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Navigational regionalism

Global Navigational Systems could have served the globe.

However, regions have specific needs.

Moreover, aspirations.

Aspirations to own and control the technology.

Owning makes sense as it adds to the might.

The desire and importance of 'being mighty' cannot be undermined.

So the pace for regionalism in navigation system may increase.

Still, they may work in cooperation. Hopefully.

Bal Krishna, Editor
bal@mycoordinates.org

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GATE: A boon for Galileo

It will allow receiver, application and service developers to perform realistic field tests

Guenter Heinrichs
Head of business development and R&D management , IFEN GmbH

Erwin Loehnert
Technical Manager, GATE project, IFEN GmbH

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Systems Engineer, IFEN GmbH

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IFEN GmbH

GATE is a ground-based realistic test environment for developers of receivers, applications and services for the future satellite navigation system Galileo. GATE is currently being built-up and as from beginning of 2008 - several years before Galileo becomes fully operational - Galileo signals will be emitted by 6 earth-fixed transmitters in the area of Berchtesgaden, located in the southeast of Germany in the German Alps. This will provide the opportunity for receiver, application and service developers to perform realistic field-tests of hardware and software for Galileo at an early stage. In this way GATE will also support German and European products for Galileo entering the market.

While the motivation of the US ground-based ranging test bed Yuma in the 70's was to prove the concept of satellite navigation, no one doubts that Galileo will work from a conceptual point of view. However, it is still an ambitious technological project, introducing a signal structure far more sophisticated than the GPS C/A Code. In fact there are three major mission objectives to be covered by GATE – Signal Experiments, Receiver Testing and User applications.

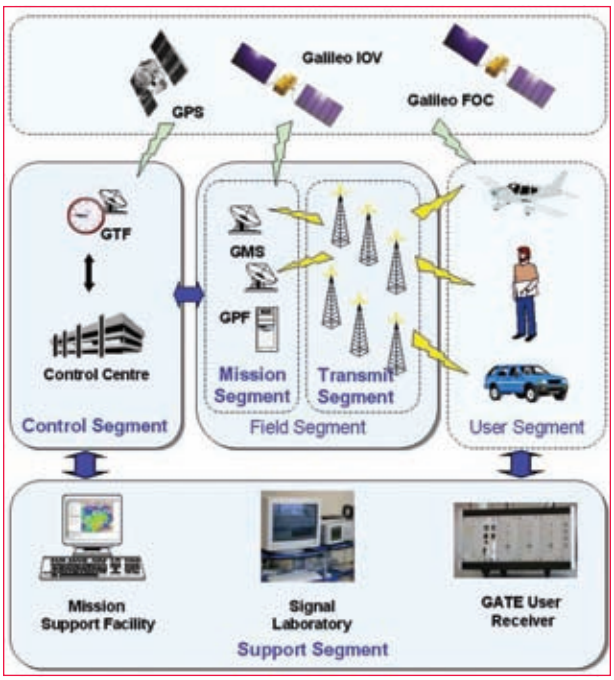

Figure 1: GATE Infrastructure Overview

GATE Infrastructure & Test Area

GATE System Architecture

Differing from real (navigation) satellite missions a differentiation of the GATE system into the typical sectors Space Segment, Ground Segment and User Segment is not adequate. A division of the GATE system into the four segments - Transmit Segment (GATS), Mission Segment (GAMS), Control Segment (GCS), and the Support Segment – was considered as more adequate. Figure 1 gives an general overview of the system architecture of the GATE infrastructure.

The ground-based transmitters, which are part of the GATE Transmit Segment (GATS), will emit all frequencies foreseen for Galileo. Therefore they have to be flexible in signal generation and adaptive to changes in signal structure. As GATE is a real-time system it is necessary to feed the navigation message in real-time to the transmitters. They are also equipped with stable atomic clocks. The following Figure 2 shows the six envisaged transmitter locations, as well as the transmitter rack and the corresponding transmit antenna.

