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Coordinates

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A MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

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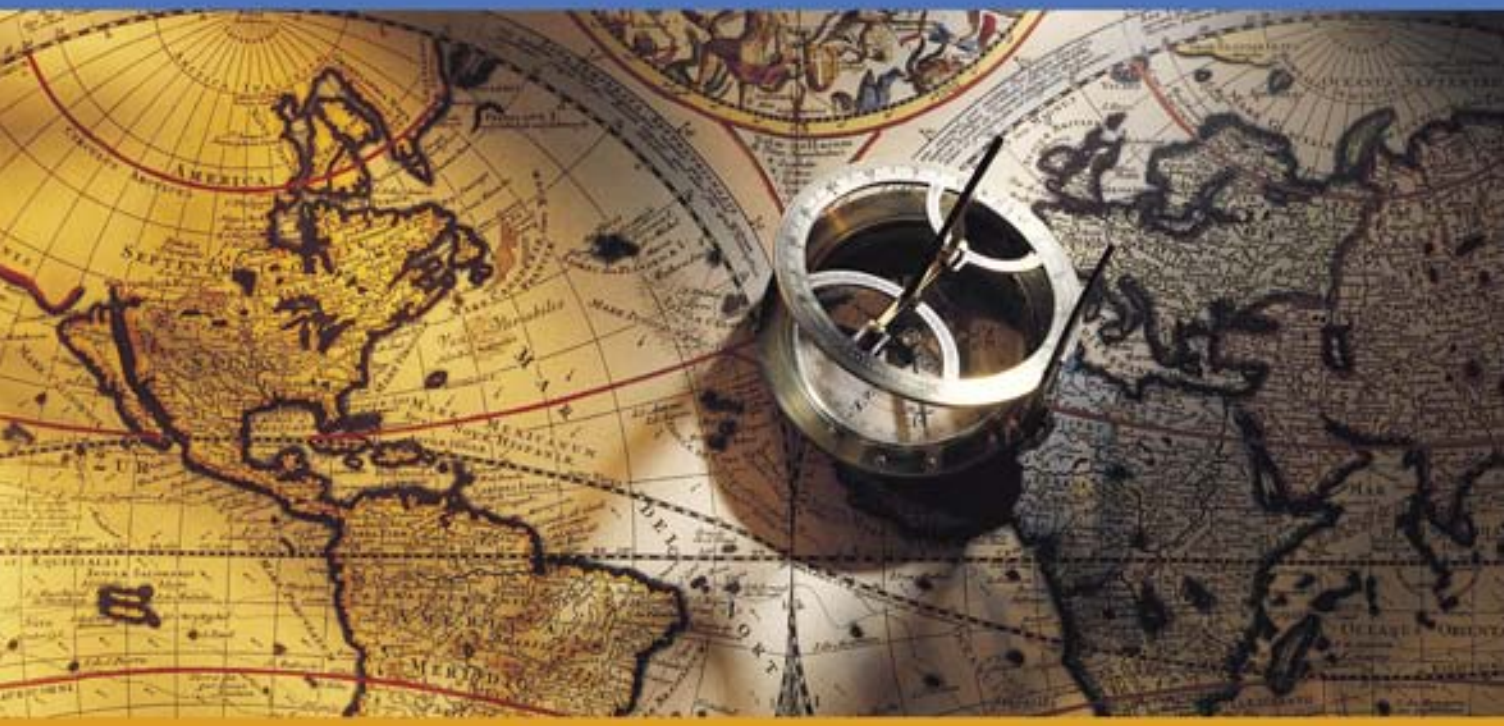

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Articles






Columns

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Pursuing a vision

There is a need to make available high resolution digital maps produced in India.

There is a need to place them on a website

There is a need to create a virtual Earth for India for easy access to its citizens.

There is a need to do this in a time bound manner with suitable policies and adequate security mechanisms.

Dr A P J Abdul Kalam, President of India gave the above missions at 26th Congress of Indian National Cartographic Association (INCA) in New Delhi on Nov 22, 2006 (*complete speech on page 6*).

The President has a vision of transforming India into a developed nation before 2020 and he considers such a mission is relevant to Vision 2020.

Coordinates would like to contribute in this great vision.

To start with, we are publishing an open letter to the President of India by Dr Muneendra Kumar where he emphasises that such a vision can only be achieved with sustained efforts and revolutionary solutions (*page 7*).

We have a vision and missions put forwarded by the President of India himself.

There is a need to answer the question 'What stops us?'

Bal Krishna, Editor
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"Map the earth to enrich the globe"

Dr A P J Abdul Kalam, The President of India outlines the priorities and mission for Indian cartographers while addressing the 26th Congress of Indian National Cartographic Association

I am delighted to participate in the 26th Congress of the Indian National Cartographic Association (INCA). My greetings to the organizers, delegates of the Conference, cartographers, scientists and technologists, users of cartographic products and distinguished guests.

India has a vision of transforming itself into a developed nation before 2020. There are number of missions which need inputs from cartography technologies that will certainly accelerate the process of development. The programme such as Bharat Nirman Programme including PURA (Providing Urban Amenities in Rural Areas), networking of rivers, infrastructure development in 63 cities through Jawaharlal Nehru Urban Renewable Mission, mapping of earthquake prone areas and recurring floods in north Bihar and Assam require vital inputs at the stage of planning and implementation level. The mission of INCA should be to assist the implementation of developed India vision using their core competence in cartography in partnership with ISRO, NRSA, Survey of India, State Remote Sensing centers, Thematic map making organizations, Indian Remote Sensing Industries, Academia, Research Institutions and other IT organizations. Hence, I would like to talk to you on the topic "Cartographers: Partners in National Development". Let us now look at some typical requirements of rural and urban development programmes of the nation, where cartographers are major partners.

PURA (Providing Urban Amenities in Rural Areas)

India is on the mission of establishing 7,000 PURAs (Providing Urban Amenities in Rural Areas) in different parts of the country integrating six hundred thousand villages (2 lakh village Panchayats). This integration will bring prosperity to rural India. PURA envisages four connectivities: the physical connectivity of village clusters through quality roads and transport; electronic connectivity through tele-communication with high bandwidth fiber optic cables reaching the rural areas from urban cities and through internet kiosks; knowledge connectivity through education, skill training for farmers, artisans and crafts persons and entrepreneurship programmes. These three connectives will lead to economic connectivity through the establishment of enterprises with the help of banks, micro credit and marketing of products. Since the PURA Clusters need road connectivity, the optimum road alignment without damaging the environment, uprooting the trees and disturbing the water bodies is a prerequisite. The information has to be generated for each block for meeting the 11th plan demands of establishing number of PURAs in the State. As a part of physical connectivity, link roads emanating from PURA clusters joining the main roads have to be planned in such a way that they can meet the growing traffic resulting out of higher economic activity in the PURA Clusters. A combination of ground survey, satellite remote sensing data, and Aerial pictures has to be used to derive relevant maps at larger scale better than 1:10,000 and even at the level of 1:2000 as appropriate in a time bound manner within the next two years.

Jawaharlal Nehru National Urban Renewal Mission

The Government of India has undertaken several initiatives to encourage sustainable urban development in the country, including the recent declaration of a national incentive-linked fund, the Jawaharlal Nehru National Urban Renewal Mission (JNNURM). The JNNURM covers 63 of the largest cities in India. The Ministry of Urban Development (MUD) has been designated as Executing Agency (EA) for the infrastructure and governance component of the JNNURM. India's cities require structured infrastructural development, environmental upgradation and adequate urban infrastructure, particularly the planned sewage and drainage system. The entire infrastructure needs improvement quantitatively and in qualitatively. Urban development and management is necessary to deliver better quality of life to our citizens, considering the local and national economic growth. Thus, JNNURM envisages provision of modern drainage system, provision of drinking water in each house, electrical and electronic connectivity, rain water harvesting and water recycling and provision of congestion free roads. JNNURM is a time bound programme. It is very important for the cartographers to provide cartographic data for each of the 63 cities and towns, using the satellite imagery coupled with GIS. They should first establish the existing road network

with contours, green areas, location of original water bodies, existing sewage and drainage systems. New alignment has to be provided keeping a 50 years growth profile in mind updated at an interval of ten years. Availing temporal information obtained through satellite remote sensing will enable better planning and regular monitoring. Based on this study, they must provide new connectivity contours, the new sewage system alignment, possible transportation of sewage system remains after treatment and above all a multi-layered road system to remove traffic congestion. It should be made mandatory for the city administration to use such data and information for decision making.

Disaster Management

Earthquake

Though India is rich in natural resources, many parts of India also faces different types of natural disasters such as earthquake, incessant down pour leading to localized floods, drought, avalanche and landslide in hilly areas, storms and tsunami. It may not be possible to avert the natural disasters, but the suffering and misery due to loss of life and adverse socio-economic impact can be minimized. First the mapping of the earthquake prone areas with suitable details enables the detailed precautions in construction and emergency actions. A powerful-enough earthquake just a few seconds in duration can still make current maps suddenly out of date, at the same time severing power lines, gas mains and water pipes. Secondary disasters such as landslides may have taken place in some areas. Satellite images can provide updated views of how the landscape has been affected, while images before and after the event enable authoritative damage assessment as a basis for planning remedial action.

Flood and water management

I have observed certain unique features in the river system of Bihar. Though Ganga, the main river is flowing from West to East, there are two types of flows coming into the Ganga. Because of the flow from both the directions no water is saved and everything goes to the Sea. Also, the main flood bearing river the Kosi when it comes into Bihar is already in the plains and we have to find innovative flood management techniques. Cartographers should provide high resolution maps in partnership with agencies involved in satellite imagery and aerial photography for planning water harvesting and water management system leading to flood control even in the steep slopes of hill area.

Flood control through Layered wells

There is an urgent need to find long-term solution to control flood, store and utilize the surplus water during

An Open Letter:

To: Dr A P J Abdul Kalam, President of India

Sub: India has a VISION
Ref: President Dr. A P J Abdul Kalam Address at INCA 2006

Dear Dr Kalam,

While reading with great interest your vision articulated at 26th INCA 2006, India deserves nothing less than the best. The correct mapping of the Defense Series of Maps (DSMs), which will be produced by Military Survey Directorate and Survey of India as mandated in National Map Policy released last year, is extremely critical. Any thing less can lead to "life or death" of a war fighter. I interpret this "A dead war fighter would never return to tell us what was wrong".

Here, I would like to identify the contribution of geodesists of the Survey of India (SOI) towards the fulfillment of the VISION. They must stop using the 19th century Indian Datum, 1980s "solutions" of the West, and an un-valid datum, which does not exist. Only a correct and accurate newly realized Indian Geodetic Reference System (IGRS) would provide the required geodetic foundation. The cartographers will never progress, if they will keep using the status quo or 16th century UTM projection with its problematic grid system for the Indian datum. They would have to come out of the bondage of the past and look towards the new concepts and solution(s).

Fortunately, starting of the new DSMs and OSMs has provided the SOI a unique opportunity to lead the "change" from the OLD to the NEW. Additionally, the SOI does not have to search for the new revolutionary solutions, as they are already available. I might point that the new "solutions" have evolved just at the right time.

My humble request, as an India born ex-SOI officer, is that my extraordinary geodetic and cartographic expertise should be considered by India. I am fully aware of all about the "Good Coordinates" for India and have all the "right" solutions, which will make it possible to march ahead with full speed. Considering all the aspects, I guarantee that my contribution India will have the "best" IGRS, DSMs, and OSMs.

When you as President of India invoked a VISION, it must be fulfilled. But, ALL this can only be achieved with sustained effort and "revolutionary" new solutions. And, time is now for the Indian geodesists and cartographers to start the "visionary" march.

With best regards, sincerely yours,

Muneendra Kumar, Ph.D.

drought. In the Gangetic region, I have recommended construction of layered wells in the entry points of Kosi river. Normally the flood water has certain dynamic flow conditions. The layered wells assist gradual reduction in dynamic flow velocity after filling each storage well. The water thus stored will be useful during shortage period. Similar solution can be found for the north-eastern region. The complex problem today is to find out the location of multi-layered well in the entry point of floods arising from the Himalayan region. Innovation lies in finding a suitable place in finding a solution even though the Indian side entry point contours are very steep. Hence, there is a big challenge to cartographers to provide location of multi-layered wells, taking into account the path of the flood water movement.

Mapping Geothermal potential

In 2005, I visited Iceland a volcanic island, a small European country with highest per capita income in the Atlantic Ocean with the population of 300,000 people. This island has unique phenomena of terrain having volcanoes and earthquakes. This situation has been converted into an advantage by that nation by discovering the geothermal resources at 2 kms depth. These resources provide both hot water and steam. The steam is used for generation of electricity and supply to many parts of the island and the hot water is supplied for heating the homes. We found the cartographers have mapped the island with all its ridges, the volcanic and earthquake prone regions, geothermal resources of the future and its marine resources. Of course they use satellite imagery to locate the school of various types of fishes. May I suggest to the cartographers, to map the geothermal resources in Andaman & Nicobar Islands, of the total 300 islands I understand one or two islands are having active volcanoes. Also, Himalayan states may have tremendous geothermal potential. These are also required to be mapped in a time bound manner.

Technology enabled cartography

To address all the inputs needed for the above programmes, we need to use the latest scientific technologies and tools. In this context, the application of Information Technology in the form of GIS, Satellite Remote Sensing, Satellite photo-grammatry, satellite communication and Internet play a vital role. India has planned for a series of satellites specifically for cartographic applications. The first in the series, CARTOSAT-I launched in May 2005 is the first high resolution satellite that collects the details of terrain surface in stereo mode with the spatial resolution of 2.5 meters. As of today, I understand that more than 90% of the country is covered with stereo images. These images could also be used for better urban planning, cadastral level information of land and water resources. This satellite mission has enabled developing Digital Elevation Model (DEM) This elevation model is useful in GIS environment, providing a terrain model to facilitate drainage network analysis, watershed demarcation, erosion mapping, contour generation and quantitative analysis like location-distance-area-volume calculation. The DEM could also provide scene simulation and fly through visualization of the terrain. I am happy to note that Department of Space has launched a mission called CARTODEM for generating DEM of entire country using indigenously developed software package. The elevation accuracy of DEM will be better than eight meter. It is expected that in the middle of next year, major part of our country will be covered by DEM. Such an input should be made use of effectively by the Cartographers of the country for generating quality input data for PURA planning, design and development of state level waterways, urban planning and disaster management. As you may be aware, CARTOSAT-II is to

Journey from the mind to the market

President of India, Dr A P J Abdul Kalam has put forward a framework called 'World Knowledge Platform' while inaugurating the second conference on 'India R&D 2006: Mind to Market'. Dr Kalam said this platform will integrate the core competencies of the partner countries to develop knowledge products and will enable joint design, development, cost effective production and marketing of the knowledge products in various domains. He said initially the mission of world knowledge platform is to connect and network the R&D institutions, universities and industries using fiber broadband from the partner nations on selected R&D missions. The President said that fiber optics connectivity across the world is only waiting to be lighted up, which will make the world borderless. He said mission of world knowledge platform will be to take up the mission in some of the following areas which are of utmost urgency to make our world a safe, sustainable and peaceful and prosperous to live in. Focusing on energy, agriculture and food processing he said the other areas are water, healthcare, knowledge products, automobile and traditional medicines.

