. The advocacy for an orthophoto/GPS-based cadastral survey of rural properties also seemed a very forward-looking article.

I appreciate that you included discussion of progress on the Galileo program, because global navigation satellite systems incorporate other systems in addition to GPS: Galileo, Russia's GLONASS system, India's GAGAN, Japan's MSAS and QZSS programs, and even China's Bei-Dou. I was, however, a little surprised to see no discussion of what I understand to be an imminent agreement for India's participation in the Galileo program.

***Glen Gibbons***
*Group Editorial Director & Associate Publisher, Geospatial Business*
*ggibbons@questex.com*

We received an overwhelming response to our inaugural issue. While space does not permit us to respond/reproduce all of them, we thank each of you individually.




**talktous@mycoordinates.org**

The first issue of Coordinates impresses me, in terms of the materials published; it's relevancy to current issues which is in the minds of many over here. Probably, it would be good if you have something on utility mapping in the coming series, the technical context and in particular the legal context as well.

***Ahmad Fauzi bi Nordin***
*JUPEM, Malaysia*
*fauzi@jupem.gov.my*

We are delighted to receive the inaugural issue of June'05 of Coordinates and have gone through the same with interest. It is excellent and very informative.

One suggestion: In the front cover last three lines should have been in a more brighter colour for eye catching.

***Jayanta Chatterjee***
*Managing Director*
*DVP Geomatic Pvt. Ltd.,*
*New Delhi, India*
*dvpindia@vsnl.net*

It looks great! I am glad to see "Munee" Kumar is active with you. A walking geodetic legend ! I like your publication - as you get going - we'll see a more international mix of authors. I'd like to see an Editorial column - I am always interested in reading what people like yourself have to say about what is going on in our community.

Excellent beginning !

***Henry Tom***
*USA*
*henrytom@verizon.net*

Congrats on your new venture. I hope your new magazine will do extremely well and get that much required freshness in the Indian GIS media scene.

***Lt Col Rajat Baijal***
*Noida, India*
*rabaijal@yahoo.com*

I found Coordinates very interesting and informative. Certainly, it is good news that this initiative is taken up, as most part of our country is still ignorant regarding GNSS activties.

I am sure this initiative will not only promote the awareness but also the business opportunities and also an overall growth for the Indian community.

***Ravindra Babu***
*z3073030@student.unsw.edu.au*

Congratulations on your first edition of Coordinates and thank you for the opportunity to read this first edition.

As a foundation member of the Spatial Information Industry Initiative in South Australia (and its development manager), I understand some of the issues you are seeking to address.

Our Spatial Information Industry Initiative had the backing of our Premier (most senior politician in our state) and sought to bring together the private spatial information industry, public sector developers and the local academics.

One of our major learnings from the experience was the difficulties between technical language and every day language in communicating what the industry was and had the potential to achieve. This difficulty included the word "spatial" which continually got mixed up with the space industry and as a geographer I was very resistant to accepting a name change for the initiative – however we now talk about locational technologies.

The other major difficulty was between those how produced the information (mainly the public sector) and those that wanted to use the information (the private sector). This revolved around 2 issues the cost of the information to the users (as the public sector was grossly under funded and expected to make up its shortfall from revenues) and that spatial accuracy prized by the produces was greater than that required for commercial applications and/or the information required by the private sector was not available (privacy restrictions) or was not collected (as it is not information required by the public sector).

I make these observations as I suspect that you will also have institutional (or policy) issues in India restricting the spread of the technology and information, which unless resolved will prevent the realisation of your goals

***Allan K Barnes***
*Change Matters, Australia*
*chmatter@chariot.net.au*

# Global Usage of Ellipsoidal Heights

DR MUNEENDRA KUMAR

With the Navy Navigation Satellite System (NNSS), we first started surveying directly ellipsoidal heights. This capability became universal with the GPS. Around the mid-1990s, the accuracy of a few cm for a surveyed ellipsoidal height (h) for single points and 1 ppm or better for differential heights (Dh) became realistically achievable.

Many of us started "floating" the use of ellipsoidal heights as a new approach, but without providing simple explanation(s) and/or algorithm(s). A better approach is to identify the specific applications and then show how the ellipsoidal heights can be used.

Before users will start using the ellipsoidal heights, we, the provider, have to first come out of our centuries old concept and practice(s). If they can be used, then why not!

*Dr. Muneendra Kumar's paper identifying where and how the ellipsoidal heights can be used will be published in our next issue - Editor.*

**Muneendra Kumar** Ph.D. is Chief Geodesist (Retired), U S National Geospatial-Intelligence Agency **munismk@yahoo.com**

# Was early warning of Sumatra earthquake possible?

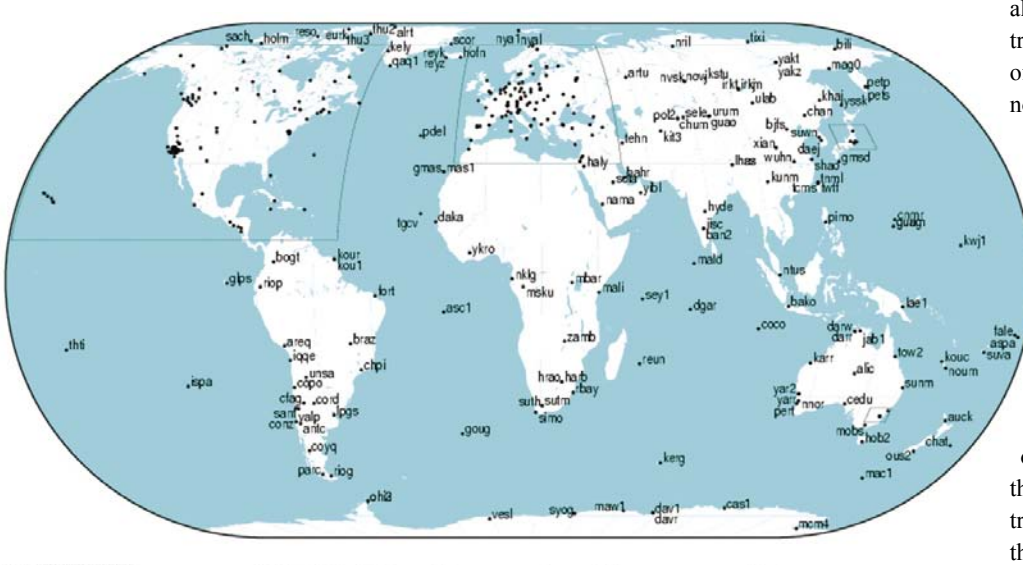
The authors have discovered serious signals within ten days before the earthquake with respect to the daily change ratio of triangle areas near the origin of earthquake

SHUNJI MURAI, HARUMI ARAKI

Since Japan is an earthquake prone country with a lot of volcanoes and active faults, Geographic Survey Institute (GSI), the Government of Japan has constructed about 1,200 GPS Fixed Stations called "electronic control points" all over Japan. Since 2003, GSI released GPS data to public through web site. The authors have already checked and confirmed the evidence of early warning for the past big earthquakes such as Tokachi Earthquake (M8.0: 2003.9.26) and Nigata Chu-etsu Earthquake (M6.8: 2004.10.23) which occurred in Hokkaido, north of Japan and middle of Japan respectively. International GPS Service (IGS) provides world wide GPS data at GPS stations located at 10 stations near Indonesia and other Asian regions.

The past prediction of earthquake had been based on statistical analysis with the past earthquake records or a sort of estimation from additional records. Most of seismic scientists have not relied on GPS data because the accuracy of GPS data used to be intolerable and also the actual earthquake happened in several ten kilometers depth though GPS stations are located just on the surface of the earth. However there are some geodesists who tried to use GPS data for planimetric movement of the surface of the earth. In most cases, elevation data are not used due to the low accuracy. The movement analysis has been based on the assumption that a point is estimated as a non-move or fixed point. This analysis has two weak points. One is that the analysis is not three dimensional though there may be a type of earthquakes which will move not in the surface plane. The second problem will be the assumption to keep a point as fixed, though any point may have possibility of movement.

In consideration of the past methods, the authors have developed a new early warning system for big earthquakes with more than M6.0 using daily GPS data in geo-centric coordinate system.




GPS Stations in the world

## Indicators for early warning

The authors have proposed the following indicators or factors.

- **Coordinate System** The geo-centric coordinate system with the origin as the center of gravity of the earth, X axis as Greenwich Meridian on the surface of the equator, Y axis as 90 degree East longitude Meridian on the surface of the equator and Z axis as the rotational axis of the earth (ITRF2000 based on GRS-80). We considered that the center of gravity is the most reliable fixed point of the earth.
- **Triangle Networks** The triangle networks should be considered all possible combination of triangles because the possibility of earthquake directions will not be able to be estimated. In this regard, the triangle networks are different from the geodetic triangle networks and triangulated irregular networks (TIN). A triangle with very narrow angle will be allowed.
- **Daily change ratio of a triangle area** Because of the fluctuation of GPS data of geo-centric coordinates, we thought relative change of a triangle area will be more stable than the movement of point movement. In addition, we can predict a rough location of the

origin of earthquake from the maximum value of the change ratio. The daily change ratio of triangle area can be calculated from the following formula.

Daily Change Ratio of Triangle Area= (Area of the day - Area of the previous day)/ Area of the previous day

- **Triangle Area** Triangle area is computed for the projection plane of XY, XZ and YZ, which enables three dimensional analyses though map oriented understanding would be a little hard. The reason why the triangle area change is used instead of the movement of coordinates because the sensitivity for the change ratio of triangle area is much higher and also we can estimate the location where earthquake may occur.
- **Threshold** The maximum change ratio of triangle area in XY, XZ or YZ plane should be checked. Normally the unit of the change ratio is represented as ppm (one millionth) depending on the size of the triangle area. In case of Sumatra Earthquake, the triangle network has several hundreds and thousands kilometers distance between GPS stations. It gives the unit of 0.01 ppm in the daily change ratio of triangle area. The threshold is set up 0.03 ppm.
- **Sudden change of sign** The maximum change ratio will fluctuate from plus to minus or vice versa in a plane which showed the maximum ratio.

## Evidence of early warning for Sumatra offshore earthquake

The authors selected the following ten GPS stations as listed in IGS web page.

1) bako: Cibinong, Indonesia: E: 106.8500, S: 6.4910
2) ban2: Bangalore, India: E: 77.5116, N: 13.0343
3) coco: Cocos Island, Australia: E: 96.8339, S: 12.1883
4) dgar: Diego Garcia Island: UK

Figure 1: Triangle network of GPS station

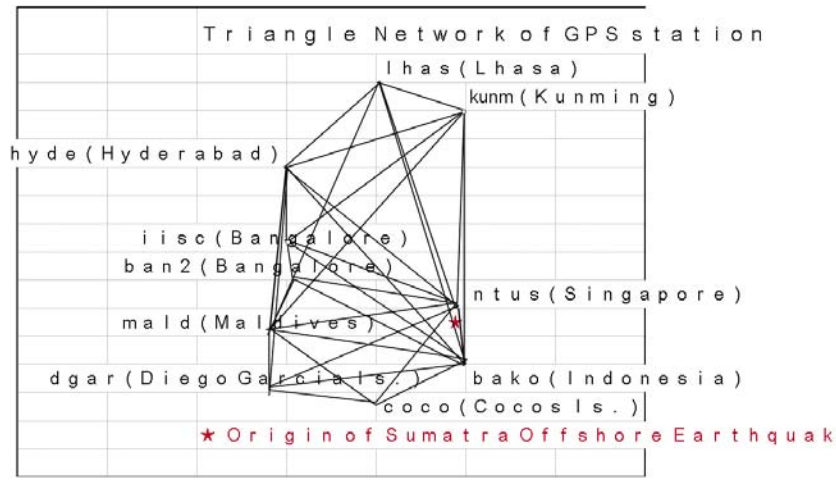



Figure 2: Daily change of triangle area in x-y plane

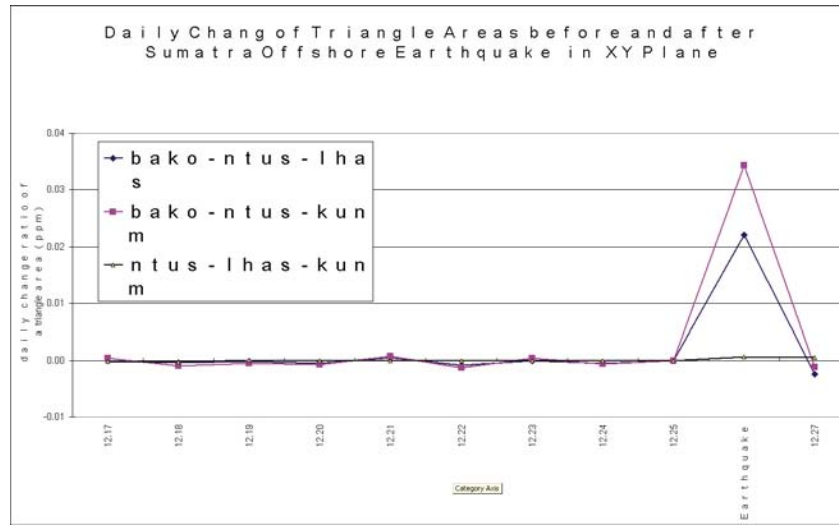
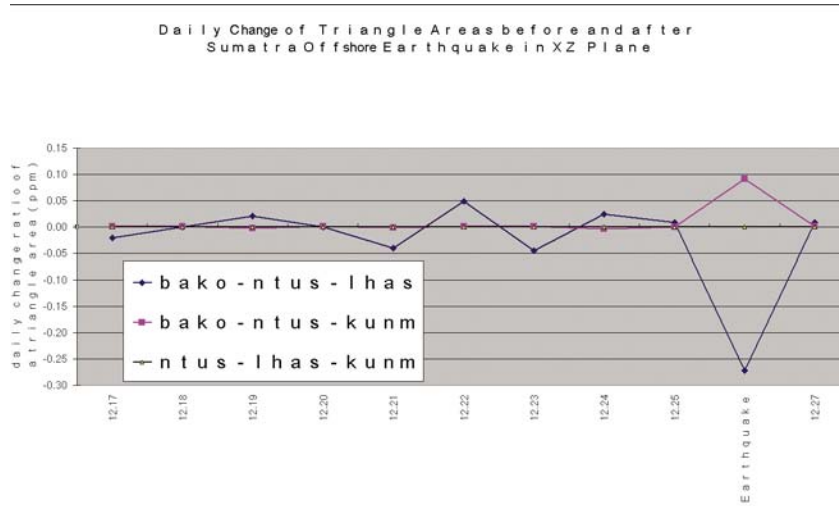



Figure 3: Daily change of triangle area in x-z plane



Territory: E: 72.3702, S: 7.2696

5) hyde: Hyderabad, India:
   E: 78.5509, N: 17.4172
6) iisc: Bangalore, India:
   E: 77.5704, N: 13.0211
7) kunm: Kunming, China:
   E: 102.7972, N: 25.0295
8) lhas: Lhasa, china:
   E: 91.1040, N:29.6573
9) mald: Maldives:
   E: 73.5263, N:4.1886
10) ntus: Singapore:
   E: 103.6799, N 1.3458

Figure 1 shows location of those GPS stations from IGS home page. We checked many cases of triangle combinations in which we found those triangles with bako, ntus, lhas and kunm showed evidence for early warning as shown in Figure 2, 3 and 4 with respect to the daily change ratio from December 17th to 27th, 2004 for XY, XZ and YZ projection plane respectively. There was a drastic daily change of -1.2 ppm in YZ plane in the triangle of ntus-lhas-kunm on the 18th December 2004, 8 days before the earthquake. There was also big change of -0.04, 0.05 and -0.05 ppm in XZ plane in the triangle of bako-ntus-lhas on the 21st, 22nd and 23rd respectively December 2004, 3 to 5 days before the earthquake. In XY plane we don't see very critical movement till the earthquake.

On the day of the earthquake, the change ratio of the three triangles; bako-ntus-lhas, bako-ntus-kunm and ntus-lhas-kunm was drastic with the change ratio of -0.27 ppm in XZ plane, 0.09 ppm in XZ plane and 0.14 ppm in YZ plane respectively. It should be noted that the two tringles of bako-ntus-lhas and bako-ntus-kunm showed the reverse change in XZ plane with the change ratio of -0.27 and +0.09 respectively. If we check the direction of the big fault between Indian and Eurasian Plate along the Island of Sumatra as shown in Figure 5, the direction of bako-ntus-lhas is almost the same with the direction of the boundary of the two Plates.