The GATE Mission Segment (GAMS) monitors the navigation signals by using two GATE Monitoring Stations (GMS), performs the time synchronisation of all system clocks and generates navigation messages and steering commands to be sent to the six transmitters. The tasks denoted above are mainly performed by the two GAMS core elements, the GATE Processing Facility (GPF) and the GATE Monitor Receiver (GMRx), both developed by IFEN GmbH.

The GATE Control Segment (GCS) includes all the functionality and facilities that are required for the mission control and operation. The main tasks it has to perform are to monitor and control the entire GATE system, to host and operate the control centre, which serves as operational node of GATE including e.g. the mission planning, to host and

Figure 2: GATE Transmitter Locations and Transmitter Rack GATE Infrastructure Overview

provide the GATE system time, and to archive the GATE mission data.

The main tasks of the GATE Support Segment (GSS) finally comprise the appropriate preparation, i.e. simulation and planning, of the GATE experiments with dedicated software tools, as well as the provision of the GATE User Terminals equipped with a combined Galileo/GPS receiver.

GATE Test Area Berchtesgaden / Germany

The GATE test area is located in the region of Berchtesgaden in the very south-eastern part of Germany / Bavaria. The service area is depicted in the maps shown in FIG. 8 below. The GATE test area, which is roughly limited by the imaginary connection lines between the signal transmitters, has a size of about 65 km², while the GATE core test area, as marked in Figure 3 below on the right hand side, is about 25 km². The two monitoring stations are located at an exposed position quite centric within the GATE test area. As it can be seen from fig. 3 below, Berchtesgaden is surrounded by high mountains rising up to over 2000 m. The establishment of the GATE transmitters on well exposed positions allows for the emission of the GATE signals with average elevation angles between 10 to 15 degrees from a user's point of view located within the GATE test area.

Positioning performance in the GATE test area

Static field tests

At the "GATE central point", which is located quite in the centre of the core test area, all transmit stations (GTS) are visible and HDOP and VDOP values are very good for the GATE service area. Therefore the positioning accuracy obtained is very favourable in the vicinity around this point. The Figure below shows the positioning performance at the GATE central point for a static receiver in the three different GATE modes.

The receiver was installed in a van with the GATE user antenna on the top of the van. The van was parked beside the road at a reference mark, which had been surveyed with a precision of 10 cm.

Figure 3: GATE Service Area Berchtesgaden / Germany (core test area marked in red, transmitters marked as red dots) and view into the GATE test area

The experiment was performed in the GATE Base Mode and Extended Base Mode as well as in Virtual Satellite Mode, where the GATE/Galileo signals are simulated as they were transmitted from orbiting satellites. In fact of course the signals are transmitted by the earth fixed transmitters, so that signal fading and multipath effects, due to building and the landscape, are still present. The viewgraphs in Figures 4 show the position solutions on L1 frequency. The observation time for the static measurements was about 5 to 10 minutes for each GATE mode. The GATE position accuracies ($\sqrt{2}\,\sigma$) for these measurements are below 10 m for all three modes.

Dynamic field tests

Several tracking / positioning tests with the GATE system under dynamic conditions with a speed of up to 100 km/h were performed. The standard dynamic tests cover low dynamic conditions with an averaged speed of about 30 to 50 kilometers per hour. A sample track of a test drive in the EBM mode is presented below in the left-hand figure. High dynamic tests can only be performed at a section of the road B20, which passes the eastern part of the GATE area in north/south direction, where a good visibility of the GATE transmitters is available. The road B20 is the only one in the GATE area where it is allowed to drive at 100 km/h. As starting point a dedicated position at the roadside was selected where all 6 GATE transmitters could be tracked well. After a short time of static positioning with all 6 signal sources – to make sure that the GATE receiver is in a well-defined starting position with stable tracking – the test car was accelerated rapidly up to a velocity of more than 90 km/h.

The sample results of a test drive in the GATE mode VSM are presented in fig. 5.