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be launched in January 2007 capable of collecting the terrain features with better than one meter spatial resolution. I am sure that the country will have satellites for acquiring details at sub meter level in the next five years.

Advances in Computer Sciences and space technologies, today provide us the capability not only to integrate diverse data sets but also with real time communication of data from far flung areas. Referencing of these data sets to their geographical locations has given rise to a powerful Geographical Information System (GIS) which is finding increasing use in almost every facet of our day to day life, be it as administrator or as planner or as executive monitoring a project or a tourist finding his way through navigation systems. These applications demand dynamic integration and visualization which in turn provide challenges to the cartographer as to how to integrate and process the data in real time and provide the visualization of out put as per user requirement. Yet another challenge to be addressed by the cartographic community is how do we ensure data integrity, interoperability and accuracy while fusing data from disparate data sources. Also advances in other technologies like GPS, mobile telephones, digital cartography, and photogrammatry will complement the cartographers in their endeavours for national development.

Missions for Cartographers

Since I am in the midst of Cartographers, I thought of giving the following six missions relevant to Vision 2020 for immediate implementation.

1. Creating a network of all organizations and cartographers participating in this Congress so that they can interface and provide inputs for the development of modern cartographic products required for national development missions.
2. Bringing out large scale maps using advanced technologies for various national development programmes like PURA, interlinking of rivers, survey/resurvey of cadasters, Urban development, metro rail, water ways.
3. Provide cartographic inputs to drought, flood and earthquake prone areas to the disaster management teams for effective planning of disaster management delivery system.
4. Making available high resolution digital maps produced in India and placing the maps on website thereby creating virtual Earth for India for easy access to its citizens in a time bound manner with suitable policies and adequate security mechanism.
5. Identifying wastelands which are essential to take up Jatropha cultivation for bio diesel production. Cartographers should come out in identifying the exact quantum of wasteland available in the country and help the government and farmers for enabling the Jatropha cultivation.
6. Training and building a human resource team which can face the cartographic challenges of the twenty first century.

Cartography has come a long way from the days of Ptolemy and is playing a major role in our lives through new technologies such as GIS, GPS. I am told that most of the mapping of the western world is done in Delhi, Hyderabad and Bangalore. There is a need for a campaign to increase the awareness of the common man regarding utility of geo-spatial data and its use. Cartographic community has a key role to play in national development and I am sure you will provide value added services to all national missions.

With these words, I inaugurate the 26th Congress of Indian National Cartographic Association and my best wishes to all the participants' for success in their mission of providing quality cartographic products to the needy.

May God bless you.
http://presidentofindia.nic.in

... and Everest retired ...

By 1840 Everest was beginning to think of retiring. He was reaching completion of the Great Arc which was his initial aim but after that he had no further plans that would keep him in India. The last link in the Arc was the re-measurement of the Bidar baseline which took place in December 1841. Measured under the supervision of Alexander Waugh, it was the longest of all the Indian baselines at 41 345 ft (= 7.8 miles). Measured with compensating bars it took from October 19th to December 4th to complete.

Obviously there was much office work for Everest to complete after all the field work for the arc was over and it was November 1842 when he submitted his resignation and he sailed from India on December 16th 1843.

Retirement for many people is a time looked forward to for rest and hobbies, but not so with George Everest. Within a few months of arriving back in England he was becoming active in many of the prestigious Societies in London including The Royal Geographical Society and The Royal Society. After a visit of some months in 1845 to the United States he was back working on his Report of the work on the Great Arc with all the results including his second set of parameters for the figure of the earth. Of course it was to be expected that the second set of results were noticeably different to the first if for no other reason than that there was an interval of some 17 years and considerably more information to hand. The comparison was thus:

1830 a = 20 922 931.80 ft, b = 20 853 374.58 ft (a-b)/a = 1:300.80

1847 20 920 902.48 20 853 642.00 1: 311.043

Of the two results, the first set was much more widely used than the second set.

At the same time he must have been seeing the society ladies of London because in late 1846, aged 56, he married Emma Wing who was only 23 years old, so young enough to be his daughter. They achieved 20 years together and had six children. Unfortunately only the eldest son had any family and they both died around the time of the First World War. So the direct Everest line died out in 1935. Many people claim descendancy from George Everest but they are all indirect through his only married brother Thomas Everest. This was a line that was to include, through marriage, George Boole of Boolean algebra fame.

The Wing family of George Everest's wife was a well known family from Rutland, in Eastern England. One relative of the17th century was Vincent Wing who, in 1664, wrote a book on *The Art of Surveying.* Several members of the family became eminent in astronomy, law and the Army.

Whilst George Everest's professional life in the Survey of India is well chronicled there is a severe lack of information about his private life not only for his time in India but more surprising, for his retirement period in England. The comment of his niece in a published writing of 1905 did not improve matters. She said "that circumstances into which I cannot now enter, led to the destruction of nearly all written memorials of his life…." Various hypotheses have been put forward over the years as to why this should have occurred but so far there is nothing to prove any one of them and it would be fruitless to try discussing them here. If any reader has documents of any sort relating to his personal life at any time I would be interested to hear from them. Did he in fact deposit any documents in an Archive somewhere as so many of his famous contemporaries did?

It was 1861 before he was awarded the honour that he had felt for so long that he deserved. He was awarded the C.B. in February 1861 and was knighted in March of the same year.

Almost until the time of his death on 1 December 1866 at the age of 76, Sir George was on the Council of the Royal Society and a Vice President of the Royal Geographical Society.

The lasting memorial to him is, of course, something in which he played no direct part – the naming of the mountain. At the time of the discovery of such a high peak in the 1850s exceptional efforts were made to find a local name for it. When all suggestions could be disproved for one reason or another, Andrew Waugh, the then Surveyor General and Superintendent of the GTS, decided that it should be named after "My illustrious predecessor". Rather naturally since that time there has been extensive debate on the name but this is not the place to go into that. Suffice to say that Sir George never saw the peak and never named it after himself.

In summary he was obviously a hard task master, single minded in determining to see his task through, and with formidable knowledge not only geodesy but with the ability to invent and repair instruments, and to survive so much by way of the hazards of India at that time. The meridian arc together with his two sets of parameters will be a lasting memorial to his genius for many more years to come.

Much of what has appeared in these instalments on Sir George Everest's life and work can be found in: Smith, J.R. 1999. *Everest. The Man and the Mountain.* Whittles, Scotland.

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River cross-section surveying using RTK Technology

The Yangtze River project case study

BENLIN XIAO , FENGMING WAN , CHANGQING WU AND KEFEI ZHANG

China has a vast expanse of land with intertwining rivers and mountains, abounds in lakes and reservoirs. The survey of rivers and lakes as well as the protection and exploitation of these resources plays an important role in Chinese economy. Cross-section survey of water bodies is a key part in hydrographic engineering survey. Traditional methods of cross section survey of a river such as theodolite intersection, theodolite stadia, electronic distance measurement, depth-surveying bar, leadline, handlead survey and echo sounder are the main methods used for water bathymetry. These methods are not only prone to the inaccuracy of instruments, distances, weather conditions, intervisibility and communication device, but also involved in tedious workload which leads to low efficiency. Some unfavorable factors such as the flow of the water and the nonlinear movement of the surveying ship make measuring the depth of the water more difficult. Lack of skills and cooperation among surveyors might result in a low accuracy in the position fix of cross-section points, thus further affects the quality of cross-section survey of the river. The application of real-time kinematic (RTK) GPS positioning technique has opened a new avenue for the cross-section survey of rivers (Wu, 2005). Simultaneous utilization of RTK GPS technology and the shipboard sounding method (e.g. digital depth sounder) will greatly improve the accuracy and efficiency of cross-sectioning survey of rivers(Qiu and Fong, 2002; Qiu 2004; Zhang et al, 2002).

Basic principles of RTK GPS

For high accuracy GPS positioning, "differential" GPS technique is used where one receiver acts as "the base" and the rover is positioned in a close vicinity of the base to take advantage of the nature of spatial correlation of the GPS measurement errors such as atmospheric delay, orbital errors, clock errors and other factors in GPS survey. Carrier phase measurements are taken and unknown integer cycles of the carrier waves (i.e. the integer ambiguities) need to be resolved prior to the baseline solution is computed through a "double-differenced" process. Real-time data processing of the GPS measurements at both base and rover stations will make it possible to obtain the stations' real-time three-dimensional coordinates with a centimeter level accuracy after a successful initialization process (Hu et al., 2005). In practice, a GPS receiver is set on a base station whose coordinates are precisely known. This GPS receiver is connected with a data transmission mechanism, which transmits the observations and the base station information to (one or more) remote roving receivers. With the GPS signal corrections transmitted in real time from a reference receiver at a known location and the information from four or more visible satellites, a data processing is carried out in real time at the rover station, and the ambiguity resolution, position and accuracy of the rover station is obtained. The critcal requirements of the RTK techniques include: simultaneous measurements from a minimum of two GPS receivers, the separation of the base and rover is less than 10-20km and an on-the-fly data link.

Figure 1 Geographical location of the project area along with Yangtze River (in relation to the Three-gorge dam project).

Cross-section survey of river in Jinjiang Reach

Introduction of the Project

Yangtze River is our mother river. Chinese people have been living by the mother river generation by generation happily and benefited greatly. At the same time, people have suffered a lot when serious floods occurred.

According to historical records the damage is low along lower reaches, high along upper reaches and most severe along middle reaches where Hubei province is located. Taking 1998 as an example, Hubei Province experienced a heavily flooding year with 66 counties waterlogged, 1.54 million hectares of fertile farmland flooded, and 3.83 billion RMB of properties lost (Lei et al., 2000). Figure 1 shows the middle reaches and lower reaches of the Yangtze River and the geographical location of the survey project area respectively.

The portion between ZhiCheng and ChengLingJi of the Yangtze River is named Jingjiang Sector, which is the crucial sector of the middle reaches of the Yangtze River and is 347.2 km long (OuChiKou is considered as the dividing line of the upper Jingjiang stretch and lower Jingjiang stretch respectively). Figure 2 shows the run of the Jingjiang sector. The upper Jingjiang stretch is a slightly curved bifurcated reach, while the lower Jingjiang Reach is a meandered reach. There is an important dike along Yangtze River - the Jingjiang embankment in the north side of the river.

During the past several decades, the Yangtze River has silt up and the riverbed has been elevated significantly. As a result, the flood water level of the Yangtze River, similar to Huanghe River, the second biggest river in China, has risen by 1.5 to 2.5 meters along the middle reach. Significant changes have taken place in Jingjiang reach since the extraordinary floods in 1998 and 1999, respectively. The bifurcated reach has seen frequent flow fluctuations of the mainstream, erosion and sand deposition of the shoals. The water level of the Three Gorges Reservoir impoundment reached 135 meters in June 2003 and this led to the release of clear water and scoured in the downstream of the Three Gorges Dam. This made Jingjiang reach threatened by frequent bank failures, and the high risk of Jingjiang flood has not been mitigated.

Therefore, to investigate the run of the river along the Jingjiang reach is of paramount importance. To meet the needs of the assessment of potential risk, emergency management, and safety research of shipping and the design of other Yangtz river related engineering projects, river course survey of the Yangtze River along the Jingjiang reach is carried out.

The survey system requirements

Two sets of dual frequency geodetic GPS receivers (Trimble 5700) are used for the survey. The manufacturer's specification of the receiver is: 10 mm+1ppm (Horizontal) and 20 mm+1ppm (Vertical) for kinematic survey. One receiver is set as a base station with an on-the-fly datalink capability. The other GPS receiver is a rover receiver that is used in the survey ship. A laptop computer, SDH-1C3D numeral echo sounder and other necessary accessories (e.g. power supply, and other fittings) are used. A survey software package (Hypack), cadastral and topographical plotting software CASS 4.0 are also used. Figure 3 shows some field operation and station setting up of the survey using both GPS and a total station.