Figure 4: Daily change of triangle area in y-z plane

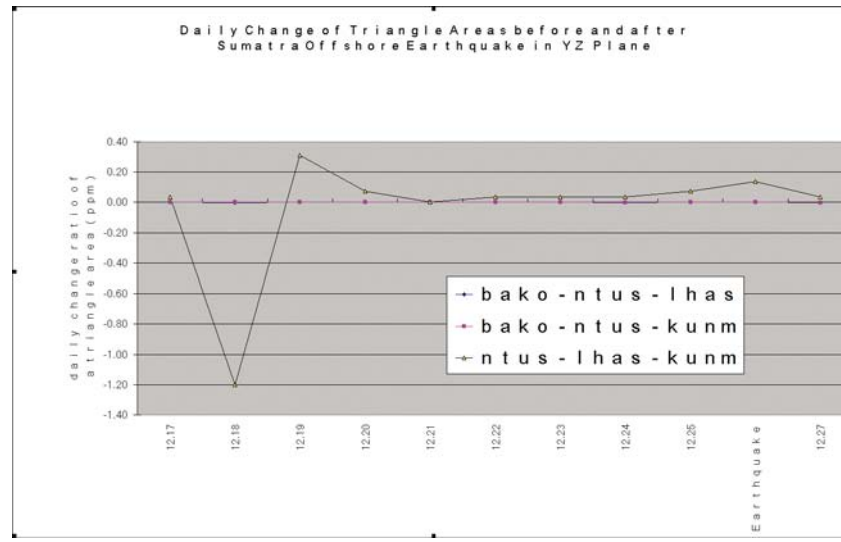



Figure 5: Location of GPS stations and boundary of plates

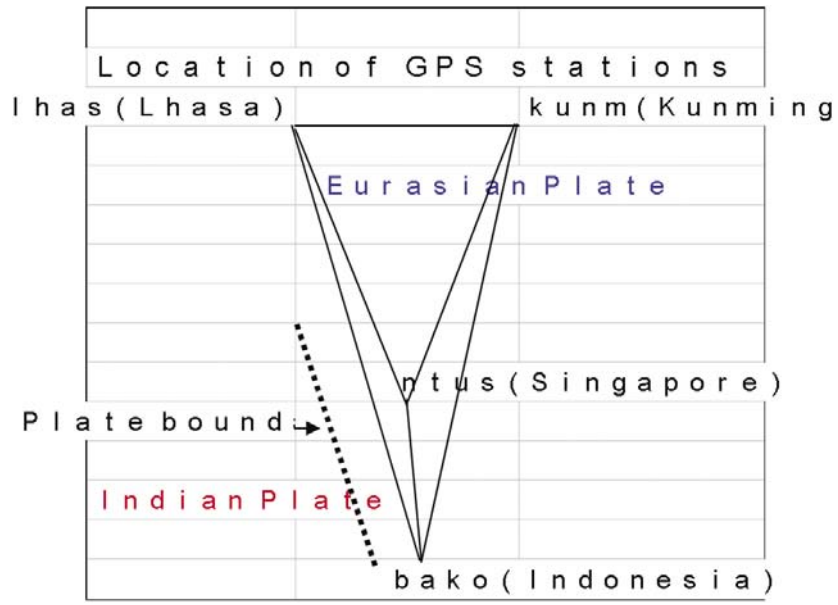
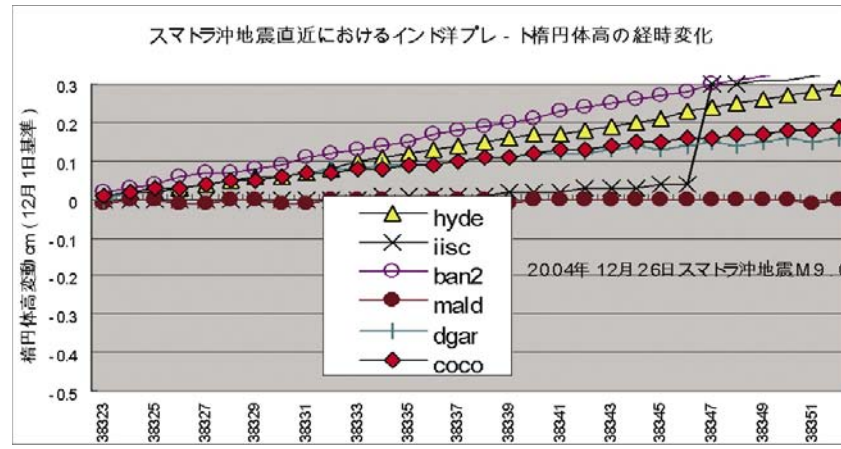
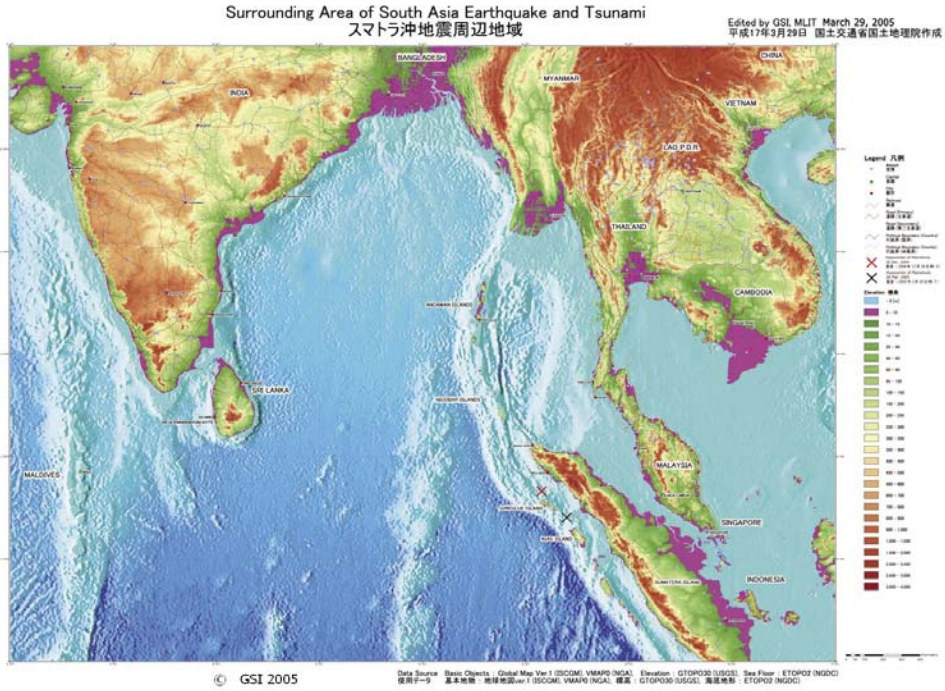



Figure 6: Change of ellipsoid height before and after the earthquake (1)






## Change of ellipsoidal height before and after the earthquake

The authors also checked the change of the ellipsoidal height for the ten GPS stations. Figure 6 and 7 shows the height change with the datum as of the 2nd December 2004. It will be interesting to find that ntus in Singapore and iisc in Bangalore, India showed downs and ups respectively though other points except mald in Maldives showed a trend of ups gradually.

## Conclusions

- It was easy to have detected Sumatra Offshore Earthquake itself from GPS daily data.
- The evidence of early warning was found in the daily change ratio of the triangle area of ntus-lhas-kunm (Singapore-Lhasa-Kunming) in YZ plane on the 18th December 2004, 8 days before the earthquake, and bako-ntus-lhas (Indonesia-Singapore-Lhasa) in XZ plane on the 21st to 23rd December 2004, 3 to 5 days before the earthquake.
- On the day of the earthquake, the three triangles of ntus-lhas-kunm, bako-ntus-lhas and bako-ntus-kunm showed very drastic change. The two triangles of bako-ntus-lhas and bako-ntus-kunm showed the reverse movements along the boundary of the Indian and Eurasian Plate.

## Reference

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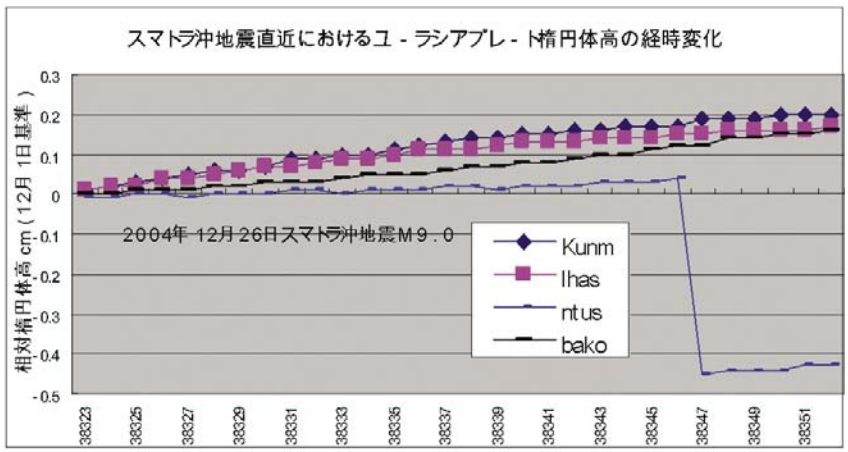
GSI (Geographic Survey Institute) Web Site: http://www.gsi.go.jp

MURAI, Shunji and ARAKI, Harumi (2003), Earthquake Prediction Using GPS, GIM, Volume 17, No. 10, October 2003

MURAI, Shunji and ARAKI, Harumi (2004), Prediction of Earth quake and Volcanic Eruption using GPS, Asian Journal of Geoinformatics, Vol. 4, No. 3, March 2004

SOPAC Web Site: http://sopac.ucsd.edu/cgi-bin/sector.cgi

Figure 6: Change of ellipsoid height before and after the earthquake (2)



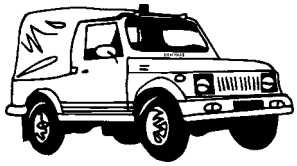

**Shunji Murai** is Professor Emeritus, University of Tokyo
**sh1939murai@nifty.com**

**Harumi Araki** is Director, Environmental Geo-science Corporation,
**arakey@mbf.ocn.ne.jp**

## GPS surveys to resolve Sir Creek dispute

Top scientists from India and Pakistan conducted geologic surveys in the disputed region and a seal of approval is likely soon for a newly demarcated boundary. The decades-old Sir Creek boundary dispute between India and Pakistan is on the verge of a final settlement. Following the ongoing composite dialogue between the two countries and general improvement in relations, both New Delhi and Islamabad have exchanged final documents related to the boundary dispute after detailed surveys were carried out by joint teams in the Rann of Kutch. *www.deccanherald.com*

## Delhi Police call for global bids for vehicle tracking system



The Delhi Police in India has initiated moves to invite expression of interest from global players for the GPS-based automatic vehicle tracking system. Once installed, the system will help centralise monitoring of PCR vehicles on a GIS map of the city. Presently, there are 400 PCR vans deployed throughout Delhi, which is expected to be increased to 600 very soon. GPS devices including GPS receiver, mobile data terminal, modem, transmission equipment and accessories, will be installed in each vehicle.

## London tests GPS tracking network on buses

Transport for London announced that it has signed a £120 million contract with Siemens AG to implement the world's largest GPS tracking system on the capital city's bus fleet. Siemens will install satellite monitoring units in 8,000 buses over the next four years. The network represents one of the largest and most complex urban transportation systems in the world. *www.thenewspaper.com*

## Fleet tracking system made affordable

MobiApps Holdings, India, has been selected by U.A.E. based Al Futtaim Technologies to provide affordable fleet tracking and monitoring systems in West Asia. The joint marketing partnership will focus on West Asian countries. m-Trak from MobiApps allows managers to log in from any PC to access real-time information on a specific vehicle or group of vehicles. Based on GPS/GSM/GPRS technologies, the system generates information such as speeding, unauthorised stoppages, distance travelled, SOS alerts, etc. *www.business-standard.com*

## GPS/GIS to locate mail addresses in Saudi Arabia

Four consortia of Saudi companies are to invest over SR1 billion in a state-of-the-art postal delivery system under a phased program covering all parts of the Kingdom. Usamah M.S. Altaf, vice president of Saudi Post, said the new service known as Wasel, would be a high-tech delivery system. It will rely on the integration of GIS, GPS and satellite imagery to locate houses and commercial addresses.

Post boxes in residential areas will enable registered members to post their mail. *www.arabnews.com*

## Navigation systems for Russian space and transport vehicles

Directives were issued by the Russian Government for equipping space and transport vehicles and means designed to conduct land-surveying and cadastral works with GLONASS or GLONASS/GPS

Satellite navigation systems will be installed on space means (rockets, boosters, space vehicles, landing modules (vehicles); aircraft; sea and river vessels; road and railroad means; instruments and equipment for land-surveying and cadastral works. *en.rian.ru*

## New wireless device for US military

A wireless device being developed in Greensboro to track soldiers' movement through dense jungles or rugged mountains passed its first major test last week and could go into production within two years.

The device, called TrakPoint, is about the size of a soda can and combines the electronic signals used in cell phones with the satellite technology used in GPS hardware. *msnbc.msn.com*

## First trans-African flight with EGNOS successful

A pioneering flight from Dakar to Mombasa, Africa, using EGNOS, the European satellite navigation system that corrects and improves GPS data, was a complete success.

Africa was crossed at its widest part with a plane using this accurate and guaranteed positioning system provided by the EGNOS test bed signal, to navigate and make landings.

The mission was carried out by the European Space Agency in collaboration with ASECNA (Agence pour la sécurité de la navigation aérienne en Afrique et à Madagascar). *www.esa.int*

## Ground-based GPS nets $5m grant in Australia

The Federal Government has awarded a Canberra company a grant of nearly $5 million in response to an "avalanche" of interest in the company's GPS technology.

Local company, Locata, has developed a ground-based GPS that does not rely on GPS satellite signals, which cannot penetrate buildings or infrastructure. It has developed ground-based transmitters that are one million times stronger. They can be used to provide global positioning information indoors and where satellite signals fail. *www.abc.net.au*

## Mount Everest measured again

A record 24 Chinese mountaineers and scientists conquered Mt Everest, re-measured its height and set up a survey beacon atop the world's highest peak. During their 77-minute stay at the peak, they have erected a survey beacon at the top of the peak and used GPS and radar devices to measure the height. *www.ptinews.com*

## NovAtel GPS receivers deployed in China Port

NovAtel Inc., announced that its dealer, Beijing BDStar Navigation Co. Ltd., completed deployment of NovAtel GPS-based systems for the Tianjin port Container Terminals (TCT). Under the TCT contract, NovAtel supplied ProPak-G2 dual frequency GPS receivers integrated with BDStar's custom GIS database software. These receivers allows for the automation of the pick-up, transfer and placement process by tracking containers from port entry to exit. *home.businesswire.com*

## Japanese trucking firms use GPS to help reduce emissions

Major Japanese trucking companies are introducing GPS devices in their fleets to measure emissions accurately and to optimize truck routes, with the goal of reducing CO2 emissions. Nippon Express has installed such systems in all of its 17,500 trucks at a cost of ¥2.5 billion ($23.8 million, or $1,360 per truck). It further plans to use it in another 10,000 trucks owned by group companies. *www.greencarcongress.com*

## GPS technology used in unmanned helicopter

Combining a patented computer program and GPS with an existing minicopter, an Israeli company has developed an unmanned aerial vehicle (UAV) that could be the next homeland security defense tool. All the aspects of flight -- takeoff, hovering and landing -- are completely autonomous, making this UAV a first. *www.mysan.de*

## Prismless Total Station by Topcon

Topcon South Asia announce the introduction of new TOPCON GPT-3000LN long range reflectorless total stations. With a non prism distance measuring range of 1,200m and a pulse laser measuring beam , it is the ideal tool for construction site use or for making measurements in crowded areas, besides other applications.

GPT-3000LN has many applications like Remote Elevation Measurement, Missing Line Measurement, etc. It also comes with Roads software conssisting of two major components; defining complete roads and stake out roads. It is also water and dust protected. *www.topcon.com.sg*

## Garmin Introduces the GPSMAP(R) 3005C

Garmin International Inc., introduced the GPSMAP 3005C, a value-priced multifunction display (MFD) for use within the powerful Garmin Marine Network. Designed for a smaller boat or as a secondary unit on larger craft, the GPSMAP 3005C offers powerful GPS chartplotter, weather, sonar, and radar capabilities when connected to the Marine Network. *biz.yahoo.com*

## Fun with GPS Gives New Look at Possibilities with GPS Technology

A new book from ESRI Press explores the unlimited possibilities of using GPS technology for education, recreation, and entertainment. Fun with GPS includes maps, photographs, and activities that help readers enjoy and get the most out of their personal GPS devices. The book also offers tips on incorporating GPS technology into the classroom to reinforce science, math, and geography curricula; provide groundwork for project-based learning; and enhance the importance of schoolwork to students.

# Offtrack

## Track your pets with GPS

The collar beacon, developed by GlobalPet founder in New York, determines an animal's poition using GPS satellite signals and reports these back to the owner via cellular phone. The device is about the size of a large wrist watch and weighs 0.15 kg. It clips discreetly onto a pet's collar and can even monitor a pet's well-being, by tracking the surrounding temperature. The device notifies the owner when its batteries run low. The GPS component uses an ultra-compact, multidiectional antena,which can pick up satellite signals regardless of the antenna's position.

## Horses wired for optimum performance

Researchers at Massey University's equine research centre in New Zealand are studying new ways of measuring the fitness and athleticism of racehorses. Two- and three-year-old horses carried GPS units in their saddlebags and their jockeys' helmets were fitted with receiver antennae. This enabled researchers using heart monitors to assess heart-rate data against the speed and time information collected by the GPS receivers. *www.stuff.co.nz*

## Skate maps with Global Positioning Systems

GeoSkating a project initiated in Netherlands is hoping to help skaters by automatically generating skate maps using GPS, cellphones and the internet. While skating, GPS position data is collected and published to a server via the skater's cellphone - the skater can also enhance the GPS data with road surface ratings and by adding pictures and videos. The server then draws geographic maps that show the road quality and media at the appropriate locations. Skaters can even be shown moving on the map in real-time. *www.engadget.com*

# "There is good infrastructure for GPS research in India"

says Dr G D Gupta, Advisor & Head (Seismology Division), Department of Science and Technology, Government of India. He explains the relevance, potential and applications of GPS in various activities of Seismology Division

## What are the key features of the National Seismicity programme?

The Seismicity programme is implemented with a comprehensive approach focusing on various aspects. The focus is not only on basic research on earthquake processes but it also lays emphasis on public awareness and outreach programmes.

## Is there a GPS specific programme?

In 1998, DST formulated a comprehensive national programme on earthquake hazard assessment and related geodetic studies. There are over 34 permanent stations operational at various locations. A National Data Centre is also being set up & functional at Survey of India. These are operated by several research, academic and national organizations such as Centre for Mathematical Modeling and Computer Simulation, Bangalore; Centre for Earth Science Studies, Trivandrum; Indian Institute of Geomatics, Mumbai; IIT Bombay; IIT, Kanpur; GB Pant Institute of Himalayan Environment & Development, Almora ; National Geophysical Research Institute, Hyderabad; Wadia Institute of Himalayan Geology, Dehra Dun, etc.