The dynamic positioning tests of the GATE receiver with Galileo signals in the GATE test area gave proof of the operational capability as well as the performance of the receiver and the whole system also under dynamic conditions in all three GATE modes. This was evaluated not only for the receiver in uniform motion but also particularly with regard

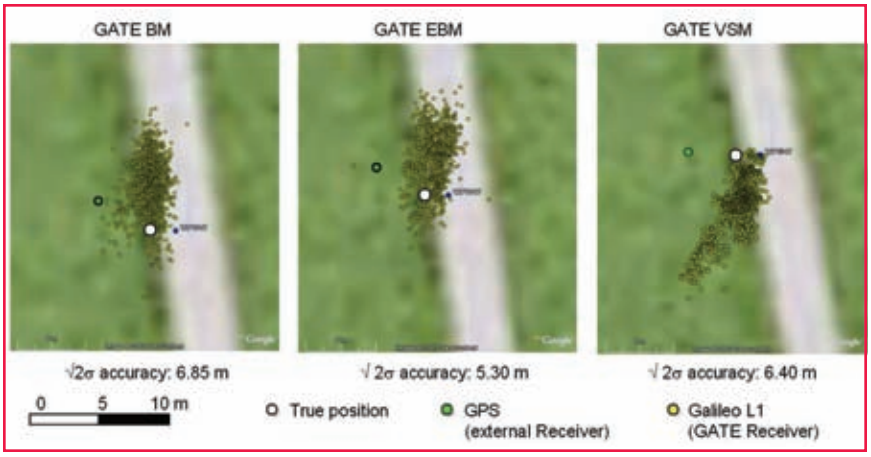

Figure 4: Galileo position estimates in BM, EBM and VSM at the GATE central point, Map© Google

to significant accelerations of the receiver. The acceleration values during the relevant parts of the test runs were in the range from about 15 to 20 seconds for speeding up from 0 to about 100 km/h. Also under these conditions regular Galileo position updates were obtained. Slight outages in the position solution, as seen in Figures 6 are the result of a conventional epoch by epoch data processing of the GATE User Terminal Software. For estimation of the position solution a standard least-squares approach is used to get unfiltered solutions for each single epoch. A Kalman-Filter or dead-reckoning algorithm as it is implemented in common low cost GPS receivers would smooth such outliers in the position solution. For the position estimates illustrated in this paper even no carrier smoothing was applied to smooth the pseudo-ranges obtained from the code measurements from only data channels. Hence, any degradation of the measurements' quality due to e.g. signal shading, as it is the case in the wooded part of the road in the fig. 5, strongly effects the quality of the position solution.

Regarding the illustrated tests in this paper it should be pointed out, that in all operational modes of the GATE system the receiver has at maximum six GATE transmit stations in view. Due to the vegetation and housing in the GATE test area and the low elevation angles of the transmitters in view at the user receiver position, shading of lines of sight to the transmitters occurs very often, while moving through the test area. Position outliers are often caused due to heavily degraded HDOP values, especially in VSM mode, when the remaining (not shaded) lines of sight represent a satellite constellation where the satellites and the user form a polyhedron with a very small volume (e.g. the satellites are situated nearly in one line from the users point of view). To a certain extent such scenarios can be evaded by an elaborate configuration of the virtual satellite constellation to be applied. However, it is not possible to completely avoid such cases, because this would result in too frequent PRN switches of the transmitters. A PRN switch will decrease the number of potential available measurements at least for the time that is needed to receive the whole navigation message of the "new" satellite (at least 50 seconds for F/Nav and 15 seconds for I/Nav messages).

Figure 5: Sample track of dynamic GATE positioning in EBM (left) and VSM (right), Map © Google

Conclusions

GATE is a terrestrial test environment for developers of Galileo (Galileo/GPS) receivers, applications and services. The test range is situated in the region of Berchtesgaden/Germany. GATE is currently running in trial operation and will be fully operational soon. The terrestrial test bed is considered to be a necessary intermediate step for Galileo from laboratory into orbit in terms of realistic RF signal transmission. It will not only support signal validation by providing valuable data but also provide insight in building a ranging system, simply by building it. This contributes to mitigate risks in the development of Galileo. Currently further tests and optimisations with respect to environmental conditions are being performed.