Cross-section survey

Along the riverbanks, there is a dense flood protection forest. It would be very labor intensive and resources demanding if the conventional cross sections survey technique is used to carry out the survey, this is particularly true for the control survey to connect the area with n high-order ational control points (Jiang et al., 2001; Zhao, 2005). In this aspect, the adoption of the RTK GPS technology is ideal. First, a preliminary design is conducted to use the existing 1:2000 bathymetric map of the Yangtze River. The cross-section survey lines are designed to be roughly perpendicular to the direction of the river course. The positions of the cross-sections control points are then selected in open fields and monuments are established. Each cross-section usually consists of two cross-section points and one in each side of the river. Finally, the 3-D coordinates (both plane coordinates and height) of the points are surveyed. The three-dimensional coordinates of each cross section line are input into a laptop computer. Appropriate geodetic datum parameters in the laptop computer are chosen priori to the computation of the results and the WGS-84 coordinate system and transverse Mercator projection are used in the survey. The unit of the measurements is meters and the area surveyed is located at geographical

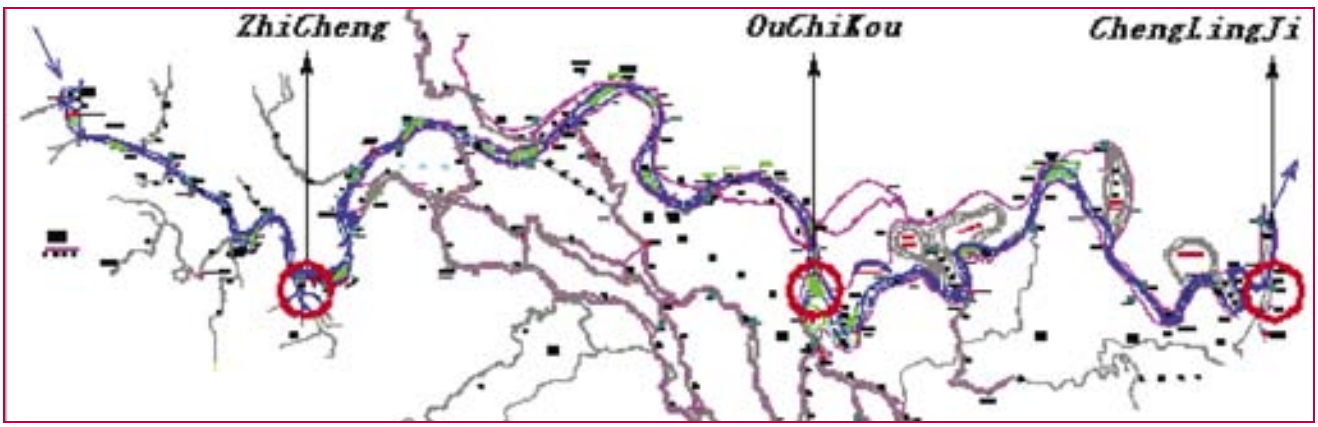

Figure 2. The Run of the Jingjiang Reach of the Yangtze River

Figure 3. Field survey operation using both GPS and total stations ((a) total station survey, (b) RTK on-shore survey, (c) RTK GPS base station setting up).

position of longitude 111°18'00"E to 111°18'10"E and latitude 22°31'25"N to 22°31'35"N respectively.

During GPS survey, a base station needs to be located over a known point and the base station should be chosen in such a way that there is no potential strong disturbance sources such as electromagnetic wave, microwave, high voltage power line disturbance etc to avoid the effects of the GPS signal reception and transmission. Before formal survey commences, known control points need to be checked first so that any transformation parameter mistakes or the data/ parameters errors can be detected and corrected (Huang et al, 2001). Then two points of a cross section line will be measured then their coordinates will be automatically produced in the laptop computer and displayed on the screen. At the same time, the laptop computer will also show the position and station number of the surveyor. So the surveyor may know whether he/she is on the cross section line or not as well as knowing intervals between the stations. The component of the station 3-D coordinates from GPS is also re-surveyed using an Electronic Total Station (ETS) for both confirmation and quality check.

Cross-section survey of the river

Cross-section survey of the river depends on cross-section measurement method used. The cross-section interval will be set about 200 meters apart, and Trimble 5700 GPS is used to fix horizontal position. GPS reference stations are located at open, ashore known points so that the reception of GPS satellite signals is not potentially blocked and the data link of GPS signal transmission does not pose any problem. GPS roving station is located in a powerboat for bathymetric survey. A common set of GPS satellites are recorded at both the reference and rover stations simultaneously. Coordinates of the mobile station are computed using both the received GPS satellite information and the differential information from the reference station via the data link. The SDH-13D digital echo depth sounder is used to measure water depth of the points. The sounding pole of the echo sounder and the GPS rover station antenna are put in the identical horizontal position. The echo sounder is controlled by the computer to collect water depth signals in an electronic form and then transformed into a digital form (i.e. numbers).

The river cross-section survey data collection and recording is carried out by the laptop computer with the Hypack survey software. Each cross section line is roughly perpendicular to the shoreline with an interval of 200 meters. Before the survey is carried out, the space of the measurement points needs to be established in the Hypack survey software. The survey boat is driven along with the cross section line while the laptop computer collects coordinates and the depth of water automatically.

The height is measured through trigonometrical leveling with ETS. The height of each cross section is derived from the ETS. The elevation of the underwater surveying point is therefore deduced from the water level and the water depth. During the survey process, water level at the related hydrometric station and water level observation station is recorded at the same time for a necessary check.

Data processing and visualization

The office work consists of the following two parts: data edition and visualization

After the field survey work, GPS data which is recorded in the receiver/or data card needs to be downloaded through Trimble proprietary software package – TGO (v1.6).

Four data files will be created. They are observation file (*.o) carrier phase and pseudo range observation file, navigation file (*.n), epoch parameter file and survey station information file.

GPS baseline vector is processed in order to promptly check the quality of the field observation data. 17 control points of Shashi river reach are used as checking points to evaluate the RTK GPS results. Coordinates from GPS RTK are compared with the coordinates derived from Electronic Total Station measurements. The results are listed in the following Table 1.

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As for the height component, China national standard datum is used. The model of Electronic Total Station is Nikon DTM532 - C, with an angle measurement precision of 2 seconds and distance measurement precision of 2mm+2ppm. The maximum distance measurement range is 3,600 meters.

According to the statistical results shown in Table 1, the maximum difference of the horizontal locations among the control points is 0.36m. The elevation difference is generally less than 0.1m, which illustrates the coordinates by RTK method and ETS is within the allowable error of this type of project. We can, therefore, conclude that the surveying results are accurate and reliable. During the process of office plotting, a specific plotting software package is used to edit the data collected in the field and all the data are transformed into discernable format by the topographical and cadastral plotting software package CASS4.0. The chart is plotted under the AuotoCAD2000 environment. The chart of the 413th half river cross-section in Shashi river gulf is shown in Figure 4.

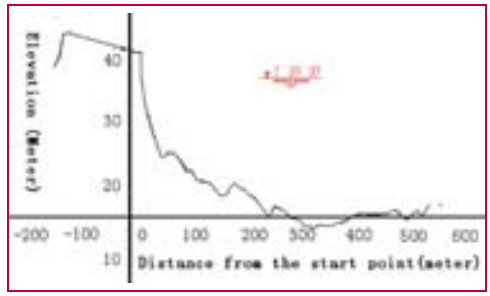

Figure 4 A Half River Cross-Section in Shashi River Gulf

The next generation of GNSS

In many regions, the availability of a GPS reference station network means that surveyors can utilize RTK GPS without the need to set-up their own local reference station. They can simply go to the field, set up a communication link to a GPS reference station network infrastructure then begin RTK GPS surveying. GPS reference station networks are increasingly popular as many government agencies have found it more economically viable to invest in GPS reference station networks rather than maintaining traditional ground geodetic control network. Using an array of permanently installed reference stations over a region or entire state removes the need to establish local control in the work area and set up temporary field reference receivers.

The motivation behind using multiple reference stations for GPS corrections is to model and correct for distance-dependent errors that reduce the accuracy of conventional RTK positions in proportion to the distance from a rover to its nearest reference station. Two leading international companies, Trimble Ltd and Leica Geosystems, have developed a network solution software, called GPSnet (VRS-Virtual reference station) and Spider (using the Master-Auxiliary Concept) respectively, to generate RTK corrections through a network of reference stations (Trimble Navigation Ltd. 2006; Leica Geosystems, 2006).

The main benefits of next generation GNSS are its rich space infrastructure, rich signal, and better geometry which can significantly reduce the position dilution of precision (PDOP) factor and provide additional system for cross check. The most valuable benefit will be the enhanced resolution of the integer ambiguities encountered in carrier phase tracking as the receiver attempts to determine the unknown number of full cycles between the carrier wave received and the one generated locally.

Conclusion

It is of great advantage to apply the RTK GPS technology to the surveying project of the banks and cross sections of the river, for it achieves fast position fix with a high accuracy,

Table 1 Statistic comparisons of the measurements from both GPS and total stations

Testing Points	RTK Measured Coordinate (m)			ETS Measured Coordinate (m)			Differenced (m)	
	N□m□	E(m)	H(m)	N(m)	E(m)	H(m)	□S	□H
Chang V7	3319168.03	637559.61	37.930	3319167.77	637559.85	37.903	0.36	0.031
Jing 77L2	3319275.94	637562.57	38.090	3319275.84	637562.66	38.09	0.14	0.000
Li 12L2	3262747.13	415581.64	34.922	3262747.12	415581.64	34.881	0.01	0.041
Jing 186R2	3260902.85	418608.02	36.440	3260902.84	418607.99	36.493	0.03	-0.053
Jing 180R2	3257100.74	410153.1	36.490	3257100.94	410153.17	36.543	0.21	-0.053
Jing 77R2	3265238.22	406030.93	37.180	3265238.22	406030.99	37.25	0.06	-0.070
Jing 176L1	3267555.77	403520.52	31.970	3267555.7	403520.72	31.971	0.21	-0.001
Jing 177L2	3268819.41	406072.04	32.670	3268819.48	406072.12	32.63	0.11	0.040
Jing 175L3	3265783.58	401257.29	33.440	3265783.59	401257.27	33.412	0.02	0.028
Jing 169L2	3272736.98	395839.38	32.970	3272736.94	395839.4	33.04	0.05	-0.070
Li IV05	3275541.46	395310.57	32.760	3275541.4	395310.22	32.73	0.36	0.030
Jing 168L1	3275541.48	395311.47	32.540	3275541.61	395311.27	32.543	0.24	-0.003
Jing 167L2	3277609.18	394729.91	33.030	3277609.21	394729.82	33.02	0.10	0.010
JingShang72	3284292.7	397267.86	33.870	3284292.74	397267.85	33.824	0.04	0.046
Jing 150L2	3287183.64	395998.26	33.860	3287183.67	395998.12	33.886	0.14	-0.026
Jing 138L3	3294435.27	385816.94	33.950	3294435.33	385816.82	33.872	0.13	0.078

high efficiency and high productivity in comparison with the traditional time-consuming and labor-intensive surveying practice. The project demonstrates that the Trimble 5700 GPS receivers, integrating with the SDH-13D digital echo depth sounder, can be one of the best solutions for the survey of the Yangtze River. More significantly, the application of the GPS RTK technology to Yangtze River surveying at Jingjiang reach made it possible to meet the needs of all other engineering projects related to Yangtz River in dry seasons. As a result, the completion of the project in a dry season is a critical support to other highly-prioritized projects such as Three Georges Dam construction. The accomplishment of the project sets a good example to implement surveying of big river like Yangtze River and Huanghe River which are the two biggest rivers in China.

To gain accurate and reliable survey results, our experience suggests that

1. When satellite signals are blocked by objects such as tall buildings or big trees, RTK GPS survey may experience problems. This may lead to a system initialization problem since the requirement for a minimum number of satellites cannot be met and the receiver cannot be initialized. At this circumstance, it is necessary to use conventional surveying techniques for the collection of the field data.
2. When undertaking the bathymetric surveying, the rover receiver is mounted on the boat. Because of the tumbling and rushing of waters, it is paramount important to be sure that the GPS positioning data matches the depth surveying data of water. That is the GPS surveying and the digital echo depth sounder surveying must be synchronized perfectly.
3. Occasionally, the rover GPS receiver experienced signal reception problem which leads to a difficulty to successfully resolve integer ambiguities. This is mainly because the GPS antenna is interfered by the radio signal transmitted from the reference station. It is therefore, suggested that the antenna of the radio transmitter should be far enough from the GPS antenna.

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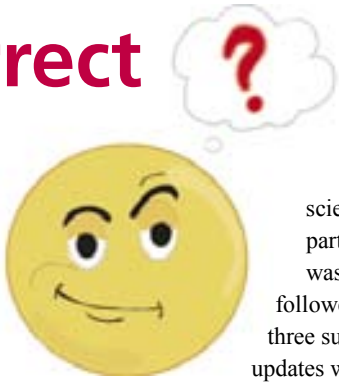
Is definition of WGS 84 correct



A Geodetic Analysis

Muneendra Kumar, PhD and James P Reilly, PhD

The first and original version of the "WGS 84", defined by a special committee of the Defense Mapping Agency (DMA), was released in September 1987. As this task of updating the WGS 72 was concurrent with development of the North American Datum (NAD) 1983, the committee members always had many in-depth discussions with the members of the special committee of the National Geodetic Survey (NGS). This approach ensured the correct geodetic definition both for WGS 84 and NAD 83. Around 1992, it was decided by DMA that, in future update(s) of the "WGS 84" for accuracy enhancement, the academia and other satellite geodesy experts would be associated. However, that scientific participation was not followed and three subsequent updates were carried out without in-depth discussions of satellite geodetic theory and/or correct statistical evaluation. The non-scientific procedure(s) allowed definition deficiencies to creep in. This paper outlines the geodetic details of the three updated versions of 1994, 1996, and 2001 and brings out in "open" the definition deficiencies in the current version WGS 84 (G1150), which otherwise will remain hidden within the National Geospatial-Intelligence Agency (NGA).

The correctly defined "WGS 84", the coordinate system used in GPS, is a critical requirement for the geodetic integrity and accurate GPS positioning.

Geodesists without Boundaries

To provide analysis, interpretation, opinion, advice, and/or consultation concerning Geodetic System and Datums, Maps, Charts, GPS and Marine Positioning, Geospatial Information System, gravity, and International Boundaries, an independent experts group is formed "Geodesists without boundaries" under the leadership of Dr Muneendra Kumar, Nat. Geospatial-intelligence Agency (Retired), USA. The other members of the groups are Prof Erik W Grafarend, University of Stuttgart (Retired), Germany; Prof James P Reilly, New Mexico State University (Retired), USA; Dr. Manohar G Arur, Survey of India (Retired), India; Dr Siva Gopal, Battelle Memorial Institute (Retired), USA. For details contact, Dr Muneendra Kumar, *munidmk@kmapsystems2005.info*

1984 "Original" Definition

The WGS 84 was originally defined with BIH Conventional Terrestrial System (CTS) for Reference Epoch "RE (84.0)". The main satellite data sets used were from the Navy Navigation satellite System (NNSS). At the time of release in 1987, the accuracy achieved was in the order of ± 1 - 2 meter and as such the tidal effects, as specified in the International Association of Geodesy (IAG) Resolution 16 of 1983 were not considered.

