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Volume III, Issue 8, August 2007

THE MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

Geospatial futurology

NSDI – then, now and whe(never)

Managing land information

The benefits of future GNSS

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Articles

Columns

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This issue of Coordinates is of 40 pages, including cover.

The shades of independence

India celebrates 60 years of independence.

We are happy once again.

A celebration for democracy and democratic values.

On the occasion, we take a look at two movements.

National Spatial Data Infrastructure *(page 10)* and Sustainable Land Information Management System *(page 22)*.

Description of status and prescriptions of action plans.

Ironically, these are being discussed even today.

Both of them could have been tools to further democratic rights.

It is not that efforts are not there. They are.

That is why we have National Map Policy in place and a resolution on NSDI.

We also have 'right to information'.

'Right to spatial information' eludes. Is that too much to ask for?

There are changes.

Positive changes in approach and mindsets.

That gives us hope.

And we live on hope

Bal Krishna, Editor
bal@mycoordinates.org


Idea:
Manage a city's infrastructure from the ground up.
Realized:
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Geospatial futurology

Technology will be needed to help manage an increasingly uncertain world

Robin Mannings works in the Research Department of BT and is part of a small foresight and futurology team. He has a special interest in geospatial information and positioning systems.

At the turn of the millennium there was a mood of optimism and then it all changed. The dot-com bubble burst, 9/11 occurred and climate change became an "uncomfortable truth". In other words the spirit of the age, or Zeitgeist, changed and new challenges now face societies, industries and individual people.

Technology will be needed to help manage an increasingly uncertain world where the need for good quality maps and mapping will increase.

Disruptive technologies are those which are unexpected but which have the power to change industries (not always for the good of the established players). Mobile telecommunications and the internet are good examples, and the telecoms industry is now on the lookout for new disruptors. Whereness i.e. knowing where everything or everybody is located, is a good example of a potential new disruptive technology. Although maps and GIS (Geographic Information System) are used as part of "whereness" today, in the future mobile devices will have location based services that will increasingly be able to act as sensors and create and update maps and related information spaces whilst using them. This is likely to have an impact on the traditional business of map making.

As society gets more wealthy, people have more resources to spend on things that are less important (as shown by Maslow's famous hierarchy of needs). In the past, most resources were spent on the basics like security, nourishment, clothing and warmth. Building on these foundations, some money may be available for things like education, and relationships. Finally there may be a little resource left for non-essentials covering aspects such as self-actualisation and creativity. In future, these non-essentials become the new essentials as people spend more money on fun, games, entertainment and the arts - things that speak to their emotions.

Although maps are essential to the efficient management of the old essentials (particularly as the climate changes) it is likely that the most profitable applications will be associated with the new essentials. Examples might include augmented reality games where the reality of the outdoors is combined with the virtual reality of the computer world. When part of new mobile games or sports maps will be digitally displayed. People will move around with a digital bubble of geo-spatial information which will cause "magic" to happen when it intersects with other people's bubbles or the bubbles associated with physical things. The magic could involve the delivery of various forms of multimedia (music, video clips etc). Clearly, new mobile devices like the Apple iPhone could be very important once positioning technology is bundled in.

There are many technical challenges for the future map industry. Firstly, moving from the 2D maps we have today, to 3D maps (that include embedded multimedia) that range indoors. Adding the dimension of time gives us 4D geospatial-temporal information spaces where dynamic events (e.g. a traffic jam) can be combined with more static information (e.g. the road section

where the jam is occurring). Secondly, the issues of openness, concerning the sharing of information and trust and the availability of open APIs (Application Programming Interfaces). Thirdly, the web, which is already advancing using the APIs in user generated mash-ups, will continue to develop as the semantic web gathers pace, making information more meaningful. This should lead to advancements in "machine learning" and artificial intelligence (which has always included research projects where mobile robots follow maps). As computer power increases then map information can become increasingly automated in its creation, manipulation and use.

The final challenge will be to make things simple for people who just want answers to problems and some fun with minimum hassle. Maps (which many people find difficult) are increasingly touching the lives of citizens but in some ways we need to make the GIS disappear so the clever software does all the work.

Is Google Earth disruptive?

Ed Parson, Geospatial Technologist, Google

I am not sure if new technologies like Google Earth are disruptive. People have often spoken about Google and Micorsoft being disruptive. It may be true in certain context.If you see the natural evolution the geospatial industry in last twenty years, I think that both have put many elements in a place in a form that has a widespread appeal. I think it has increased people's awareness in geospatial information, certainly in the mass market. Actually, five or ten years before there was not much demand but with the involvement of big companies, much bigger footprints are now available. It surely has increased awareness.

Maybe what Google and Microsoft have done, will be disruptive to people who are creating information. With Google Earth in place, there is much wider demand and better understanding what is possible and what's available. For the countries where spatial information have limited availability and accessibility, such questions may be raised by the their citizens why they are not as well mapped and well represented as Western Europe and North America. I think such question may drive some changes and many may consider Google as disruptive in such situations and contexts.

Expanding horizons in a shrinking world

15-19 July 2007, Cambridge

THE theme of the Cambridge Conference was "Expanding horizons in a shrinking world". The conference was attended by 220 delegates from 70 countries. The conference was sponsored by ESRI, Intergraph, Oracle, Rolta, Topcon, DGC, Trimble, GeoEye, Ordnance Survey and i-spatial.

The conference was officially inaugurated by Kate Adie OBE, BBC's chief news correspondent. She shared a number of stories from her career as a BBC reporter including the one highlighting the importance of maps. Vanessa Lawrence welcomed the delegates of the conference.

The opening plenary addressed by Air Marshal Stuart Peach, Chief of Defence Intelligence explained how geographic support to military operations has changed over a century. The second plenary was on "Dissolving Borders – from national mapping to regional and global SDIs". It came out of the discussions and presentations that the Nationally produced GI is often inconsistent with neighboring countries and so fails to meet the needs of sustainable development. However, Africa has a vision for spatial data to permeate every aspect of society and for it to be consistent across the continent. There were five workshops scheduled on the first day. The workshop on "Land Administration for the 21st century" continued the debate on the need for accurate surveys and the role of the private sector in custodianship of records. The workshop on "Models for Geospatial Rights Management" observes that the copyright law is complex and rights provide to users are not always clear. The challenge is finding way to standardize licensing terms so technology can implement them. Al Gore's award winning documentary, An Inconvenient Truth was screened in the third workshop. The fourth workshop Imagery Matters discussed on differing value of imagery, currency, fitness for use and ease of interpretation for the growing user base. The fifth workshop "Winning support from key stakeholders" highlighted the importance of time, stick and carrots approach, political support, rules and engagement, regular and effective communication, coordination and mutual cooperation, understanding the cost benefit equation and patience.

On 17th July, the first plenary focused on "New technologies – Disrupting or Enabling". It came out that disruptive technology often leads to innovative uses, frequently unrelated to the original design intent. The second plenary "Risk and Disasters" highlighted the wide variety of disaster forms and differing responses. Five workshops also conducted during the day were on Partnering, Mapping for Disaster Response, Education, Licensing and Reference Framework for Active Networks. The highlight of the day was the Hotine Lecture by Prof Sir Martin Sweeting OBE, Executive Chairman – Surrey satellite Technology Ltd and Director- Surrey Space centre. He gave lecture on use of small satellites for remote sensing and navigation.

On 18th July, the first plenary "Business Models and Sustainability" shared experiences of Ghana, Norway, Canada and Britain. Ghana presentation focused on the importance of government subsidy needed to achieve cost recovery whereas Norway's contention was to separate the State and commercial activities. The Canada experience focused on data standardization to meet customer needs. Britain emphasised that the value-added partnerships facilitate Trading Fund Models. The second plenary was addressed by Jon Williams, World News Editor of the BBC. He said that it is very difficult to gain the trust of the audience but it is very easy to lose it. The workshops of the day were on Capacity Development, Mapping for Disaster Response, Archiving Geospatial data for long term preservation, the business of SDIs and Customer Experience Thinkings.

On 19th July the first plenary "From Silos to Webs – How do we Make Interoperability a Reality?". Spatial information is a fundamental layer of an SDI, but is not the only consideration. Technical changes and developments are solvable. Organisational change in the NMO community will take time and represents a greater challenge. The second plenary "Beyond Mapping – Geo-enabling Government and the Citizen NMOs' role in geo-enabling government was examined from the perspectives of land management and of wider technology, science and business trends. Given the speed of change in geospatial information use, NMOs need to re-think priorities and strategies, address resistance to change and the increasing levels of user expectation, while continuing to be concerned with information quality.

The Final Plenary was on "Future of NMOs – Replaced by NSDIs or Commercial Interests? Views on the future of National Mapping Organisations (NMOs) were expressed by the panel before opening the discussion. It was agreed that NMOs have a future but must continue to be relevant to customers depending on what they are tasked to do and how they are tasked to do it. They must be agile, responsive and capable of adapting to change.

An interesting feature of the conference was a daily newsletter on which this report is based on. The Cambridge conference was well designed and well organized with a very high quality content. The focused on relevant issues and was able to engage delegates on those topics. It also reflected the wonderful leadership of Ms Vanessa Lawrence and a great team spirit of the organizing team led by Mr Hugh Buchanan, Ms Sallie White and Ms Clare Hadley. Kudos to the entire Cambridge Conference team.

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NSDI – then, now and whe**never**

Mukund Rao
Former President, GSDI
mukundr@blr.vsnl.net.in

Mukund Rao has played a leading and key role in the NSDI movement right from beginning. He, along with others, was one of the key persons that translated the vision of the "triumvirate" into actions. He has worked for NSDI for the past many years and is known for his clear-views on NSDI. He was also the President of the Global Spatial Data Infrastructure (GSDI) Association and drove global SDI efforts. Who else better to prescribe what needs to be done now for the India NSDI. Coordinates produces this article from the presentation that he made at the 6th NSDI Workshop in Goa)

- Editor

RECENTLY, in July, 2007, I attended yet another NSDI Workshop – I think the 6th one at that since 2001 when the NSDI was "crafted" in India. This time, in the serene and rainy environs of Goa. Amidst the lush green and beautiful orchard-like estate of the hotel held, was a gathering of a few dedicated and committed NSDIites that I have seen for the past many years – holding on and hoping that the day will come when the NSDI will be operational. The passion for nsdi which was evident clearly and obviously.

Through this presentation, I shared what I know of what happened in the past – so that lessons can be learnt. I decided to provide a plain assessment from my technical point of view. I decided that I will once again identify and prescribe what needs to be done even now.

NSDI, Then...

It was great euphoria for almost 300-400 Indians (and quite a few meshing international experts) SDI professionals when the "NSDI: Strategy and Action Plan" was adopted in the impressive 1st NSDI workshop in Delhi in Feb, 2001. Fortunately, the great personality of Indian Space – Dr K Kasturirangan and yet another great person – Dr V S Ramamurthy jointly spear-headed this NSDI concept at that time. Mr Amitabha Pande, yet another driving force for NSDI, made all efforts to shape this NSDI concept.

What was NSDI then? As I know of then, it was the same as NSDI is even today. NSDI was of "working together of spatial data agencies", of the will of "sharing spatial data", of "using spatial data for national good", of "integrating images and maps for GIS solutions", of "an Indian SDI leadership", of "best of technology for NSDI", of "rigorous and common standards for spatial data", of "good spatial data policies", of "partnerships and GIS enterprises" and of "collective good of all agencies". Those were the principles on which Dr Rangan, Dr Ramamurthy, Mr Pande and many others from SOI, ISRO, NIC, FSI, GSI, NBSSLUP, NATMO and many other private and academic institutions founded NSDI.

There was no upmanship, no competition, no ownership-conflicts, no departmental differences at that time. NSDI was to have brought about a seamlessness in the spatial fabric of India.

Things moved from 2001 onwards – speedily at the beginning and slowed down later. We soon moved on to Ooty for the 2nd NSDI Conference. Ooty Conference, in July, 2002, was a watershed of a sort for NSDI. Expectations were high and the "iron was hot" (as they say). Six key Secretaries of Government of India (GOI) and about 180 Indian NSDI stakeholders and a fantastic action plan brought a forward-looking Ooty communiqué – which brought the NSDI dream a bit closer to reality. Then started the trudge ahead – Agra in November, 2003 where the NSDI Metadata and Exchange Standards were unveiled; Lucknow in November, 2004 – where the NSDI thrust was renewed; Hyderabad in November, 2005 – where NSDI was called for re-juvenation again and Goa in July, 2007 – where NSDI was almost being seen "as gone down history".

What should have happened?

In 2001 when NSDI was envisioned, it was planned that in 5-years a major achievement would be made to thrust Indian spatial technology. It was envisaged that NSDI would be approved in 2002; NSDI Metadata/Exchange/Agency-Server/Network/Applications standards published by 2002; NSDI and Map Policy re-defined in 2002/03; NSDI Portal established in 2003/04; NSDI Data and Application services operational in 2004/05 and by 2006/07 India would move to position many ENTERPRISE-GIS and enable a vibrant and world-leading SPATIAL-BUSINESS sector of images, maps, services and solutions and finally products. We had hoped that India, by 2007/08, would have a major share of the world-GIS market which is estimated at more than US$2Billion or more.

What went wrong?

When the NSDI concept was so sound and visionary, technically correct, well-accepted and most required, then what went wrong?

The first and foremost thing that happened was that in 2003 NSDI "lost the vision and guidance" of its great visionaries and leaders-of-class. Dr Rangan left ISRO to take on a more challenging role as Member of Parliament; later Dr Ramamurthy left DST after super-annuation and around that time Mr Pande also left DST. That, according to me in hind-sight, was the biggest loss to NSDI at a crucial time that NSDI could not become operational and positioned at that time. The other thing, from hind-sight, that I feel was that the policy frame-work for NSDI and Map Policy were also not revised at the right time to position NSDI as a mechanism.