GATE will provide the opportunity for receiver, application and service developers to perform realistic field-tests of hardware and software for Galileo at an early stage, i.e. several years before the full operability of Galileo. And last but not least, GATE will allow full end-to-end testing of unmodified / commercial Galileo receivers. For further information on GATE please refer to the official project homepage http://www.gate-testbed.com.

Acknowledgments

GATE is developed on behalf of the DLR (German Aerospace Center, Bonn-Oberkassel) under contract number FKZ 50 NA 0604 with funding by the BMWi (German Federal Ministry of Economics and Technology). This support is greatly acknowledged.

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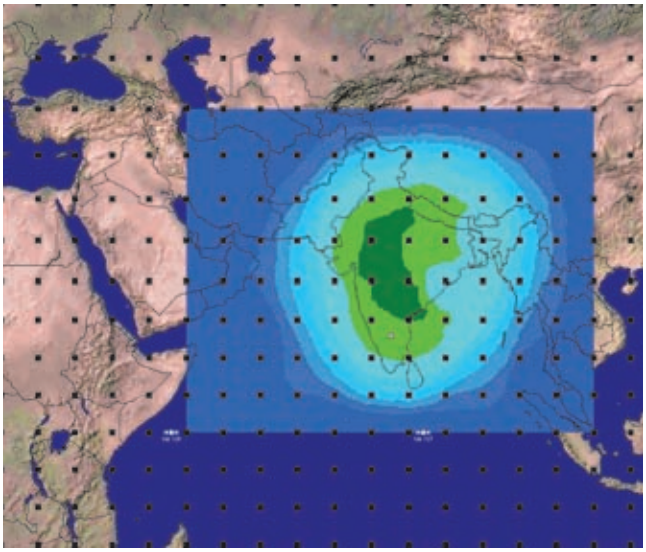
GAGAN update

The user level testing of GAGAN has been completed

Arjun Singh
Airport Authority of India
Delhi, India

GROUND segment of GAGAN i.e. Indian Reference Station (INRES) at Delhi, Kolkatta, Guwahati, Portblair, Ahmedabad, Banglore, Jammu and Trivanthapuram is in place. Except Portblair, other stations have been connected to Indian Master Control Center (INMCC) with fiber optic cable in synchronous loop mode. Portblair is connected through dedicated satellite communication network. Its integration and connectivity test with seven INRES with INMCC have been completed. The INRES data is being received through fiber optic cable at INMCC Banglore for corrections and validation checks of the erroneous data. Preliminary Site Acceptance Test (PSAT) of GAGAN ground element was conducted in May 2006 with help of satellite emulator.

The Ground segment of GAGAN is expected to be integrated with INMARSAT 4F1 till April 2008 and GSAT would be available for GAGAN ground segment integration by August 2008. The user level testing of GAGAN has been completed in May 2007. The Final Site Acceptance Test (FSAT) of GAGAN system was completed in August 2007. The GAGAN signal is available for testing and trial. The PRN of GAGAN GEO is 127 and continuously broadcasting correction data for users.



The installation of GPS-TEC at all 20 stations has been completed at 5° x 5° grid size. The IONO data is being collected on the basis of 24x7x365 basis for last for years and has been archived at ISRO space application center Ahmadabad. Ionospheric data from 20 TEC stations are being analyzed by a number of Indian universities and R&D institutions involved in ionospheric studies for development IONO-TROPO model that is suitable for Indian airspace. As per current analysis results, 5 more TEC stations are recommended for equatorial anomaly region which will from 2° x 2° gird size, to achieve better IONO model in the equatorial anomaly region.