The "Three" WGS 84 Updates

1994 "WGS 84 (G730)"

This version was updated with the International Earth Rotation Service (IERS) realized International Terrestrial Reference Frame (ITRF) 1992[1], RE (88.0). During this update, NGA moved the RE (88.0) of the defining ITRF to RE (94.0), which is incorrect. For this "change", DMA geodesists did not have the capability and expertise. And, they did not have the authority to override IERS. *Note: With a new origin and orientation of its three axes, WGS 84 (G730) is geodetically a different coordinate system than the original WGS 84. For mapping, the two could be considered the same. [1] First six ITRF solutions, viz., ITRF 1988, ITRF 1989, ITRF 1990, ITRF 1991, ITRF 1992, and ITRF 1993, were realized for the RE (88.0). As the ITRF 1993 was based on all the data sets available up to the end of year 1993 and thus realized in 1994, it would not have been possible for DMA to define the WGS 84 (G730), which was realized using the GPS data for the week starting 2 January 1994.*

1996 "WGS 84 (G873)"

At the time of this update, the ITRF 1994, RE (93.0) was used (Note: ITRF96 (93.0) was not available). But, DMA geodesists again incorrectly moved the epoch of the defining "RF" to RE (97.0). And, for geodetic application, they created the third WGS 84. In addition, ignoring IAG Resolution No. 16 of 1983 and bypassing IERS Conventions (IERS, 96), which recommend the "Zero-tide" model, National Imagery and Mapping Agency (NIMA) geodesists adopted an "arbitrary" practice to use "Tide-free" model. *Note: According to IERS, the positions in the "Tide-free" environ are non-realistic and not observable.*

2001 Current "WGS 84 (G1150)"

During the updating of this version, the ITRF00, RE (97.0) was used. But, like the 1994 and 1996 versions, NIMA geodesists incorrectly moved the RE of the defining RF from (97.0) to (01.0), They also kept the 1996 practice for "Tide-free" model, even after being alerted that the world's eminent geodesists support the "Zero-tide" of the IAG' standing Resolution No. 16 of 1983. Furthermore, during

the adjustment of the GPS tracking stations network, about 65% stations were held fixed (Note: An objection by the first author was not even discussed). This over constrained adjustment is statistically incorrect and not acceptable. *Note: For geodetic positioning, this is the fourth version of WGS 84.*

The "Version" Identifiers

The "G730", "G873", and "G1150" indicate the GPS-week, of which the data sets were used to realize the three updates. As these "identifiers" do NOT specifically identify any definite time epoch, they do NOT have any geodetic significance.

Important "Contrast" To Note

In SIRGAS 2000, the "RE" of the defining ITRF has NOT been "moved".

Analytical Conclusion

The current "WGS 84 (G1150)" is incorrectly defined, does not comply with IAG Resolution No. 16 of 1983, and its time epoch is not definitive. Furthermore, the adjustment of the GPS tracking station network is statistically incorrect.

Reference

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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.

Ukraine might take part in European Space Program

During public hearings of a draft national space program for 2007 - 2011, Deputy Director General of the National Space Agency of Ukraine Eduard Kuznetsov said that some projects of the program might be included into the first European space program, which is presently being drafted, "Cabinet's press office" reported. Among the projects he first of all mentioned creating a space Ionosat system for comprehensive study of seismic-ionospheric and solar-Earth connections and their impact on technological and biological processes on the Earth. The program is supposed to start in 2010. Among the program's likely participants were named Poland, Turkey and China. *http://en.for-ua.com*

China's satellite navigation plans threaten Galileo

China's decision to expand the functionality of its satellite navigation network could undermine the economics of Europe's nascent Galileo system, according to sources close to the project. Until now, experts believed that China's "Beidou" navigation system – a 35-satellite constellation – would only be used by its armed forces. This explained China's decision to invest €200 million in Europe's €2.5 billion Galileo programme.

But things appear to have changed in Beijing. On 2 November, the country's official news agency Xinhua reported that Beidou would, from 2008, begin providing an "open" level of service, with 10-metre accuracy, in addition to its "authorised", encrypted military service. Precisely how open this 10-metre service will be, remains unclear, but the Xinhua report implied that it would be available free to all Chinese citizens and to other countries whose governments strike a deal to use the signal in satellite navigation devices. If this is true, it could be a big problem for the Galileo consortium, which had hoped to recoup part of its €2.5 billion investment in Galileo by selling receivers and commercial signal subscriptions in China.

It is not clear whether there are sufficient frequencies for Beidou to be used globally. But new agreements may be needed to ensure receivers are compatible with all three navigation standards: Galileo, the US-run Global Positioning System, and Beidou. Officially, however, the European Commission (EC) says it does not expect China's plan to impact on Galileo. *http://space.newscientist.com*

Work starts on ground control for Galileo space system

Work to build the new Galileo satellite-navigation system advanced with the official start of construction of the ground control centre in southern Germany. Transport Minister Wolfgang Tiefensee said at a foundation-stone ceremony in Oberpfaffenhofen near Munich that Germany would thus become the centre of the European satellite navigation industry. *http://science.monstersandcritics.com*

European Galileo joins GPS on one chip

A European Union project team is working to combine Europe's Galileo and the US's GPS satellite positioning technology onto one chip along with a 3G UMTS receiver for use in a mobile phone. "An integrated chip like this reduces the components a manufacturer needs to use, and reduces power consumption," said Günter Heinrichs, co-ordinator of the Gawain project. "It will make it very attractive for handset manufacturers to include navigation as standard with their mobile phones." *www.electronicsweekly.com*

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Land Information Online

Singapore Land Authority puts map-based land ownership information on the Net

Imagine: you want to know whether a plot of land or a building is state or privately-owned in order to tip-off a case of mosquitoes-breeding, overgrown or fallen trees, illegal parking, noise pollution, or even rubbish dumping. Imagine: you are interested to rent space and apply for permit to hold a corporate event, organize a family carnival, or simply to start a business. Imagine: you are interested to buy a strip of land adjoining to your property. Who do you call?

From November 22, 2006, LandQuery, the map-based information service on land ownership has been made available free to the public. LandQuery can provide information on:

a. Whether the land is State or privately owned;
b. Contact details of the public agency responsible for a particular State land or its managing agent; and
c. Land boundaries and lot numbers.

The LandQuery is a strategic partnership amongst the public sector, to capture a comprehensive database of public land ownership information. Enforcement agencies will find it useful to determine ownership for operational field work, such as maintenance, solving cases, or simply conducting routine checks. The general public will also be able to contact the right public agency for feedback on a particular State land.

This is just one of the many ways that the new online information service, known as LandQuery, can help public sector officers respond faster to public feedback on land matters, said Associate Professor Ho Peng Kee, Senior Minister of State for Law and Home Affairs, at a public launch ceremony of the new services at the Singapore Land Authority.

Also new is the StreetMap@Singapore that offers a simple and quick way to search for location information. Users are able to search using 5 different search keys and are able to download the maps for personal and non-commercial use.

These two services are enhancements to the current services that SLA is providing through the Integrated Land Information Service (INLIS) (www.inlis.gov.sg) portal.

Associate Professor Ho said that LandQuery hosts information on State land managed or used by about 50 different government agencies.

Hitherto, SLA receives enquiries from members of the public on land ownership generally for the following purposes:

1) Interest in renting a piece of land or property;
2) Interest in buying remnant land adjoining to their property; and
3) Land maintenance issues like mosquito breeding, overgrown trees, illegal parking and rubbish dumping.

Between April to August this year, SLA received on average per month, about 50 enquiries pertaining to land/property maintenance issue, and another 35 enquiries on rental of state land and properties.

StreetMap@Singapore is a basic online street directory service that provides the public with basic information like buildings and road names. Users can do a simple search using the following parameters: road name, address, postal code, building or development name and the nearest MRT or LRT station.

Maps from StreetMap@Singapore can be downloaded for free for personal and non-commercial uses. For example, users can utilize these maps for their own personal invitation cards.

Associate Professor Ho also updated the progress and enhancements of INLIS since its inception in 1998. INLIS is as one of the more successful government e-commerce sites; there are now 28 services from the initial 6, a 4-fold increase in services. This augurs good progress of SLA within the last 5 years in its move toward becoming the leading land and property information provider. Five years on, the number of electronic transactions conducted via INLIS has increased significantly in tandem with the growth of the Internet. The annual INLIS transactions grew from about 3,900 in 1998 to 132,000 in 2005. It is expected to achieve 30% increase this year. The yearly INLIS transacted value increased correspondingly from $48,000 in its first year to close to $2.35 million in 2005.

The other services added in INLIS in 2006 are:-

1. Image of HDB Leases

2. Image of HDB Instruments
3. Image to Private Property Instruments
4. Image of Index to Caveat Book
5. Image of Index to Land Book
6. Image of Private Property Deeds.
7. Property Title Information – Estate and Land Description
8. Property Title Information – Encumbrances Information
9. Land Information – Lot History
10. Historical Information
11. Caveat Index Information
12. SiReNT GPS data

Previously, customers had to make their way down to the SLA counter personally to purchase the images of the scanned documents, which was a time-consuming and bothersome process. By making these documents available for sale on the INLIS website, customers can purchase them in the comfort of their own homes or offices, thereby saving them much time and trouble.

Real estate agents, lawyers, homebuyers, surveyors, engineers, architects and other professionals and the larger public have benefited from the all the available services on INLIS.

SLA Head of Land Information Centre, Mr Lim Ming Khai said: "SLA hopes that with the provision of all these services including LandQuery and StreetMap@Singapore, public service efficiency and productivity will be enhanced. To the members of the public, it saves them fuss and time; all part of our commitment to enhancing quality public service."

The vision for INLIS is for it to become the gateway to land information services across various agencies to utilise land information, and to continually improve land data's usefulness and accessibility. INLIS aims to make it easier for residents and businesses to find and use quality land information about Singapore.

The 2 services of LandQuery and StreetMap@Singapore can be easily accessed through *http://www.inlis.gov.sg*.

ICG holds first meeting

The International Committee on Global Navigation Satellite Systems (ICG) met in Vienna, Austria, on 1 - 2 November, to review and discuss Global Navigation Satellite Systems (GNSS) and their promising applications. The ICG addressed the use of the applications to promote the enhancement of universal access to, and compatibility and interoperability of space-based navigation and positioning systems and the integration of these services into national infrastructures, particularly in developing countries. The meeting was hosted by the United Nations Office for Outer Space Affairs (OOSA).

In 2004, in its resolution 59/2, the United Nations General Assembly invited GNSS and augmentation providers to consider establishing an International Committee on GNSS (ICG) based on the recommendation of the United Nations Committee on the Peaceful Uses of Outer Space to implement one of the major actions called for in the resolution "Vienna Declaration: Space Millennium for Human Development", adopted by the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space and endorsed by the General Assembly in its resolution 54/68. On this basis, the ICG was established in December 2005.

The participants at the first ICG meeting included: China, India, Italy, Japan, Nigeria, Russian Federation, United States, the Civil GPS Service Interface Committee, the Committee on Space Research, the European Space Agency, the International EUPOS Steering Committee, the IAG Reference Frame Sub-Commission for Europe, the International Federation of Surveyors, the International Association of Geodesy, the International Association of Institutes of Navigation, the International Cartographic Association, the International GNSS Service, the International Telecommunication Union, and the United Nations Office for Outer Space Affairs.

The ICG adopted its Terms of Reference and work plan as developed in international meetings since 2002 and incorporating the proposals made by the open-ended ad hoc Working Group of the ICG, which met in Vienna in March, June, and October 2006. The current work plan includes: Compatibility and Interoperability, Enhancement of performance of GNSS services, Information Dissemination, Interaction with National and Regional Authorities and Relevant International Organizations, and Coordination. All participants will cooperate, as appropriate, on matters of mutual interest related to civil satellite-based positioning, navigation, timing, and value-added services. In particular, they will cooperate to the maximum extent practicable to maintain radio frequency compatibility in spectrum use between different GNSS systems in accordance with the ITU Radio Regulations. UNOOSA is currently serving as the Secretariat of the ICG.

A proposal to establish a "Providers Forum" to enhance compatibility and interoperability among current and future global and regional satellite-based systems was also noted by the ICG. The potential members of the Providers Forum could include the United States, the Russian Federation, the European Community, the European Space Agency, Japan, China and India. The potential members will advise the ICG through OOSA upon final agreement to establish the Forum.

The ICG accepted the invitation of India to host the second meeting next year.

Using Assisted-GNSS to locate handsets in wireless networks

This paper discusses the current state of Assisted-GNSS for locating mobile handsets and some results of a Hybrid A-GNSS investigation.

Dr Neil Harper

There are many different types of technologies employed in calculating the location of handsets in wireless networks with various levels of success and accuracy. Assisted-GPS (A-GPS) is a positioning technology that is presently used for locating handsets in wireless networks and is gaining traction in the market. An A-GPS server provides assistance data to the handset in order for it to have a low Time to First Fix (TTFF), weak signal acquisition and optimize handset battery use. A-GPS is used as a location technology in isolation or hybridized with other positioning technologies that provide range-like measurements.

In this paper positioning and standards for A-GPS in wireless networks is discussed along with some results of simulations of Hybrid A-GPS positioning.

An A-GPS server provides data to a wireless handset that is specific to the approximate location of a handset. The assistance data helps the handset lock onto satellites quickly and also potentially allows the handset to lock onto weak signals. The handset then performs the position calculation or optionally returns the measured code phases to the server to do the calculation. The A-GPS server can make use of additional information such as round-trip timing measurements from the cellular base station to the handset in order to calculate a location where it may otherwise not be possible, for example when there are not enough GPS satellites visible.

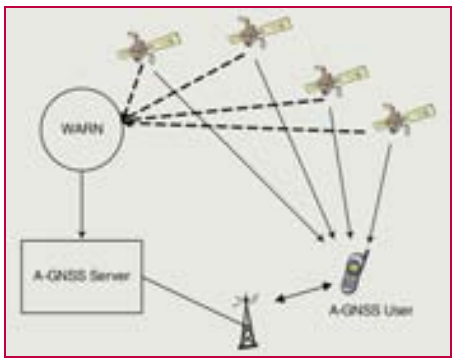

Figure 1 A simplified A-GNSS architecture

Assisted Global Navigation Satellite System (A-GNSS) extends the concept to other satellite navigation systems besides GPS. There could be 80 GNSS satellites orbiting the planet within 10 years, all transmitting a variety of signals. This includes GPS, GLONASS, Galileo and other satellites. This will give a receiver access to many more satellites which will improve both accuracy and yield. More satellites means that position accuracy is less susceptible to satellite geometry and also provides greater redundancy when doing the position calculation.