The second thing, resulting from the first issue, was the emergence of "ownership conflicts" for NSDI – which was never prevalent till that time (except in jovial-jabs between agencies). Suddenly, we found agencies having differences on who should "lead NSDI" – which, incidentally, was least of the issue at that time in the NSDI concept (what was more relevant was to make NSDI happen).

This, then led to the third issue - what I jovially call, "departmental turf-wars" – true characteristics in the government domain of "two-ducking". And, as is usual in these scenarios, bureaucratic wrangles were the most prevalent at all levels. These also caused more delays and "confusion" and resulted in not making things happen for the country's good can we learn from all this? Yes, the message is clear – the collective good of the nation is prime and most important – not of who "owns or leads". This is the founding principle even for NSDI.

Even as I say all this, I must acknowledge that much has been achieved in the past 6 years. We had the NSDI Metadata and Exchange Standard documents; we also had a NSDI proto-type developed in 2003; we have good satellite images (but not yet maps from these images); we have a Map Policy announced; we have regularly had 6 NSDI workshops and in and last year, in 2006, thanks to a very dynamic Minister of S&T and a pragmatic Secretary, DST – who have both seen the NSDI getting approved (through all thick-and-thin) and who both envision that NSDI will be the future of MAPS and GIS in India. Consequently, the NSDI Committee has been announced in 2006 and thus … hope is still there.

NSDI Now...

I still feel that in the next few years, with renewed thrust, NSDI has the potential to become the model it should have been.

I reproduce here what I have been saying about NSDI years. According to me there are still the same six Founding Principles of NSDI that need to be addressed for the success of NSDI even today. The first, is the availability and easy accessibility to spatial

D-1/11 Sterling City, ISRO Complex,
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July 29, 2007

The Editor
Coordinates, New Delhi
Sub: NSDI: Needs a magic wand

I went through your above mentioned article in Coordinates of July 2007 and felt very uneasy with your questions "Who needs it? Who owns it? What drives it and what stops it?" It is pretty late in the day to be asking such questions but let me attempt some answers. What stops it: a poor understanding of the basic system. If the benefits were understood then it would not be languishing from conference to conference. What drives it: user demand. That also answers the question who needs it. Who owns it? The 'I' in 'NSDI' stands for 'infrastructure'. Roads are infrastructure. Who owns roads? We have to look at NSDI as a facility or a service. No one owns it outright but people participate in it. The Internet model is relevant here. No one owns the Internet. Sure, industries have provided the hardware and software for the networks and the servers, some governments have used it to provide a backbone but the Internet is not owned by any of them.

I believe that it is these irrelevant questions that have led the efforts astray. As a person who did have to do something with the early pre-NSDI and NSDI efforts I believe that turf battles have queered the pitch. The ideal Indian NSDI model would have been a national network (like NICNET) with all data generators (like DOS, SOI, MOEF, States, etc) hooking on to it with their offerings. The standards for the offerings would have to be nationally agreed and adhered to. I believe the lead to create base standards should have been with Survey of India through their topomaps. Each generating agency should have created their own thematic standards and publicised them. All access could be regulated through a single login via a portal like the one currently being run by NIC.

I found the Goa Chief Minister's offer to set up a regional or state hub very revealing as it shows precisely that desire for ownership that is killing the NSDI. What the CM could have offered is to create a server for all data of the state of Goa and hook it to the NSDI network. He would then have realised that what will trip up this effort is the benighted Map Policy. Goa being a coastal state falls under the secret category and its maps cannot be put on a network. Without going into too many details I may also point out that this policy is based on technological capabilities that existed ten years ago.

Today's technology has enabled services like Google Maps, a spatial data infrastructure that is global and democratic. Our vision for NSDI was national and democratic. It is sad to realise that NSDI could have been realised six years ago but for the restrictive regulatory environment.

Seeing this situation, I feel that the regulatory issues are the real bottlenecks. I also believe that if turfs are opened up for partnerships and collaboration we could have the system up and running in a year.

Will the next NSDI conference be a round table where each of these issues can be debated and resolved?

Arup Dasgupta

data – unhindered but regulated, maybe, and requiring sound and adaptive policies for spatial data sharing. We need the foundation of good, reliable and basic GIS databases (Make data available and applications, demand, market will follow through). This leads to the second, good "GIS Process Standards" – a standardisation of the entire process of "spatial technology" - images, mapping, GIS database creation, Spatial outputs, Spatial data Quality Assessment and Spatial Services (If all GIS data available is as per common and agreed standards, applications, demand and market development will be easier). The third is technical inter-operability - integration using the Services Oriented Architecture (SOA) and based on Web standards (Spatial data and Application Services will be the order of the day for GIS in the future). The fourth requirement would be spatial modelling and applications which brings new perspectives and visualization of spatial information and new insights to societal and economic processes of society - natural resources management, land planning, engineering and infrastructure, disaster management, education, health services and business (GIS Services will broaden and touch almost all aspects of society and citizens). The fifth important parameter is partnerships and enterprise for GIS - replete with the infrastructure, mission critical capabilities, and robust architectures associated with other enterprises. The "forced" boundary between Spatial Technology and conventional Information Technology will disappear – and horizontals of a new kind would emerge (the more inclusive GIS will be with other technologies/enterprises the more success for GIS). This leads to the last of the important issue – developing the GIS user communities by educating and orienting levels of society to become Spatial-savvy and benefit from the spatial technologies (if every citizen learns and benefits from GIS, it is he who will ultimately drive GIS technology and its future growth).

Action plan

Within the above founding principles, I feel that the following 7-point Action-Plan for NSDI will be very relevant:

ONE: Immediately call for the Meeting of the NSDC. The NSDC has been approved from May, 2006 as the NSDI "think-tank" and of all luminaries in the government and supported by private and academic sector. The NSDC is the think-tank that must direct and guide NSDI. The NSDC should consider the Strategy and Action Plan of NSDI, the status of things that have been achieved so far and then set specified actions that must be taken for NSDI.

In this context, positioning a CEO is also of utmost urgency. The CEO has to be a person of leadership, drive, vision, acceptance and technological strength. Finding such a CEO is not difficult – give him the charge and also the flexibility and authority that can bring results.

TWO: Establish the NSDI Portal at the earliest – based on already-defined NSDI Metadata and Exchange standards and also the data holdings of various agencies that are available till now. The NSDI portal should be able to have tools that allow search map and image data of the country; allow image and map data access (as per rules); allow NSDI users to publish their image/map data (as per procedures) and even allow customized applications to be undertaken for obtaining final solutions (and not data) by users. This, I feel, is possible as most agencies have already encapsulated their data holding and organizing the Metadata Server, Data Server should not be at all difficult. In fact, such a portal has already been show-cased in July, 2002 and later show-cased in NSDI Workshops also. Why not make it open and accessible, now?

THREE: Immediately organize and make available a digital National GIS Foundation Dataset – a set of standardized layers that all users can use to start any of their their GIS applications. Why can India not have a standard national/state/district/village boundary layer on standards that are compatible for various scales of 1:50K, 1:10K and 1:2K? Why cannot there be a standard dataset of roads and other general features on standards that all can use?

I think, NSDI should work for a NATIONAL FOUNDATION GIS dataset (contents can be defined carefully) that is an amalgamation of SOI maps, IRS images and available information in the country – and this should be available for the development of the country to any user un-hindered.

FOUR: Standardization is the key to NSDI. The more one standardises – the image formats, the map formats, the map legends, the map planimetry and GIS design, the better for any NSDI. Actually, I feel, that standardisation is the key to NSDI and the standrdisation must be a mission-mode in NSDI.

In another perspective, India has done well in standardization – we have a common NSDI Metadata Standard – allowing a common Metadata format; we have a NSDI Exchange Standard – allowing and Indian format for exchange of spatial data; we have NNRMS Standard – allowing definition of image, thematic maps and GIS design formats. We have done well in this regard.

FIVE: Cadastral data is the back-bone of administration of land and development in the country. We need a movement in NSDI for a National E-Cadasrtre – that allows the encapsulation of cadastral maps into the NSDI.

I personally envision that unless land management and individual beneficiary level data can be touched, a large market of applications of benefit to farmers, real-estate, urban management and infrastructure, citizens etc will be less-served.

A National E-Cadastre will open up many of the uses of NSDI and images and maps of the country to citizens, farmers, agriculture, land management, development etc and these would be maximised.

SIX: Policies are the crux of NSDI and the use of images and maps in the country. India, today has independent Image and Map policies – and that too that need revision in the context of NSDI and what is happening in the world. These individual policies need to be re-looked holistically to make a meaningful spatial data policy for the nation – be it images, topographical maps, thematic maps or survey data.

We have separate Map Policy and RS Data Policy in position now – but if we look at these there are "contradictions and also gaps" in what technology offers now. For example, while today satellite images provide DEM of levels of 4-5m z-accuracy – leading to ~10m contour easily, how does that cope in the Map Policy? Further, what is the context of "value-addition" to topographic maps – if roads are extracted from satellite images where topographical maps are used as a reference, is it value-addition to satellite image or to topographic maps? Now, citizens can easily access high-resolution and similar images on the net and can undertake mapping work – what happens to the provisions of RS Data Policy and what happens to such maps in the Map Policy. Like these, there are many such issues that are to be clearly defined and an integrated National Spatial Data Policy – encompassing images, maps and all spatial data is urgently required.

What is needed is a clear-cut DOs and DONTs for spatial data in the country – related to acquiring/generating spatial data from surveys/procurement; images and their use; value-addition to spatial data and sharing of spatial data at all scales and resolution etc.

SEVEN: As a forward-visioning exercise, NSDI must fuel an Enterprise-GIS movement in India – supporting various government, private and citizen enterprise requirements. For example, NSDI must be the core for a Farmer's Information System as an enterprise solution for Farming community; for a routing and navigation System as a Citizen Enterprise solution; Fleet Management Enterprise GIS that manages fleets of tranport and logistics movements; Emergency Enterprise GIS that allows tackling emergencies and disasters; Land Information System for a Land Enterprise GIS; for a Municipal Enterprise GIS that allows taxation, property assessment and many other activities and so on.

NSDI Whenever ...

Even now, NSDI is not late and can be positioned if the above series of urgent steps to take forward the steps already taken are made. But what is important is that we must do it fast and quick and right – making the nation proud and successful on using spatial data – be it satellite images, maps and solutions.

Let us also face it - NSDI can just not be implemented by government alone (and it is not right too when a lot of enterprise/development activities is also done outside government domain). Private enterprise will have to play a vital and complementary role - be it in solutions, be it in joint-venture initiatives with data-owners or in working the way ahead to deliver. Academic will also have to provide advanced research of powerful spatial search engines, spatial data mining tools, modeling tools and many other research inputs.

I also perceive that time has now come for India to act fast, quick and lead the way for NSDI. Else India may well JUST FOLLOW other global-enterprise initiatives (from outside India) that will anyway go-ahead and position earth-wide image/map/solution Portals. We have seen how Google, Yahoo, Microsoft and other free-domain initiatives, along-with commercial Portals, are providing images and maps (and solutions) on a global scale (even of India) and on massive Portals – good for them and good for spatial data business.

Will our future generation view and know India only as these outside "initiatives" will portray? If we do not act now, we will be leaving a legacy for our future generation – who will feed on "outside view and offering" and will seldom believe that India also had the capability to establish map and image portals as part of a national infrastructure. It does hurt my conscience, many times. In that sense, I think the last of the chance for India for positioning a good leadership NSDI is just facing us. Make it happen now… or else there will be a good Indian spatial database (images are already there; maps also will be there soon; solutions will also follow soon later) from outside soon. **"Chak De, India, NSDI chak-de!!!"**

The benefits of future GNSS

Perspectives from Taiwan

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THE conventional geomatics industry including mapping and surveying applications has been revolutionized with the use of GPS, which is the best known, and currently fully operational satellite based navigation system operated by USA (Parkinson, and Spilker Jr., 1995). In the mean time, Russia also operates its own satellite based navigation system called GLONASS. The USA is modernizing GPS in order to retain its superiority in satellite based navigation technologies (MacDonald, 2002,). In order to keep up with USA's progress in building next generation system, Russia is taking serious steps to modernize GLONASS as well (Federal Space Agency for the Russian Federation, 2005). The GPS and GLONASS signals are free but its availability is not guaranteed and currently most users are prepared to accept this risk (Parkinson, and Spilker Jr., 1995). However, as satellite navigation becomes a vital technology across a number of critical industrial sectors, the prospect of, for example, a nation's transport infrastructure becoming dependent on this technology is a strategic risk that most industrial countries are not willing to accept. This argument initiated the Galileo program in Europe. Therefore, those systems form the mainframe of Global Navigation Satellite Systems (GNSS) (MacDonald, 2002,).

Unlike GPS, Galileo will also offer a guaranteed service to users who are willing to pay for it (e.g. commercial service – CS, and Public Regulated Service PRS) in addition to a free signal similar to that of GPS (Open Service - OS and Safety of Life service - SoL). Galileo will be available to the public in 2012 (European Commission, 2003). Despite many technical differences between these three GNSS systems, the commonality of the carrier frequencies they use creates the potential for the future development of an interoperable GNSS receiver.

The vast majority of the world will be users of these existing systems. The fundamental questions then are: "Which system or systems should a country use?"; "How to choose a combination of the systems?"; "What are the benefits and respective merits of those systems?" There is no simple answer to these questions, as the best solution will undoubtedly depend on the targeted application, which has its own requirements in terms of accuracy, reliability, robustness, cost and other application-specific criteria. What can be provided, however, is a means whereby parameters that describe these performance requirements can be computed.