## Any specific outcome of this programme?

With the establishment of many GPS stations, a good scientific infrastructure in the country has been created to aid GPS related research. GPS Permanent and campaign mode stations have helped in generating strain models and measuring the velocity vectors of different parts of the country. One of the recent examples is the unique datasets mapped by various groups pertaining to the Great Tsunami Event of December 26, 2004 and subsequent aftershocks.

## What are the activities of social relevance?

The seismicity programme has elements of societal aspects. The Seismological and GPS network help in the assessment of earthquake hazard and also generate inputs for R&D efforts which result in evolving location specific mitigation strategies. The knowledge gained through R&D efforts is also translated into public awareness and education. Special efforts have been made to prepare self-learning and educational material for engineers, planners and NGOs. School children are also made aware about the scientific aspects of earthquake hazard through a special scheme on " Earthquake Observation Programme in selected Schools of the Himalayan region".

## Tell us something about microzonation studies?

A pilot project was initiated by DST in a multi-institutional mode to microzone Jabalpur, involoving Geological Survey of India, National Geophysical Research Institute, Central Building Research Institute, India Meteorological Department and Jabalpur Engineering College as active participants. The work has been completed and the first cut microzonztion map of Jabalpur has been prepared.

Similar efforts have been initiated in Guwahati, Sikkim, Bangalore, Ahmedabad and Delhi. The studies are in various stages of completion.

## How satisfied you are with the progress of Seismicity Programme?

The achievements made under seismicity programme has made visible impact both at National and International levels in terms of understanding earthquake process/ mechanism and providing inputs for evolving suitable strategies for earthquake mitigation.

## What future you foresee of GPS technology?

The use of space technology including GPS and SAR inferrometry is immense in understanding earthquake hazard. In the last five years, DST has funded many projects and significant results have been obtained.

As no part of the country is free form the earthquake hazard, there is a need to scale up these studies by adding more GPS stations, both permanent and campaign mode. GPS with GIS have great potential and applications in the area of earthquake mapping, assessment and management.


## What if a plane crashes due to incorrect map?

Cho, George (2005) Geographic Information Science: Mastering the Legal Issues, West Sussex, England, John Wiley & Sons: ISBN: 0-470 85009-4 (HB); 0-470-85010-8 (PB) 440 pgs including Index: Pound sterling 65 (hard back) and 24.95 (PB)

Prof Cho has written this book devoted to an exploration of the many legal issues impacting the development and application of GIS. This book is a part of a John Wiley "Mastering GIS: Technology, Applications and Management" series.

The book is comprised of six very substantial chapters. Chapter One looks at geographic information science, law and policy issues. Recognising that many readers of this work will be non-lawyers, the author provides a very useful introduction to law and the legal system and the nexus between geographic information and law.

Chapter Two is entitled: "Sharing Geographic Information System". The chapter examines the policies on access to public sector information as developed by Australia, NZ, United States, and the European Union. The author notes that we are moving towards a global information infrastructure and adoption of common standards. In this discussion, Asia-Pacific and Canadian Geospatial standards are also mentioned. This chapter emphasises an important theme of the book and a major reason the work is so valuable and impressive. GIS technology today often transcends national boundaries. Moreover, countries around the world are competing to develop the most suitable regulatory framework that will achieve an appropriate balance between the needs of government, developers, users and other groups impacted by GIS technology. This comparative/international dimension requires extensive research across diverse legal systems. That Prof Cho not only achieves this but also presents the information in a clear, interesting and highly readable manner is a major accomplishment.

Geographic information is valuable and when married to GIS the economic value multiplies greatly. In this environment an understanding of intellectual property rights is essential and comprises the topic of Chapter Three. Again, we see the comparative international dimensions as most countries in the world have been impacted by developments of the World Intellectual Property Organisation (WIPO) and World Trade Organisation (WTO) negotiations that have made compliance with intellectual property requirements a pre-condition to WTO membership.

For citizens, the rapid growth and development of GIS use means that privacy is increasingly difficult to protect. Thus Chapter 4 deals with this important topic, again from the perspective of different countries, including the US, EU and Australia

As a billion dollar plus industry, the commercialisation of GIS is also an important topic. Commercialisation aspects are covered in Chapter Five. This chapter focuses on contract law, including electronic contracts. Increasingly GIS services are provided over a networked environment. This means that developments in cyberlaw (for example, the enforceability of electronic contracts) become quite important. These are discussed in this chapter together with excellent case examples and practical checklists—these features being major selling points of the work which add greatly to its readability and usefulness.

Today we live in an Information Age. But what happens if the information is incorrect and people get harmed as a result. For example, what if a map is incorrect and as a result a plane crashes causing death. The final chapter thus examines the legal standards and guidelines that govern legal liability in relation to GIS. Appropriately, Prof Cho discusses these issues within a broader context of risk management.

A special feature of this book is its student-friendliness. Summaries, learning objectives, size of print and layout all make the book very 'user-friendly'. For the researcher wanting to go deeper, the work is also amply footnoted and referenced, including references to useful websites. The checklists and frequent use of case studies to illustrate the application of the law are also commendable. The only thing missing that would have been useful is a good glossary of terms.

In summary, I think this is an impressive, substantial, important and very accessible work. It will be of great use to those operating in the GIS industry, lawyers, government employees, consumer groups and policy makers alike. I am confident that this second book on GIS and the Law by Prof Cho will prove to be even more popular and useful than the first.

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# GAGAN - A visionary approach

India is playing major role to establish the SBAS service over Indian airspace to provide seamless and universalisation services for user as well as countries adjacent to the Indian boundary

ARJUN SINGH

In order to provide seamless navigation to the world aviation community by airport service providers, the International Civil Aviation Organization (ICAO) has adopted a new strategy on the implementation of Future Air Navigation System (FANS) and use of non-visual aids for approach, and landing. The solution for the above requirements is Global Navigation Satellite System (GNSS). A stand alone GPS fails to provide the required navigation accuracy for all phases of the flight. Therefore, to achieve the required navigation accuracy, the core constellation i.e. GPS, GLONASS, and Galileo (under planning stage) needs augmentations to fulfill the GNSS, particularly in satellite-based augmentations such as WAAS (USA), EGNOS (Europe), MSAS (Japan), GRAS (Australia) and GAGAN (India). It also includes ICAO's acceptance of an offer to make the Global Orbiting Navigation Satellites System (GLONASS) available for use by civil aviation. The ICAO Council had earlier accepted a similar offer concerning the GPS. These three satellite constellations (GPS / GLONASS / Galileo) are the key components of the GNSS. This article describes briefly, the different systems including GAGAN (India) and the status of GNSS.

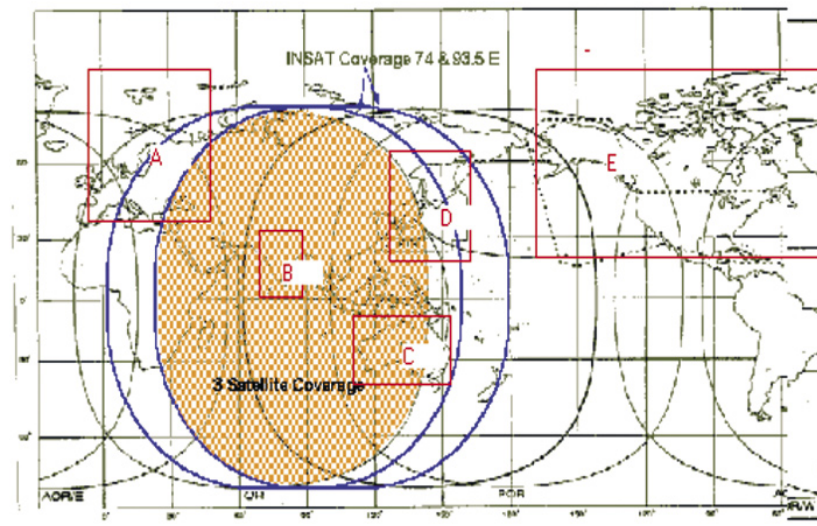



**Figure 1: Coverage and service area of worldwide SBAS**

## The ICAO strategy

The current strategy for application of non-visual aids to approach and landing was recommended at the Special Communications / Operations Divisional Meeting held at ICAO Headquarters, Montreal in spring, 1995. Delegates to that meeting discussed future ICAO policy in all-weather operations and concluded that, for a variety of reasons, it had become impracticable to proceed with implementation of the global Instrument Landing System (ILS) / Micro Wave Landing System (MLS) transition plan. The conclusion was reached in part because of developments in the application of satellite-based technology for approach and landing operations, in addition to the ILS and MLS. In future, the GNSS could be used for all weather approach and landing operations. The ICAO policy allows for continued use of ILS "as long as operationally acceptable and economically beneficial," and also for implementation of MLS "where operationally required and economically beneficial." The strategy calls for the validation of GNSS capabilities for use in Category- I operations and for the completion of feasibility studies concerning the use of GNSS in Category II and III operations.

As guidance for air navigation planners, the strategy indicates that "an internationally accepted GNSS with augmentation as required may be available for Category I operations within the 2000 to 2020 time frame." For Categories II and III, it projects that GNSS-based operations are not to be expected before 2005 to 2020 or beyond. This range of dates, which resulted from discussions at the ICAO GNSS panel meeting, effectively shows the differences between optimistic and conservative estimates of the prospects for GNSS introduction and development in the area.

In principle, the concept of augmentation is not completely new and marker beacons or DME in ILS or DME/P in MLS may be considered as existing examples of augmentation. In the case of GNSS, however,

[1] As per Indian Mythology, the entire universe is divided into three levels i.e. Akash (sky), Bhutal (Ground) and Patal (Below Ground). These levels are well defined for their importance and utilities to integrate entire universe in Unisom. Similarly the human body is consisting of the five elements and one of them is Akash. Therefore Akash is most precious element in Indian Mythology and in Sanskrit; it is called Gagan (Sky). The color of the sky, as visualized by the human eye, is blue. It looks very attractive in clear weather conditions. The sky also plays a vital role of supporting life forms on earth. Similarly, the horizon of Gagan is infinite and it has capability to provide service to unlimited number of users.

navigation satellites augmentations and their combinations, provide a large variety of functions and performance levels which would allow a great deal of flexibility but which may not be required in the real life environment. Five Air Traffic Service (ATS) provider countries have planned to have their own augmentation system and India is one of them.

## WAAS-USA

Wide Area Augmentation Systems (WAAS) is designed as an augmentation to GPS, which includes integrity broadcasts, differential corrections and additional ranging signals. It provides the accuracy, integrity, availability and continuity required to support all phases of flight through CAT-I Precision Approach (PA). The WAAS consist of one integrated system providing all navigation functionality. The delivery schedule will be accomplished in three phases be delivering an initial operating system and then upgrading the system through preplanned product improvements. Phase- I WAAS will also provide the initial operating system which consists of two WMS's, 25 WRS's leased GEOSs and ground uplinks to achieve a primary enroute through NPA capability, as well as enable GPS /WAAS to be used as a supplemental navigation aid for CAT-I PA. The WAAS project supports the development of standards, certification, facilities and procedures for operational use in the National Air Space (NAS). This includes requirement such as GPS procedures for use by air traffic, unique approach procedure for each location, obstacle clearance requirements, RNP standards, airport surveys, support for training program for civil pilot, flight inspections and revision of FAA regulations and document to reflect satellite navigation use. This project has been implemented in the year 2004 for civilian use restricted to the smaller airport and performance monitoring is being done for reliability of the system.

## EGNOS-Europe

European Geo-Stationary Satellite Navigation System (EGNOS) is the joint venture of European institutions and space industries to show their strong commitment in the development and system operations. Thanks to interoperability of the different SBAS. European's EGNOS ensures international cooperation as well as European Independence. The European Tripartite Group composed of the European Space Agency (ESA), the European community and EUROCONTROL, the European organization for safety of air navigation, manages EGNOS. In view of the operational implementation to come, the seven major European Air traffic Service Providers are on the way to from a legal entity. The EGNOS operator and infrastructure group (EOIG), France DGCA, German DFS, Italian ENAV, NAV-EP of Portugal, Spanish AENA, Swiss control of Switzerland and NAST of United Kingdom. In addition the CNES (Frabce Space Agency) the Norwegian Mapping Authority and major European air traffic management service providers actively contribute to the development and the future operation of EGNOS. All are part of the collaborator framework of the EGNOS program. The EGNOS service augments the GPS and GLONASS signals. The two satellites system sends a positioning signal to the user. The ranging and monitoring station network acquire, firstly the ranging signal generated by two constellations and GEOS, and secondly atmospheric data. This project is under technical demonstration phase.

## MSAS-Japan

The MTSAT (Multi functional Transport Satellites) Satellite based Augmentation Systems (MSAS) is the wide area augmentation system being developed by the Japan Civil Aviation Bureau (JCAB) for civil Aviation. This space based augmentation system will provide enroute through PA navigating services for all the aircraft within Japan airspace. The MSAS employs a ranging function to generate GPS like signals and enable aircraft to use MTSAT as a 25th GPS satellite. The MSAS is similar in function to the WAAS (USA). Information on real time conditions of the GPS constellations transmitted to each aircraft via the integrity function of MSAS, while the differential corrections function provides ranging error data to each aircraft. MSAS uses advanced technologies such as satellites orbit ranging and ionospheric and troposphere delay estimation assumption to ensure the reliability of these functions. MSAS has planned for two GEOS. They are: MTSAT-1R and MTSAT–2. MTSAT-1R is in the orbit since year 2004 and MTSAT-2 is expected to be launched in the year 2005. After completion of the certification MSAS will be commissioned and be operational using only MTSAT-1R from 2005 and dual operation will be commissioned in the year 2006 using MTSAT-IR and MTSAT-2.

***The performance objective of the technology demonstration system is to meet the ICAO SARPs requirements***

## GRAS-Australia

The Ground-based Regional Augmentation System (GRAS) is a system providing GNSS augmentation service by which the user receives information directly from ground-based transmitters allowing

continuous reception of the service over a large geographical area of approximately 370 Km (200NM). The ground component may be interconnected in a network. GRAS supports GNSS operations in all the phases of flight including en-route, terminal and instrument approach etc. GRAS should be viewed as complementary to Satellite Based Augmentation System (SBAS) (such as EGNOS, WAAS, GAGAN and MSAS) and Ground Based Augmentation System (GBAS). GRAS is made up of multiple ground stations with overlapping coverage. However, the service provider will have to ensure that the topology of the ground infrastructures meet the operational requirements. The GRAS SARPs (Standards and Recommended Practices) have been submitted to ICAO for acceptance and amendment in the ICAO Annexure-10 volume I

## GAGAN-India

The satellite based navigation system is one of the main components of the satellites based CNS/ ATM system adopted by ICAO for worldwide implementations. Satellite navigation uses two-core constellation of medium orbiting satellites i.e. GPS and GLONASS. The positioning services offered by these two constellations for civilian use including civil aviation falls short of accuracy, integrity availability and continuity requirements of air navigation services. Indian air space in between Europe on the West and Japan on the East occupies a very critical position and, hence there is a need to have a system to bridge the gap between the coverage of EGNOS and MSAS and to facilitate seamless navigation of the aircraft from East to West and vice versa. The expertise available with Indian Space Research organization (ISRO) will be gainfully utilized in implementation of GPS / GLONASS Aided Geo-Stationary Satellite Augmented navigation (GAGAN) to provide the coverage over Indian airspace to the users. Indian augmentation with Indian payloads on GSAT-4 satellites, which are controlled by India, will offer some amount of control and flexibility on the position accuracies available to strategic users.

At present there is no SBAS service provider over Indian airspace. Even if in the future MSAS or EGNOS is in a position to provide SBAS services at a charge over India airspace, tt will be far cheaper and strategically important to have indigenous SBAS in view of the indigenous expertise in satellites technology available with ISRO. India can then become a SBAS service provider in neighboring countries in Asia-Pacific. Since GAGAN is a technology driven project, in which the technology is still evolving, it has been envisaged that DOS / ISRO will be in the right position to drive the project with AAI providing the requisite financial, manpower and the rest of supplementary support for the project. The national plan envisages implementation of a full operational capability SBAS in three phases.

## Phase 1: Technology Demonstration Systems (TDS)

This phase requires implementation of a minimum configuration system which would demonstrates the capability of the system to support up to Precision Approach Cat-I over a limited region of the Indian airspace and will serve as proof of concept. The performance objective of this system is to meet the ICAO SARPs requirements. The TDS will broadly consist of adequate number of RIMS, an Indian MCC, NLES, space segment, IONO-TROPO modeling, required communication links necessary software for navigation and communication.

## Phase 2: Initial Experimental Phase (IEP)

In this phase, TDS will be expanded to cover the entire Indian airspace and requisite redundancies will be added to the system. SBAS elements not covered in the TDS would be incorporated in the system and their redundancies built up. The system will be available for trial operation and the data collected by AAI during such trail operation would be analyzed by ISRO to further improve the system wherever considered necessary to achieve compliance of ICAO SARPs. The IEP will be completed in a period of one year after TDS.

## Phase 3: Final Operational Phase (FOP)

During this phase, GAGAN program would have matured. Extensive tests would be carried out to establish the system stability of various element of the system as a whole. The responsibility and roles of ISRO and AAI would continue to be as the case of initial experimental phase. The system will be extensively used for its evaluation with respect to ICAO SARPs before declaring system operational. The FOP will be completed in a period of one year after IEP.

Finally we wish to add that an SBAS provider only guarantees adequate service in his service volume. In addition to this SBAS broadcast signals will be available anywhere in their Geo-stationary Earth Orbiting Satellites (GEOS) foot print coverage areas. In the case of GAGAN, its footprints overlap those of European Geo-Stationary Navigation Overlay System (EGNOS) and Multi Functional Transport Satellites (MTSAT) Satellite - Based Augmentation System (MSAS). Indian airspace falls on the edge of the footprint of EGNOS & MSAS, GEOS. It means that the level of service over Indian airspace is not defined by EGNOS & MSAS. Consequently degraded signal will be available. GAGAN has been designed taking this into account. The service area of worldwide SBASs is presented in Fig. 1. It is observed from the figure that the EGNOS (A) and WAAS (E) coverage areas are large due to two or more number of

GEOS at different locations whereas GAGAN (B) and MSAS (D) have less as they use only one GEOS.