A simplified A-GNSS architecture is shown in Figure 1. A Wide Area Reference Network (WARN) is a network of GNSS receivers that are placed geographically over the coverage area of the wireless network. The WARN collects the broadcast navigation message from the GNSS satellites and provides it to the A-GNSS Server for caching. An A-GNSS User makes an emergency call or a service is invoked that requires location and a message is sent to the A-GNSS Server. The A-GNSS server calculates the GNSS assistance data required using the location of the radio access tower as the approximate location and provides it to the handset.

Applications

A-GNSS is useful for determining the location of cellular phones in an emergency situation and also for location based services. Deployment of A-GPS in the United States is the result of the Federal Communications Commissions' (FCC) Enhanced 9-1-1 mandate. That mandate requires that for network-based solutions: 100 meters accuracy for 67 percent of calls, 300 meters accuracy for 95 percent of calls; for handset-based solutions: 50 meters for 67 percent of calls, 150 meters for 95 percent of calls [1]. When an emergency call is initiated, an emergency services coordination centre – Public Safety Answering Point (PSAP) will make use of the location that is calculated in the MLC. In Europe and Asia deployment is being driven by Location Based Services (LBS), though requirements for emergency service cellular location have been or are being established in these regions.

Standards

The different components of an A-GPS server are defined in J-STD-036 [2]. As a real-world example, the Andrew Corporation Geometrix Mobile Location Center (MLC) product supports A-GPS functionality. The MLC is deployed as part of a wireless network and its purpose is to determine the location of handsets within the network.

The MLC runs in GSM/GPRS and UMTS networks and can act as a Serving Mobile Location Center (SMLC), Gateway Mobile Location

Center (GMLC), Standalone A-GPS SMLC (SAS) or SUPL Location Platform (SLP) and various combinations of these. The MLC supports all handset-based and network-based wireless location methods, including A-GPS in both handset-based and handset-assisted versions.

There are several different standards for the A-GPS messaging with the handsets. For GSM networks RRLP [3], UMTS networks RRC [4] and CDMA networks PDDM [5] and [6]. These protocols are different ways of encoding the same basic information but are specific to the radio technology.

The Secure User Plane Location (SUPL) architecture [7] is defined by the Open Mobile Alliance (OMA) and allows bypass of many of the traditional telecommunication elements to be bypassed by relying on SUPL functionality within the target device. This makes network interoperability simpler and is a platform that is likely to get wide acceptance as the requirement to also support legacy, non-location capable, devices diminishes. The SUPL Enabled Terminal (SET) makes a secure TCP/IP connection directly with the SUPL Location Platform (SLP). The SET and the SLP exchange messages using the UserPlane Location Protocol (ULP) [8] which is the transport for the underlying RRLP messaging. ULP optionally supports RRC [4] and the CDMA PDDM standards [5] and [6]. Operators are starting to deploy SLPs and quite a few handset manufacturers offer SETs.

Present standards cater for GPS L1 C/A code assistance data. There are two Global Navigation Satellite Systems (GNSS) presently in service; GPS and GLONASS. The European Galileo project is also underway and will meet Full Operational Capacity (FOC) within several years. The SUPL specification facilitates Assisted-GNSS (A-GNSS) operation but the underlying RRLP, RRC and PDDM protocols do not currently support it. This is presently being worked by the standards bodies.

Once the A-GNSS mechanism has been defined for these protocols, an A-GNSS server will be able to provide assistance data to different types of handsets (for example a Galileo handset Assisted-Galileo) and handsets that have receivers capable of detecting satellites from multiple GNSSs (for example a combined GPS and Galileo receiver).

Standards are also being developed for providing location in Voice over Internet Protocol (VoIP) networks. VoIP allows users to make telephone calls over the IP network instead of switched circuit network. Some VoIP providers presently do not even provide access to emergency services such as 9-1-1 in the USA. The National Emergency Number Association (NENA) and Internet Engineering Task Force (IETF) are developing the architecture and standards for delivery of the location within VoIP. It is likely that the handset will talk to the Location Information Server (LIS) via a protocol that will encapsulate RRLP or some derivative messaging at its deepest layer.

Handset-based A-GPS and Handset-assisted A-GPS

There are two primary modes of operation for A-GPS. In handset-based A-GPS mode, the handset requests assistance data from the A-GPS server which is used to lock onto the satellites in view and calculate the position of the handset. In handset-assisted A-GPS, the handset requests assistance data from the A-GPS server which it uses to lock onto the GPS satellites. It then sends the GPS measurements to the A-GPS server for it to do the position calculation.

An example of messaging between an A-GNSS server and handset is shown in Figure 2. The messaging shown is one way that RRLP is used to achieve GNSS positioning of the handset. A location request could be network-initiated in the case of a Location-Based Application (LBA) providing a value-added service. It could also be handset-initiated in the case of the user making an emergency call or an application running from the handset itself.

When the location request is received at the A-GNSS Server, it sends a Measure Position Request message to the handset. If the handset has sufficient cached GNSS assistance data then, in the case of handset-based GPS, the handset will lock onto the satellites, perform the position calculation and return the location in the Measure Position Response message. In the case of handset-assisted GNSS the handset will lock onto the satellites and return the satellite measurements to the server to do the position calculation.

Generally however, the A-GNSS Handset will not have sufficient assistance data and will send a Measure Position Response to the A-GNSS Server with the assistance data types that it requires. The A-GNSS Server will then send another Measure Position Request to the handset with the requested assistance data types.

In the case of handset-based A-GNSS, the primary assistance data type is the navigation model (which contains the ephemeris). The handset uses the information in the ephemeris to calculate where the satellites are in order to refine its search and also as input to its position calculation.

In the case of handset-assisted A-GNSS, the primary data type is the much more compact Acquisition Assistance data type. The Acquisition Assistance data tells the handset which satellites to search for and provides a search window in the time and frequency domain for each satellite. The handset treats the search

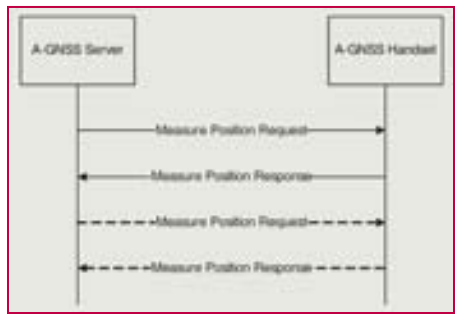

Figure 2 Example A-GPS messaging

windows as relative search windows once it locks onto the first satellite. In this mode, the handset has no need to calculate where the satellites are since it is not doing a position calculation, instead it returns the GPS measurements to the A-GNSS server in the Measure Position Response. The measurement consists of the approximate time, the code-phase chip measurements, Doppler, RMS error of the measurements, and a multipath indicator. The server can then do a self-contained position calculation or make use of additional measurements and perform a hybrid location.

Hybrid A-GNSS

There are several advantages of performing the position calculation on the server (handset-assisted A-GNSS) [9]. One of the advantages is that there is opportunity to include additional range measurements that the server can obtain from the network into the position calculation. This can improve both the yield and accuracy of the location solution.

When the handset is in an area where its view of the sky is obscured it may not be able to lock onto the minimum number of satellites to perform a position calculation. In this case the other range measurements may permit a position to be calculated when otherwise there would be none. In the case where there is more than the minimum number of satellites in view, additional measurements provide increased measurement redundancy and hence improve yield and accuracy by making the position calculation less susceptible to bad measurements.

The accuracy of range measurements depends on the radio technology and their sources. Range measurements are generally either calculated from signal strengths measured from a known source in combination with a propagation model, or are determined from timing measurements associated with known signals arriving from a known source They could be Timing Advance (TA) in a GSM network, Uplink Time Difference of Arrival (UTDOA) time difference measurements, WiFi or Digital TV (DTV) ranging signals. When incorporating these range measurements into the position calculation algorithm, the accuracy of the measurement needs to be considered so that it doesn't make the location worse.

Some results of position calculation accuracy with simulated range measurements are shown in Figure 3 and Figure 4. Here the case where there are not enough satellite measurements to do a complete GPS solution is considered. GPS data was collected over a complete day from a GPS receiver on the roof of the laboratory and consists of 80,657 distinct epochs. In order to simulate a situation where only three satellites are in view (which is the case in Figure 3), three satellites are randomly selected from each epoch and range measurements are introduced with varying levels of inaccuracy.

These simulated range measurements show how the accuracy of the overall position calculation is influenced by errors in the range measurements across a whole day of GPS data.

The position calculation function used for experiments is a parametric weighted least squares implementation where range measurements are considered as another input to the solution with appropriate weighting in the stochastic model.

Figure 3 shows the effect of the error in the position calculation when there are only three satellites in view of the receiver and there are different numbers of simulated range measurements of varying inaccuracies. It shows that when there are only 3 satellites and 1 accurate range measurement there is less than 10 metres of error over a complete day of data for 67% of the data and just over 10 for 95%. As the inaccuracy of the range measurement increases

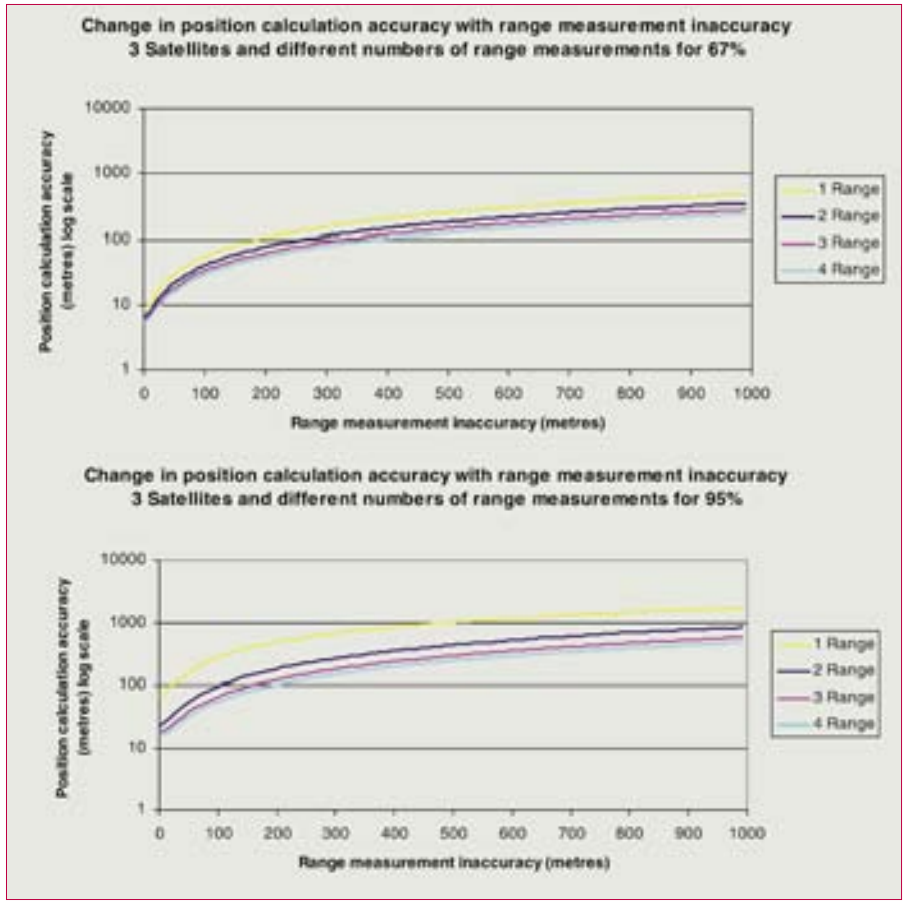

Figure 3 Change in position calculation accuracy for three satellites and 1,2,3 and 4 range measurements at 67% and 95%

the distance of the calculated location from the ground truth increases. For example, GSM TA has accuracy in the vicinity of 550 metres. So that would result in a position accuracy of over 100m at the 67% level.

Similarly, Figure 4 shows the results of using only two satellites and 2,3 and 4 range measurements. In this case the position accuracy follows a similar curve and the accuracy of the location is highly dependant on the accuracy of the range measurements.

Conclusion

Wireless standards for A-GPS are mature and are in general use. SUPL positioning bypasses traditional telecommunications and allows a handset to talk directly with the SLP. This makes network interoperability simpler and is a platform that is likely to get wide acceptance.

Standards bodies are presently considering the integration of GNSS information in order to facilitate use of the other GNSSs. This will lead to more satellites being available to the handset and an improved yield and accuracy for the position calculation.

Hybrid A-GNSS is a viable solution for improving yield when there are not sufficient satellites visible. The accuracy of the resulting location depends on the accuracy of the additional range measurements and how they are integrated into the position calculation function. It is equally applicable to control plane or user plane location architectures.