Comparing those pricy hardware GNSS simulators, high-accuracy software simulations are a cost-effective and precise tool to evaluate the performance characteristics attainable from the future GNSSs, and have been recognized as an appropriate pre-development tool for satellite navigation systems and applications in Canada and European countries. In addition, the entire hardware simulators available on the market can only emulate the signals from a single system at the present time. On the other hand, a dual systems simulator is easier to implement in the software level. The technical benefits

Table 1. Launch schedule for modernized GPS satellites

Activity	Implementation date
SA set to zero	May 2000
● GPS IIR-M Enhancements • New L2 civil signal(L2C) • M code on L1 & L2	1st satellite operation on December 16, 2005
● GPS IIF-Enhancements • New L2 civil signal(L2C) • M code on L1 & L2 • L5	1st launch currently scheduled for 3rd quarter 2008
● GPS III-Enhancements • New L2 civil signal(L2C) • M code with greater power • L5 • L1C	1st launch expected in 2013

of this approach lie in the fact that the software simulations are reproducible and totally controlled, and parameters can be changed individually if necessary for an in-depth understanding of the underlying effects. This paper introduces a qualitative assessment of the performance characteristics of the future GNSS infrastructure around Taiwan area using a multi-system software simulation toolkit being developed; therefore, representative results over Taiwan are demonstrated.

Evolving From GPS to Future GNSS

GPS Modernization

Motivated by the United States Department of Defense (DoD), the current GPS has experienced three decades' development. Although the original motivation was only for military purposes, GPS has been widely used in civilian applications during the past few decades. However, the integrity, availability, and accuracy still need further improvement for various applications. For the surveying industry, applications can be classified according to the achievable accuracy:

- Single Point Positioning (SPP) is the technique for which GPS was originally designed and delivers the Standard Positioning Service (SPS) performance mentioned above. Differential GPS (DGPS) can overcome some of the limitations of GPS by applying corrections to the basic pseudorange measurements, based on a receiver making measurements at a known point (a reference station). The accuracy achievable from DGPS can range from a few meters down to few decimeters, depending on the quality of the receiver and the DGPS technique used (Parkinson, and Spilker Jr., 1995).
- GPS Surveying also works differentially but can achieve centimeter accuracy using a special measurement technique. A typical receiver, for both SPP and DGPS[1], measure the ranges to the satellites by timing how long the signal takes to come from the satellite (the pseudorange, referred to as such because this measurement is contaminated by the receiver clock error) (Lachapelle, 2002). However, receivers used in surveying and geodesy measure the phase of the underlying carrier wave signal (the so-called carrier phase). For baselines between points separated by more than 20km, it is important that such receivers can also correct for the ionosphere (Lachapelle, 2002). For shorter baselines, dual-frequency receivers are necessary for rapid initialization of cm-level positioning. Given that civilians users only have access to the SPS, surveying receivers employ sophisticated signal processing techniques to measure the phase of the L2 signal. This level of sophistication is a major reason why surveying receivers are more expensive than receivers used for SPP and DGPS.

Therefore, a GPS modernization program was initiated in the late 1990's, in an attempt to upgrade GPS performance for both civilian and military applications. The GPS modernization program started with the cancellation of SA in 2000. It will be followed by the addition of a new a second civil code on L2 (L2C), then a third civil frequency L5. Further modernization consists of the assessment and design of a new generation of satellites to meet military and civil requirements through 2030. Table1 includes a summary of the launch schedule of the modernized GPS satellites according to MacDonald (2002).

GPS Block IIR-M is the second part of Block IIR, with eight modernized satellites being built by Lockheed Martin. The IIR-M satellites will have a new civil signal on L2 at higher signal power than normal IIR satellites. The Boeing Company has the contract for GPS Block IIF, with nine satellites in total that are intended to provide improved anti-jam capability, increased accuracy, higher integrity, and secured operational M-codes. Additionally, a third civil code at a new frequency L5 will also be included. The purpose of the GPS III program is to deliver major improvements in accuracy, assured service, integrity, and flexibility for civil users. Currently led by both Lockheed Martin and Boeing both, the team of GPS III program has proposed the use of the same signal structure as Galileo for its open signals and decided the year 2012 as the target date of the launch of first GPS III satellite.

GLONASS

GLONASS was originally deployed as the Soviet Union's answer to GPS. The design of GLONASS is very similar to GPS except that each satellite broadcasts its own particular frequency with the same codes (this is known as a FDMA, or Frequency Division Multiple Access, scheme), while GPS satellites broadcast the same frequencies and a receiver differentiates between satellites by recognizing the unique code broadcast by a given satellite (this is known as a CDMA, or Code Division Multiple Access, scheme). GLONASS can also provide a different level of service to Military users compared to Civilian users. Since the collapse of the USSR, the Russian Federation has struggled to find sufficient funds to maintain GLONASS and there are only 14 satellites functioning (as opposed to the 24 necessary for full operational capability) at the present time. However, the Russian Federation has recently commenced a program to revitalize GLONASS (Federal Space Agency for the Russian Federation, 2005).

- Current activity centers on launching GLONASS-M satellites with an improved 7-year design lifetime, which will broadcast in the L1 and L2 bands (though not on the same frequencies as GPS).From 2007 to 2008 it is planned to launch GLONASS-K satellites with improved performance, which will also transmit a third civil signal known as L3 (not the same frequency as GPS's L5). The stated intention is to achieve a full 24 satellite constellation transmitting the two civil L1 and L2 signals by 2010. The full constellation is planned to be broadcasting three sets of civil signals by 2012, as illustrated in the Figure (1).

It is worth noting that at the end of 2004 the Indian Government announced it would be contributing funds to assist Russia revitalize GLONASS. Although the frequencies of GPS and GLONASS are different, a single antenna can track all the transmitted signals. The data modeling challenges for integrated GPS/GLONASS processing have already been addressed, and survey-grade receivers

capable of tracking both PS and GLONASS have been available for many years. These combined receivers have demonstrated a marked improvement in reliability and availability in areas where satellite signals can be obstructed, such as in urban areas or under tree canopies (Lachapelle, 2002).

Galileo

Perhaps the most exciting impact on the future of GNSSs is the decision by the European Union to launch its Galileo project. Both the US GPS and Russian GLONASS are under military control, whereas Galileo was originated from the desire of civilian service. In the early 1990s, the EU began to conceive its own global satellite navigation system for better and guaranteed coverage over northern Europe. The EC assumes political responsibility for Galileo and ESA leads the program development (European Commission, 2003).

The design calls for a constellation of 30 satellites in a similar orbital configuration to GPS, but at an increased altitude (approximately 3000km higher than GPS) which will enable better signal availability at high latitudes. While the Galileo design aims for a level of interoperability with GPS, some aspects are not compatible. Galileo satellites will broadcast signals compatible with the L1 and L5 GPS/GLONASS frequency bands. Those Galileo signals are designated as L1, E5a and E5b. Galileo will also broadcast in a third frequency band at E6; which is not at the same frequency as L2/L2C GPS/GLONASS.

The details of the services from Galileo are subject to change but the current plan is to offer five levels of service, two of which are fee-based and one of which is restricted: The Open Service uses the basic L1/L5 frequency band signals, free-to-air to the public with performance similar to single- or dual-frequency GPS and GLONASS. The Safety of Life Service allows similar accuracy as the Open Service but with increased guarantees of the service, including improved integrity monitoring to warn users of any problems. This is a fee-based service. The Public Regulated Service is aimed at EU public authorities providing civil protection and security (e.g., police, quasi-military), with encrypted access for users requiring a high level of performance and protection against interference or jamming. The Search and Rescue Service is designed to enhance current space-based services by improving the time taken to respond to alert messages from distress beacons. The Commercial Service allows for tailored solutions for specific applications based on supplying better accuracy, improved service guarantees and higher data rates. This is a fee-based service.

Ten navigation signals in the frequency range of 1164 ~ 1215 MHz (E5a and E5b), 1215 ~ 1300 MHz (E6) and 1559 ~ 1592 MHz (E2-L1-E11) are selected. Among those signals, six are accessible to all Galileo users on E5a, E5b and L1 as an OS and a SoL; two signals on E6 with encrypted ranging codes are only accessible to CS users, and the remaining two (one in the E6 band and one in the E2-L1-E1 band) with encrypted ranging codes and data are accessible to authorized users of the Public Regulated Service (PRS).

The development of the Galileo system consists of three phases. During the first phase (2001 to present), the mission requirements were consolidated, the satellites and ground based components were under developed, and the overall in-orbit validation (IOV) of Galileo was started. IOV includes the delivery of the first four satellites in the Galileo constellation of 30, along with a number of ground control and monitoring stations. The first launch of Galileo satellites was at the end of 2005. Now it is on the very edge to the second phase – deployment phase (before 2012), which covers the entire network of ground infrastructure and the launch of the remaining 26 satellites; then in the third phase starting from 2012, the whole system will become commercially operational.

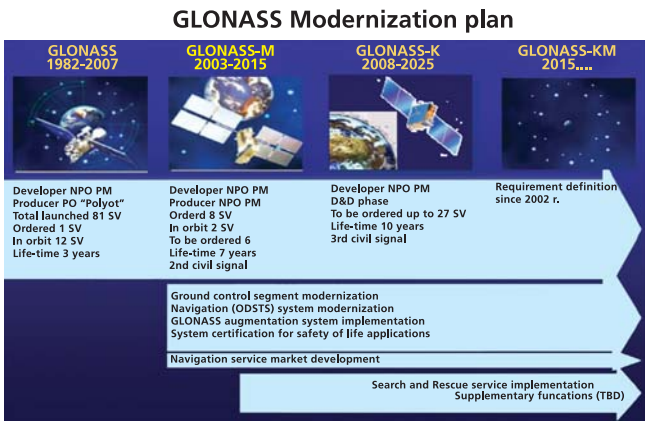

Figure 1. GLONASS modernization Plan (Federal Space Agency for the Russian Federation, 2005)

Multi-constellation GNSS

Based on the system parameters given previously, future GNSS is expected to provide at least nine frequencies with more than eighty satellites when all the systems become fully operational. Table 2 illustrates the parameters for future GNSS by year 2015.

It can be seen from the above descriptions that the next generation GNSS will bring significant improvements compared to current systems. In ten years time there may be as many as 80 satellites from GPS, GLONASS, and Galileo, broadcasting a variety of signals and codes by suitably equipped users for a range of navigation and positioning applications. The L1 signal alone is sufficient for many mass-market applications requiring an accuracy of (say) 3 to 10 meters. The availability of many more satellites will enable new applications in areas where the current lack of satellites has been a hindrance to market growth (Rizos, 2005).

More Satellites to Users

Simulation studies were carried out in order to determine the improvements to regional satellite visibility and dilution of precision (DOP) for a combined GPS/GLONASS/Galileo system. The analyses are based on the GPS, GLONASS and Galileo satellite coordinates and given receiver coordinates. The GPS satellite coordinates were

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Table 2. The parameters for future GNSS (Chiang, 2004)

	GPS	Galileo	GLONASS
No. of SV(2015)	28	30	26
Orbital plane	6	3	3
Inclination (Degree)	55	56	64.9
Altitude(Km)	20200	19100	23230
Period	11h56m	11h15m	14h05m
Frequencies (Civil use)	L1:1575.42MHz L2:1227.60MHz L5:1176.45MHz	E1:1575.42MHz E5b:1207.14MHz E5a:1176.45MHz	G1:1602~1616MHz G2:1246~1257MHz 3rd :TBD
Coordinate frame	WGS-84	GTRF	PZ-90
Time system	GPST	GST	UTC(SU)
Coding	CDMA	CDMA	FDMA

determined by using actual ephemeris (converted from the almanac files). The nominal constellation for the complete GLONASS as described in the GLONASS Interface Control Document was used (Lachapelle, 2002). The Galileo constellation was compiled from information in Dinwiddy et al. (2004).

The implemented GLONASS constellation was essentially 24 satellites in three orbital planes whose ascending nodes are 120° apart. 8 satellites are equally spaced in each plane with argument of latitude displacement 45°. The orbital planes have 15° argument of latitude displacement relative to each other. The satellites operate in circular 19100km orbits at an inclination 64.8°. The Galileo constellation comprises 27 operational satellites in a Walker constellation with three orbital planes, equally spaced with a 56° nominal inclination and an altitude of 23222km. Each orbital plane contains nine satellites, nominally 40° apart and one spare. Simulations have been performed as though the complete GLONASS and Galileo systems were operational at the time of the GPS almanac validity.

The simulated measurements are based on a single-frequency point positioning scenarios commencing at 00h 3 August 2006. The span of the simulation was 24 hours. The satellite visibilities for the GPS, GPS/Galileo and a combined GPS/GLONASS /Galileo system with a masking angle of 10° around Taiwan are shown in the Figure (2a), Figure (2b), and Figure (2c), respectively.

The combined system indicates an average of about 21 visible satellites over the 24 hour period. At the time of the simulations the GPS has an average of about 7 visible satellites. The GPS and Galileo combined constellations offers on average 15 visible satellites. General speaking, the number of satellites decreases when the latitude of the user increases. In other words, users in southern Taiwan tend to have better satellite visibility than those who in northern Taiwan. Similarly, Figures (3a) to (3c) illustrate the regional GDOP distribution for the GPS, GPS/Galileo and a combined GPS/GLONASS /Galileo system with a masking angle of 10° around Taiwan. The averaged GDOP levels of the dual system are improved approximately 60% of the levels for the standalone GPS scenario. In addition, the averaged GDOP levels of triple systems are improved approximately 80% and 20% comparing to GPS and GPS/Galileo systems, respectively.