## Ionospheric, Tropospheric and Scintillation Modeling

This part of the project, is a challenging task for Indian engineers and scientist to develop the model suitable for GAGAN service area. From the study point of view, the world can be divided into three regions i.e. mid latitudes, the auroral and polar caps, and the equatorial and equatorial anomaly region. The equatorial region extends upto ± 30 deg. Geo-magnetic latitude which is 50% of the earth's surface. Entire Indian sub continent and many other countries fall in this region.

In the mid latitude regions, SBAS is expected to provide a PA service upto Approach Vertical Guidance (APV) -I & II using a standardized grid i.e. (5˚x5˚) to communicate ionospheric delay information to single frequency users. This strategy works well in mid latitude regions where the spatial and temporal changes in the structure of the ionosphere are fairly well documented. Unfortunately, in the equatorial ionosphere the spatial and temporal variability is much greater even during quite magnetic conditions. Therefore, the current SBAS Ionospheric Grid Concept may not be applicable in the equatorial region as such. There is a need to collect a new set of data continuously over the equatorial region for year together and develop the necessary Ionospheric and Tropospheric models for GAGAN.

Ionospheric & Tropospheric modeling and scintillation studies in the L-band will be carried out over the entire Indian airspace as an integral part in the TDS Phase. Twenty total electron content (TEC) GPS receivers have been installed at the Center of the 5 deg x 5 deg. ionospheric grid points (IGP) grids over the Indian region. The data from these receivers is being logged into a personal computer and the logged data is being stored in ISRO space application center, Ahmedabad for last one year. This data is disseminated to the universities and Research & Development laboratory for development of the appropriate Ionospheric, Tropospheric and Scintillation model.

## Ground Segment for GAGAN

This segment of the project consists of the following elements:

(i) Indian Land Uplink Station (INLUS) located at Banglore
(ii) Indian Reference Stations (INRESs), located at Jammu, Delhi, Tiruvananthapuram, Bangalore, Kolkatta, Guwahati, Port Blair and Ahmedabad
(iii) Master Control Centre (MCC) located at Bangalore
(iv) 128 Kbps Fiber or VSAT Link between INRES and MCC

The installation and testing of this segment will start in the end of the year 2005.

## Conclusion

India is playing major role to establish the SBAS service over Indian airspace to provide seamless and universalisation services for user as well as countries adjacent to the Indian boundary. This is being executed by AAI and ISRO jointly. It will also provide the service to any number and type of users with integrity signal over Indian air space. In addition the availability of technical, operational expertise in this area will benefit India. It will provide India the leading role in the Asia Pacific region as SBAS service provider.

**Dr Arjun Singh** is the Additional General Manager, in Directorate of Global Navigation Satellite System of Airports Authority of India and is associated with GAGAN project.

## Products

### SatNav Technologies launches SatGuide

SatNav Technologies (P) Ltd., announced the launch of India's First Navigation System SatGuide™ late last month. It has come into an agreement with Nippon Audiotronix, who will handle the Sales and Marketing of Nippon SatGuide on an exclusive basis in India.

Nippon would handle both retail channels as well as the OEM route using their network of over 650 outlets across the country. SatGuide™ will be available with one city default information. Additional city information can be bought at a nominal charge and will be very useful for those who travel across cities regularly. Mr. Amit Prasad, MD & CEO - SatNav Technologies said, "As product principals, we will focus on the technology aspects and in expanding the geography to multiple cities in India. www.satnavtech.com *www.satguide.in*

### Leica GIS and Mapping announces new products

Leica Geosystems GIS & Mapping, LLC announced the availability of Image Analysis for ArcGIS 9.0 and Stereo Analyst for ArcGIS 9.0. These image processing and stereo feature collection tools are designed exclusively for ArcGIS 9.0. Image Analysis for ArcGIS is meant for preparing, referencing and analyzing imagery from airborne and satellite sensors.

It also announces the availability of IMAGINE Virtual Delivery. This new add-on product extends the capabilities of IMAGINE VirtualGIS across the Web, expanding the reach of the desktop 3D scene generation and viewing tool by converting IMAGINE VirtualGIS scenes and accompanying data into a Web-optimized format *www.leica-geosystems.com*

### Siemens working on standards based A-GPS for cellphones

Siemens says that it will be one of the first companies to bring a standardized solution for Assisted Global Positioning Systems (A-GPS) to the market: The so-called Secure User Plane Location (SUPL) standard is being developed by the Open Mobile Alliance (OMA) and is scheduled for release in June 2005.

While current proprietary A-GPS systems work only with devices from specific manufacturers, the OMA standard will enable the positioning service to be used on any A-GPS-capable phone on any mobile network.

Siemens is already conducting interoperability tests with A-GPS chipset suppliers Global Locate and SiRF Technology Holdings and with device manufacturers Compal Communication (CCI) and HP. The SUPL-based Siemens A-GPS solution will be offered to mobile operators as of the third quarter of 2005. *www.cellular-news.com*

### Real Works Survey Software introduced

Trimble introduced a new version of RealWorks™ Survey software for surveyors and engineers that leverages the rich point-cloud data set provided by today's advanced 3D laser scanners.

The new software version incorporates a series of new precision tools and features for civil survey, building, heritage, forensic and other applications, allowing surveyors to produce 2D and 3D information for direct output or export to AutoCAD or MicroStation software design packages.

It is also complemented by RealWorks Survey Lite that allows surveyors to offer enhanced deliverables in both format, which clients may then visualise, manipulate, print or partially edit. *www.trimble.com*

### TOPO! Xport Pro - a new software tool

Users of geospatial software have a new tool to quickly add the highest-quality topographic maps to their projects with National Geographic Maps' TOPO! Xport Pro. This enables users to add seamless topographic maps to any software that supports standard raster file formats. The maps are actual USGS quads that have been georeferenced and enhanced with up-to-date streets and roads and 3-D hill shading. The maps immediately provide context for other geospatial information and are ideal for reports, presentations, or use in the field. It is compatible with a wide range of spatially-enabled software. *www.directionsmag.com*

### Miner & Miner releases ArcFM Solution 9.1

US-based Miner & Miner, announced the availability of ArcFM Solution 9.1. It is an enterprise solution for editing, modeling, maintenance, and management of facility and landbase information for electric, gas, and water/wastewater utilities. It is being released concurrently with ESRI's ArcGIS 9.1, and supports both ArcGIS 9.0 and 9.1. *www.directionsmag.com*

### MapInfo Professional v8.0 is available now

MapInfo Corporation announced the availability of MapInfo Professional version 8.0. It enables companies in all industries to easily visualise the relationships between data and geography to drive more insightful decisions. This in turn leads to increased revenue, lower costs, enhanced efficiencies and improved service.

### Cadcorp announces new interoperable solution

Cadcorp has announced a new and free solution for managing OS MasterMap data: the Cadcorp SIS OS MasterMap Database. it is a relational database encapsulated in

a single "ODB" file that can handle anything from a single OS MasterMap chunk right up to national coverage. ODB files provide an extension to the Cadcorp SIS OS MasterMap Manager and are designed to appeal to users who want to use OS MasterMap data without having to invest in database server technology and management resources. *www.cadcorp.com*

### Garmin Launches GPS with turn by turn navigation

GARMIN launches the turn by turn GPS technology in India. This is said to be the first time that such on-road navigation will be available on a standalone basis in India. In addition to this, Vehicle Tracking System (VTS), which will help track vehicles through their entire route will also hit the markets, announced Mr A M Lalljee, Director, Aerial Services Private Ltd (ASPL)."We have an entire database across India garnered from Kalyani Net Ventures Ltd (KNVL), which has been loaded in these devices. Landmarks of cities like Delhi, Mumbai, Pune and Bangalore, which include railway stations, hotels, restaurants, hospitals, banks, ATM points etc apart from every road is available in this software." Dr Vivek S Kale (CEO, GIS Division, KNVL) added that a major application of this system is expected in the are of asset management; particularly for enterprises, which have networked assets ." This technology will be initially available for the markets of Delhi, Mumbai, Pune and Bangalore and will be introduced in other cities shortly and the rest of the country later.

### MSN announces satellite-mapping service

Microsoft Chairman Bill Gates previewed new satellite-mapping technology designed to compete with local-search offerings from Google, Yahoo and Amazon.com.

Gates, presenting at the "D" conference in Carlsbad, California, introduced MSN Virtual Earth, a map service that lets visitors zoom in on a local area and get information about restaurants, cafes, hotels, dry cleaners, and so on.

## Contracts

### Infotech Enterprises to provide enterprise wide GIS Solutions

North Delhi Power Limited has selected Infotech Enterprises Limited, to implement GE Smallworld GIS technology for GIS mapping of the entire distribution network and provide GIS based solutions for operations resource management. It has selected Infotech Enterprises after studying the leading GIS technologies available. Infotech Enterprises will implement the final phase of the GIS initiative, which started with a base-line GIS solution nearly two years ago to improve customer service and efficiency. With the latest implementation, it will scale up its GIS implementation at an enterprise wide scale.

### BAE Systems signs contract with Ordnance Survey

BAE Systems has announced that Ordnance Survey, Great Britain, has ordered multiple copies of BAE Systems' SOCET for ArcGIS product. The SOCET for ArcGIS solution has enabled the Ordnance Survey to maintain their high-level photogrammetric production workflows with SOCET SET while allowing them to capture and edit 3D national map data in stereo directly in their enterprise Geodatabase. *www.na.baesystems.com*

### Space Imaging ME bags Dubai Police 3D City model contract

Space Imaging Middle East (SIME) announced that it has been awarded a contract to generate a 3D City Model of Dubai for Dubai Police Command and Control Center. SIME's aerial division, Sanborn ME, will be doing the same. The model will show the different buildings in 3D as well as it depicts ground elevations. It is information rich and can include detailed data about landmarks, buildings and streets. It is endowed with tools to extract the needed information from the available data and can take live feed from cameras placed on top of monuments.

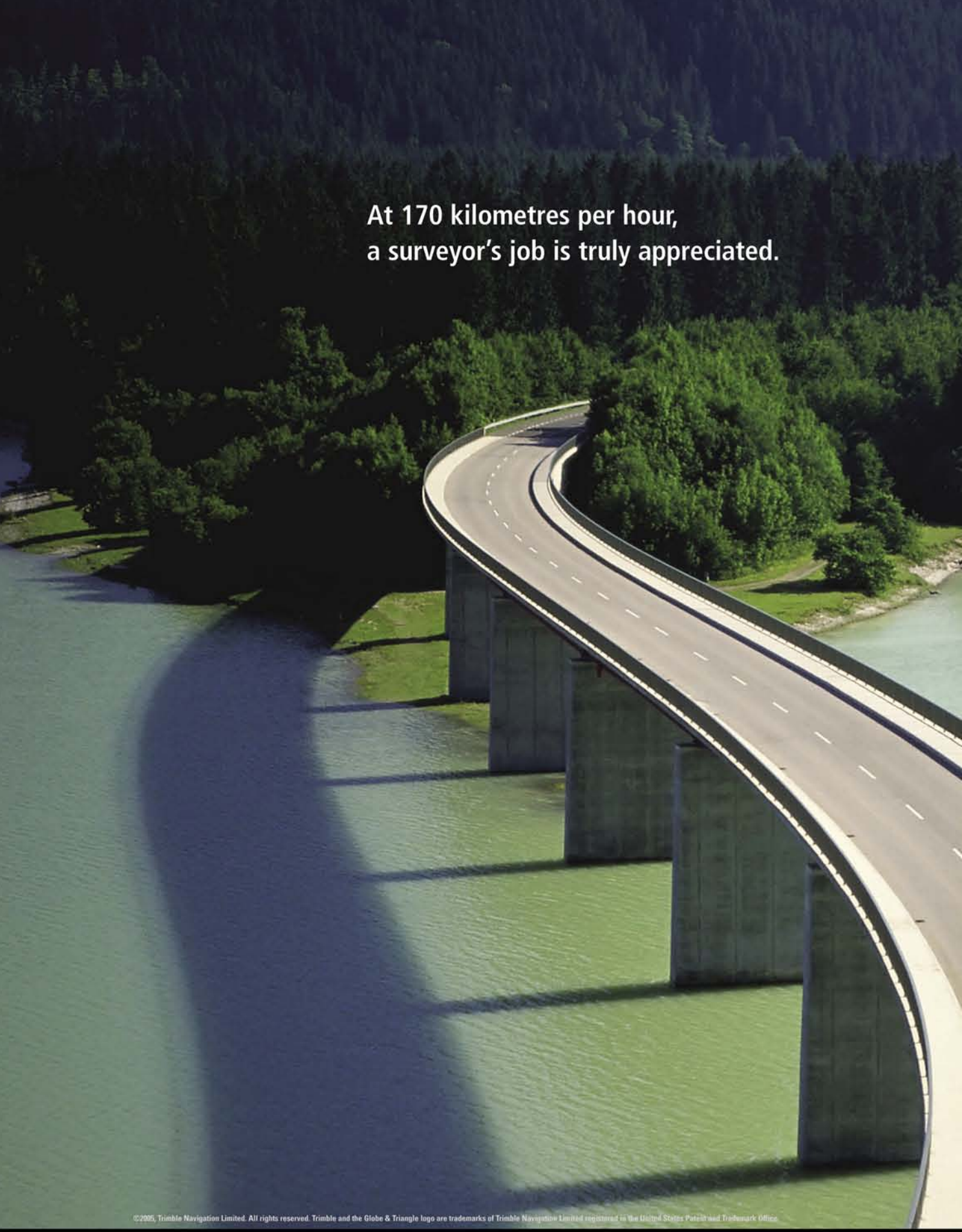
## Business

### Autodesk signs definitive agreement to acquire c-plan

Autodesk, Inc. announced an agreement to acquire all outstanding shares of c-plan AG, a provider in the European GIS market, whose customers include more than 2,000 users in 700 municipalities and utility companies. The purchase price for the shares of the Gumligen, Switzerland-based developer of the TOPOBASE(TM) family of geospatial applications and data management solutions will be approximately $18 million plus net working capital. *www.prnewswire.com*

### PCI Geomatics technology assists the European Space Agency

PCI Geomatics is helping to create the next generation of automated coastal maps through its contributions to the COASTCHART project. The project, led by LogicaCMG, is entirely funded through the Data User Element (DUE) of the European Space Agency's (ESA) Earth Observation Envelope Programme (EOEP). Once completed, the project will allow for the delineation of 6,000 kilometers of western African coastline, and will also enable standard navigation charts to be updated from space-based observations. *www.pcigeomatics.com*



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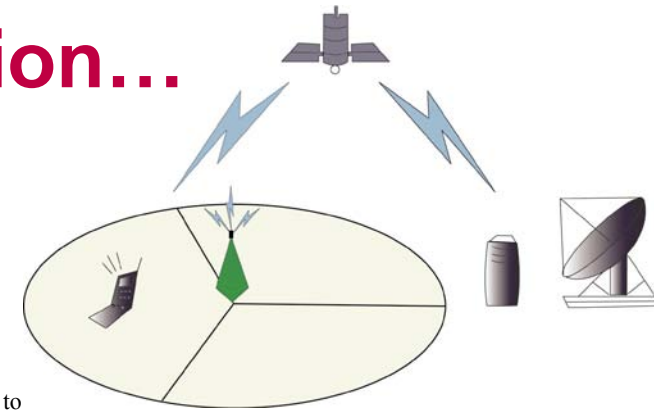
# It's all about Location...

LBS appear to be one of the next natural steps in our move towards a truly unwired permanently connected society



**NAVIGATOR**

The past decade has seen a quantum jump in mobile usage driven by two factors – one on the basic premise that almost everyone talks and walks and secondly, the underlying technology that has enabled this communication revolution. Mobile location based services (LBS) appear to be one of the next natural steps in our move towards a truly unwired, permanently connected society.

The ability to link a user's content and personalized services with his geographic location was envisaged to be a killer application, but was until recent times only a dream due to lack of technology right across the LBS value chain and interoperability– the positioning technology, handset limitations, network limitations and lack of compelling underlying geographic content. But, the last couple of years have seen extremely successful implementations by carriers worldwide including prominent ones like NTT DoCoMo, KDDI in Japan, SK Telecom in South Korea and Verizon in the US.

***the handset is becoming more of an extension of the self***

There have been two major methods to locate a handset. One is the network centric one to use the network to triangulate and locate the handset. A key benefit of network-centric solutions is that all handsets can utilize the positioning technology without modification. But network solutions are expensive since each base station must be upgraded—and they are less accurate. The other approach is to have the autonomous positioning capability (like GPS) embedded within the handset. This gives a high accuracy (< 5m), but is severely plagued with poor time to fix, high power consumption and the need to upgrade the handset to support positioning. A hybrid approach is what is adopted wherein the assistance comes in from the network and the handset positions itself.

Having obtained the position information, using it to offer the right proposition to the customer is very critical. While applications like location based billing are dependent on a seamless integration with the existing systems, majority of applications are dependent on accurate and extensive spatial information. By spatial information we mean a base map with respect to which we define the location and the spatial layers on the map that define items like restaurants, ATMs, customer demographics, etc. While the map is one aspect, the spatial layers are only limited by the kind of application we intend to deploy. This process of collection is painstaking, extensive and cannot be done by any one agency.

This brings us to the challenge of designing the LBS to obtain information from multiple sources with location information appended to it. For example, a news reporter would now not only send news but also send it with location information that can be interpreted by the system without any manual intervention. This asks for standards to be adopted by every information source. Similarly, there are standards required by the application to interface with the positioning technologies, billing systems and privacy information databases.

Conceptually, applications may be the same, but there are numerous challenges for success in the Indian context. For example, navigation applications abroad give directions based on street names. In India, where street names are limited or inconspicuous, directions using landmarks would be more effective. Another innovation could be to have vibratory and voice prompts to continually track progress and guide the user. The quality of the map, comprehensive landmark data and ability to support natural interfaces is extremely important.