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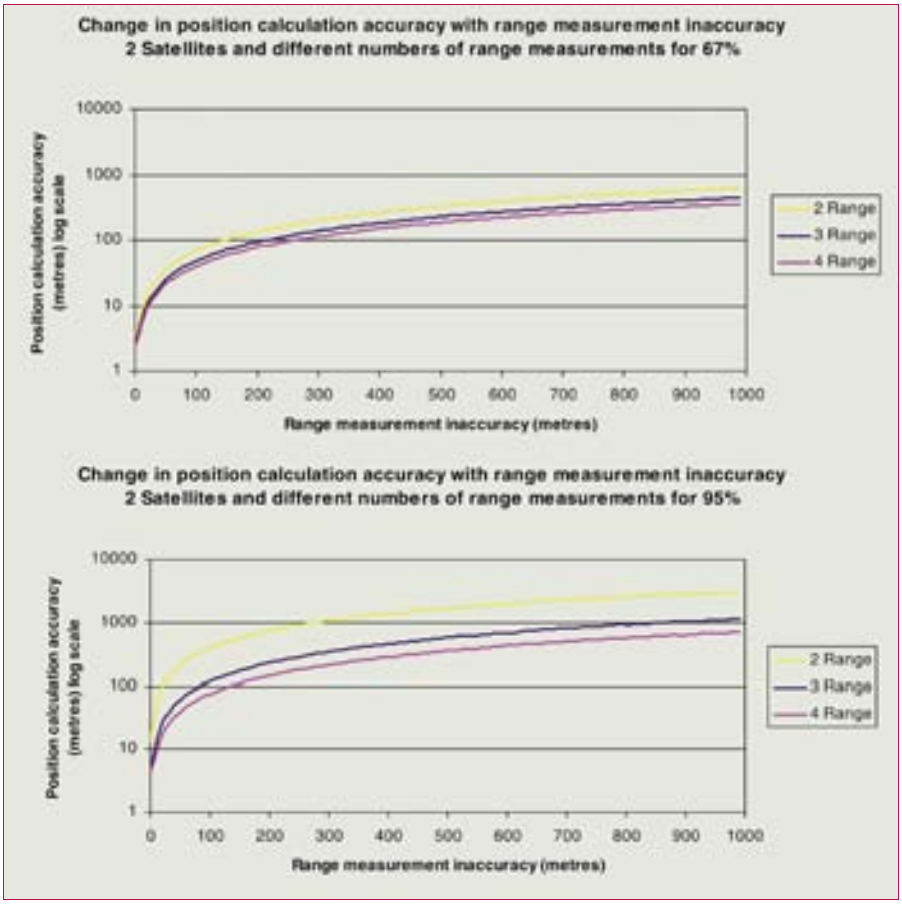

Figure 4 Change in position calculation accuracy for two satellites and 2,3 and 4 measurements at 67% and 95%

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GIS in local government

The Australian experience

ALLAN K BARNES

Universal lessons have emerged from Australian local governments using GIS for more than 25 years. This commonality of GIS experience rises above the significant variations in functions, statues, geographical coverage and population densities in Australian local government. These lessons are relevant to the skill development, data access, technology integration, and functional integration of GIS to any organisation managing the assorted demands upon a region, or locality.

Australian Local Government

Variations in the functions, statues, geographical coverage and population densities of Australian local government are a product of the continent's political development. It is one of the three tiers of government in Australia; which has a national government, 6 state governments (and 2 territories) and local governments. With elected members setting the policies of each tier of government, variations in policies and priorities are more common than a commonality of focus.

The geographical coverage of a local government (usually referred to as a council) ranges from a few square kilometres to thousands of square kilometres. Councils can also range from sparsely populated rural regions to densely populated inner city. However what councils have in common is being the most community focused of the three tiers of government in Australia.

Responding to their community's needs; a council will carry out at least the following functions:

- Access to library services;
- Environmental management (collection and disposal of rubbish, administering health regulations and policies, weed and vermin control and managing noise, which usually includes dog control and registration);
- Road (and associated infrastructure) construction and maintenance; and
- Setting and administrating planning policies.

Depending upon the political development of their region and state government, the functions of councils may also include some or all of the following:

- A full range of health services (up to public hospitals);
- Emergency services;
- Management of storm water;
- Management of waste water (sewage) disposal and treatment;
- Provision and/or distribution of gas and electricity;
- Provision of public transport;
- Supply of water;
- Transport infrastructure (including airports, marine and rail) construction and maintenance; and
- Valuation of real estate

Implementation lessons

The greatest value is achieved from a council's GIS as a shared common resource for the council, rather than a tool of one of the service teams. To ensure this corporate focus, the GIS should be managed by an on-going cross service management team.

There should be a clear separation between those maintaining the system and those with viewing only rights. This functional separation enables the "viewing users" to easily perform their functions with very little GIS knowledge and training. Typically customer service staff will start up their view of the GIS in the morning and keep the system live throughout their working day to answer any customer queries.

However, this straight forward operation of the GIS is dependent upon a set of predefined "maps" being created by a skilled GIS operator in conjunction with the user groups. Therefore different "maps" need to be generated for the different functions (eg rating, engineering, dog management, planning, fire and environmental management) of a council. While these "maps" typically share common data they need to be customised to the needs of each function. Typically the customer service staff use one that shows properties, the owners, the title references and the values.

Data maintenance duplication can be minimised by copying existing corporate data into the GIS data base. This can be done manually, or through an automated process (typically run after each working day, usually at 3 am). This process reduces the load on the main council sever (as typically users make a single inquiry of the server each day, after which the data they need for the day is resident on their PC) and provides a timely response to enquirers.

Data Access

Data pricing has been a major barrier to the take up of GIS by councils. The focus for their discontent has been state government data pricing policies. While the era of hardcopy map production was dominated by the policy of government assets supporting the community, the era of digital spatial data is dominated by the government being a business that should fund its own activities. Hence mapping products changed from being a low

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This policy change was an outcome of the ideology of competition (which sought to remove any unfair advantage a government activity might have over an identical private sector activity) and part of the general retreat from intervening in the market place. Whatever the actual economic benefits maybe for a nation; the impact of these policies on government mapping agencies has been severe and also by implication on local government.

The cost of accessing data (for GIS implementation and on-going data maintenance) remains a source of tension between local government and the data suppliers (i.e. both private industry suppliers and government mapping agencies). This tension remains even though government mapping agencies have reduced the cost of their digital mapping products to councils. While conforming to the ideology of competition; this recent policy argues that the price to councils is discounted in return for the data quality improvements to be provided by local governments.

Training and Support

The normal practice of councils is to utilise internal training for the "viewing users", with specialised training given to the GIS operator by the vendor and a help desk service (annually capped). Sourcing this training will be influenced by the level of the vendor's support skills and their user group base. Some GIS users rely upon their network of contacts in other council's to satisfy their training and support needs. Seeking alternatives to a vendor's support service is highest when the vendor's key expertise is centred in a distant location.

Staff Resourcing

A GIS operator is required to establish and maintains the "views" and merged data available to the "viewing users". GIS operators have a variety of backgrounds, including biology, IT, surveying and civil engineering. The skills required by this person include both technical and interpersonal skills. The technical skills can be learnt by a person with an established ICT/ PC skill base with an "attention to detail" approach to their current tasks. However the interpersonal skills required for a GIS to deliver real value to Council must be available prior to the purchase of the GIS.

The heaviest resourcing demands occur with the initial purchase of the GIS. Typically a full time person is required for 3 to 4 months to establish the "views" and merged data available to staff. After the implementation the staffing level can drop to a part time role, or involve 3 or more staff.

The level of GIS staffing reflects two issues: centralised or de-centralised data maintenance; and the council's priority for the use of the GIS. De-centralised data maintenance (i.e. each department maintaining their data), requires less GIS staff than a centralised data maintenance group. Should a centralised data management group also be part of one of the user departments, the GIS trends away from a corporate resource and hence its overall benefit reduces.

Functional Integration

When a GIS is a corporate resource it will either be fully integrated with other systems or be functionally integrated with key systems. At a minimum this will include a mail merge functionality that is activated by the GIS (that produces a "mail merge file" that can be accessed by the word processing software). This functionality enables land owners to be notified of changes that could impact upon their enjoyment of their land; or people to be contacted for a particular council responsibility (eg owners of dogs; vacant land holders for fire management; owners living outside of the council area etc.).

Recognition of GIS Benefits

Most local governments in Australia recognise the capacity of GIS to better meet their responsibilities. This hard won recognition flows from the publicised benefits of GIS by high profile local governments, the experience of smaller administrations and user groups and associations. Such is the recognised benefits of GIS to local government that the Spatial Initiative for South Australia was joint initiative of the state's Local Government Association and state government.

While GIS is recognised as beneficial to local government administration, difficulties remain is measuring the size of this benefit. With measurement difficulties for both costs and benefits.

Measuring the full costs benefits will usually be limited to comparing additional costs to council of the GIS. The additional costs will reflect the degree of utilisation of a council's information and communication technology (ICT) assets. Commonly Australian councils already rely upon ICT to carry out their financial and engineering responsibilities. Hence if

there is higher enough unused capacity in a council's servers, PCs, printers and network then the GIS initial costs will only be the additional cost of GIS related software and "mapping" data.

In addition a high level of in-house ICT skills will also reduce a GIS's implementation costs. The cost of training GIS users can also be reduced by only training a key user for each functional area (who then passes on their training to their fellow workers). Hence the additional cost of implementing a GIS will depend upon an organisation's existing ICT assets and staff skills.

Just as the council's assets determine the implementation costs, the use of the GIS also determines the benefits. These benefits will be at their smallest when the GIS is only used by one department in the organisation and at their greatest when used by all of an organisation. In addition a GIS implemented as a standalone system will not deliver the same level of on-going benefits as one that integrates with a council's existing ICT systems.

However, even for the most basic level of functionality at the highest cost, with the smallest benefit situations councils have reported positive benefits from implementing a GIS. Although this does not mean that they have always reduced their overall costs of operation. Rather, the GIS has enabled the council to expand their services to meet unmet community demands within the same operating budget.

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

CONFERENCE

GNSS waves at Jeju

The 12th World Congress of the International Association of Institutes of Navigation took place on the island of Chesu, or more commonly Jeju, off the southwest coast of Korea, between the dates of 18 and 20 October 2006. The IAIN Congress was hosted and organised by the Korean Institute of Navigation and Port Research (KINPR) in parallel with the Korean GNSS Technology Council's 2006 International Symposium. English was the conference language throughout. Some 252 papers had been offered and 169 selected for presentation or as posters. There were 243 delegates from 30 countries and 20 exhibitors.The IAIN Officers met before the conference, received reports from office-holders, representatives to other international bodies, appointed Elisabeth Klaffenboeck (Austrian ION) as the new representative to ICG and made the final preparations for the IAIN General Assembly that started later that day. Draft minutes of both of these meetings have been circulated widely and will be posted on the IAIN website. The major points arising from the General Assembly included an increase in annual subscriptions, homologation of the Harrison Award made in 2005 to Dr. Kotaite (then President of ICAO) and the Necho Award in 2006 to Captain Norman Cockcroft (out-going IAIN representative to IMO), approval of the selection of Stockholm as the venue for IAIN Congress 2009 organised by the Nordic Navigation Forum and the election of Officers for 2006-09. Among the latter were Dick Smith as President and Norman Bonnor as Secretary General.

The combined meeting ran for the next 3 days with, apart from plenary, 5 parallel sessions plus a tutorial domestic stream. The keynote speakers were Vidal Ashkanzi who described the 'Evolving GNSS Panorama' in a thorough, thoughtful and thematic style. John Dow from the European Space Agency followed with an excellent coverage of the practical support that the International GNSS Service (IGS) provides for new developments in satellite-based navigation systems. There then followed special talks by Ruth Neilan (GPS policy and status) Guenter Hein (Galileo: the complement or competition to GPS?) and Susumu Yoshitomi (QZSS status). Sadly the Liqing Shao (Chinese activities on GNSS) was unable to make the conference. In the parallel sessions that followed it was impossible for any one rapporteur to cover everything. To give a snap shot I chaired the general navigation maritime applications session and found it a worthwhile mixture of academic research (collision avoidance, interaction between ships) and practical application (ships' speed when docking, pilotage). Other presentations that caught my attention included the effects of geomagnetic storms, radio occultation, GPS policy in India and the impact of sea level rises on port facilities. No doubt other chairmen had similar experiences. Each speaker in the sessions was evaluated on his/her performance. The final plenary received a summary of the Congress from Jinsoo Park (KINPR), presentation of the IAIN Awards [including the Sadek best presentation won by J-B Park of TU Braunschweig for his paper on Integrated Navigation and Sense & Avoid Systems for Micro-Aerial Vehicles], details of the 2009 Congress, followed by closing remarks from Bengt Stahl (outgoing IAIN President) and Doo Chan Chang (KINPR President).

Dick Smith, President, International Association of Institutes of Navigation

GPS market expected to be worth US $757B by 2017

Research and Markets, an Irish research firm *(www.researchandmarkets.com)* has announcd that, in Western Europe the vehicle navigation market is in its initial stages, but there is a strong demand for traffic information and navigation solutions. Countries like USA, Japan, and some others have gained a cumulative shipment of 9.39 million in-vehicle navigation and traffic information units in May 2002. GPS production value globally is expected to grow to $21.5 billion in 2008 ($13 billion in 2003), according to the Industrial Economics and Knowledge Center of the Industrial Technology Research Institute. In 2003, GPS equipment sales was reported to be around US $3.5 billion worldwide, and that annual market could grow to US $10 billion after 2010, acc ording to the report. *http://biz.yahoo.com*

New GPS satellite goes into orbit

A U.S. Air Force modernized GPS Block IIR (GPS IIR-M) satellite, designed and built by Lockheed Martin was launched successfully aboard a Delta II launch vehicle. The satellite, designated GPS IIR-16M, is the third in a series of eight Block IIR-M spacecraft. *http://biz.yahoo.com*

GPS PND prices to drop 20% for whole of 2006

Global average selling prices of GPS and PNDs (portable navigation devices) are estimated to decrease by 20% for the whole of 2006 due to increasing market competition and decreased cost of components, according to Taiwanese OEM manufacturers. LCD panels, map databases and map engines (navigation software) each account for a large proportion of the total production cost of a GPS PND, followed by flash memory, receivers, processors and GPS chipsets while connectors and cable assembly account for the smallest portion, the makers pointed out. *www.digitimes.com*

Delhi construction under scanner

According to official sources, the Union Ministry of Science and Technology of India has come up with a 3D GIS to keep tabs on unauthorized constructions in Delhi. The system can be used for real time monitoring of illegal constructions, land encroachments, crowd management, property tax collection, surveillance, traffic management, environmental monitoring, disaster management, and even planning and development of areas. It is reported that the Ministry has already set up a pilot project in the city zone that includes the entire city and adjoining areas. Reportedly, every possible shop and household has been mapped through satellite images, the images being recorded by four fixed cameras in the city, and the field survey being done by employees of the Delhi Municipal Corporation. The pilot project will be monitored at each stage to evaluate usefulness of the technology for other metros across the country. Moreover, the project will deploy multiple technologies, including high resolution satellite imagery, vehicle borne and static laser systems, GPS, amongst others, to create a comprehensive 3-Dimensional database enabling modern tools such as GIS to be utilized for various applications. *www.techtree.com*

Taiwan completes setup of VBS-RTK e-GPS system

Taiwan has finished establishing a real-time kinematic (RTK) system for the nation's e- GPS base stations, catching up with world standards in developing modern positioning and land-measuring technologies, the Land Survey Bureau (LSB) under the Ministry of the Interior announced. It began to build the system as a means of achieving high-precision results on positioning, as well as for the LSB to offer multi-objective positioning services with added-value applications such as surveys for earthquakes, firefighting and rescue operations. *www.chinapost.com.tw*

Australian Army M113's to be upgraded

The Defence Material Organisation recently contracted Honeywell Germany to supply the new TALIN 500 Inertial Navigation Unit for the M113 vehicles at a cost of $11 million.