Figures (4a) to (4c) illustrate the distribution of localized visibility at the Tainan City (λ=120, ϕ=23) against raising masking angles (10o, 20o, 30o, and 40o). Similarly, Figures (5a) to (5c) illustrate the distribution of localized GDOP at the same location against varying masking angles. Figures (4) and (5) indicate that the availability and reliability in the urban environment are improved with the increasing number of satellites, therefore, both surveying and navigation communities will find the significance of future GNSS.

The Benefits of More Satellites

The benefits of extra satellites have already been proved by GPS and GLONASS combined system. Galileo brings all that and more. The benefits of the expected extra satellites and their signals outlined above can be categorized in terms of availability, accuracy, continuity, reliability, efficiency,

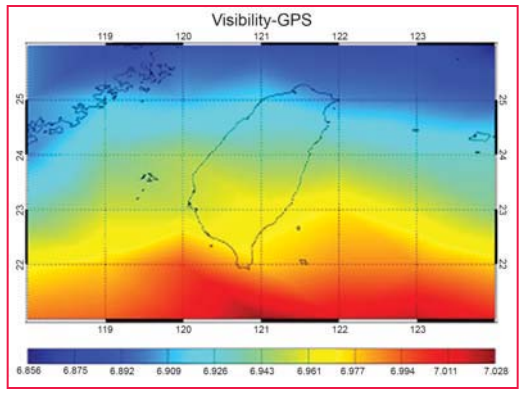

Figure 2a. Visibility of GPS standalone

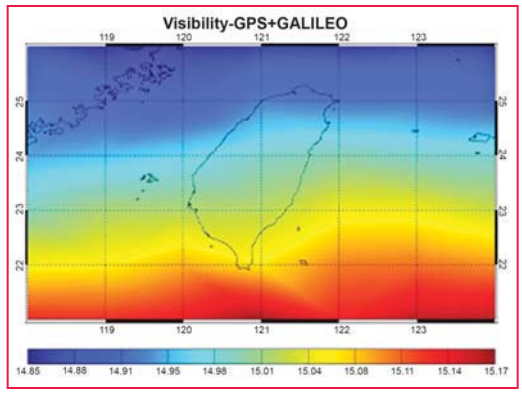

Figure 2b. Visibility of GPS+Galileo

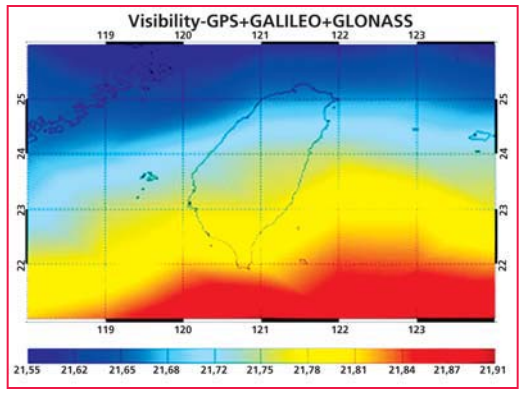

Figure 2c. Visibility of GPS+Galileo+GLONASS

and ambiguity resolution issues.

Availability

One of the most important benefits of simultaneously using GPS, Galileo, and GLONASS is the improvement in availability, especially in urban areas, as indicated in the previous section. From another point of view, the potential of GPS and Galileo to work as mutual backups is able to improve the reliability when either system is under some type of failure.

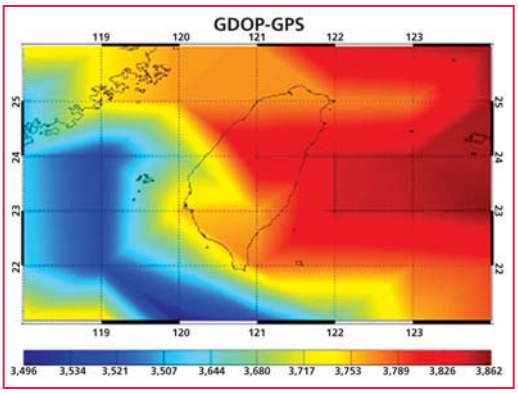

Figure 3a. GDOP of GPS standalone

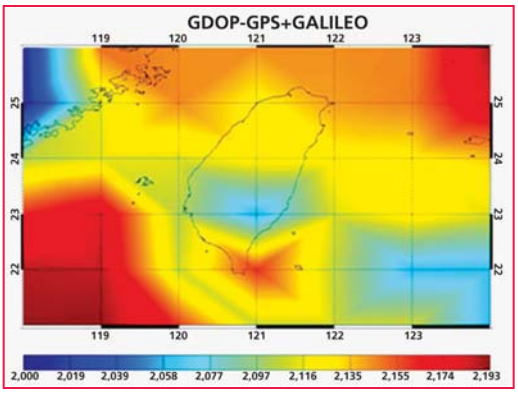

Figure 3b. GDOP of GPS+Galileo

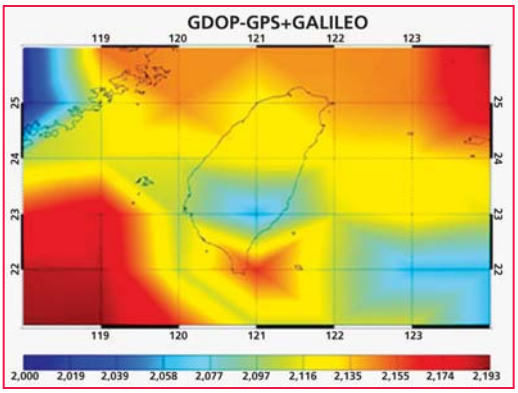

Figure 3c. GDOP of GPS+Galileo+GLONASS scenario

Accuracy

More satellites to observe means a given level of accuracy can be achieved sooner. More signals means more measurements can be processed by the receiver's positioning algorithm. Positioning accuracy is less susceptible to the influence of satellite geometry. The effects of multi-path and interference/ jamming are mitigated; mean meaning the measurement quality is higher.

Continuity

GPS, GLONASS and Galileo being independent GNSS means major system problems, unlikely as they are, are a very remote possibility of occurring simultaneously.

Reliability

With extra measurements the data redundancy is increased, which helps identify any measurement outliers. The new measurements will be more independent than the current L1 and L2 measurements, because code-correlation techniques (based on knowledge of the PRN modulating range codes) will be used, rather than the 'codeless/ cross-correlation' techniques employed in today's dual-frequency GPS receivers.

The current L2 GPS measurements by survey-grade receivers are noisier and less continuous than those expected to be made on either of the new signals L2C or L5, hence reliable dual-frequency operation will be enhanced. More signals means that service is not as easily denied due to interference or jamming of one frequency that may prevent the making of critical pseudorange and/or carrier phase measurements. It may. However, there will be an impact on efficiency (in terms of time to- ambiguity resolution) if not all frequencies/codes can be tracked. It should also be emphasized that newer systems, with improved electronics and antennas in the satellites and user receivers, will deliver overall improvements in data quality.

Efficiency

For carrier phase-based positioning, to centimeter accuracy, the extra satellite signals will significantly reduce the time required to resolve ambiguities. In addition, the density of GNSS reference stations to support differential positioning

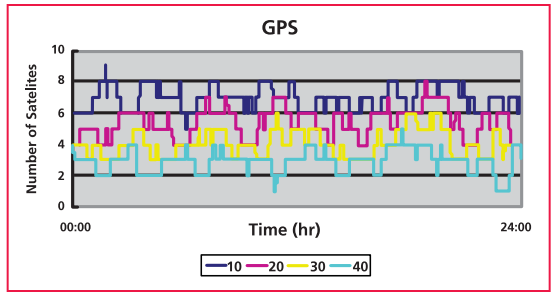

Figure 4a. Localized visibility of GPS scenario

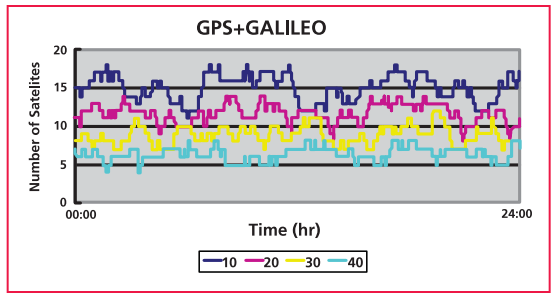

Figure 4b. Localized visibility of GPS+Galileo scenario

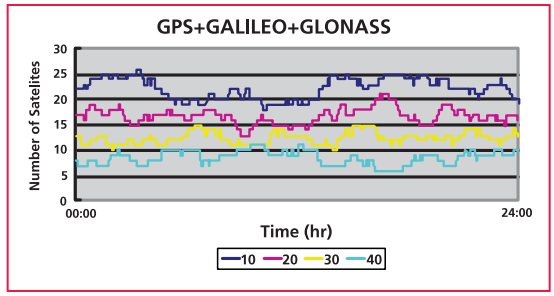

Figure 4c. Localized visibility of GPS+Galileo scenario

using triple-frequency techniques may also be reduced significantly

Ambiguity resolution

The improvement in UERE will lead to an improvement in the SPS stand-alone accuracy and will enable a better initial receiver position to perform ambiguity resolution. Both the accuracy of the initial receiver position and the UERE will impact the estimation of float ambiguities. A better estimation of float ambiguities will bring more ease in the integer ambiguity fixing.

Poor geometry might lead to degradation in the stand-alone positioning accuracy, given a certain magnitude of UERE. A large offset in the initial position might result in slow ambiguity fixing or even incorrect fixing if the position converges to an incorrect place due to the poor geometry. When both GPS and Galileo are simultaneously in operation, compared to the case of GPS only, there would be a global improvement in the constellation geometry since more than 50 satellites will be available. In this regard, there will also be a corresponding global improvement in ambiguity resolution.

Ambiguity resolution directly on L1/E1 is very difficult since the wavelengths are so short that the measurements of L1/E1 are susceptible to ionospheric errors and other errors. However, the proper combination of the phases on the two carrier frequencies might have benefits of a longer wavelength and lower vulnerability to ionospheric errors or other errors, so the ambiguity may be easier to fix than for L1/E1 ambiguities. Once three frequencies are available, more combinations among the phases of different carrier frequencies are possible

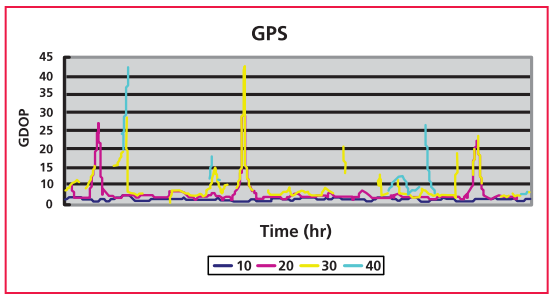

Figure 5a. Localized GDOP of GPS

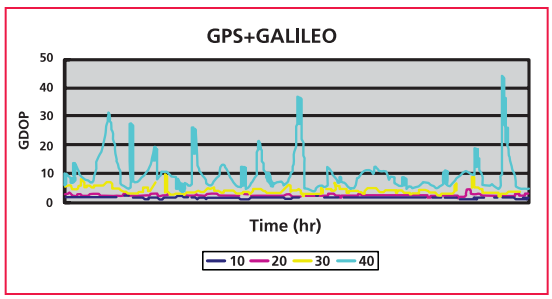

Figure 5b. Localized GDOP of GPS+Galileo

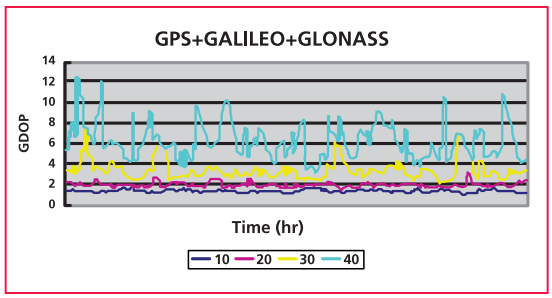

Figure 5c. Localized GDOP of GPS+Galileo+GLONASS

Conclusions

A technical benefit of the geomatics and surveying industry in Taiwan is given in this article. The USA is modernizing GPS, Russia is refreshing GLONASS, and Europe is moving ahead with its own Galileo system. Extra satellites will make possible improved performance for all applications, and especially where satellite signals can be obscured, such as in urban canyons, under tree canopies or in open-cut mines. The benefits of the expected extra satellites and their signals outlined above can be categorized in terms of availability, accuracy, continuity, reliability, efficiency, and ambiguity resolution issues. All the performance indices given in this article strongly indicate the benefits of future GNSS.

Acknowledgement

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Managing land information

The efficiency of Land Information Management System will be assessed by its capacity to meet the needs of the land managers and users in urban and rural areas

Brig M V Bhat
Addl Dir Gen Mil Svy, India

LAND forms important part of development activity. Land revenue is one of the sources of income for state governments. It may come from land holdings by private individuals, real estate transactions or other natural resources being tapped by various sections of the society. Hence, creation of a Land Information Management System involves:

- Collection and depiction of accurate information on boundaries, land holdings and ownership, with reference to other spatial information.
- Collection and depiction of topographical and attribute information regarding land use and natural resources.
- Updating and maintenance of the information.

A LIMS is a computer system stored with spatial data pertaining to land parcels which can be easily retrieved, received and sent, for depiction, query, analysis and manipulation for arriving at judicious decisions. The LIMS should also generate reports and outputs of the analysis which is easy to handle and independently meaningful. Development of a LIMS involves the following

1) Data Collection.
2) Data representation in a computer.
3) Design of application software for analysis and create Decision Support System.