The kind of applications that can be deployed is only limited by the imagination of the developer but of course is driven the business viability of each one of them. With the advancement of technology, the handset is becoming more of an extension of the self, continually using the location information to perform various operations.

**Navigator** is a pseudonym of our contributing author.
**talktous@mycoordinates.org**

# Geodesy

**IV Murali Krishna**
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Geodesy is science of the measurement and mapping of the earth's surface. Satellite Geodesy in an orderly intensive manner started with the launch of the first artificial satellite SPUTNIK in October 1957. By the year 1964, many basic geodetic problems had been successfully tackled.

Most significant of the problems tackled are determination of a precise numerical value of the earth flattening, determination of the general shape of the global geoid and determination of connections between the most important geodetic datums. Since 1980 satellite methods are increasingly used by the surveying community replacing the conventional methods. This process started with the first results obtained with he NAVSTAR Global positioning System (GPS). The applications of geodetic satellite methods are determined by the achievable accuracies. Some of the applications are cited as follows:

- Establishment of global terrestrial reference frame
- Establishment of Geodetic control for national networks
- Control points for crustal motions
- Terrestrial control points in photogrammtery and remote sensing
- Control points for cartography during expeditions
- Detailed surveying for land records, LIS, GIS, town planning and boundary demarcation etc
- Position and velocity determinations for geophysical observations
- Precise positioning for marine mapping, marine geology, bathymetry and connection of tide gauges

The list is by no means could become exhaustive but only illustrative as there is no limit technically for the possible applications.

The physical shape of the real earth is closely approximated by the mathematical surface of the rotational ellipsoid. The ellipsoid surface is smooth and convenient for mathematical operations.

This is why the ellipsoid is widely used as the reference surface for horizontal coordinates of geodetic networks. For most practical applications ellipsoidal coordinates systems are preferred because they closely approximate the earth's surface and they facilitate a separation of horizontal position and height. Usually a rotational ellipsoid is selected which is flattened (f) at the poles and which is created by rotating the meridian ellipse about its minor axis b. Here ais major axis. The geometric parameter f = (a - b) / a. The value of numerical eccentricity e = (a*a - b*b) / a*a.

On the other hand the ellipsoid is much less suitable as a reference for vertical coordinates (heights). Instead the geoid is used It is defined as that level surface of the gravity field which best fits the mean sea level, and may extend inside the solid body of the earth. The vertical difference between geoid and a particular reference ellipsoid is called geoid undulation.

Appropriate well defined and reproducible reference coordinate systems are essential for the description of satellite motion. Reference coordinate systems is satellite geodesy are global and geocentric because the satellite motion refers to the centre of the earth. Terrestrial coordinate systems are generally local and represented by local coordinate systems The relationships between the both the systems must be known with sufficient accuracies. As such we will deal with reference coordinate system in satellite Geodesy in the next issue..

*The Coordinates Class room espouse readers to graticules of Mathematics and Physics that epitomize the Geospatial Information Technology. A chain of structured presentations related to interdisciplinary principles that define Geodesy, GPS, GIS, Geospatial data management and Image processing are to be en suite in this section in each issue of the Coordinates. Initially the chain trembles with Geodesy which is the mother of technologies to position the Coordinates.*

## Indo-Canada to sign S&T agreement

India and Canada will sign a comprehensive agreement on science and technology later this year to give a boost to the research activities taking place in both countries and to help the transfer of technologies. Announcing this at a joint press conference with the Minister of Science and Technology, Kapil Sibal, the Canadian High Commissioner to India, Lucie Edwards said her country would sign such an 'umbrella agreement' for the first time in 25 years.

The collaborations this year will focus on five themes – Earth Sciences and Disaster Mitigation, Environmental and Climate Change Technologies and Alternative Fuels, Information and Communications Technology, Nano-technology and Nano-science, Biotechnology, Health Research and Medical Devices. She also disclosed that the recently released Canadian International Policy Statement "paid significant attention to India as well as Science and Technology and suggested key initiatives to support partnerships in this sector with key markets, like India".

Mr Sibal announced that Canada will be the partner country in this year's Technology Summit and Technology Platform to be held in New Delhi from September 21-22.

## GIS mapping to help revamp Indian NE towns

The North-East towns of Shillong and Gangtok are set to get facelifts with the help of scientific mapping. Using tools like comprehensive mapping with GIS, a $15-mn project funded by the Australian government will work out a model for revamping these two hill towns by November 2005. It is expected that the Asian Development Bank (ADB) will extend a soft loan for implementing urban planning in five NE towns, including Shillong and Gangtok. *economictimes.indiatimes.com*

## Web GIS application for India's first Eco-Informatics Centre

MapInfo Corporation announced that Ashoka Trust for Research in Ecology and the Environment (ATREE) has selected and successfully developed a webGIS application using MapInfo technology as part of India's first Eco-informatics Centre. Based out of Bangalore, the Eco-informatics Centre brings together knowledge in the fields of information technology and ecology to further the conservation and management of India's natural resources. Built on MapInfo's leading edge MapXtreme technology, the Eco-informatics Centre's website hosts a web-enabled Geographic Information Systems (GIS) facility. This solution permits interactive querying and mapping of spatially referenced information and its main purpose is to deliver- free of cost-geographic information on conservation and the environment, allowing users to visualize, analyze, and integrate various types of data. *www.ecoinfoindia.org*

## Satellite map on distribution of Jharkhand mines

With the help of mines and the geology department, the Jharkhand Space Application Centre (JPAC) is creating the Mineral Information System (MIS), under which land will be scanned to ascertain the distribution of minerals. Under MIS, land will be analysed and a detailed map will be prepared. The map will analyse the deposits of minerals. The data and map will be put online through the state government website www.jharkhand.gov.in. For the first phase the Namkom block of Ranchi has been selected. *news.webindia123.com*

## Map of chemical elements distribution released for China

Chinese scientists have drawn a geo-chemical map, unveiling the distribution of 39 main chemical elements and oxides including gold, silver, copper and lead in China, according to a report in the People's Daily. The map, which took three years to draw, was recently recognized officially by the China Geological Survey Bureau. The map is the fruit of a national geo-chemical reconnaissance,which began in 1978. The survey covered 6.5 million square kilometers - 67 percent of China's territory. Scientists have tested 39 chemical elements by analyzing 142 geochemistry samples and got 55.4 million original data, the newspaper said. *news.xinhuanet.com*

## Nationwide GIS in Thailand by year end

Thailand will get its first nationwide GIS by the end of the year, which will provide a detailed digital map of the country's resources and allow for better management across government agencies. Previously various government departments had their own GIS systems that were largely incompatible. The national project was initiated by Prime Minister Thaksin Shinawatra as part of plans for e-government and for better management of natural resources. The Agricultural Ministry, which oversees the digital map project, awarded an 832-million baht contract to ESRI (Thailand). GIS Data general manager Surasak Theanvanichpant said the map would create a single standard at a scale of 1:4,000. GIS Data works. *www.bangkokpost.com*

## Scientists map ocean floor near Palmer station in Antarctica

Using inflatable boats, a portable depth sounder with GPS, and a REMUS autonomous underwater vehicle, a team of scientists and engineers have created the first detailed chart of the ocean floor around Palmer Station in Antarctica, revealing previously unknown submerged rocks. The new chart, the first in 50 years, was made by a research team from the Woods Hole Oceanographic Institution (WHOI) and the University of Southern Mississippi over five weeks in April and early May as they looked for sites for a new underwater

observatory. Their findings revealed a number of previously unmapped submerged rocks, among them a set of sharp rocky pinnacles that are potential navigational hazards. www.innovations-report.com

## First map to name America to go for auction

A 500-year-old world map that was the first to call a once mysterious landmass west of Europe "America" is due to go under the hammer in London on Wednesday, the auction house Christie's said. The "truly groundbreaking" map is also the first printed portrayal of the Earth as a globe, the first that distinguishes North and South America individually, and the first depiction of a Pacific Ocean, it said. Printed in 1507 by the German geographer Martin Waldseemuller, the map is just one of four in existence and is expected to fetch between 500,000 and 800,000 pounds ($905,000-$1.4 million, 740,000-1.2 million euros). *travel.discovery.com*

## UN atlas uses satellite imageries to show environmental damage

The United Nations has unveiled a new world atlas that uses satellite imagery to show the often damaging environmental changes sweeping the planet. The UN Environment Programme (UNEP) produced the atlas, called "One Planet Many People," to mark World Environment Day.

The atlas compares and contrasts satellite images of past decades with ones from the present. It finds many of the world's precious resources have seriously deteriorated because of rapid urbanization, overfishing and the loss of forests. *www.cbc.ca*

## ASPRS releases update to Lidar data exchange format standard

American Society for Photogrammetry and Remote Sensing (ASPRS) released version 1.1 of the ASPRS Lidar Data Exchange Format Standard (LAS) at its 71st Annual ASPRS Conference and Exhibition held in Baltimore, Maryland in March. This binary data exchange format is an industry standard for the exchange of lidar data between various hardware manufacturers, software developers, data providers and end users. *www.asprs.org*

## OGC establishes Risk and Crisis Management Group

The Open Geospatial Consortium Inc. (OGC) has established a Risk and Crisis Management Working Group (RCM WG) to address the global need for better sharing of geospatial information in risk management and emergency management.

The purpose of the RCM WG is to establish requirements and best practices for Web service interfaces, models and schemas for enabling the discovery, access, sharing, analysis, visualization and processing of information related to natural and human-caused risks and the management of related crises. *mail.opengeospatial.org*

## Ordnance Survey reports market-wide growth

The national mapping agency of Great Britan reports encouraging market growth in the take-up of data, particularly in the private sector, with partner channels showing a 14% rise. The growth helped to offset an anticipated fall in overall trading revenue (down £1.3 million to £100.4 million), which was due to the effect of payment profiles agreed in advance under long-term licensing agreements.

The financial performance for 2004-05 produced an improved surplus of £9.2 million (up from £5.6 million last year), offering vital investment potential for major technical and business priorities such as product development and enhanced IT infrastructure. The surplus also means Ordnance Survey can make its first ever annual dividend payment to government, a total of £800,000 this year.

## Plantation Management

Pacific Rim Palm Oil Ltd, (PRPOL), Singapore one of SE Asia's growing palm oil plantations owns a total of more than 60,000 hectares of palm oil plantations. It felt the need of GIS solutions not only to manage large amounts of data accumulate every year for each field in each of the plantations but also could provide plantation managers with an intelligent and efficient data analysis tool to introduce 'site specific' management techniques. In collaboration with the Potash Phosphate Institute (PPI) and Agrisoft Systems a computer software development company, PRPOL implemented an Oil Palm Management Programme (OMP) – that includes a database management and information system solution (DBMS) for agronomic data analysis. It uses OMP to record, store and analyze agronomic data (i.e., yield, leaf and soil analysis, environment, climate, pest and disease, and palm census data) recorded on a field-by-field basis. Trimble Pathfinder GPS equipment and software is used to collect geo-referenced information (point and line data) for use in mapping. PRPOL used MapInfo Professional to produce maps, integrating data from the OMP DBMS and GPS dataloggers. Satellite images are also used for palm counting and estate development planning.

The database system provides PRPOL with reports that summarize data at the field, division and estate level and contains built-in tools for particular kinds of data analysis. The integration of MapInfo with dynamic data from OMP provides the means for plantation managers to produce 'management maps' showing key agronomic parameters that can be updated and generated easily.

## Satellite imagery helps in...

### ...gauging cocaine

South America's cocaine output rose by 2 percent last year, according to an U.N. report. The main source for data on coca production was satellite imagery of the production areas, backed by plane and helicopter observation and field studies on the ground. *www.signonsandiego.com*

### … mapping methane

Using satellite technology, researchers from University of Heidelberg in Germany and the Royal Netherlands Meteorological Institute have for the first time mapped the highest methane emissions coming from the Gangetic plains in India, Southeast Asia and parts of China. The main source seems to be rice and cattle farming in these regions. *www.newindpress.com*

### …locating mass graves in Bosnia

International experts in satellite imagery, geology and forensic archaeology have completed a research visit to Bosnia to investigate new methods of locating and mapping mass graves. The experts from University of Birmingham and Applied Analysis Inc, a U.S. private company, were part of this project organized by the International Commission on Missing Persons, based in Sarajevo. *www.zaman.com*

### …crop estimates in Pakistan

The Pakistan government has decided to use satellite information to make crop estimates by replacing the antiquated system based on reporting by revenue department officials. Sources in the finance ministry told that the Pakistan Space and Upper Atmosphere Research Commission shall be funding the project. The new system shall give accurate information about sowing and harvest of different crops. *www.dawn.com*

## Saudi Arabia set to launch six mini satellites

Saudi Arabia shall very soon launch six mini satellites for a range of applications, including the location of water and mineral sources, environmental pollution control, urban planning, agricultural production and weather observation. They are part of a group of 24 mini satellites manufactured and designed by team of Saudi scientists and engineers as part of a program to harness space technology for commercial purposes, according to Prince Turki Ibn Saud, vice president of King Abdul Aziz City for Science and Technology (KACST) Research Institutes. *www.arabnews.com*

## Most detailed earth portrait underway

The most detailed portrait ever of the Earth's land surface is being created with ESA's Envisat environmental satellite. The GLOBCOVER project aims at producing a global land cover map to a resolution three times sharper than any previous satellite map.

It will be a unique depiction of the face of our planet in 2005, broken down into more than 20 separate land cover classes. The completed GLOBCOVER map will have numerous uses, including plotting worldwide land use trends, studying natural and managed ecosystems and modelling climate change extent and impacts.

An international network of partners is working with ESA on the two-year GLOBCOVER project, which is taking place as part of the Earth Observation Data User Element (DUE). Participants include the United Nations Environment Programme (UNEP), the Food and Agriculture Organisation (FAO), the European Commission's Joint Research Centre (JRC), the International Geosphere-Biosphere Programme (IGBP) and the Global Observations of Forest Cover and Global Observations of Land Dynamics (GOFC-GOLD) Implementation Team Project Office. *www.physorg.com*

## First India-US Joint Working Group Meeting

The India-US Joint Working Group on Civil Space Cooperation held its first meeting at Antariksh Bhavan, the Headquarters of ISRO at Bangalore during June 29-30, 2005.

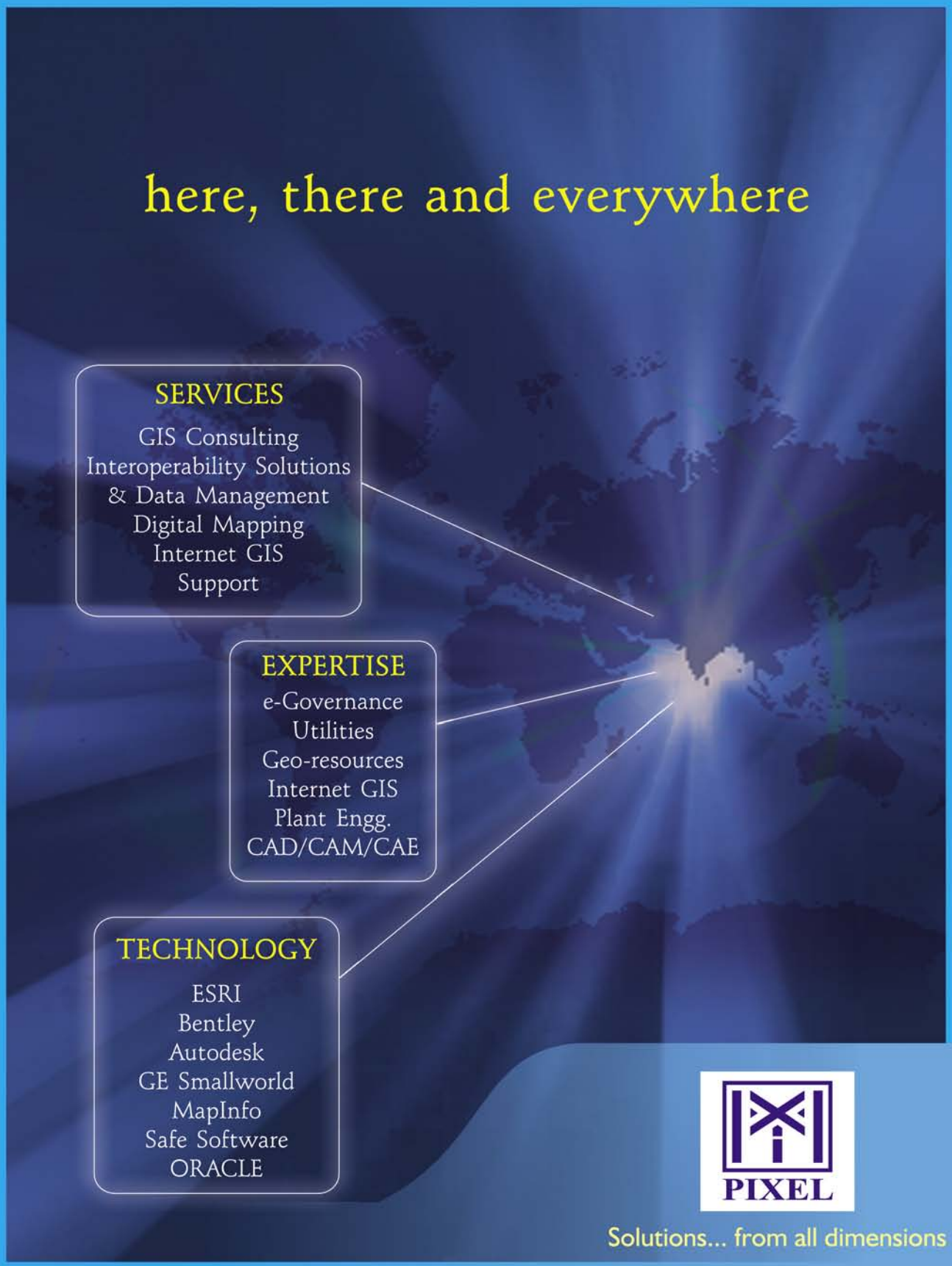
The Joint Working Group (JWG) deliberated to explore the potential and possibility of cooperation in earth observation, satellite communication, satellite navigation and its application, space science, natural hazards research and disaster management support, and education and training in space.