The TDS phase results are to demonstrate the expected vertical and horizontal positional accuracies over 95% of the time with the associated Time-to-alarm (TTA) capability. Results were better than 7.6 meters accuracies in both vertical and horizontal over 95% of the time within the perimeter of the reference stations. Using type 62 (test) messages, the TTA was better than 6.2 seconds. Results were well within the exit criteria set by ISRO and M/s Raytheon and exhibited good performance.

Flight trials are scheduled in first quarter of 2008, to check the integrity of the up linked GAGAN signals. DGCA (India) officials are involved in the training process for certification of the system and preparation of certification documents. In November-2006, FAA and AAI have signed MOC for GAGAN certification and validation of SIS.

Finally, ISRO in association with the AAI will be developing the entire system through all the stages of TDS-Extended, and Final Operation Phase (FOP). The final FOP document is under review. ISRO will continue to provide technology support, maintenance and replenishment of the space segment of the system, as and when required, to maintain the system as a robust system.

Total cost of the GAGAN project is Rs 644.00 Crores (140 m USD) GAGAN Coverage is in TDS Phase on 24 Hours availability. Less coverage due to non-implementation of regional IONO-TROPO Model.

Through a scanner, darkly

Technological milestones in GNSS in 2008

John Kelly
Technical director/architect, Rockwell Collins

Any look into the crystal ball of (even the near) future is fraught with caveats, error, and less than perfect clarity. However, certain extrapolations and not-so-wild guesses do exist.

GNSS, General – Existing (and near term proposed) systems will continue to expand, receive modernization support, and move (slowly) towards increased interest in securitizing systems and data utilized in the GNSS source-to-user "food chain". Nationalism of systems and (at least regionalism of) augmentation sources will progress.

Left unknown is GALILEO and the impact of a renewed GLONASS. It is likely that increasing signal saturation on GNSS frequencies will contribute to a heightened interest in non-L band GNSS (and non-SV or even non-RF) methods of navigation, although advances will continue very slowly due to technological challenges.

Tracking and "reverse tracking" – The convergence of mapping and communications will continue at breakneck speed, further enabling the location (and status) monitoring of additional high to medium value objects. While awaiting for other technologies to enable true ultra-low cost commoditization of GNSS and comms elements (required for obsequious tracking of the high quantity of lower-value items in the world), additional value will be obtained by "reverse" tracking, or exploiting more of the information gleaned by knowing location and presence of objects to provide new services and opportunities.

Others: Due to the constraints of space, let me list some additional ideas (or at least general memes) to look for in 2008 and beyond - PPS GPS for commercial flight, decline of terrestrial augmentation sources, increase in terrestrial and space based imaging and survey networks, convergence in mapping sources, increase in pay for precision services, increase in communications/navigation convergence, acceleration in commoditization of GNSS components, and a slow advance in antenna technology. Here's to 2008.

Galileo is necessary

If GPS is disrupted, EGNOS will warn about it, but will not be able to continue on its own

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EUROPE is building its own global satellite navigation system, Galileo, which will offer very accurate positioning and timing, under civilian responsibility. This system will be compatible with the two other existing systems, GPS and GLONASS. A user will be able to use the same receiver to calculate his position from signals sent out by any satellites combination, however Galileo will offer to all users a bi frequency system that will allow knowing position within one meter of accuracy, which is unprecedented for an openly accessible service. Apart from extreme circumstances, it will always be available and its users will be informed in a few seconds of a potential disruption of one of the satellites. Thus it will be usable for safety of life applications, requiring the highest security level, such as plane landing, train circulation or car guidance.

Today European users have no other choice than use data provided by the American GPS or Russian GLONASS to know their position. But military operators of both systems don't wish to give any guarantee on the continuity of service. Satellite localization has become the standard for high sea navigation and it will soon be the case for terrestrial transports and air traffic. If it would happen one day that the signal be disrupted a lot of sailors would find it difficult to go back to conventional methods of sailing and to use old almanacs and sextants to calculate their positions. In a few years, when satellite positioning will be generalized, the consequences of a signal disruption will be worse, endangering not only the efficiency of transports systems but also the security of people.