It is important at this stage to understand the basic issues involved in developing an efficient LIMS. These basic issues are:

- Magnitude of the basic tasks in a cadastral system – number of parcels to measure and register.
- Need to relate these parcel information with other spatial information.
- Magnitude and types of problems involved in the land ownership.
- Role of the cadastre and to appreciate the requirement of it's completeness, comprehensiveness, usefulness and effective use.
- Use of existing land records in an efficient manner in the decision support system in National and Global scenario and achieve incremental improvement in measurement and depiction accuracy, in a specified time frame.
- Facilitate use of latest technology in storage of available information and incorporate updated information in the system continuously.
- Understand the availability of the capacity to do the job and requirement to build capacity to support the system.

Status of the system at present

Cadastre in India is a State Subject. The respective state governments have their own system of collection, depiction and maintenance of land information. Cadastral records form the input to assess land revenue. Most of these records have been developed by surveys carried out more than 50 years before.

Positional information and measurements

Measurements are not on a national framework. Different techniques were adopted by government agencies while initially building these records. Though at the time of these surveys, the techniques were modern, in the present context, they are outdated and burdened with errors. Descriptive and numerical information recorded in field have been converted into graphical records. These have been prepared decades ago and not updated. They have the following drawbacks:-

- The field and graphical records are in a mutilated condition.
- They are not on uniform or standardized scale.
- The procedure adopted during data

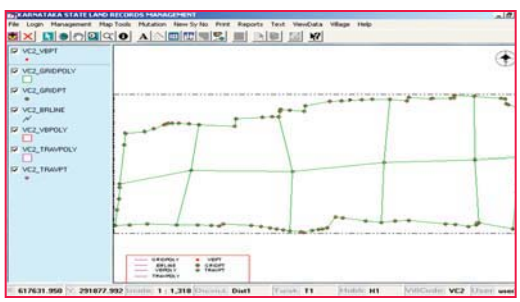


Figure 1 : The Boundary Line Poly is followed by the creation of Grid Point and Grid Poly layers.

collection did not ensure that the inconsistencies are detected and minimized to keep it within tolerance.

- In many cases the records are not even available.
- Due to inconsistencies in records and measurements, a lot of litigations have cropped up.
- They are not on a national framework. Hence integration to smaller scales for analysis on national basis is not possible, within acceptable limits of discrepancies and tolerance.

Attribute information

The land use information is not updated from time to time. This leads to under valuation of the holdings leading to loss in revenue during transactions. In most of the states, the land administration is managed by using hard copy revenue data either in the form of maps or descriptive documents. The information has following drawbacks:

- They are outdated by decades and hence the government is undergoing loss due to incorrect assessment of taxes.
- The change in land use information is not informed by the owners from time to time, which is binding as per the law, hence loss in revenue.

What needs to be done

It is essential that creation of Land Information Management System is done with the following approach:

1) State level and National level connectivity.
2) Use of the LIMS.
3) Use of existing records till new records are created addressing all issues involved.
4) Use of modern technology keeping in mind the terrain conditions.
5) Status of the system in individual states.
6) Transfer of technology and know-how to state governments and industry in carrying out the work.
7) Building capacity in local level and involving them in the process of collection of data.
8) Collect once and use many times for many purposes.

Need for national connectivity

Cadastral records need to be corrected for creation of a scientifically designed Sustainable LIMS. Correction cannot be done in an ad-hoc manner because public will have no faith in the system. Hence it is necessary that the records are created afresh, by actual survey on the ground. During the process, most modern methods of survey should be adopted so that the errors in the records due to inconsistent methodology are removed. While doing so, if the national connectivity can be achieved, it will be easy for integration of the data and analysis on a national scenario. There is also requirement to streamline the procedures in carrying out the filed data collection so that inconsistency can be removed to the maximum extent. (Figure -1)

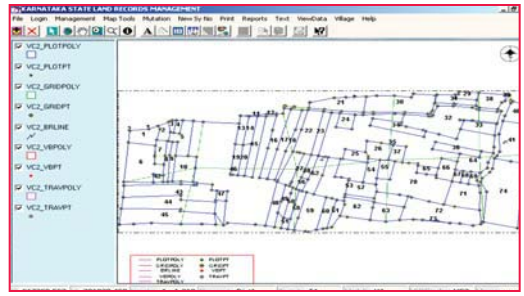


Figure 2 : After the Grid Poly Layer is created, PlotPoint and PlotPoly layers will be created.

What is required?

The salient requirements will be:

Urban areas

In urban areas, the land value is quite high and the spatial data is multi-fold requiring different types of data for different purposes, which the LIMS should be able to generate from the information stored. Data collected to meet mapping standards on 1:1,000 scale with height accuracy of 0.5 meters should be sufficient for most of the land management purposes. For example:-

- spatial data showing accurate footprints of buildings with road network will be required for Location Based Services (LBS), like telecom, gas, power, internet, cable TV, vendors etc. Geographical positional accuracy may not be of great importance, but relative positions should be sufficient.
- land use and attribute information needs to be incorporated for assessment of tax. This can be done by linking the plots with data base consisting the land use information.
- accurate plot information with ownership. (Figure -4)
- various surface infrastructure like power lines, communication network, telecom network etc., underground or subsurface information like, cables of different types, water supply, gas pipe-line, sewerage system etc., spatial information like number of stories in a building, telephone connections etc. are required accurately.
- Accurate information on land use for planning purposes.
- Demographic information for each owner connected through data base
- Updated information almost every 6 months to one year.

Rural Area

In rural area the land value is not as high as urban areas. But, ownership details and plot measurements should be accurate to avoid disputes on ownership and boundary. Data collected to meet mapping standards on 1:5,000 scale with height accuracy of 2 metres should be sufficient for most of the land management purposes. They should depict:-

- village boundaries with road connectivity information from village to village, for the country as a whole is required.
- accurate plot boundary information and ownership details. (Figure -2)
- Land use information connected through data base. (Figure -3)
- Soil, water, irrigation connected

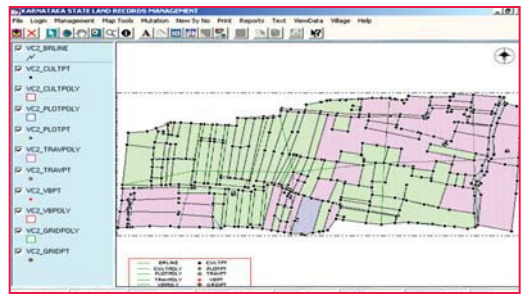


Figure 3: Finally the Cultivation poly will be created and the village map with all the layers will be displayed in the viewer.

through data base for each plot.
- Demographic information connected through data base for each owner.
- Built up area with details of each building.
- Drainage, water supply, telecom, power supply information accurately depicted.
- Updated information for every 5 years.

Hilly and Forest areas

In hilly and forest areas, the land value is not that high. Data collected with mapping standards on 1:10,000 scale with height accuracy of 5 metres should be sufficient to meet following needs:-

- Accurate boundary demarcation and depiction compatible with adjoining village boundary details.
- Forest management.
- Government /waste land management.
- Land use depiction connected through data base.
- Positionally accurate Communication facilities.
- Updation every 5-10 years.

Technology available

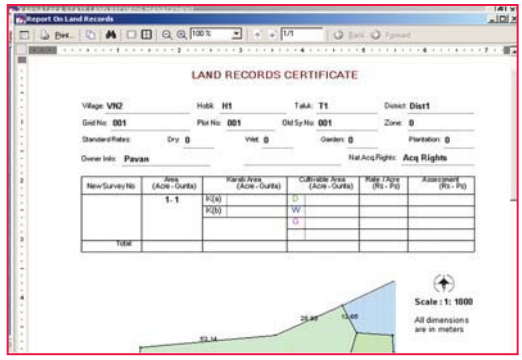
Different technology available and limitations are discussed in brief below. Ground survey cannot be avoided to build a foolproof record. Depending on the constraints and ground conditions, particular technology can be used.

Electronic Total Station Survey

Establishing control by traverse and later distance measuring is done using the total stations. This replaces the conventional theodolite and chain measurements or plane table traverse for establishing control. Detail survey is done by digital recording of data instead of FMBs of conventional system. The data can be downloaded, processed and records created. This process is time consuming.

Global Positioning System and Total Station

GPS is used for establishing control points required for detail survey in an area. This technique is replacement for the theodolite and traversing method, reducing the efforts and time required for establishing stations and observation. However, clear sky view of about 15° over the instrument is essential for tracking of the navigation satellites. Difficult to use in jungle/ tree covered areas. Total station is used for further traversing and detail survey electronically, and process in a computer medium. However in this method, we get accurate records after the entire process is completed. Staged upgradation of records using available records is not possible. This is a time consuming process.



Figur 4 : LRC Report

Photogrammetric survey combined with GPS, Total Station and ground checking

Aerial photo gives a pictorial ground truth and is a proof of ground at the time of photography for times to come. Digital Aerial photographs on 1:25,000 scale are sufficient to prepare a base map on 1:5,000 scale. However, contiguous area of about 5000 sq km will be economical. For rural area this should be sufficient. In urban areas where land value is of significance, we require measurement accuracy upto 5-10cm in a plot of 6metres x 9 metres size. In such areas 1:1,000 scale survey will be required and aerial photo on 1:5,000 will be essential. GPS is used to establish minimum ground control required for photogrammetric survey. A base map will be generated on 1:5,000 scale for rural areas and 1:1,000 scale for cities which can be taken to the ground for ground checking and picking up attribute information.
The process can be done in two ways:

- Generation of line maps from aerial photo: Using digital photogrammetric technique, line maps can be created which can be taken to ground for incorporating cadastral information and other topographical details. This can be brought back to office and incorporated in the data base.
- Generation of orthophoto, incorporating information on ground and then creating digital data base: Ortho photos give accurate base and true picture of ground while in field. Deployment of persons on field work can be done with minimum time and simultaneous work can be done both in office and field for creating digital data base. (Figure -5)

Use of PC Tablet/ Palm top for detail survey and data capture in field

The digital line maps prepared in photogrammetry can be stored in PC Tablet/ Palm top and taken to ground to incorporate attribute information, down load to computer and process to get information desired. Certain amount of post processing of data will be required.

Airborne Laser Terrain Mapping

This technology is very costly but can be used in forest areas to get accurate height. Certain amount of post processing is required.

Suggested procedure

The task of creating a LIMS cannot be achieved at one go. It is proposed to achieve the goal in an incremental manner with the following objective:-

- Establish National Connectivity and use the work of scanning and computerization done already to superimpose and build first level LIS using line map prepared using geo referenced Aerial Photographs (Figure -5)
- Densify the Control to provide framework for plot survey and build Cadastral Records. Update the LIS already created using this information.

How to achieve the above goal

Achieve National Connectivity

Survey of India has already undertaken the work of establishing 300 precise GPS stations in India which will be about 100 km apart. Using these points as base, Survey of India will provide GPS

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- High Resolution Imaging & Products
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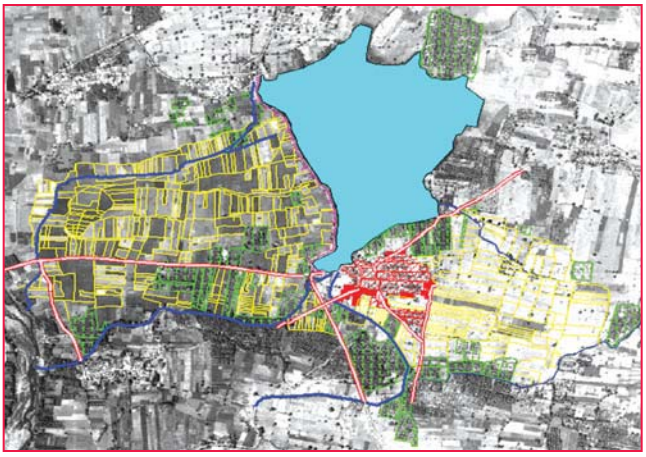

Plate 5 : TAILURU VILLAGE Photogrammetric Data Scale 1:15000

stations at about 5km apart ensuring 2 points for each village, which will be prominent points (Tri junctions of village). These points will further be used for establishing dense control by Total station traverse or GPS for plot level survey.

Preparation of Image Maps and Line Maps on 1:1,000/1:5,000/1:10,000 scale

High Resolution satellite imagery will be used to prepare geo-referenced ortho rectified Image maps for plain areas. Aerial Photographs on scale 1:20,000 will be used for undulating terrain. This will be done by using the 5km apart GPS control points for rectification of the satellite image or aerial photographs. The available village maps, digital or otherwise, will be superimposed on the Image maps. This Image map will be digitized to create Line Maps with topographical features, and plot boundaries as existing in the village map records, to form First Level LIS. The measurements recorded in creating the old records will be linked to the digital records in a GIS environment. This will be completed by Survey of India in two years time.

Achieve measurement accuracy by Resurvey of plots using local resources and update the records

Survey of India will help State Government to further densify the control by GPS/ Total Station to facilitate village boundary and plot boundary survey. Required Training as Capacity Building Measure can also be imparted. However, Survey of India does not wish to carry out the job of building further cadastral records by ground measurement of plots. This needs to be done by respective state Land records personnel using the GPS points and Line Maps already prepared, to meet legal requirements. Survey of India can render supervision efforts/ technical know how to build the computerized LIS. In a coordinated effort, this process should be completed in 3 years time, as a National Movement.

Collection of other attribute Information required for land management

A suitable data base form should be devised to collect and record the land information and demographic information which will help assessment of tax and economic status of each plot owner. Information should be collected for each plot and ownership on a well designed format, with a key field which can be used as link between different thematic information for that ownership. This work could be outsourced to some extent, by dividing the forms to different categories of information, so that information required as per statutory requirements could be collected by the Land Records officials and other information could be collected by out sourcing. Certain information regarding water source and soil classification can be obtained from the respective organization and incorporated in the data base.