The JWG noted that significant progress has been made in the U.S. GPS, the U.S. Wide Area Augmentation System (WAAS) and the Indian GAGAN space-based Positioning, Navigation and Timing Systems (PNTS). Both sides have a shared interest in promoting interoperability among existing and future civil space based PNTS to create a Global Navigation Satellite System (GNSS). This area is ready for expanded bilateral cooperation. *www.isro.org*

## India aims to grab 10 percent of global satellite launch market

India, having earned 3 billion rupees (Rs) last year from its space programs, expects to win 10 per cent of the global satellite market over the next five years. ISRO chief, G Madhavan Nair told recently that he expected to maintain a revenue growth of 25 per cent because "our greatest advantage is the cost-competitiveness of our space program".

Mr Nair said countries like Brazil, Chile, South Africa, and Germany had asked for India's satellite data and images. He also said that The CARTOSAT-2 was getting integrated and would be ready for launch by this year-end. *www.spacedaily.com/news*

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# License required to operate GPS in India

"We are committed to meet genuine requirements of the GPS users" says P K Garg, Wireless Adviser to Government of India, Wireless Planning and Coordination (WPC) Wing, Ministry of Communications and IT, Government of India. Mr Garg expresses his frank opinions on issues ranging from role and mandate of WPC to rationale of licensing and its implementation issues

## What is the mandate and role of WPC, Ministry of Communications and IT?

The Wireless Planning and Coordination (WPC) Wing of the Ministry of Communications and IT, created in 1952, is the national radio regulatory authority responsible for frequency spectrum management, including wireless licensing and caters for the needs of all wireless users in the country, government or private, security or non-security. It is also the national nodal agency for all matters related to International Telecommunication Union (ITU) and the Asia Pacific Telecommunity (APT) and is responsible for treaty obligations on behalf of the Government of India. It also exercises the statutory functions of the Central Government and issues licenses to establish, maintain and operate wireless stations as well as possess, develop and deal in wireless equipment in the country.

## What is the basic approach the WPC to fulfil its mandate?

The Radio Frequency Spectrum and associated geostationary and other satellite orbits are limited natural resources. Radio waves are international in character. Since they cannot be confined to national boundaries hence are more susceptible to harmful interference. Like any other natural resource, it cannot be owned but can only be shared amongst various countries, users, technologies etc. Assignment of frequencies is governed by international treaties formulated under the aegis of the ITU, which are signed and ratified by Government of India. Further, it is also subject to various other international agreements with other countries. The trend of modern telecommunications is towards mobility with ever increasing data rates. Even fixed services are using wireless technologies. This has increased the pressure on already scarce spectrum. Hence, there is a need for increase sharing and re-use of all frequencies.

## Is it true that one needs a license from WPC before using a GPS?

Yes, it is true. If we go strictly by rule that exists on paper, making a GPS operational without a license from WPC is not allowed. However, the government is always alive to the practical situations and requirements. For example, the cordless phones were exempted from licensing requirements with specified frequencies and RF power.

## Is there a licensing requirement for the use of GPS for Real Time Kinematic (RTK) Survey?

When it comes to use of radio frequency, there is a need of license to be obtained. There are well-defined guidelines regarding this. Such licenses also need to be renewed annually or bi-annually. An applicant is expected to follow the rules and regulations stipulated by the Government of India.

## How much time does it take to get a license from WPC?

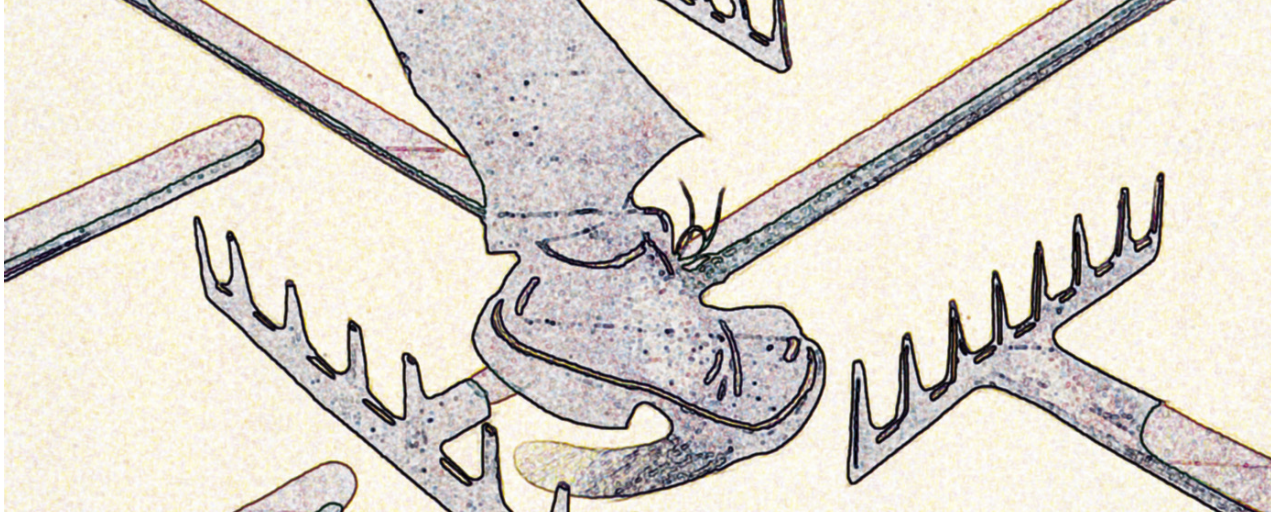
Generally, it takes from four to six months. For government agencies, it takes lesser time. Our department is also too hard pressed on human resources as there has been a quantum leap in the telecom segment, especially the mobile phone companies. Just to cite an example, about 7 years back the revenue of WPC through license fee and spectrum charges was about Rs 250 million which has gone more than 40 times last year.

## Can anything be done to reduce this timeframe?

The functions of WPC Wing are being made automatic and on-line. This should improve the situation. However, in many cases the decision is not taken by the WPC alone, hence it is bound to take some time.

## What is the rationale behind the licensing policy?

The policy is not without rationale. It is important to avoid the harmful interference with other users and agencies.



## Is there any mechanism available to monitor the misuse of frequency spectrum?

The Wireless Monitoring Organisation (WMO), with headquarters in New Delhi, is the field organisation of WPC Wing for radio monitoring. It monitors the radio spectrum to ensure its harmonious use. It has monitoring stations of varying capabilities and coverage at 22 locations, including one satellite monitoring facility. Certain instances of misuse need not necessarily mean that the law itself is irrelevant.

## Don't you think that such licensing has outlived its utility? And that too under the Telegraph Act of 1885. Isn't that too old?

As a regulatory authority, we have to follow the rules. Also, ITA 1885 may appear to be old, but it is a beautiful piece of law, which covers all forms of telecommunications and has permitted privatization and competition whenever required.

## Licenses are generally associated with undesirable hassles like corruption and laid back beauracracy. Please comment.

We try our best to be free from undesirable elements and practices. There are clear guidelines and we follow them while issuing license.

In WPC, we are committed to policy of transparency, efficiency and timely response to users. Hence, we are in the process of automation where the provisions will be from online submission of application forms to the monitoring of status of any application. We are creating a computerized database for this purpose. This effort is time consuming as it is important that quality of information is not compromised and data is appropriately validated.

## Any initiative to help the growth of positioning and navigation technologies?

On the part of the WPC, we would like to support the growth of positioning and navigation technologies. We request the users to abide by the law of the land and on our part we are committed that the genuine requirements of the users would be looked into with an open mind.

**Mr. P. K. Garg** Wireless Adviser to the Government of India, has 35 years of experience in various aspects of radio frequency spectrum management and radio communications. He heads the Wireless Planning & Coordination (WPC) Wing of the Ministry of Communications & IT, which is the national spectrum management agency in India. He has served the orgnaisation in different capacities, both at headquarters and in the field.

He holds a degree in Electronics & Communication Engineering and is a Fellow of the Institution of Electronics & Telecommunication Engineers for last 20 years. He is presently a nominated member of the IETE Council. He has also been awarded the 'Eminent Engineer Award' for the year 2003 by the Institution of Engineers, Delhi Centre.

Mr. Garg has widely traveled for participation in various international and regional conferences, meeting and Study programs. Since 1980, he has taken part in various conferences and meetings of International Telecommunication Union (ITU), Geneva, Asia Pacific Telecommunity (APT), Bangkok, International Telecommunication Satellite Organisation, Washington (USA) and other international & regional bodies connected with telecommunications. He has chaired many committees and working groups at international conferences. He is presently the Vice-chairman of the Special Committee on Regulatory & Procedural Matters of the ITU Radiocommunication sector.

Mr. Garg has served as the Senior UN & ITU Expert in Radio Frequency Spectrum Management in Saudi Arabia for about two years. He has also worked with the Government of Seychelles as Senior Technical Expert under ITEC program of Ministry of External Affairs.

# Using positional and navigational technology in Australia

The Australian community, industry and government benefit from location based technologies being used to resolve their issues

ALLAN K BARNES

While digital techniques were introduced to map production in the 1970's, the driver for utilising digital tools to manage this wide range of activities was the land administration functions of the six states and two territories. Developed in concert by the legal and surveying professions, these state and territory based land administrations functions led to digital land valuation systems as early as 1968 in South Australia. Building upon such initiatives; government guaranteed computerised land registration and automated valuation systems have been built.

While these initial land parcel based systems contained a wealth of locational data (eg land use, building details, sale prices etc) they relied on hard copy maps and plans for their graphical modules. This need to utilise digital graphical modules to display and analyse land parcel data led to all states and territories building and maintaining a digital cadastral databases. These data bases were completed from 1986 (South Australia) to 1998 (Tasmania) and form the backbone of the data used by locational technologies in Australia.

## National recognition of digital cadastral data

Integrated data combining the individual digital cadastres and road centre lines are now available from a joint consortium. The last two national censuses were successfully conducted using digital data from this consortium. Seeking to combine commercial goals and government responsibilities, the consortium provides these data to business and governments. In addition these data are also distributed (under licence) through software suppliers.

## Environmental and natural resource applications

During these cadastral developments, natural resource data was increasingly captured and analysed using locational technologies. Environmental agencies have developed sophisticated models to predict a variety of threats (eg locus, fire, salinity etc) and are essential to natural resource management. Paralleling the work of environmental agencies the mining agencies and industry have developed 3D location based technologies.

## Utility applications

Highway engineers have developed PC based pavement management systems which use Microsoft products (eg Access and Excel). By partitioning a road into fixed length segments and allocating roughness and condition ratings these tools are used to plan, cost and maintain roads to agreed standards within constrained budgets.

Utility infrastructure business (public and private) have digitally captured the location, function and interconnections of their assets. These data are then overlaid on the cadastre and topographic data to analyse asset decay, failure and demand. Utilising such analysis, service availability is improved and costs contained.Route analysis tools are used by public transport providers and the waste disposal business (mostly public) to minimise travel distances and maximise loads for each journey.

## Commercial applications

With few exceptions, private companies have been reluctant to publicise how they utilise locational technologies. Those companies that will admit to using these technologies argue that to discuss such use and the outcomes will undermine any commercial advantage gained by their initiative.

However it is known that locational technologies have been used by companies to:

- Focus their marketing on those locations most likely to purchase their product;
- Identify locations of a higher insurance risk (eg criminal activity, fire etc.);
- Identify non-commercial bank branches (i.e. a mismatch between bank products and the population's characteristics);
- Evaluate site suitability (particularly the fast food chains); and
- Manage their vineyards.

Some of these tasks are undertaken by third party companies, such as a company which undertakes street address based data cleansing. This process uses a clean and complete street address data base to correct the commonly used location key of street address in a company's files. Then duplicate records are removed from their client company's customer data base and the client company is able to more effectively market their products to their existing customers.

## Integration of mobile and management applications

While emergency services are using locational technologies to reduce response times and the size of their fleet, these technologies are also being used for counter terrorism purposes. The locational technologies used by these services are usually integrated with other information technology to provide a more complete management system, which will typically include a locational analysis module. Some of these services also have a GPS enabled fleet to provide real time fleet monitoring.

## Social applications

The location of health service delivery (both the actual location and the services delivered at each location) is analysed using locational technologies. This analysis is then used to relocate services in a more socially equitable and efficient way. Similar analysis is also performed by education and social services agencies has resulted in the development of a "remoteness" index which is now used by the Australian government across a number of portfolios for the delivery of services.

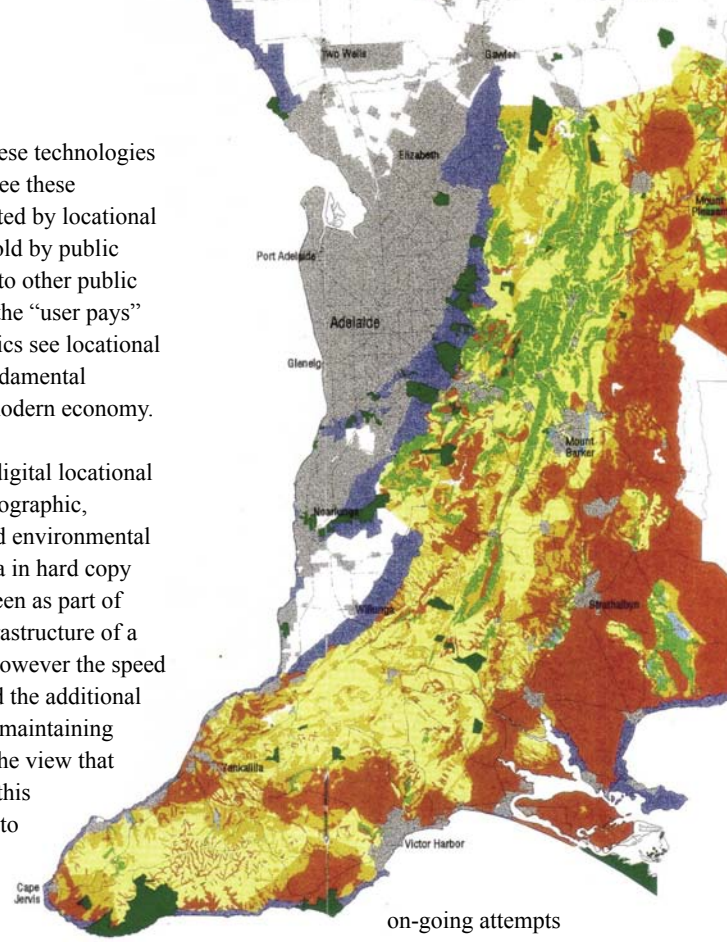
## Defence applications

The Australian defence forces were the first body to develop automated digital mapping techniques for map production in the early 1970s. The military continues to have a high commitment to the use of locational technologies across a range of logistics, training and combat applications.

## Policy barriers

At the same time there are still a significant number of public and private sector entities that are yet to use, or underutilise, location based technologies. Hence there remain many opportunities to expand the use of these technologies in Australia. Many see these opportunities restricted by locational information being sold by public agencies (including to other public sector agencies) on the "user pays" principle. These critics see locational information as a fundamental infrastructure of a modern economy.

Until the advent of digital locational information (i.e. topographic, cadastral, census and environmental data); locational data in hard copy map formats were seen as part of the fundamental infrastructure of a modern economy. However the speed of dissemination and the additional cost of creating and maintaining digital data fuelled the view that the user should pay this additional overhead to government. This debate continues in each of the jurisdictions that collect and distribute digital locational data (i.e. each of the six Australian states, two territories and within the Australian government).




Whatever the accuracy of the criticism the only barriers to open access to locational data in Australia are price and the Privacy Act. The Privacy Act stops public access to any records that contain sensitive personal information (name, address, health, finance), but allows public access to consolidated data (from which you can not identify individuals).

However, while not being a barrier to data access, the various formats and data standards add to the cost of integrating locational data. There are more and more tools being developed to address this data integration issue; however unless each data set's Metadata is carefully considered it is unlikely that data from a variety of sources can be successfully integrated.

In addition unless the data access is governed by robust and well administered policies, a potential user may not be able to access the data they require for their task. The on-going attempts to have common data access and use policies for Australia are yet to be realised (in practice) by all of the jurisdictions.

## Typical professional attitudes

The acceptance of locational technologies into every day applications has (and is) driven by the passion of the locational enthusiasts. These enthusiasts have included: map makers, land valuers, land registration officers, environmentalists, town planners, civil engineers, geographers and surveyors.

The most resistant professions to the introduction of locational technologies have been those with little or no background in graphical analysis (eg accountants and professional managers). To overcome this resistance Price Waterhouse and Coopers were commissioned to undertake a national cost benefit analysis of land information and its uses. As this study by a major management consulting company identified significant benefits, it is often quoted when seeking "treasury" approval for new locational projects.

# Galileo update

**Galileo – the European Programme for Global Navigation Services for civil purposes is an initiative led by European Union. We provide regular updates to our readers on the Galileo programme. India is likely to sign an agreement whereas Ukraine seals deal with EU on Galileo.**

## Galileo Joint Undertaking, Chinese RS Centre to sign contract

Galileo Joint Undertaking (GJU) and National Remote Sensing Centre of China (NRSCC) will sign seven contracts soon, said a GIU official. The cooperation between China and European Union (EU) on satellite navigation is "crucially important" and expected to have a very successful future, said executive director Rainer Grohe in a press release.