The new system integrates GPS and the inertial navigation functions, enabling the M113 to navigate effectively and accurately in all environments, including regions where GPS is unavailable due to terrain masking or enemy jamming. *www.epicos.com*

GLONASS to be operational by late 2007

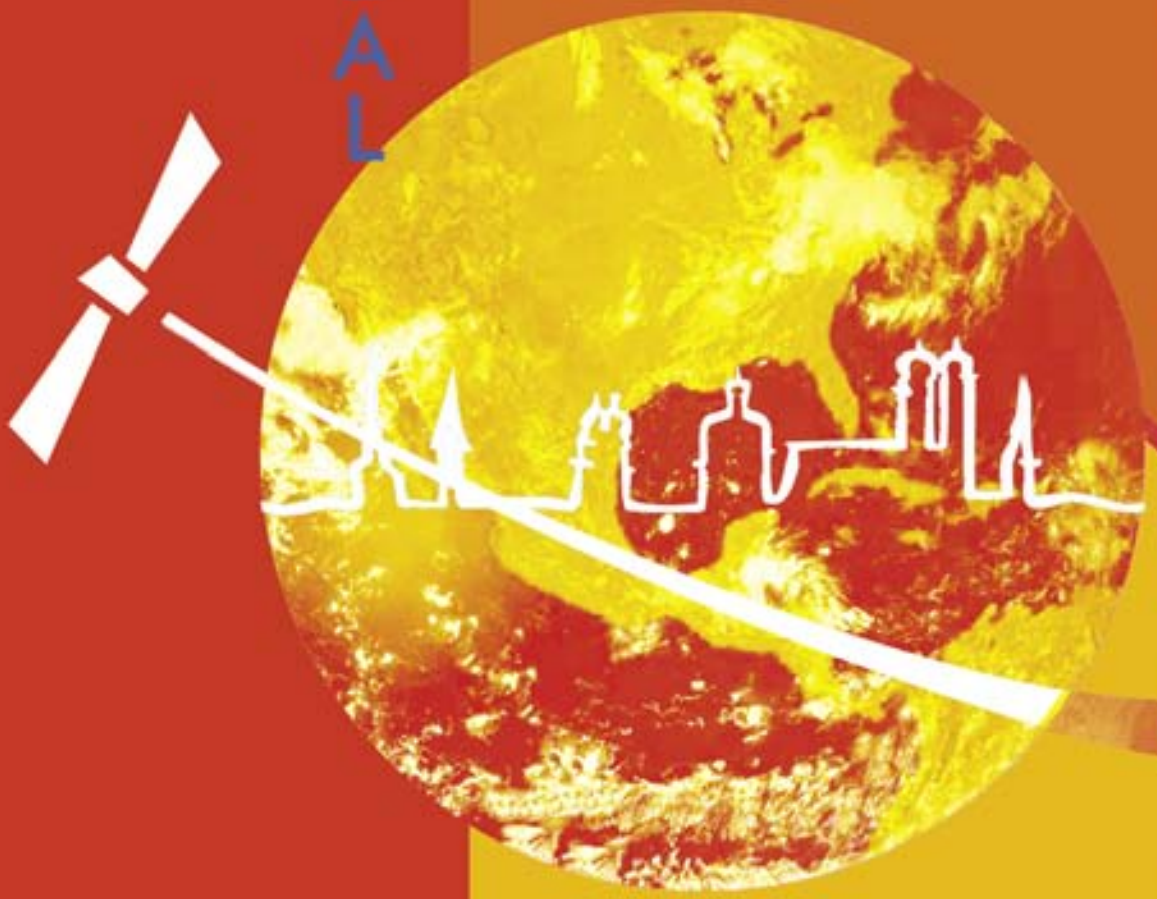
GLONASS will become fully operational by the end of 2007 according to, Russian Deputy Prime Minister, Defence Minister Sergei Ivanov. *www.tass.ru ,http://en.rian.ru*

Traffic Cast deploys traffic information system in Shanghai

TrafficCast International Inc. and TrafficCast China (Shanghai) announced the deployment of the world's largest cellular probe system in Shanghai, in strategic partnership with mobile carrier China Mobile. The anonymous mobile phone position and signalling data in China Mobile's GSM Network are collected, analysed, and converted into travel time and speed information for major highways and surface streets in Shanghai. The system collects cellular data from 10 million China Mobile subscribers in Shanghai, and covers all roads within the Inner Ring Area, including 483 miles of major roads comprising 1,700 roadway segments. *www.trafficcast.com*

MUNICH SATELLITE NAVIGATION SUMMIT

...GOES GLOBAL



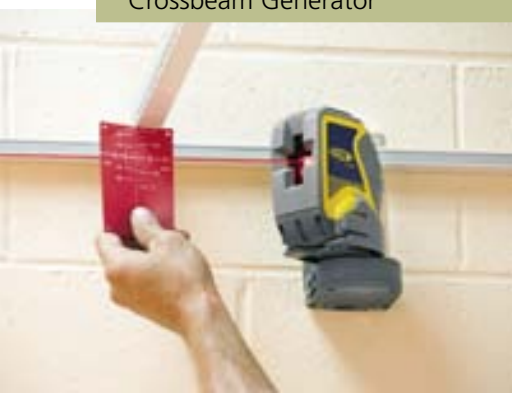
6-8 MARCH, 2007

www.munich-satellite-navigation-summit.org

+++ A DEBATE BETWEEN THE GALILEO RESPONSIBLES +++ STARTING, WAITING OR NO INTEREST IN GNSS

IN GNSS APPLICATIONS, ESPECIALLY (NOT?) IN GALILEO ? +++ A DEBATE BETWEEN THE GALILEO RESPONSIBLES

Spectra Precision Laser LG20 Crossbeam Generator



Trimble has announced new Laser portable tools — Spectra Precision Laser LG20 Crossbeam Generator, Spectra Precision Laser HR250 Laser Receiver and Spectra Precision Laser HD50 Handheld Distance Meter.

The easy-to-use, self-leveling Spectra Precision Laser LG20 Crossbeam Generator is a rugged, one-person tool designed for a variety of interior and exterior applications. The LG20 is a highly versatile hand tool that replaces a level, square, plumb bob, chalk, and optical instrument for faster completion and increased accuracy on the job site.

Feature-packed and developed for use with the LG20 Crossbeam Generator, the optional HR250 Laser Receiver is a versatile, economical laser for long-range interior and exterior applications up to 75 m (250 ft). *www.trimble.com*

PCI Geomatics' Geomatica LidarEngine

PCI Geomatics has announced the signing of OEM agreement with Ambercore Software Inc. for the creation of Geomatica LidarEngine. Geomatica LidarEngine is a high performance data management, analysis, and visualization tool for LiDAR . Its architecture and algorithms are suited for processing the very large volumes of LiDAR data.

It has also announced that will support the upcoming German radar satellite TerraSAR-X for image processing, correction, and analysis. The satellite is set to be operational in mid 2007, and PCI Geomatics software will support the sensor's data as it becomes available. Infoterra holds the exclusive commercial exploitation rights for TerraSAR-X data and will supply radar data, as well as a variety of radar-based geo-information products, via a dense distribution network *www.pcigeomatics.com*

DVP India bags orders form Eaga Energy

Jayanta Chatterjee, MD, DVP Geomatic Private Limited, informs that DVP-India has received a bulk order for 7 nos. of DVP software licences-version 6 along with bundle adjustment software, nuvision 3d stereo glasses, stealth 3d mouse etc. from Eaga Energy India Private Limited, Kolkata. Eaga Energy is also one of the major players at NRSA, Government of India, Hyderabad for doing several urban and utility mapping projects in India by using DVP *dvpindia@vsnl.net*

u-blox releases TIM-4R dead reckoning GPS module

u-blox AG, released the TIM-4R GPS module with dead reckoning technology that ensures 100% road coverage in even the most challenging GPS signal environments. Powered by u-blox' 16-channel ANTARIS 4 positioning engine, this GPS module provides uninterrupted positioning in environments where GPS operation was previously not possible and offers better navigation performance using less power than its predecessor, the TIM-LR. *www.u-blox.com*

NovAtel Inc. launches AdVance RTK precise positioning solution

NovAtel Inc., Canada has launched its new Real Time Kinematic (RTK) precise positioning solution – AdVance RTK - providing a significant technology advancement to the company's OEMV family of receivers through superior algorithms that enhance precision and performance. NovAtel's GNSS OEMV-2 and OEMV-3 receivers will now be available with the new AdVance RTK as part of the Version 3.100 firmware release. *www.novatel.com*

Hemisphere GPS introduces Crescent DGPS receivers

CSI's Hemisphere GPS division, has introduced its new Crescent(TM) R100 Series DGPS Receiver. The Crescent R100 is the ideal solution for professional mapping, guidance and navigation applications. It joins the Crescent A100 Smart Antenna, Outback S2 and Outback BaseLine. *http://micro.newswire.ca*

TomTom speeds up GPS positioning

A free service from TomTom, USA, called QuickGPSfix allows TomTom GO users to get an immediate connection between their device and a GPS satellite allowing their position to be "fixed" within seconds. The service works by predicting satellite orbits for up to seven days and the sending these to TomTom devices while they are connected to a personal computer. *www.mobilised.com.au*

Epson offers licensing for its A-GPS receiver technology

Seiko Epson Corporation announced that it has begun offering licensing for its A-GPS (Assisted Global Positioning System) reception technology for mobile phones and portable information terminals. This technology is designed for the SH-Mobile G21 single-chip LSIs used in mobile phones, and is licensed to Renesas Technology Corp. *www.webwire.com*

Topcon awarded world's first GNSS technology contract

Topcon Positioning Systems (TPS), USA has been awarded the world's first government GNSS contract designed to harness signals from all current and planned positioning satellite systems – GPS, GLONASS, and Galileo (G3). The Tennessee Department of Transportation (TDOT) will begin using the world's first satellite reference network, which will utilize more than

40 satellites currently operational. The total available satellite signals available for use will exceed 80 when all the Galileo satellites are in service, and system upgrades and additions to the GPS and GLONASS systems are completed. *www.topconpositioning.com*

Lockheed Martin completes system requirements review for GPS lll

The Lockheed Martin GPS III team announced the successful completion of a System Requirements Review (SRR) for the U.S. Air Force's next generation Global Positioning System Space Segment program, known as GPS Block III. GPS Block III will enhance space-based navigation and performance and set a new world standard for positioning and timing services. *www.lockheedmartin.com*

FME Feature Data Source released for Autodesk geospatial products

Safe Software, announced the development of the FME Feature Data Source for Autodesk Map 3D, Autodesk MapGuide Enterprise, MapGuide Open Source, and Autodesk MapGuide Studio. *www.safe.com*

Infotech Enterprises joins Bentley ELS programme

Bentley Systems, Incorporated has announced that Infotech Enterprises, has joined Bentley's Enterprise License Subscription (ELS) programme. The Bentley ELS programme grants organizations unlimited access to the entire ELS software portfolio for a fixed annual fee. *www.bentley.com*

GeoEye-1 to use SGI Technology for processing imagery

GeoEye, has purchased high-bandwidth, high-performance compute technology from SGI.The four SGI Altix 350 systems have 16 Intel Itanium 2 processors on each system. It runs Novell SUSE Linux Enterprise Server, version 9, ensuring the Altix deployment dovetails with existing GeoEye applications. The systems will be attached to a storage area network that will also include a previously purchased SGI Altix 3700 server, which will be used for image reconstruction activities when GeoEye-1 is launched in 2007. *www.geoeye.com.*

Leica Geosystems launches Leica SmartPole

Leica Geosystems adds a further tool to its System 1200 Series of surveying system, Leica SmartPole. with which, the coordinates and orientation are determined On-the-Fly whilst conducting the survey, using both GPS and TPS. This saves time in planning and executing the survey. While using it, it is not necessary to identify control points in the office and search for control in the field, to first measure orientation points and only then detail points.

It has also launched Leica SmartWorx, the Onboard Software for all Leica System 1200 instruments, offers a broad range of functionality to cover all tasks. Coupled with the most advanced equipment, Leica SmartWorx provides a software suite, whuch is easy, fast operating concept that leads the user straight to what he needs. Seamless data flow is guaranteed between SmartWorx and the PC Software Leica Geo Office, as well as with all office software packages. *www.leica-geosystems.com*

Tata Consultancy Services, India awarded Asia Partner

MapInfo Corporation, has awarded its 2006 MapInfo Asian Partner of the Year award to Tata Consultancy Services (TCS), India. With over 78,000 employees and sales of US$2.97 billion in 2005-06. *www.mapinfo.com*

Virtual Earth 3D, launched by Microsoft

Microsoft Corp. has announced US availability of Virtual Earth 3D, a new online mapping interface that is part of the Live Search offering, providing consumers with a three-dimensional experience to search, browse and explore the real world online. The consumer version is free and accessible from any Web browser. Virtual Earth does not require external or downloaded software. It is a byproduct of Microsoft's May acquisition of Vexcel, a company that specialized in remote sensing and aerial mapping. *www.microsoft.com*

Elcome Technologies opens office in Hyderabad

Elcome Technologies opens a branch office at Hyderabad with Service Facility in a graceful function held at Hyderabad on 9th of November. It was inaugurated by Mr Avinash Chander, Director, Advance Systems Laboratory, Ministry of Defence, Government of India. While addressing the gathering, he appreciated the endeavours of Elcome Technologies for extending its service facility to Hyderabad . He emphasized that such initiatives will go a long way to users of the technologies . Mr Bob Mortin, Dir. Business Development, GSR Asia Geosytems Div also made a presentation on Leica's New Products. Many dignitaries were present on the occasion including Mathew Smith, VP GSR Asia, Geosystems Div; Mr Ajay Seth, MD, Elcome Technologies and many representatives from Survey of India, National Remote Sensing Agency, NGRI etc.