Analysis and output

The collected information on control, topography and cadastral details can be processed in the computer using a suitable software for getting plot, grid and village map outputs. Other data collected will help in assessment of tax and economic status of the families. Land use information collected will help analysis from local level to national level. By a suitable generalization technique, the integration of topographical maps on small scale may be done using the same information so that the data on cadastral records and topographical maps will be compatible. This will help integration of Natural resources data in the context of National Spatial Data Infrastructure (NSDI).

Proposal

Survey of India will take up the project using any of the above mentioned methods/ approach depending on the requirement of the states. It will only extend necessary help in training of persons at state level or technology to the industry, to help creation of a LIMS as follows:

PHASE I

- GPS Control for National Connectivity in two stages(100 km apart in stage I and 2 points per village in II Stage): This will be done by Survey of India.
- Generation of Image Maps using Aerial Photo, and creating Line Maps superimposed with village maps : (1:1,000 scale for towns/cities, 1:5,000 scale for rural areas and 1:10,000 scale for forest and hilly areas): This will be done using industry and resources of state governments. However, because of the security and restricted use of aerial photo, the premises of Survey of India will be provided to carry out the work under Survey of India supervision.
- Generation of First Level LIS: Line maps will be generated from aerial photos using digital methods. On this the available land records can be superimposed as attributes and used till accurate records are built.

PHASE II

Achieving measurement accuracy, revision survey and correction of records:

The existing line maps generated in Phase I will be used for deriving coordinates and positions of plot boundary as identified on ground and marked on line maps. This will save lot of time and cost of resurvey. Most of the plot boundaries could be identified on the line maps as they are created from the image maps. With training to local level officials, this job can be done by Land records officials, within their own resources. The measurements so obtained, could be used to correct and update the records. As each village would have properly geo referenced GPS points,

there will not be much error in the data so gathered. Minor errors will be adjusted within the village and hence records will match with adjoining plot maps without any difficulty. Same data will be used to prepare the village, Taluk and small scale maps at higher levels by data integration.

Advantages of GPS/Total Station/ Photogrammetric survey and ground checking procedure:

This approach will help in :-

1) The existing records in measurement can be used as attribute and first level data can be electronically generated and used. This will take about 2 years for the entire country.
2) The photographs will give ground information at the time of photography and become all time proof and record.
3) Many persons can be employed simultaneously on multi layered tasks and will time and cost by about 40% in general, about 60% cost and time saving in rural areas and about 40% in cities.
4) Local level officials/ industry will be fully involved in the process and they will actually be doing the ground data collection.
5) Each village can be given an ortho-rectified photo image of the village. Capacity can be built at village level for incorporating information on this ortho-rectified photographs, so that villagers will be involved in the process of updating records, with facility for scrutiny/ verification. On-line transmission of data can be achieved for on line flow of information from local to national level.

Conclusion Survey of India will adopt procedures and technology depending on the need of each state and help in transfer of technology, supervision of work, and build capacity among states and industry to do this gigantic task. It will provide facility in it's premises for tasks which are of classified nature, like use of photogrammetric techniques. It will also strive to build capacity at local level among people to have a system for systematic and continuous upgradation of information.

Geomatics for infrastructure development

A seminar on "Geomatics for Infrastructure Management" was organized by Institution of Surveyors at Institute for Defence Studies and Analysis, New Delhi on 23-24 July 2007. This program was organized by the Institution in accordance with the main objectives of the Institution to create awareness among government agencies, professionals, public, NGOs, academia and administrators on the state of the art technologies, in handling of geo spatial data. The Seminar was inaugurated by Lt Gen Utpal Bhattacharyya, PVSM, AVSM, Director General (MP&PS), Integrated HQ of MoD(Army). Brig M V Bhat, Additional Director General, Mil Svy and President of the Institution of Surveyors gave a glimpse about the program. Introducing the establishing of the Institution in 1950 as a professional body by active initiative by then Prime Minister Pt. Jawahar Lal Nehru, Brig Bhat dealt about the object of the Institution to promote and progress the profession of surveying by dissemination of knowledge of science and practice of surveying techniques. The Chief Guest after the customary lighting of the lamp and release of Souvenir, addressed the gathering. He underlined the importance of accurate and uptodate spatial data for efficient planning and timely execution of infrastructure projects. There were over 200 persons attending the inaugural ceremony and 157 delegates participating in the technical sessions.

The seminar was sponsored by Natural Resources Data Management System, Dept of Science & Technology and All India Council for Technical Education, Govt of India. Industry represented by Rolta India Ltd, Erdas India (P) Ltd, Bentley Systems(P) Ltd, Elcome India (P) Ltd, Leica Geosystems who are the leaders in GIS and related activities demonstrated their capabilities and latest technologies in exhibition. Survey of India and National Remote Sensing Organisation exhibited trends in map making with latest technologies and different types of satellite imageries and their use in infrastructure planning. Media represented by Coordinates and Geospatial Today covered the proceedings.

The following recommendations emerged after the deliberations:

Government may consider to sharing of spatial data like heights, gravity, geophysical etc. with private agencies which are very essential for exploration of resources for accurate positioning and speedy execution of projects.

Policies may be framed speedily to allow private partnership in data acquisition using sensors and aerial platforms to infuse new techniques and technologies available in the private sector in the country/ abroad.

Interoperability must be maintained in techniques, applications and data sets developed by different agencies both in private and government sectors.

Awareness programs must be conducted for the stake holders frequently to familiarize about the intricacies of spatial data, policies governing generation and sharing of data and technology transfer to users etc.

ESRI's International User Conference Continues to Inspire

In his opening address at ESRI's 27th annual International User Conference, staged this June in the expansive San Diego Convention Center, company president Jack Dangermond set the tone for the weeklong event by announcing that the conference theme, The Geographic Approach, emphasized the unique perspective for analysis and understanding offered through geography and GIS technology.

"Today, the world has many pressing problems for which we must find solutions including an ever-increasing population, global warming, social conflict, natural resource shortages, loss of biodiversity, and security concerns," said Dangermond. "GIS provides both the framework for a comprehensive situational view of these challenges and the analytical capabilities required to develop sustainable solutions to resolve them. GIS equips the user with the tools, methods, and workflows to support collaboration and action," he declared.

Environmentalist and Nobel Peace Prize Laureate Wangari Maathai treated the 13,000-plus attendees to an impassioned talk about the criticality of environmental awareness and action in her Keynote Address. As founder of the Green Belt Movement in Kenya, her group has planted over 40 million trees in the past 30 years. They recently adopted GIS technology, which Maathai called "an extremely valuable tool. GIS helps in planning, marking, and monitoring the trees. It makes our work easier and more efficient."

Conference attendees always eagerly anticipate ESRI's new software announcements, and were not disappointed. Among the announcements, David Maguire, director, products and international, discussed the improved geoprocessing capabilities in ArcGIS 9.3, its support for advanced statistical analysis and geographic visualization, and how it can be applied to scientific computation. Clint Brown, director of software products, detailed the development of ArcWeb Services, which is leading the evolution of GIS to an Internet-based system that is interconnected, interoperable, integrated, and dynamic.

Recognition for exceptional contributions is an important aspect of the conference. This year, the President's Award was presented to the Nature Conservancy, while the Lifetime Achievement Award went to Don Cooke, founder of Geographic Data Technology. The Saudi Aramco Corporation was recognized for making a difference in the lives of others with the Distinguished Service in GIS Award. 165 companies received Special Achievement in GIS Awards.

Another highlight of the annual user conference is the Map Gallery exhibition, where ESRI's user community can display their mapmaking techniques and creativity. This year, more than 1,000 maps were entered into the 15-category competition.

In addition, a number of users hosted pavilions in the map gallery to display their work including GIS Aids Recovery of Post-Tsunami Indonesia; North American Zoos, Aquariums, and Botanical Gardens; the United Nations System; National Geographic Society; Service at Sea; National Geospatial-Intelligence Agency (NGA) Palanterra Interactive Island; National Aeronautics and Space Administration (NASA) / Jet Propulsion Laboratory (JPL) GIS Applications for Space-Based Operations; and San Diego Host Committee GIS. The Green Belt Movement detailed the environmental work of Wangari Maathai.

The conference included more than 300 technical workshops, 900 user presentations, 100 user group meetings, and 1,000 business partners offering a variety of solutions and services.

Concurrent conferences included the ESRI Education User Conference; the ESRI Survey & Engineering GIS Summit; and the inaugural National HAZUS User Conference, hosted by the Federal Emergency Management Agency (FEMA).

Summarizing the event, Dr. Petra Zimmermann, assistant professor at Ball State University, said, "As a first-time attendee of the ESRI International User Conference and Education User Conference, I have definitely been wowed! I've had the pleasure of attending thought-provoking paper sessions, excellent workshops and labs, and inspiring Plenary Sessions at both the EdUC and ESRI UC. I've met so many wonderful people and have received many tips and ideas, both for my research and my classes, and I look forward to implementing them."

Jim Baumann, jbaumann@esri.com

Jim Baumann writes about international GIS-related topics for ESRI. He has written articles on various aspects of the computer graphics industry and information technology for more than 20 years.

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Leica GMX902 GG and Leica ScanStation 2

The Leica GMX902 GG is a high-performance GPS + GLONASS receiver, specially developed to monitor sensitive structures such as bridges, mines or high rise buildings and crucial topographies such as land slides or volcanoes. Leica has also announced a major advance in the capabilities of pulsed (or "time-of-flight") laser scanners for as-built and topographic surveys. The maximum speed for 'ScanStation 2' is 50,000 points/second, more than 10-times that of its ScanStation predecessor (4,000 points/second) and the highest in the industry for pulsed scanners. *www.leica-geosystems.com*

Total Stations for Heavy and Highway Construction

Trimble has announced the introduction of the Trimble® SPS730 and SPS930 Universal Total Stations for heavy and highway construction with features like Servo, Autolock, Robotic, DR Reflectorless and ATS modes of operation. Trimble has also introduced Integrity Manager™ software for monitoring the dynamics of GNSS infrastructure networks. In a GNSS network, movement of a reference antenna due to various reasons like tectonics, weather or simple human error results in reduced data integrity. With this software, network operators can detect movement and whether action is needed. *www.trimble.com.*

Topcon acquired certain assets of Javad Navigation Systems

Topcon Corporation, Japan has acquired certain assets of Javad Navigation Systems, Inc. (JNS), which was created as part of the July 2000 agreements between Topcon and Dr. Javad Ashjaee. *www.topcon.co.jp*

Rolta buys Orion Technology

Rolta India acquires Orion Technology, a Canadian software and integration company. It expects to generate around $100 million over the next three to five years by integrating the acquired technologies. *www.business-standard.com*

Niels Appel appointed Executive Vice President at Contex

Mr Niels Appel has been appointed Executive Vice President of Sales & Marketing for Contex. He will be responsible for the development and implementation of Contex's global sales and marketing strategies and programs. Coordinates speaks to Mr Appel on Context strategy for Asia-Pac region.

How does Contex plan to capitalise on the growth of geospatial technologies?

The GIS/Mapping/Remote Sensing market is a core market for Contex. The customer needs high quality scanning with extreme accuracy; we are the market leader in that segment. Since Contex began to produce scanners in 1989, we have worked with a "never compromise on scanning quality" strategy that fits perfectly into a the GIS/Mapping/Remote Sensing market. In Asia-Pac we intend to continue to invest in resources and marketing; expand the number and breath of our partners and finally, are evaluating the current product portfolio .

Any new product you anticipate for the GIS/Mapping segment?

We will continue to develop products and solutions for the GIS/Mapping/ Remote Sensing market in order to maintain our position. 2008 will be another landmark year for Contex.

How do you estimate the potential of your product in the Asia-Pac region?

Asia-Pac region is a big investment area for us due to the growing economy and an increasing need to digitize millions of maps. Our product portfolio fits very well with the needs of the Asia-Pac region. While some customers are willing to comprise quality in order to get a larger volume of solutions for the same price, this trend is diminishing as a low quality scan results in more manual work. This becomes significant with the increasing labour costs in the region.

What is the significance of the Contex buy out by Ratos in your overall business?

We are very happy with our new owner Ratos for a number of reasons. Ratos has seen the potential both in Contex as a company and also in the market we are in. Our plan is to grow both organically and also by acquisitions. So I do not foresee any significant changes in the way we operate. I see a significant opportunity for growth with Ratos. Contex is a very healthy company – we are financially in very good shape, we have the strongest product portfolio in the market and we have a very robust organization. So with Ratos as a new owner, we have all that is needed for accelerating our growth.

Ratos AB acquires Contex

Ratos AB, Sweden, shall buy the Contex Group (including Contex Holding A/S, Contex A/S, Vidar and Z Corporation) from EQT and other shareholders. Ratos is expected to assume ownership within 2 months. For Contex, the change of ownership marks the beginning of the next phase in the development of the Group. The transfer of ownership will not change the daily operations, structure, management, nor will it change the strategic direction.

Tele Atlas announces agreement with BAKOSURTANAL

Tele Atlas has signed an agreement with BAKOSURTANAL, Indonesian mapping organisation, to incorporate digital maps within its existing Indonesia database by September 2007. The Indonesia map is part of a virtually seamless Southeast Asia map solution from Tele Atlas that includes extensive coverage of Singapore, Malaysia and Thailand. *www.teleatlas.com*

TomTom bids for Tele Atlas NV

TomTom NV shall buy Tele Atlas NV for 1.9 billion euros by paying 21.25 euros per, a 28 per cent premium to the company's closing price of 16.55 euros.