As early as beginning of the 90s, European Union understood how important it was that Europe has its own worldwide satellite navigation system. The decision to develop such a system can be compared to decisions taken in the seventies to launch other big European projects like Ariane or Airbus. The European Commission and the European Space Agency have therefore joined forces to create Galileo, an independent system, under civilian control and whose quality will be permanently guaranteed.

The Global Navigation Satellite System will allow the emergence of new value added services and products meant for road, rail, air and maritime transports but also for professional applications such as fishing, precision farming, oil prospecting etc. Furthermore it will become a crucial tool for civil protection.

Social and economic spin-offs from Galileo, in Europe as in the world at large, are huge. They will notably come from the additional capacities that this system will bring to GNSS.

Until now the design, development and in orbit validation phase have been co-financed by the European Commission and the European Space Agency and it has been recently decided that the deployment of the overall system will be also financed by public money, the private sector coming into the picture for operations once the system is fully installed.

A first Galileo satellite was launched in December 2005. This satellite named GIOVE A (Galileo In Orbit Validation Element) marked the concrete start of Galileo in space. This successful launch allowed to secure the frequencies allocated to Galileo within the International Telecommunications Union and also to check critical technologies currently under development for the Galileo system. Indeed before having a full system operational on orbit it is mandatory to double check any new technology since in the very hostile environment of space there is no way back, this is why everything has to be achieved step by step. For example with GIOVE A, and GIOVE B to be launched this spring 2008, new types of atomic clocks are tested, a key issue since time is at the heart of any satellite navigation system.

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the satellites has to be understood since it is the first time Europe launches a satellite in what is called the Medium Earth Orbit, at 23222 km of altitude, and it is necessary to monitor the radiation encountered so as to characterize this specific environment and therefore build the operational satellites accordingly. The lessons learnt from this phase are taken for the following step: four satellites to be launched to validate the basic design of the Galileo constellation and its associated ground segment.

The first results from GIOVE A in space are very encouraging since they are in line with what was expected giving confidence that Europe can achieve it! When this "In Orbit Validation" phase will be done the remaining satellites will be launched to get to full operations capacity. Once fully deployed the Galileo constellation will comprise 30 satellites (27 operational and 3 backup), posted on 3 orbital planes with an inclination of 56° with the equator. This will ensure a perfect coverage of our planet with the help of a network of stations distributed all around the earth, Galileo being the first complete civil satellite navigation system.

Waiting for Galileo, Europe is already working in the satellite navigation field: ESA, with the European Commission and Eurocontrol, is developing EGNOS (European Geostationary Navigation Overlay Service). This is a network of ground stations correcting and processing GPS signals and transmitting the improved data via geostationary satellites. Compatible with equivalent systems in the world such as WAAS in the US or MSAS in Japan, EGNOS is now in pre-operational service for non safety of life applications and will be later certified for safety of life services. With EGNOS Europe can already show its know how in satellite navigation with the European Industry engaged in working in this promising new technologies whilst at the same time a strong community of users can start developing many value added services, notably in the transport domain. Already with EGNOS many applications have been demonstrated from tracking the riders on the Tour de France to guiding the blind persons, virtual tolling on highways and monitoring rail traffic.This development of EGNOS is a tremendous experience, paving the way for Galileo.

But of course if GPS is disrupted EGNOS will warn about it but will not be able to continue on its own... This is why the second step, Galileo, is necessary!

When operational, Galileo will allow a full set of services: from the Open service, similar to what GPS provides today but with a better accuracy, to services that GPS, a military system, cannot or does not want to offer: Commercial services, Safety of Life for civil aviation , maritime transport etc. and also Search and Rescue service: a person in distress will be able to send an SOS associated to its position in quasi real time, a message that will be acknowledged and the S & R team will be able to intervene rapidly in a very well defined area.