According to Zhang Guocheng, acting director of NRSCC, the seven projects in the segments of space, ground and applications will be contracted to Chinese companies and organizations by the end of July. According to a cooperation agreement signed by the NRSCC and the Galileo Joint Undertaking last October, China pledged to invest in research and development on space technology, ground equipment and application systems for the Galileo Programme. As the first non-EU partner for the programme, China agreed to invest 200 million euros, including 70 million euros in the first phase of the cooperation. *http://news.monstersandcritics.com*

## EU, Ukraine seal Galileo and aviation agreement

Negotiations on Ukraine's paticipation in Europe's satellite radio navigation programme finally reached approval. The agreement was initialled in Kiev by François Lamoureux, Director-General for Energy and Transport at the European Commission, and by Oleh Shamshul, deputy Minister of Foreign Affairs of Ukraine. A first agreement between the EU and Ukraine in the field of civil aviation was also initialed. The Galileo agreement initialed with Ukraine provides for co-operative activities on satellite navigation in a wide range of sectors, particularly in science and technology, industrial manufacturing, service and market development, as well as standardisation, frequency and certification. It also represents the first step towards the extension of EGNOS (European Geostationary Navigation Overlay Service) to Ukraine and the participation of the country in the programme through a stake in the Galileo Joint Undertaking. *http://europa.eu.int*

## India to participate in EU's Galileo project

India is likely to sign an agreement soon to participate in Galileo project. According to the official, India, with its vast geographical area, stands to benefit significantly from the Galileo project that will comprise a constellation of 30 satellites. India had agreed to participate in the Galileo programme at the end of the fourth India-EU Summit in 2003. *www.hindustantimes.com*

Many of the organisations that introduce locational technologies focus on more efficient processes and delay the decision support applications. A typical more efficient process is reducing the staff time and effort to contact those living within a specific location. This function is required by planning regulators to contact abutting land owners during a planning approval process; or for civil engineers to contact those about to impacted by a civil engineering works.

However, once the technology is delivering real identifiable benefits, the technology's critics become willing supporters of expanding its use to decision support. This change in attitude is seldom quick, but once converted to the value of locational technologies the initial critics can become its major sponsor in an organisation. Such a change of attitude has led one state to merge its locational technology policy development into its general information technology policies and strategies.

## Relevance to Indian Debate

These summary reflections of the development and challenges of fully utilising locational technologies are not offered as a blue print. Rather these reflections are offered to assist the Indian debate of the most effective way to gain widespread acceptance positional and navigational technologies in your jurisdictions.

Allan K Barnes has worked on major locational systems with the South Australian Government; including the state's digital cadastral data base and the Spatial Information Industry Program. He also served as Deputy Registrar General and Manager of the state's Information Technology strategy, and is now Principal Consultant of Change Matters.
**chmatter@chariot.net.au**

## July 2005

IGARSS 2005
25 - 29 July 2005 Seoul, Korea
**reg@igarss05.org**
http://www.igarss05.org

25th Annual ESRI International User Conference
25 - 29 July, San Diego, USA
**dsosa@esri.com**
http://www.esri.com

European Navigation Conference 2005
19-22 July, Munich, Germany
http://www.enc-gnss2005.com/

ESRI Survey/GSI Summit
July 23 - 26, San Diego, USA
http://www.esri.com/events/survey/

## August 2005

IAG/IAPSO/IABO 2005
22 – 26 August, Cairns, Australia
http://www.dynamicplanet2005.com

GITA Annual Conference 2005;
15-17 August, Melbourne, Australia
**imsevent@bigpond.net.au**
www.gita.org.au

Map Asia 2005
22 - 25 August, Jakarta Indonesia
**info@mapasia.org**
http://www.mapasia.org

11th GIS AnnualConference in Vietnam (GISnet'11)
August 8th, 2005, Vietnam
**phuoc.gis@bdvn.vnd.net**

## September 2005

12th International Symposium on Deformation Measurement
12 - 15 September 2005, China
**isdm12@sdust.edu.cn**
http://www.fig.net/isdm12

International Workshop Series in GeoInformation Science
27 Sep - 15 Oct 2005 Hong Kong SAR
**jlgis@cuhk.edu.hk**
http://www.jlgis.cuhk.edu.hk/events

The 6th Arab Map conference
12 - 13 September, Cairo Egypt
**arabmap2@iti-idsc.net.eg**
http://www.ngisc.gov.eg

International Symposium on Landslide Hazard in Orogenic Zone
25 - 26 September, Kathmandu Nepal
**symposium@nels.org.np**
http://www.nels.org.np

Navtech Seminars
12 - 13 September, Long Beach, United States
http://www.gpsetc.com

50th Photogrammetric Week
5 - 9 September 2005, Stuttgart, Germany
**info@ifp.uni-stuttgart.de**
http://www.ifp.uni-stuttgart.de

ION GNSS 2005
13 - 16 September, Long Beach, USA
http://www.ion.org

GeoSolutions 2005
28 - 29 September, Birmingham, UK
**sthomas@cmpinformation.com**
http://www.geosolutions-expo.com

Kuwait First Remote Sensing Conference & Exhibition
26-28 September, Kuwait
**info@promedia-international.com**
http://www.kuwaitremotesensing.com/

50th Photogrammetric Week
05- 09 September 2005,
Germany, Stuttgart
**martina.kroma@ifp.uni-stuttgart.de**
http://www.ifp.uni-stuttgart.de/phowo

5th International PHOTOMOD User Conference
13 - 16 September 2005, Latvia, Jurmala
http://www.racurs.ru

## October 2005

GeoBusiness Conference 2005
13 October 2005 London United Kingdom
**conferences@geobusiness.co.uk**
http://www.geobusiness.co.uk/events

Asia and Pacific Region Socet Set Users Conference;
24-26 Oct Cairns; Australia
**rob.coorey@baesystems.com**

Trimble Dimensions 2005 User Conference
23 - 26 October, Las Vegas, USA
**rhonda_heninger@trimble.com**
http://www.trimbleevents.com

URISA's 43rd Annual Conference
9 - 12 October, Kansas City, USA
**info@urisa.org**
http://www.urisa.org/annual.htm

Asia and Pacific Region Socet Set Users Conference; BaE Systems
24-26 October, Cairns; Australia
**rob.coorey@baesystems.com.**

Intergeo 2005
4 - 6 October, Dusseldorf, Germany
**ofreier@hinte-messe.de**
http://www.intergeo2005.de

## November 2005

The 12th world congress of the Intelligent Transportation Society (ITS).
6- Nov 10, 2005 San Francisco, CA, United States
**http://www.itsworldcongress.org**

25th International Cartographic Congress
28 Nov – 1st Dec 2005Sagar, M.P. India
**rkt_sagar@hotmail.com,**
**inca25_sagar@yahoo.com**
www.incaindia.com

AfricaGIS 2005
30 Oct - 4 Nov, Pretoria, South Africa
**fduplessis@openspatial.co.za**
http://www.africagis2005.org.za

GEOINT 2005
30 Oct - Nov 2, San Antonio, USA
http://www.geoint2004.com

12th world congress of the Intelligent Transportation Society - 2005
6 - 10 Nov, San Francisco, USA
http://www.itsworldcongress.org

South East Asian Survey Congress
21 - 25 Nov , Brunei
**secretarygeneral@seasc2005.org.bn**
http://www.seasc2005.org.bn/congven.html

ACRS 2005
7- 11 Nov, Vietnam, Hanoi
**eisa.ig@fpt.vn**
http://www.acrs2005.ac.vn

Qatar GIS Conference & Exhibition 2005
14 -16 Nov, Qatar, Doha
**info@gisqatar.com**
http://www.gisqatar.com

AGI 2005
1- 3 Nov, Chelsea Village, London
**angela.mcmahon@agi.org.uk**
http://www.agi2005.org.uk

2nd International Conference 'Earth from Space'
30 Nov - 2 Dec, Moscow, Russia
http://www.transparentworld.ru/conference/

## December 2005

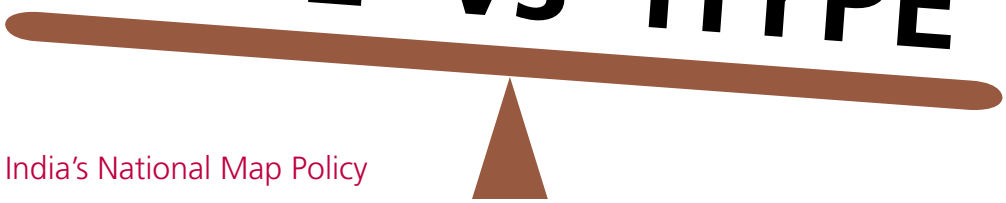
Middle East and Africa Conference for ESRI Users 2005
6th – 8th Dec 2005
meauc2005@qs4it.com
**www.qs4it.com/meauc2005**

Gulf Traffic - GIS Zone
12 - 14 December, Dubai UAE
**davyd.farrell@iirme.com**
http://www.gulftraffic.com

First International Symposium on Health GIS
1 - 2 Dec, Bangkok, Thailand
**healthgis@gmail.com**

GNSS 2005
8 – 10 Dec, Hong Kong, China
**lswuchen@polyu.edu.hk**
http://www.lsgi.polyu.edu.hk/GNSS2005

# HOPE vs HYPE



## India's National Map Policy

The unveiling of the National Map Policy by Ministry of Science and Technology, Government of India in May this year is a historic decision, a major step forward. However, the policy raises both expectations and questions. Many of them will hope fully be addressed by the guidelines that are expected to follow. Meanwhile, Coordinates initiates a discussion on National Map Policy. From now onwards, we will publish opinions of a cross section of the geomatics community in every issue

### 1 Preamble

All socio-economic developmental activities, conservation of natural resources, planning for disaster mitigation and infrastructure development require high quality spatial data. The advancements in digital technologies have now made it possible to use diverse spatial databases in an integrated manner. The responsibility for producing, maintaining and disseminating the topographic map database of the whole country, which is the foundation of all spatial data vests with the Survey of India (SOI). Recently, SOI has been mandated to take a leadership role in liberalizing access of spatial data to user groups without jeopardizing national security. To perform this role, the policy on dissemination of maps and spatial data needs to be clearly stated.

### 2 Objectives

- To provide, maintain and allow access and make available the National Topographic Database (NTDB) of the SOI conforming to national standards.
- To promote the use of geospatial knowledge and intelligence through partnerships and other mechanisms by all sections of the society and work towards a knowledge-based society.

### 3 Two series of maps

To ensure that in the furtherance of this policy, national security objectives are fully safeguarded, it has been decided that there will be two series of maps namely

a. Defence Series Maps (DSMs)- These will be the topographical maps (on Everest/WGS-84 Datum and Polyconic/UTM Projection) on various scales (with heights, contours and full content without dilution of accuracy). These will mainly cater for defence and national security requirements. This series of maps (in analogue or digital forms) for the entire country will be classified, as appropriate, and the guidelines regarding their use will be formulated by the Ministry of Defence.

b. Open Series Maps (OSMs) – OSMs will be brought out exclusively by SOI, primarily for supporting development activities in the country. OSMs shall bear different map sheet numbers and will be in UTM Projection on WGS-84 datum. Each of these OSMs (in both hard copy and digital form) will become "Unrestricted" after obtaining a one-time clearance of the Ministry of Defence. The content of the OSMs will be as given in Annexure 'iA'. SOI will ensure that no civil and military Vulnerable Areas and Vulnerable Points (VA's/ VP's) are shown on OSMs.

The SOI will issue from time to time detailed guidelines regarding all aspects of the OSMs like procedure for access by user agencies, further dissemination/sharing of OSMs amongst user agencies with or without value additions, ways and means of protecting business and commercial interests of SOI in the data and other incidental matters. Users will be allowed to publish maps on hard copy and web with or without GIS database. However, if the international boundary is depicted on the map, certification by SOI will be necessary. In addition, the SOI is currently preparing City Maps. These City Maps will be on large scales in WGS-84 datum and in public domain. The contents of such maps will be decided by the SOI in consultation with Ministry of Defence.

### 4 National Topographical Database

SOI will continue to create, develop and maintain the National Topographical Data Base (NTDB) in analogue and digital forms consisting of following data sets:

a. National Spatial Reference Frame,
b. National Digital Elevation Model,
c. National Topographical Template,
d. Administrative Boundaries, and

e. Toponomy (place names).

Both the DSMs and OSMs will be derived from the NTDB.

## 5 Map dissemination and usage

- Open Series Maps of scales larger than 1:1 million either in analogue or digital formats can be disseminated by SOI by sale or through an agreement to any agency for specific end use. This transaction will be registered in the Registration database with details of the receiving agency, end use etc.
- Through the agreement, SOI will allow a user to add value to the maps obtained (either in analogue or digital formats) and prepare his own value-added maps.
- The user should be able to share these maps with others – the information of all such sharing will also require to be logged in the Map Transaction Registry.

## 6 Applicability of previous instructions

The Ministry of Defence has from time to time issued detailed guidelines on various aspects of map access and use. These instructions shall continue to hold good but for the modifications cited herein.

*www.dst.gov.in/doc/NationalMapPolicy.doc*

## Annexure 1A

| MAJOR DETAILS | SUB DETAILS |
|---|---|
| GENERAL | Latitude/Longitude<br>Name of State/District/Administrative index<br>Topo sheet Number/Year<br>of Survey/Edition/Index to topo sheets<br>Magnetic variation from true North direction<br>Map reference<br>Bar scale/Representative Factor |
| ROADS | All Roads |
| TRACKS | All Tracks, pass, footpath |
| STREAMS/canals | All streams/canals |
| DAMS | All earthwork dams |
| RIVERS & River Banks | All rivers with details, banks, islands |
| WELLS | All wells/tube wells/springs |
| WATER FEATURES | All Tanks |
| EMBANKMENTS | All embankments, Road/rail/tank |
| RAILWAYS | All gauges with stations, tunnels |
| OTHER LINES | Light railways or tramway |
| CONTOURS | Contours with sub features |
| ICE FORMS | All features |
| SAND FEATURES | All sand features |
| TOWNS OR VILLAGES | Inhabited, deserted and forts |
| SETTLEMENTS | Huts, Towers, Antiquities |
| RELIGIOUS PLACES | All including tombs/graves |
| SHIP | Light ship, buoys, anchorages |
| LAND FEATURES | Mines, Vine on trellis, grass, scrub, cultivation limit |
| PLANTATIONS, Trees | All features |
| BOUNDARY, BOUNDARY PILLARS | International to village,<br>Forest, all boundary pillars, village trijunctions |
| HEIGHTS | Spot, approximate |
| BENCHMARKS | Geodetic, tertiary, canal |
| OFFICES | All post/telegraphic/police stations |
| BUNGALOWS | All including camping ground |
| FOREST | Reserved Protected |
| NAMES | Administrative/Locality or tribal |

## >> Experts speak

# "A landmark decision but it misses the seamark"

**Muneendra Kumar**, Ph.D. Dr. and Senor "WGS 84", Consulted to 100+ countries around the World. **munismk@yahoo.com**

The only thing new is introduction of DSMs and OSMs. It is surprising that Indian geodesists, cartographers, and other experts have "guided" the Government to retain the 19th century, mix it with 20th, and introduce the incompatibles. And, all this is to start the 21st century!

Thus, here are a few innovative observations for the record.

For DSMs –

1. The "Everest/WGS 84" is not a valid "datum". Does it mean that Indian geodesists are to define WGS 84 all over again with the Everest ellipsoid?
2. In general, the 1: 25, 000 and 1: 50,000 are the two scales for topographic maps. Thus, two incompatible projections and the associated grids will be an operational nightmare for the war fighters.
3. It is also not clear that contours will be in which height system. The old heights will be in conflict with GPS.
4. Having full information about the definition problem in WGS 84, Indian geodesists should have worked for a 21st century accurate and correctly defined Indian Geodetic Reference System (IGRF) 2005. It would also be easy to enhance the accuracy of IGRF, as and when India requires.
5. This series for the whole country should only be for selected areas.

To maintain two overlapping series is practically unrealistic.

For OSMs –

1. The right and timely choice for the horizontal datum would be the new Indian Geodetic Reference System 2005.
2. When a new 21st century mapping system with zero distortion is available, India has a better choice over a 16th century projection with distortion.

For Charts –

1. The policy does not "cover" the nautical and aeronautical charts. No-projection, seamless, and distortion less charting is available.
2. For safe navigation, new technique to survey time-invariant sea floor depths provides a 21st century system than the most ambiguous LAT datum.

In the 21st century, India deserves the Best and that is achievable only with new research, ideas, techniques, and innovation.

## "The civil maps seem to have the needed features"

**Prof J G Krishnayya**
Director, Systems Research Institute, Pune
**geoconcept@vsnl.com**

The National Map Policy is a major positive step forward.

I note that Contours have been included in the Open Maps to be sold to the public. This is a great relief. I cannot say anything about the Military maps as I do not know much about their needs. The Civil ("open") maps seem to have the needed features. The fact that City maps at high resolution will also be "open" is all to the good. It is also good to leave the restriction-of-map-objects issue to the SoI, so that once the maps come into the public domain, we do not have to worry about anything which is depicted thereon.

I also note that people who procure the maps from the SoI are at liberty to provide value-added additions and to resell. That is a major step forward. However, I note that a (typically Indian) bureaucratic interpolation was made in the Policy statement requiring registration of each purchase when one buys the map – and also when one resells the map. This does not really seem to provide any REAL safeguards (what are we now safeguarding in regard to the "open" maps?), and I hope it will eventually be dropped by the Ministry as they implement the system of map-distribution.

With the exception of the above requirement, I can only welcome the statement of Policy, and express my hope that the (unspoken, unfortunately) objective of the whole policy - namely a much more rapid rate of utilisation of the maps aimed at economic growth and more efficient land-use and planning and investment decisions – is achieved.

## The impact will hinge on the implementation guidelines

**Ajay Lavakare**
CEO, RMSI
**Ajay.Lavakare@rmsi.com**

The Map Policy per se is very reasonable. The concept of having two series of maps, one restricted for defense and security (Defense Series Maps, DSM), while the other will be open to the public (Open Series Maps, OSM), both of which will be derived from a National Topographic DataBase (NTDB), should meet with unanimous support and approval from the geospatial industry. The contents of the OSM, as provided in Annexure IA of the policy are fairly comprehensive, and it is good to see that latitude-longitude, contours and spot heights are part of the contents of the OSM. I am very pleased to see that permission to publish maps both in paper and digital as well as over the web has also been granted to users in the policy. Another welcome move is the clarification that the City Map series being prepared by the Survey Of India (SOI) will be in the public domain. A very progressive section in the policy refers to permissions granted to users to "add value to the maps" and in fact even prepare their own value-added maps, after entering into an agreement with the SOI. The creation and maintenance of a Map Transaction Registry to track all transactions related to OSMs with scales larger than 1:1M will, I suspect, become extremely cumbersome, although one can understand the logic behind such a move.