DigitalGlobe expands distribution network in Australia

DigitalGlobe has announced the addition of Geoimage Pty Ltd, Australia to its network of distribution partners. Geoimage will resell DigitalGlobe's products throughout Australia, New Zealand, Papua New Guinea and the islands of the South West Pacific. *http://media.digitalglobe.com/*

Optech Plays Key Role in NASA's Phoenix Mars Mission

Optech lidar technology shall be launched toward Mars aboard NASA's Phoenix Mars Lander. Canada is playing an important role in this mission by contributing a meteorological station to track the weather and climate on Mars.

The main sensor of the meteorological station is a lidar instrument designed by Optech and built in collaboration with MDA Space Missions, the Canadian Space Agency. *www.optech.ca*

Google Earth integrates SOCET

SOCET GXP v2.3, image analysis and mapping software integrates with Google Earth and the ESRI geodatabase thus enabling analysts to evaluate and share intelligence data.

It interacts with Google Earth in real time, 3D colour visualization and gives geospatial context to objects of interest. *www.baesystems.com*

Automated 3D Station "NET1" by Sokkia

Sokkia Japan has released the NET1 automated 3D station, offering enhanced measurement efficiency for industrial, construction and deformation monitoring applications.

It has the latest total station technologies - auto-pointing, auto-tracking, reflectorless measurement and wireless control to greatly increase efficiency in a wide range of applications. *www.Sokkia.co.jp*

Footprint of entire Russia from space

ScanEx R&D Center has acquired almost the entire coverage with high resolution images of the Russian territory of 17 million square km. In line with the agreement with French SPOT Image company, two satellites – SPOT-2 and SPOT-4 – have been performing continuous imagery of the entire Russian territory starting March 2006 at the resolution of 10 m in panchromatic mode and 20 m in multispectral mode. The images are acquired by the network of universal ground receiving stations of ScaEx Center in Moscow. *www.scanex.com*

Autodesk introduces Enhanced Geospatial Solutions

Autodesk, Inc. has launched Autodesk MapGuide Enterprise 2008 and Autodesk Topobase 2008, two geospatial softwares that provide organizations with a platform to share location, design and enterprise information across departments. *www.pressreleases.autodesk.com*

Marine Navigation and Safety of Sea Transportation

The 7th International Navigational Symposium on Marine Navigation and Safety of Sea Transportation TransNav'2007, organized jointly by the Faculty of Navigation, Gdynia Maritime University and the Polish Branch of the Nautical Institute held from 20 to 22 June, 2007 in Gdynia, Poland. The theme of this year Navigational Symposium: "Marine Navigation and Safety of Sea Transportation" is, therefore, most timely as it provides participating distinguished delegates who represented Maritime Education and Training (MET) and research institutions, shipping industry, shipowners, classification societies, maritime administrations, ports, services, professional institutes, agencies, societies and navigational instrument manufacturers.

What could be more relevant, therefore, than representatives from 35 countries all over the world coming together to discuss the best possible ways of preparing staff at sea, in shipping companies, ports and maritime administrations to meet these challenges?

The papers presented at the TransNav'2007 covered a full range of topics, from operations, management and organization to engineering and sciences. The Symposium main topics were Marine navigation, Safety and security of maritime shipping, Sea transport and transportation technology, Hydrography, geodesy and marine cartography, Geomatics and GIS in maritime applications, Electronic chart systems ECS and ECDIS, and many more.

It is my pleasure to inform that the following very important persons have kindly accepted the honorary patronage of the Symposium: Mr. Rafal Wiechecki - Minister of Maritime Economy Ministry of the Republic of Poland, Capt. Nicholas Cooper - President of the Nautical Institute, VAdm Alexandros Maratos, President of the International Hydrographic Bureau, Dr. Wojciech Szczurek - Mayor of Gdynia and Prof. Jozef Lisowski - Rector of Gdynia Maritime University.

Symposium Proceedings titled "Advances in Navigation and Safety of Sea Transportation" was organized thematically like a Monograph.

On the occasion of World Hydrography Day on 21st of June a special plenary session was organized under chairmanship of RAdm. Dr. Czeslaw Dyrcz and Capt. Piotr Pernaczynski, former and present Head of Hydrographic Office of the Polish Navy. The theme of this year's celebrations was "Electronic Navigational Charts (ENCs); an essential element of safety at sea and efficient maritime operations".

A round table panel discussion was organized under chairmanship of Prof. Vidal Ashkenazi, UK. It was the most attractive part of Symposium. The title of Round Table Plenary Session was "Galileo: A Significant Benefit to Marine Navigation?". In the Symposium participated distinguished delegates from over 60 institutions from 35 countries around the world.

The winner of the best presentation award, Mr. Oguzhan Gurel (Turkey), was presented to the audience at the end of the Symposium during the Closing Ceremony.

The winner of the best paper award, Prof Frantisek Vejrazka (Czech Republic), was presented to the audience at the end of the Symposium during the Closing Ceremony.

The 7th Symposium was accompanied by a small exhibition (Imtech, Transas, C-Map by Jappesen, PC Maritime), which will display the latest developments in on-board equipment, education and training, safety and navigation infrastructure, and navigation technologies and equipment.

All TransNav'2007 papers are presented at http://transnav.am.gdynia.pl and the Co-ordinates website.

Prof Dr Adam Weintrit, *weintrit@am.gdynia.pl*

Airtel announces GPS navigation

Bharti Airtel, in collaboration with Sweden-based Wayfinder Systems, launched its GPS-based Navigation Application on compatible mobile handsets. The systems is complete with detailed maps and points-of-interest of several cities across the country. It will be available on the BlackBerry 8800 and will cover information on cities including Delhi and NCR, Bangalore, Mumbai & Navi Mumbai, Thane, Pune, Chennai, Hyderabad, Kolkata, and Chandigarh. *www.techtree.com*

China's mobile navigation market to grow more than 10-fold by 2011

With falling Average Selling Prices (ASPs) for GPS handsets, domestic GPS handset shipments will rise to 16.5 million units in 2011, more than 10 times the 1.4 million in 2007, iSuppli Corp. predicts. Both China Mobile and China Unicom began to provide navigation services this year. They have partnered with digital-mapping, handset and chipset suppliers to bring GPS to the mobile market.

In contrast to dedicated Personal Navigation Devices (PNDs), GPS handsets receive mapping data through wireless networks to provide navigation and hence do not need to embed mapping data—only free GPS navigation software. As an option, consumers can install complete maps into their GPS-enabled handsets to use the navigation service and only retrieve specific data on longitude, latitude and altitude directly from orbiting GPS satellites. The optimal route to the user's destination is then displayed based on GIS software and on the digital map installed. *www.isuppli.com*

Nokia launches A-GPS service

This Assisted GPS (A-GPS) service helps Nokia Maps users find their current locations faster using their Nokia mobile device with built-in GPS. Nokia intends to equip all of its future devices that have built-in GPS with this service. The first device to use this service is the Nokia 6110 Navigator. *www.nokia.com*

Sprint, Google to collaborate on WiMAX mobile Internet services

Sprint and Google Inc. shall soon bring WiMAX mobile Internet customers search, interactive communications and social networking tools though a new mobile portal. This collaboration will help spur new mobility and location-assisted services as Sprint untethers Internet access for consumers, businesses and government customers. *www.sprint.com*

Broadcom joins S60 Ccommunity

Broadcom Corporation announced that it has joined S60 Product Creation Community. It will have access to software, technology and S60 ecosystem resources for developing advanced smartphones based on S60 software. Broadcom's recent acquisition of GlobalLocate for GPS solutions, and its complete line of power management and RF solutions round out the extensive list of products it now offers to S60 customers. As a member it can work with S60 ecosystem members to integrate Symbian OS® and S60 software on Broadcom's Mobile platforms. *www.broadcom.com*

Wi-Fi muscling in on RFID's location-based services markets

Wi-Fi-based Real Time Location Systems will become an $800 million dollar market by 2012, according to ABI Research report. This study examines the key vertical market segments spurring growth, as well as some of the drivers for horizontal growth such as fixed-mobile convergence. *www.abiresearch.com*

LBS spending in 2007 nearly USD 1.5 bln

The worldwide market for location-based telecommunication services is expected to reach nearly $1.5 billion in 2007.According to The Insight Research Corporation, location-based telecommunication services are most popular in Asian countries, where they provide wireless subscribers with tailored information based upon their current physical location. *www.insight-corp.com*

Value-added offerings to spur growth of location-based services

According to Frost & Sullivan, Asia Pacific Location-based Services Market, covering 13 major Asia-Pacific economies - was worth US$291.7 million in 2006, and is expected to grow at a CAGR (compound annual growth rate) of 15.3 percent (2006-2009) to reach an estimated US$447 million by end-2009.

Japan and South Korea are the most developed LBS markets accounting for nearly 92 percent of the total revenues in Asia-Pacific.

The demand for LBS in the rest of Asia-Pacific has been inhibited by issues like privacy infringement concerns, inter-operability issues, lack of advanced GPS -enabled handsets, and a general lack of a conducive eco-system and user interest. *www.frost.com*

CEOs review the progress of EGNOS

The CEOs of the Members of the European Geostationnary Navigation Overlay Service (EGNOS) Operators and Infrastructure Group (EOIG) and of the ESSP met recently in Paris to review the progress of EGNOS. The first in-flight operational trials conducted recently in Spain, Switzerland and France have confirmed the capability of EGNOS-based approaches similar to existing precision approaches (Cat I) supported today by conventional navigation systems, in line with the high standard safety procedures of civil aviation.

The European Commission Communication is proposing to secure the financing of EGNOS for the next six years with public funding. The CEOs of the EOIG urge the States to achieve a financial resolution in October 2007, in order to guarantee the success of the launching phase of EGNOS as a new air navigation system. *michel.calvet@aviation-civile.gouv.fr*

Pseudo-satellites allow accurate navigation in Helsinki Harbour

Pseudo-satellites, ground-based substitutes used when signals from 'real' satellites are not available, can deliver accurate positioning information in places where conventional solutions fail. This was demonstrated recently in Helsinki harbour in Finland as part of a project supported by ESA. The solution is to set up a system with two or three pseudo-satellites, called pseudolites, installed in elevated locations. The pseudolites achieve the same result as satellites in orbit, transmitting data sent by the EGNOS network and its data access system.

The results of the demonstration, which was performed by the Finnish Geodetic Institute and Space Systems Finland, showed that the ranging measurements from pseudolites provide navigation solutions compatible with those from GPS satellites, at a low cost. This unique way of providing positioning data could offer accuracies of a few centimetres. *www.sciencedaily.com*

Russian railways pushes GLONASS/GPS

Russian Railways is working on integrating satellite navigation signals from GLONASS/GPS in its automated rail transport systems. Some 7,000 locomotives are now fitted with navigation receivers. With a total volume of up to 20,000 users, rail transport is the second-largest potential market for satellite navigation receivers in Russia after road users. *www.satnews.com*

Eye in the sky' to keep tab on DTCs

Delhi Transport Corporation (DTC) passengers will soon also have electronic displays informing them about the next bus stop and the time when a particular bus will reach a bus stop based on CDMA or GSM. *http://timesofindia.indiatimes.com*

GPS helps Beijing Olympic officials to ensure food safety

GPS will be used to ensure food safety at next year's Beijing Olympics. Olympic organizing officials spelled out high-tech plans to make sure healthy food is delivered to the 10,500 athletes residing next year in the Olympic Village. *www.iht.com*

Spanish authorities to fine GPS navigation misuses

Spanish traffic authority (DGT) is studying a new law to fine drivers using their GPS navigation systems while their vehicle is in motion. Using a mobile phone when driving is forbidden in Spain and using a navigation device will be the same. An estimated 1.3 million GPS navigation devices will be sold in Spain in 2007. *www.gpsbusinessnews.com*

High-Tech GPS, 3G Phones Stir Japanese Market

E-wallet phones, GPS phones, and related services are gaining traction today in the Japanese mobile phone market, according to market research firm In-Stat. Shipment of 3G phones exceeded 92 percent of 47.8 million phones sold in 2006 in Japan. *www.instat.com*

Hemisphere GPS' Crescent™ R100 Series RTK Technology now shipping

Hemisphere GPS, Crescent R100 Series DGPS Receivers now support RTK is in full production release and available as an upgrade to all customers. Crescent R100 Series Receivers use both GPS and SBAS (WAAS/EGNOS/MSAS) to provide rapid initialization, improved reliability, and real-time centimeter level accuracy. *www.hemispheregps.com*

Applanix New POS LV 610 System

Applanix has introduced POS LV 610. It is a turn key solution designed for the specific needs of mobile mapping service providers and engineering /survey professionals. The first Applanix POS LV 610 unit has already been purchased by Toyota Central R&D Labs Inc. for use in vehicle dynamics reference data gathering to better study vehicle motion and road positioning. *Applanix.com*

Speck Systems Limited has been adjudged by CRISIL as the Most Promising SME (Small and Medium Enterprise) of the Year 2007 and also the 'Most Promising SME in the Non Retail, Trading and Others' category for the year 2007. The 'Emerging India Awards 2007' was received by Mr. KCM Kumar, Managing Director of Speck Systems by Prime Minister of India. Total number of entries for the award were 1,25,000

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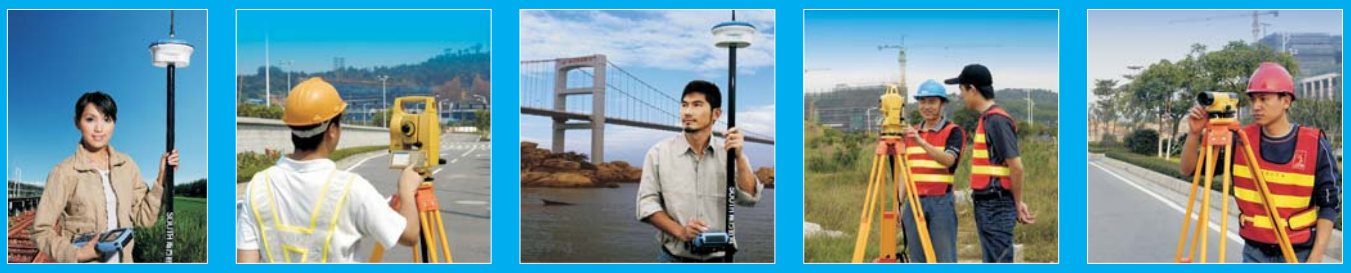

HTTP://WWW.SOUTHSURVEY.COM

Chief Surveyor of Singapore is first Asian to receive coveted spatial science award

The Department of Geomatics, University of Melbourne will be presenting its annual Thornton Smith Medal for 2007 to its first Asian recipient outside of Australia. Mr Soh Kheng Peng, who is chief surveyor of Singapore, Singapore Land Authority.