Navman chooses eGain for better customer service

Navman, chooses eGain to help map the future of its customer service. Rapid growth in the demand for GPS technology has led to growth in demand for customer support services. To deal with this increase, provide 24 hour support and handle emails in a number of different languages across three continents, Navman implemented an eGain solution. Results include a reduction in average response times by 50% and an initial workload decrease of over 66%, allowing employees to deliver better quality support.

India, ASEAN sign agreement to boost science and tech cooperation

India and ASEAN (Association of South East Asian Nations) have signed a joint declaration for cooperation in Science & Technology. Mr. Kapil Sibal, Minister fo S&T and Earth Sciences and Dato' Dr. Jamaluddin Mohd. Jarjis, Minister of Science, Technology and Innovation, Malaysia and Leader of ASEAN delegation said that the declaration will not only strengthen the Science & Technology ties between the countries in the region but will also make ways for new horizons.

India has offered ASEAN countries training in space technologies, including remote sensing applications and satellite design, as a part of measures to step up co-operation in the field. India, through the Indian Space Research Organisation, has offered ASEAN countries short-term training programmes in satellite design to help them fulfill their aspirations in the niche field. Besides, satellite design India has also offered access to remote sensing data, including satellite imagery of the region for weather forecasting.

The Heads of Science and Technology Agencies of the State/ Governments of Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, The Philippines, Singapore, Thailand and Viet Nam and India gathered and met in New Delhi, India on 6th November, 2006 for the 12th Technology Summit and Technology Platform, organized jointly by the Department of Science & Technology, Confederation of Indian Industry (CII) and ASEAN Committee on Science & Technology (COST). *www.financialexpress.com*

Agreement on INSPIRE system

The European Commission has welcomed the agreement reached by the European Parliament and the Council in Conciliation on a directive creating INSPIRE - Infrastructure for spatial information in Europe.

The INSPIRE Directive is now likely to be enforced from summer 2007. It has been designed to control various aspects of the spatial data in the possession of authorities around Europe, including: creation of metadata, technical developments promoting interoperability, use of data services, principles on access to data and the related charges, and national co-ordination. *http://europa.eu.int*

Nepal plans satellite imaging of forests

The Ministry of Forest and Soil Conservation (MoFSC), Government of Nepal, is currently working on a proposal concerning satellite imaging of the country's forests, which will eventually culminate in the latest inventory of the endemic vegetation. The move follows keen interest demonstrated by Finland in this connection. Finland had financed the first ever inventory of vegetation in 1993. The Nordic nation had also helped in drawing up Forestry Master Plan around the same time. *www.thehimalayantimes.com*

Maharashtra Jeevan Pradhikaran wins 'BE Award of Excellence'

The Maharashtra Jeevan Pradhikaran has bagged the "BE Award of Excellence" in Geospatial Public Works category. Dr. S.V. Dahasahasra, Chief Engineer and his team prepared a hydraulic model entitled, "Disaster Management – Interlinking of Water Works in Mumbai Metropolitan Area", which will be useful for more than 10 cities in the region in combating risk management. It will suggest modus operandi of how a metropolitan city can get alternative water supply if its water supply fails in disaster. *http://mahajeevan.com*

Defence land records in India to be computerised

In a move to check the encroachment of sprawling cantonments and estates, the Defence Ministry has begun computerising defence land records across the country.

The total defence land holdings located inside 62 cantonments are estimated to be about 17 lakh acres (6,87,990 hectares). Under the new plan, the computerisation will involve forming a GIS and all survey and revenue records would be digitized and integrated into a land records database at a cost of Rs 2.52 crore ($550,000). The software for this has been christened RakshaBhoomi. The defence estates department is undertaking the project as a joint venture with NIC. *www.newkerala.com*

Digital map to provide medical aid during emergencies

The Vadodara-based Emergency Medical Services (EMS) Council, a network of medical emergency and city hospitals, in Gujarat, India, has initiated digital mapping of the city, and is constantly updating it, so as to give precise locations to ambulances which rush to pick up patients/victims in the shortest possible time.

The people manning the EMS Council control room would refer to the digital map as soon as they receive an emergency call, and convey directions to get to the address to ambulance drivers equipped with wireless sets. A year after the experiment, of the 67 calls received, 38 could be reached in record time due to the precise directions *http://cities.expressindia.com*

Launch of Emergency Information Website in Australia

Australian Disaster Information Network (AusDIN), an internet website that allows the public to access emergency information across Australia was launched. It will provide links to emergency management organisations in every state and territory. The website will also tap into weather reports, spatial information, warnings and alerts, and provide information on preparing for disasters and what to do in times of evacuation. There will be links to recovery organisations, charity and support groups, and international links

Garmin enters LBS platform market

Garmin has announced the availability of the Garmin LBS Toolkit, a flexible location-based service platform that can serve as the engine behind third party LBS applications. It incorporates Garmin's navigation API, local search, real-time content delivery services, and mobile advertising delivery services, into one powerful platform. *www.garmin.com*

PDA-based wireless GPS navigation system

Cingular Wireless has become the first wireless carrier in the U.S. to introduce a wireless navigation system with 3D maps and "fuzzy search" when it launched an enhanced version of TeleNav GPS Navigator on the Nokia E62 device. Using this system, customers will receive turn-by-turn directions while driving and view colorful 3D moving maps on the device's screen. *http://cingular.mediaroom.com*

Philips launches RFID medical asset tracking

Royal Philips Electronics, Medical Systems division launches 'Philips Asset Tracking Solution', a turn-key solution used for locating hospital assets and improving efficiencies. Using Wi-Fi based technology from AeroScout, the system has been designed around hospitals' existing 802.11 wireless infrastructure. *www.usingrfid.com*

Destiny Wireless launches GPS service

Destiny Wireless, U.K, introduces a location-aware DP&P service that can locate mobile workers when they have completed a task or job and automatically navigate them to their next job. Using a handheld device with GPS receiver and SATNAV, mobile workers are able to receive jobs within their geographical remit and effectively plan their route to client-site. On arrival, they can perform their jobs and enter details using their digital pen and paper, enabled by Anoto Functionality. *www.destinywireless.co.uk*

Motorola introduces the M710 iDEN car phone

Motorola's M710 helps enable LBS via integrated AGPS, such as personal and business navigation solutions and fleet management applications. Such applications include optimised routing, traffic advisories, weather updates and roadside assistance. Also available are Automatic Vehicle Location (AVL) and Java programming capabilities that help allow fleet management dispatchers to communicate specific operational needs. *www.motorola.com*

Wavecom and eRide to create first Geo-Location technology

eRide Inc., Satellite Navigation Technology, and Wavecom S.A., Paris, announces their collaboration that brings a new generation of location and navigation capabilities to mobile applications. *home.businesswire.com*

Solar-powered tag readers improve traffic management

A team of transportation researchers in New York will be testing an array of wireless, solar-powered readers to monitor traffic flow. The units will be deployed to collect traffic data during the morning commute on busy Capital Region roads. The portable units, which are based on the same technology as E-ZPass tag readers, could eventually be used to provide valuable data for a variety of applications, from decreasing congestion in work zones to assisting emergency evacuations. *www.eurekalert.org*

Combining positioning and communications technologies

British police officers, Italian fire fighters and Greek taxi drivers are amongst the many users testing innovative LBS under the LIAISON project. The results could mark a coming of age for converging communications and positioning technologies. LIAISON is one of the largest current initiatives to develop and implement a new generation of LBS for the professional market. The project approach, based on what is called 'enhanced assisted GPS', is designed to improve the speed, accuracy and reliability of existing GPS systems, allowing a whole new range of time, cost and life-saving services to be developed. Some applications are likely to be on the market before the project ends in April 2008. *www.innovations-report.de*

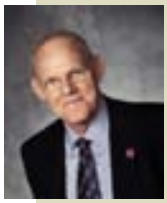
60 percent of WCDMA handsets will be GPS/Galileo enabled

Berg Insight research report forecasts that 60 percent of WCDMA handset shipped worldwide will have integrated GPS/Galileo receivers by 2010. GPS is already a standard feature in CDMA handsets for the US market. Recently similar requirements were also announced in Japan, prompting NTT Docomo to introduce GPS on all 3G terminals from 2007. www.berginsight.com

New GPS parking hits the spot for Paris

A service starting next month could help Parisian drivers locate a nearby parking spot using a cellphone or GPS navigation device. The system will monitor about 120 garages across Paris. *www.taipeitimes.com*

Professor Stig Enemark, New FIG President



During the General Assembly, held on the XXII FIG Congress in Munich, Prof. Stig Enemark (Denmark) was elected as new president of FIG 2007-2010. Matt Higgins (Australia) and Dr Dalal S. Alnaggar (Egypt) were elected vice-presidents for the same term of office and Prof. Paul van der Molen as vice-president for 2007-2008. The new Council will start its work on 1st January 2007.

NEWSBRIEF - REMOTE SENSING

India's Space Commission on comprehensive legal document

With private players gaining easy accessibility to satellite data, India's Space Commission is working on a comprehensive legal document on issues related to outer space to ensure that internal security is not endangered, informed Mr. G Madhavan Nair, Chairman of the Indian Space Research Organisation and Space Commission. "Remote sensing satellites are focusing on all important installations and a number of agencies like Google Earth are buying such data and placing it in the public domain, which can be a potential danger to internal security," said Mr. Nair. *www.hindu.com*

NIGERIASAT-2 Earth observation satellite

The Federal Government of Nigeria has signed a contract agreement for the construction of the nation's second Earth observation satellite with British firm Surrey Satellite Technology Limited (SSTL). The new satellite which is named NigeriaSat-2 brings to three the number of satellite projects the nation has embarked on since 2001 when it began a space programme through the establishment of the National Space Research and Development Agency (NASRDA). When it goes into orbit the satellite will send down 32-metre high resolution imaging data for various applications in mapping. *www.vanguardngr.com*

Egypt to launch its first scientific satellite

Egyptian Higher Education Minister Mr. Hani Hillal said that Egypt, in cooperation with Ukraine, will launch a scientific satellite by the end of 2007 in Kazakhstan, the official news agency MENA reported. The satellite, named as Egyptsat 1, will be launched from Kazakhstan. Egyptsat 1 will carry two remote sensing devices -- an infrared one and a multi-spectrum one, according to an earlier MENA report. Egyptsat 1, once launched, will be the country's first satellite for scientific research. *http://news.xinhuanet.com*

MARK YOUR CALENDAR

January 2007

Second Asia Pacific Conference for ESRI Users
18-19 January 2007
The Taj Palace Hotel
New Delhi
www.esriindia.com/apuc2007

National Technical Meeting "GNSS Benefiting Mankind"
January 22-24, 2007, San Diego, CA
www.ion.org

February 2007

Integrated Water Resource Management- (IWRM-2007)
5-7 February, Banglore, India
www.angelfire.com/planet/kerf/

Geomatica 2007: Geomatics for Development
12-16 February Havana, Cuba
www.informaticahabana.com/

Current Trends in Remote Sensing and GIS Applications
15-17 February, West Bengal, India
iitkgpconf2007@yahoo.com

3rd Annual GIS Conference and Exhibition
19-21 February, Kuwait
www.gulfgis.com

March 2007

Munich Satellite Navigation Summit 2007
6 - 8 March 2007, Munich, Germany
info@munich-satellite-navigation-summit.org

GEOFORM+ 2007
13-16 March, Moscow, Russia
http://www.geoexpo.ru/defaulteng.stm

3rd Asian Space conference
21-23 March, Singapore
http://pdcc.ntu.edu.sg/ASC2007/

April 2007

63rd Annual Meeting, Featuring New Bio Navigation Workshops
April 23-25, 2007, Cambridge, MA
www.ion.org

May 2007

Spatial Sciences Institute Biennial International Conference
14-18 May, Hobart, Tasmania, Australia
www.ssc2007.com

Intergraph 2007
21-24 May, Nashville, Tennessee, USA
http://www.intergraph2007.com

International Conference on Integrated Navigation System
28-30 May, Saint Petersburg, Russia
elprib-onti@telros.net

Geoinformation for Disaster Management (Gi4DM2007)
23-25 May, Toronto, Canada
junli@ryerson.ca

5th International Symposium on Mobile Mapping Technology
28-31 May, Padova, Italy
naser@geomatics.ucalgary.ca

June 2007

Rivers 2007: 2nd International Conference on Managing Rivers in the 21st Century: Solutions Towards Sustainable River Basins
6-8 June, Kuching, Sarawak, Malaysia
rivers2007@gmail.com.

21st Pacific Science Congress
12-16 June, Okinawa, Japan
psc21@to.jim.u-ryukyu.ac.jp.

27th ESRI International User Conference
18-22 June San Diego, California USA
www.esri.com

Geoinformation Forum Japan
20-22 June, Pacifico Yokohama, Japan
geoforum@jsurvey.jp

July 2007

Cambridge Conference 2007
15-20 July Cambridge, UK
www.ordnancesurvey.co.uk/

August 2007

XXIII ICA International Cartographic Conference
4-10 August, Moscow, Russia
info@icc2007.com.

ISPRS Workshop on Updating Geo-spatial Databases with Imagery
28-29 August, Urumchi, Xinjiang, China
jjie@nsdi.gov.cn, jiangjie_263@263.net.

September 25-28, 2007

ION GNSS 2007
September 25-28, 2007, Ft. Worth, TX
www.ion.org

November 2007

ISG/GNSS 2007
6-8 November, Kuala Lumpur, Malaysia
md.nor@fksg.utm.my

WG I/6 Workshop on Earth Observation Small Satellites for Remote Sensing Applications
13-16 November, Kuala Lumpur, Malaysia
mazlan@fksg.utm.my

Keep your database up-to-date

Leica MobileMatriX has been developed for seamless dataflow between field and office, and was designed specially for the needs of field surveyors and GIS data collectors. Now it is possible to seamlessly extend the office database into the field, with direct interfaces to Total Stations (TPS) and Global Positioning System (GPS) sensors. All surveyed and collected data is automatically stored into the ESRI® Geodatabase format, eliminating the need for data conversion when moving data between Leica MobileMatriX and ArcGIS™ databases. To update the office database, simply use the synchronization mechanism to transfer the data from office to field and vice-versa. To ensure maximum compatibility with all systems, Leica MobileMatriX allows the user to interact with data from different CAD packages and other GIS office solutions.

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- when it has to be **right**

Leica Geosystems