However, the impact this Map Policy will have and whether it will really result in economic benefits of over Rs. 20,000 crores as estimated by the Minister, will crucially hinge on the detailed implementation guidelines that are expected to follow. While the Map Policy is very reasonable, these guidelines that will flesh out the details need to be reasonable and clear as well. My first hope is that there is a time-bound schedule for publishing of these guidelines, because without timely guidelines, the Map Policy will be not be implemented with the impact that the government hopes to have. My second hope is that the guidelines will be comprehensive, clear and fair to both the private and public sector. Some of the issues and questions that the geospatial industry will hope to see addressed and clarified in these guidelines are:

- Will the OSMs cover some/all areas of the country that were previously "Restricted" after

removing Vulnerable Areas and Vulnerable Points?

- What will be the procedure for access to the OSMs for the private sector? Hopefully this will not be a tedious or bureaucratic process that makes it very difficult for the private sector to access the OSMs, thereby defeating the very purpose of the Map Policy.
- What will be the nature of the agreement between the Survey Of India and the users for getting permissions to add value and to prepare their own value-added maps? The guidelines will also address and describe the terms of agreement for further resale of the value-added maps to other users.
- Clear and unambiguous product information and pricing structure for access to maps. It would be of great benefit if the Survey Of India could publish a well-defined catalog of metadata on each map that contained information such as vintage of maps, data layers available, etc. and an up-to-date pricing catalogue.
- What will be the policy regarding keeping the OSMs current? One of the big drawbacks of the present maps of the SOI is that many of them have not been updated for many years.

One of the Objectives of the Map Policy is "to promote the use of geospatial knowledge and intelligence through partnerships and other mechanisms by all sections of the society. The partnership approach has been adopted by other national government mapping organizations. An example is the Ordnance Survey of Great Britain's data reseller partnership with the private sector, which makes it easier for all sections of the society to access and use geospatial data without compromising the ownership and associated revenue considerations for the Ordnance Survey. We hope that the guidelines embrace such partnership concepts.

Lastly, now that we have seen the National Map Policy, one is tempted to ask for a more comprehensive National Spatial Policy that covers other equally important sources of spatial data acquisition and information, such as aerial photography and satellites and other remote sensing devices.

## A welcome step but…

**N. K. Agrawal**
former Director Survey of India **nande@rediffmail.com**

The map policy creates more confusion than what was already there. Comments are given below: -

1. National Topographical Data Base (NTDB) has to be clearly defined in detail. Does it cover all topographical maps on all scales? National Spatial Reference Frame and National Topographical Template need further explanation.
2. Map Dissemination and Usage (Para 5). Open series maps on scales larger than 1:1 million can be obtained only after registration and agreement with Survey of India for specific end use. Does it mean that the maps will not be available to general public, over the counter? Presently general public can get all unrestricted maps over the counter. Will there be a fee for registration?
3. Para 3. Defence series maps will be prepared without dilution of accuracy. Does it mean that there will be dilution of accuracy in Open Series Maps? If so to what extent?
4. Para 3a. Defence series topographical maps will be on Everest / WGS84 and Polyconic / UTM projection. It is not clear whether all maps will be on both datums and projections.
5. Para 3b. It appears that sheet numbers and layout etc. of OSMs have not yet been finalized. When will the new maps of the whole India will be available, is not known. We fear that it may take a very long time, may be even 10 years to make available all OSMs. Time frame has not been given.
6. Annexure 1A. Details to be included in OSMs have been listed. I would have been better if the details, which cannot be included in OSMs, had been listed. The inclusion list creates a lot of confusion. A few examples are given below: -

   A) 13 Water features – Tanks. Does mean that water features other than tanks, such as reservoirs, swamp or marsh etc. cannot be included?
   B) 27 Heights. Spot approximate heights can be shown. Does it mean that triangulation heights and spirit-leveled heights cannot be shown?
   C) 28 Bench marks-Geodetic, Tertiary, Canal. Does it mean that railway; road or other benchmarks cannot be shown? It is not clear whether heights of these benchmarks can be shown? Also if the heights are to be rounded to 1 metre or 0.1 metre.

   Similar are the cases with many items. It is silent on coastal features, high mountain features, Electric power lines, Telegraph and telephone lines, water pipe lines etc.

7. It does not speak about supply of coordinates in curvilinear or rectangular systems. To what accuracy coordinates can be supplied, has not been mentioned.
8. It is silent on air photographs.
9. It is silent on satellite imageries.
10. It does not deal with gravity data.
11. What about independent surveys by state government, local government and private agencies?

It is hoped that all concerns mentioned above will be looked into and a comprehensive map policy is formulated soon.

# Scalable GPS infrastructure

## The building blocks of tomorrow

GPS infrastructure can be said to be essential to the growth and development of the surveying community

NATHAN PUGH

As the designers and builders of infrastructure; surveyors, engineers and construction contractors know well the benefits gained from a strong infrastructure. Whether transportation, utilities or communication systems, infrastructure constitutes a society's basic structure, the foundation upon which the growth of a community, state or entire nation depends.

But infrastructure doesn't happen overnight. Consider the nation's the nation's massive transportation system. Built over several decades, the Interstate Highway system in the USA is a good example of infrastructure's scalability—the ability to grow over time as needs increase—and the need for sound urban planning. A powerful network based on smaller interconnecting state roadway systems, the massive Interstate Highway system was discussed and designed as early as the mid-1930s, but not fully approved and started until the mid-1950s. Funded by the Federal-Aid Highway Act of 1956, President Dwight Eisenhower pushed for a national system after being impressed with the strong autobahn network in Germany.

Today, similar planning foresight is taking place in states across the nation as private firms, municipalities, and state and federal organizations are providing real-time kinematic (RTK) Global Positioning System (GPS) infrastructure capabilities to their areas. Similar to the national highway system's importance to the nation as a whole, GPS infrastructure can be said to be essential to the growth and development of the surveying community.

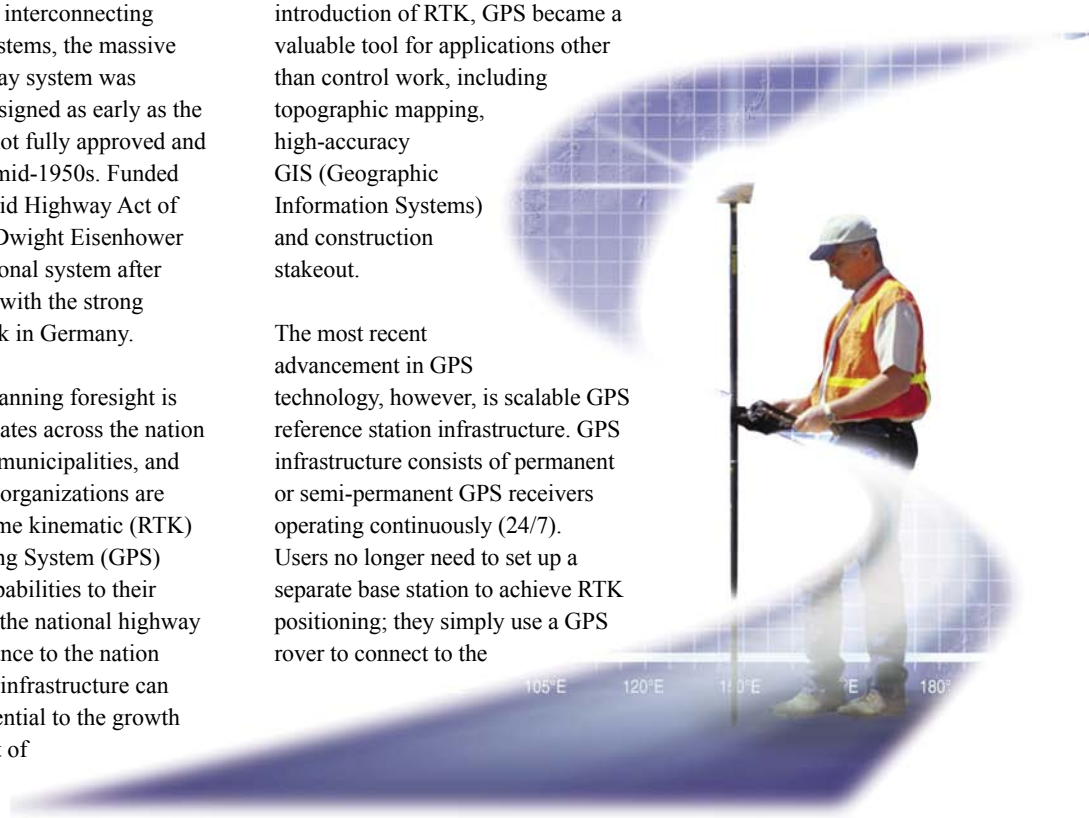
### GPS Infrastructure

For two decades, the tools of GPS have mainly been individual receivers designed for various accuracies and capabilities. Initially, surveyors who used GPS in the early 1980s endured long observation periods in the field and time-intensive postprocessing back in the office. As a result, GPS was really only feasible for establishing control. To gain centimeter-level accuracy positioning in the field, surveyors in 1993 began using RTK GPS technology, which also minimized data postprocessing. For RTK positioning, a reference receiver (station) transmits its raw measurements or observation corrections to a rover receiver via a data communication link, whether radio modem or cell phone. With the introduction of RTK, GPS became a valuable tool for applications other than control work, including topographic mapping, high-accuracy GIS (Geographic Information Systems) and construction stakeout.

The most recent advancement in GPS technology, however, is scalable GPS reference station infrastructure. GPS infrastructure consists of permanent or semi-permanent GPS receivers operating continuously (24/7). Users no longer need to set up a separate base station to achieve RTK positioning; they simply use a GPS rover to connect to the established infrastructure. GPS infrastructure can range from a single reference station to a wide-area Virtual Reference Station network; for each option, GPS infrastructure offers several benefits:

- Ubiquitous positioing over a large area
- Common coordinate reference frame
- Reference station security
- Decreased learning curve to achieve precise GPS surveying
- Cost savings for capital improvement projects (government) or larger profit margin on the same type of jobs (private sector)
- Reduced cost for field crews for field setup and equipment costs

The choice of each option depends on requirements and coverage area. Let's look at each.



## Single reference station

The first step in scalable Global Positioning Systems (GPS) infrastructure is an independently operated community reference station providing data for multiple applications. Private firms, municipalities and larger agencies all find single reference stations a good starting point to gain network RTK benefits. Generally, a single reference station is connected to one computer for a variety of application including:

- Postprocessed file logging for static surveying
- Single-base RTK positioning for precision applications within a 20 km radius
- DGPS corrections for submeter accuracy within a 200 km radius

The prime example of single reference station infrastructures is the National Geodetic Survey (NGS) Cooperative Continuously Operating Reference Station (CORS) network. The Cooperative CORS network consists of single reference stations independently operated by governmental, academic, commercial and private organizations. Through a link on the NGS Web site, users can access the data by contacting the individual station for three-dimensional (3D) positioning activities throughout the U.S. and its territories. CORS sites have to meet established criteria for inclusion in the national database.

## Multiple reference stations controlled centrally

The next step in GPS infrastructure is multi-station networks that are controlled at one central site. Analogous to having multiple offices linked together through a wide area network (WAN), these networks cover a larger area. Each station offers single-base RTK positioning but all stations are managed centrally. This level enables an organization with multiple offices to be on a common coordinate reference frame; similar to their IT network, the GPS infrastructure can be controlled using the same architecture as the IT network.

This second infrastructure level expands the geographic territory covered by single reference stations and enables a single administrator to operate an unlimited number of receivers in a network. Cities, counties, states, nations and private firms can establish and control a network of fixed reference stations to provide RTK corrections or postprocessed data for their area of operation.

Quality control is also enhanced at this level. Administrators can monitor the coordinates relative to the other reference stations, holding one fixed and monitoring the base lines. This enables administrators to ensure the network stations aren't moving over time and that coordinates—and thus data quality—are correct.

## Full atmospheric and systematic error modeling

Offering the largest coverage area while minimizing the number of reference stations, the third step in GPS infrastructure is the VRS™ network (Virtual Reference Station). Including three up to a multitude of stations, VRS network software processes the entire network simultaneously, offering greater quality control and higher data accuracy at greater distances. Additionally, along with offering scalability in the number of reference stations, network configuration and architecture are also scalable. VRS networks can run on just one server, or have 10 or more servers running GPS solutions, depending on the redundancy, reliability and processing power required.

In the field, the farther users get from a reference station using conventional RTK, the more susceptible they become to reduced accuracy and performance due to ionospheric and tropospheric factors, also called PPM errors. With a VRS infrastructure, network software provides a fully modeled solution that factors in potential PPM errors. Users connect into the system using a wireless connection; the software acknowledges the users' field positions and allows them to operate as though there is a reference station—a virtual reference station—right next to their rover. As a result, the PPM error is significantly reduced, enabling surveyors to work at long distances from the physical reference stations.

In Asia-Pacific, several countries have installed GPS infrastructure networks , amongst them China (for e.g, in the cities of Sichuan, Beijing, Shanghai and Wuhan) , Malaysia (myRTKNET was launched recently in May 2005), Australia (in the states of Queensland and Victoria), Taiwan and Japan.

**Nathan Pugh** holds a BSc in Geomatics Engineering from the University of Calgary. He has worked in the GPS surveying industry for eight years, including roles with Trimble in product management and applications engineering. Nathan is currently Trimble's Americas GPS Infrastructure Manager.

# "What is the difference between Everest Spheroid and WGS 84?"

NoCoordinates is a new section, where readers questions – sensible and funny, both are answered.

## Indian Geodetic System

A suitable geometrical mathematical surface is necessary to be defined for mapping Earth's surface as its surface is very complex, making it unsuitable for computations and mapping. This geometric surface is called reference surface which is based on the following assumptions:

1. It is an oblate ellipsoid of rotation formed by rotating an ellipse whose major axis and minor axis are nearly equal to that of the equatorial axis and polar axis of the Earth. Rotation of ellipse is about its minor axis.
2. This reference surface is rotating from West to East (anticlockwise) with nearly the same speed as that of the Earth.
3. Mass and Volume of this surface is nearly equal to that of the Earth.
4. Center of the ellipsoid coincides with the center of gravity of the Earth. Minor axis of the ellipsoid coincides with polar axis of the Earth.

India and other countries of the world made measurements in their countries and defined reference surface to serve as Datum for mapping. In India the reference surface was defined by Sir George Everest, who was Surveyor General of India from 1830 to 1843. It has served as reference for all mapping in India. Indian system can be called Indian Geodetic System as all coordinates are referred to it. The reference surface was called Everest Spheroid.

The initial point for mapping on the surface of the Earth was chosen at Kalyanpur in Central India. On realization of the system it was found that our system is in error and the assumptions have not been fully met. It is estimated that center of Everest Spheroid is nearly a kilometer from the center of gravity of the Earth. It is also realized that minor axis is not parallel to polar axis but inclined to it by a few seconds. The system is therefore a local one and needs to be redefined, as it is not suitable for higher defense and scientific applications. The system will not be suitable for launching Inter Continental Ballistic Missiles.

## World Geodetic System 84 (WGS 84)

The United States Of America Defense Department defined World Geodetic System 84 for global navigation and positioning system to cater to their sophisticated defense needs. This global system is named as NAVSTAR GPS. USA has been spending billions of dollars every year since seventies and will continue to so. The system was extensively during recent Iran – Iraq war successfully. To define WGS 84 similar sets of assumption were made as for Indian system. WGS 84 is an accurate system as its center is estimated to be only + or - 2 meters away from the center of gravity of the Earth. It will be fair to assume that assumptions in this case are almost met. The system is therefore most suitable for higher defense and scientific applications.

To convert the coordinates from Indian to WGS 84 and vice versa 3 translation parameters, 3 rotation parameters and 1 scale parameter are required which can be determined by observations. It is not easy to determine reasonably accurate transformation parameters.

*N. K. Agrawal, nande@rediffmail.com*

## Any answers?

1. Can the existing mobile phone network act as a low cost alternative positioning system vis a vis the satellite based positioning system?
2. Is it possible to have a very low cost indigenous GPS in India?

Readers are requested to send new questions, and answers of the above-mentioned questions to: talktous@mycoordinates.org. The answer can maximum be of 250 words.

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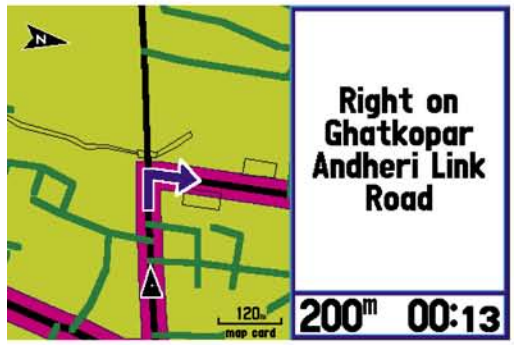


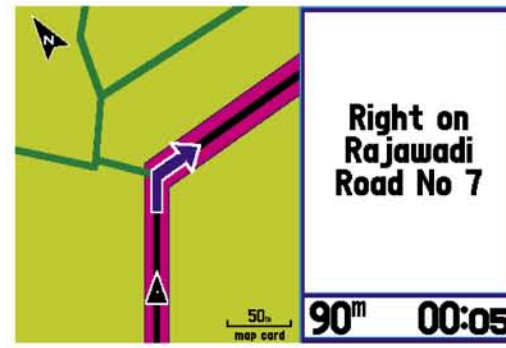


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