The Medal commemorates Jim Thornton Smith who founded the Department of Geomatics at the University of Melbourne in 1949 and was instrumental in the formulation and introduction of the Bachelor of Surveying degree in 1948. The Medal is awarded to a graduate from the Department of Geomatics who has shown a high level of distinction and leadership in the discipline.

Google Earth helps uncover tax fraud

Argentina's tax authorities are using Google Earth's satellite to track down fraud. Existing property maps were superimposed in Google Earth to reveal the changes. It is also being used to check if taxpayers may have expanded their homes in ways that would increase their value for taxation. *www.news.com.au*

UN-Habitat signs agreement with ITC

UN-Habitat and ITC, The Netherlands are clustering their knowledge in the field of urban development in developing countries.Recently, director of UN-Habitat Dr. Tibaijuka and ITC rector Prof. Molenaar signed an agreement relating to cooperation in the fields of capacity development, training and research. *www.itc.nl*

Michael Goodchild and Don Cooke in GIS Hall of Fame

The Urban and Regional Information Systems Association (URISA) Hall of Fame Laureates are individuals or organizations whose pioneering work has moved the geospatial industry in a better, stronger direction. Michael Goodchild and Don Cooke will join this esteemed group during the Opening Ceremony at URISA's 45th Annual Conference in Washington, DC this August. *www.urisa.org/*

Geokosmos to conduct LiDAR survey of the French railways

Using combined airborne laser scanning and digital aerial photography technology Geokosmos surveyed the railroads that connect Amiens and Bouillon.

The captured data was used for producing a large-scale digital topographic map (scale 1:500) and a digital orthophoto (GSD 5 cm) that will help French National Railways Service to provide technical assessment of its infrastructure. The accuracy of captured data was conducted with high density of laser points – 7 points per 1 sq. m. Planimetric and height and accuracy constituted 5 cm. *www.geokosmos.ru*

U.S. Geological Survey makes Topographic maps available

U.S. Geological Survey (USGS) is using the GeoPDF format to make its primary base series quadrangle maps available online. The initial project, started by the US Army Corps of Engineers, involved converting more than 60,000 USGS Digital Raster Graphics to GeoPDF files. These maps are used by businesses and consumers for all kinds of applications from engineering to land use management and recreation such as hiking, hunting and camping. *http://store.usgs.gov.*

ADSIC announces the launch of the AD-SDI

Abu Dhabi Systems and Information Committee has launched the Abu Dhabi Spatial Data Initiative (AD-SDI), the latest stage of the government's strategy to stay at the cutting edge of GIS technology. The AD-SDI will coordinate vital data-sharing activities while leaving primary responsibility for development and maintenance of framework data with specific custodian agencies. *www.sdi.abudhabi.ae*

NDMC to introduce smart map of the city

New Delhi Municipal Council finishes making the country's smartest map by this year end using a combination of GIS, DGPS and Management Information System. The first phase of the project, expected to be completed by year end, will map out all sewer and water lines and 14,000 manholes. The system will eventually have 55 kinds of facilities, including details of all 12,000 manholes, 2,35,000 trees, 17,000 light poles, 12,000 buildings, roads, toilets and sewers in the area. *www.cities.expressindia.com*

China introduces new policies on geographic information

China has introduced new policies on approving and announcing significant geographic information. According to China's State Bureau of Surveying and Mapping, information will be approved by the State Council, after an audit of surveying and mapping authorities and a consultation with the relevant State Council departments and army surveying and mapping authorities. The announcement of the heights of China's world-famous mountains, according to law, will help address incorrect and inconsistent data regarding the mountains. It will also guide communities in using such geographic information, ensuring that the data is accurate in its various applications. *http://www.cctv.com*

Incomplete maps illegal in China... Chinese map vendors fined

Several hotel chains operating in Shanghai face fines for providing guests with improper maps which only show part of China, not the entire country. Such maps were found at six hotel chains in Shanghai, but they have only provided information on two of the companies. The law states that any person or company found publishing maps that show only part of the country can be fined up to 10,000 yuan (US$1,315) *http://www.shanghaidaily.com*

ISRO to launch Israeli Satellite

ISRO is planning to launch an Israeli satellite from Sriharikota which is expected to cost approximately $15 million. Israel has opted for the Indian PSLV as it is more reliable than its own Shavit rocket and also Israel's defence ministry has laid down new orbital requirements for TechSar which Shavit could not provide. *http://timesofindia.indiatimes.com*

Antrix may sign pacts to launch large satellites

Antrix Corporation Ltd is targeting at least one satellite launch every year on a commercial basis. The commercial arm of the Indian Space Research Organisation (ISRO) shall launch of two to three large satellites in the 2.2 to 2.4 tonne range. Antrix is targeting the emerging market for small scientific and commercial satellites of up to the 600 kg class. *www.dnaindia.com*

ISRO project on Kamrup's ecology

A two years ISRO sponsored project would reveal the environmental reality of Kamrup district in Assam by using satellite imagery and ground-based observation to conclude the land-use pattern, surface water quality of large water bodies, and air pollution at select points of the district. *www.assamtribune.com*

AU, Remote Sensing Applications Centre sign MoU

The Andhra University (AU) and Andhra Pradesh State Remote Sensing Applications Centre (APSRSAC), India signed recently a memorandum of understanding (MoU).

IT in agriculture and scope of large-scale investments in infrastructure, especially in irrigation, power, credit and research will be implemented using the satellite-based data, GIS based Data Analysis and the dissemination of these advisory services through Information Centre for Technology (ICT) which will help sustain the Indian Agricultural Sector. *http://www.newindpress.com*

Galileo update

US, EU agree on GPS–Galileo compatibility

The United States and the European Union (EU) have announced a formal agreement to make respective global navigation satellite systems (GNSS)-GPS and Galileo-compatible with one another.

The European Commission (EC) said a joint working group had overcome technical challenges to design interoperable civil signals. Experts have agreed that a multiplexed binary offset carrier (MBOC) waveform will be used on both systems instead of the binary offset carrier, or BOC (1,1) waveform, as stated in a 1984 agreement between the United States and the EU. The MBOC signal was proposed by a technical working group to examine further refinements to the design. www.satnews.com

Galileo challenges sat-nav firms

A competition, which aims to find novel ideas that exploit the pin-point accuracy of Europe's soon-to-launch Galileo system, is calling for entries. The eventual winner of the UK Satellite Navigation Challenge will then compete in a European tournament for cash and support to kick-start the business. "Everybody has been amazed at what clever entrepreneurs have been able to do [with GPS]; it does far more than what anyone could have dreamed of when they invented the system," said Richard Peckham of EADS Astrium Navigation, and one of the Judges of the UK competition. "I think the same will be true in the future when you have Galileo plus GPS." He said the UK competition was primarily looking for something that had business potential. Last year's competition, for example, was won by Genesys Consultancy, which suggested a product to help predict natural disasters like volcanic eruptions and earthquakes. http://news.bbc.co.uk/1/hi/sci/tech/6897944.stm

UK presses private Galileo role

The UK says it still believes the private sector should share the risk and the cost of developing Europe's satellite-navigation system, Galileo. In May, the European Commission abandoned negotiations with a private consortium to help it build the system. But new UK transport minister Rosie Winterton said the commercial sector should still have a role in developing the new sat-nav service. "Galileo is considered a key [European] Community project, but we are clear that it cannot be carried out at any price; it has to be affordable, and it has to be value for money," she told a House of Commons debate on the project. http://news.bbc.co.uk/2/hi/science/

Germany remains opposed to extra EU budget

German finance minister Peer Steinbruck remains opposed to using additional public funds to pay for the Galileo satellite navigation system, saying he does not want any changes to the original financing plan. Germany does not want to siphon off extra cash from the EU budget for Galileo as proposed by the European Commission. http://www.hemscott.com/news

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http://www.geospatial-exh.com/

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First International Summer School on Global Navigation Satellite Systems
Sep 02 - 09 2007
Berchtesgaden, Bavaria, Germany
heike.haas@unibw-muenchen.de

58th IAC Expo/GISTEX 2007
September 24 - 28, Hyderabad, India
info@iac2007expo.org, http://www.iac2007expo.org/

INTERGEO 2007
25-27 September, Leipzig, Germany
info@hinte-messe.de, www.intergeo.de

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

October 2007

36th Annual ILA Convention and Technical Symposium!
October 14-17, at the Embassy Suites Orlando International Drive Orlando, Florida, USA

9th South-East Asian Survey Congress
28 October - 2 November, Christchurch, New Zealand
http://www.conference.co.nz/index.cfm/surveyors2007/

Nav 07 The Navigation Conference & Exhibition
30 Oct 2007 -01 Nov 2007
www.rin.org.uk, conference@rin.org.uk

November 2007

IMTA (Asia Pacific) Annual Conference & Trade Show 2007
November 2 - 3, Gold Coast, Australia
imtaaspac@chariot.net.au, http://www.maptrade.org/events/displayevent.php?id=79

International Symposium and Exhibition on Geoinformation & International Symposium on GPS/GNSS
05 - 07 Nov 2007, Johar Bahru, Malaysia
http://www.fksg.utm.my/isg07/index1.html

Trimble Dimensions 2007
November 5-7, Las Vegas
www.trimbleevents.com

4th International Symposium on LBS and TeleCartography
8-10 November
Hong Kong, SAR, China
http://www.lsgi.polyu.edu.hk/LBS2007/

ACRS2007
November 12-16, 2007, Kuala Lumpur, Malaysia
http://www.macres.gov.my/acrs2007

27th INCA International Congress
Visakhapatnam, India
21-23 November 2007
http://www.hydrobharat.nic.in/lst_Circular_INCA_2007.pdf

14th Session of the Asia-Pacific Regional Space Agency Forum
21-23 November
Bangalore, India
www.aprsaf.org/text/ap14_info.html

ESRI South Asia User Conference 2007
29 - 30 November
Singapore
uc2007@esrisa.com
http://www.esrisa.com/pages/uc2007

December 2007

MEST 2007: 4th Middle East Spatial Technology Conference and Exhibition
10-12 December 2007, Kingdom of Bahrain
bseng@batelco.com.bh, http://www.engineer-bh.com/mest2007/

February 2008

GSDI-10 St. Augustine, Trinidad
February 25-29, 2008
http://www.gsdi.org/gsdi10/

Munich Satellite Navigation Summit
19 - 21 February 2008, Residenz München, Germany
http://www.munich-satellite-navigation-summit.org/

May 2008

Plans2008: Position Laction and Navigation Symposium
May 6-8, 2008, Monterey, California,
www.plansconference.org

June 2008

International Conference: "Studying, Modeling and Sense Making of Planet Earth"
1 – 6 June, 2008
Department of Geography, University of the Aegean, Mytilene, Lesvos , Greece
http://www.aegean.gr/geography/earth-conference2008/en/main_fr.htm

July 2008

ISPRS2008
3 – 11 July, 2008
Beijing, China
www.isprs2008-beijing.org/

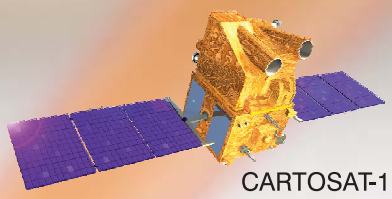
August 2008

ESRI's 28th annual International User Conference
August 4-8, 2008 in San Diego, California
www.esri.com

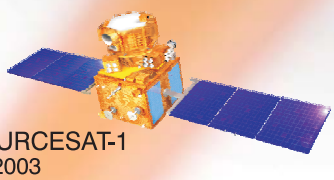
CARTOSAT-2

... a new bird of Indian Remote Sensing Satellites (IRS)

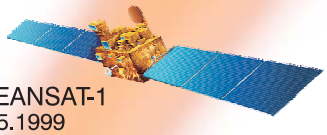
CARTOSAT-2
10.01. 2007
PSLV-C7



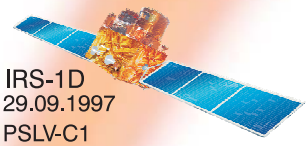
CARTOSAT-1
05.05. 2005
PSLV-C6



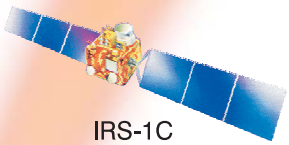
RESOURCESAT-1
17.10. 2003
PSLV-C5



OCEANSAT-1
26.05.1999
PSLV-C2



IRS-1D
29.09.1997
PSLV-C1



IRS-1C
28.12.1995
MOLNIYA

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