And finally the Public regulated service will be at the discretion of each European Union government for its ambulance, its customs, and its police forces. Galileo will be this new and safe tool made in Europe for Europe and beyond, whose foundations are currently being built by the European Space Agency.

BOOK REVIEW

Towards a Spatially Enabled Society

Edited by Abbas Rajabifard
ISBN 978-0-7325-1620-8

Published by Centre for SDIs and Land Administration, Department of Geomatics, The University of Melbourne

'Spatially enabled government', 'spatially enabled society', 'spatially enabled'…… These are terms which we are hearing more and more of these days. A society or a government can be regarded as spatially enabled when location and spatial information are regarded as common goods made available to citizens and businesses to encourage creativity and product development. Spatial enablement uses the concept of place to organise information and processes. Spatial enablement and in particular, spatially enabled government increasingly operates in a virtual world. However, we still have a long way to go. Spatially enabled government is now part of the objectives of countries in the Asia Pacific, Europe and North America. The combination of strategies in the spatial enablement of government and mainstream e-Government are now an emerging trend in Australia and many other parts of the world.

With this background, this book aims to contribute to the understanding of spatial enablement, and address the issues, challenges and requirements that are involved. The book is dedicated to Professor Ian Williamson, from Centre for SDIs and Land administration, The University of Melbourne to showcase his contributions to teaching and research in land administration and SDI which formed some of the foundations of spatial enablement. Contributors are from UN agencies, international professional associations, Academia from Europe, Americas, Asia and the Pacific and industry.

The book is divided into three parts. The first two parts comprise a number of chapters relating to the overall theme, "Towards a Spatially Enabled Society", in two focus areas:

The next generation of Land Administration System to support sustainable development; and SDI development to support a spatially enabled society.

The final part contains information reflecting on the career of Prof Ian Williamson.

The editor is very grateful for the cooperation and input of contributors from these disciplines to the individual chapters as well as to the overall theme of the book. It is hoped that the book achieves its objective in contributing to understanding and addressing the issues, challenges and requirements surrounding the achievement of a spatially enabled society.

Japan: Augmenting navigation

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MSAS (MTSAT Satellite-based Augmentation System is the Japanese satellite based augmentation system which has been prepared by the Civil Aviation Bureau of Ministry of Land, Infrastructure, Transport and Tourism (MILT) and started on 27 September 2007, to serve for improving accuracy, integrity, and availability of GPS positioning on the civil aircrafts. It has two geostationary satellites, called MTSAT-1R and MTSAT-2 located at 140 and 145 degrees in the east longitude, on the orbit of 3600km above the Equator. The satellites were launched in February of 2005 and 2006 respectively, long after the launch failure on November 1999. MTSAT, which stands for Multi-functional Transport SATellite, also has a function of geostationary metrological satellite.

The satellites transmit the augmentation data signal for GPS positioning using the same frequency L1 of GPS, which specification is the same as the WAAS in USA, EGNOS in Europe and GAGAN in India. It also works as an extra GPS satellite by sending the ranging signal.Though the data are transmitted by the global beam, the ionosphere grid data for L1 frequency, which are estimated from the L1 and L2 measurements, are in the area between 105 and 170 degrees in the east longitude and between 5 and 65 degrees in the north latitude at every 5 degrees.

The preliminary evaluation of the accuracy in Tokyo area at about 140 degrees in east longitude and 36 degrees in north latitude in rather ideal circumstance shows that the 2drms is reduced to 2 m from 3 m without MSAS correction. The improvement is not remarkable presumably due to the recent calm ionosphere condition.

The SBAS is originally designed to serve civil aircrafts flying long range by geostationary satellites with a wide service area However, the users in land and ocean can equally access freely without extra device by just reforming the firmware of GPS receiver.

There are two types of DGPS services in Japan. One is the Maritime Differential GPS (DGPS) service, which transmits the correction data followed by RTCM SC-104 for DGPS positioning with the radio beacon waves of around 300 kHz. It has been operated by Japan Coast Guard, also managed by MILT since 1999 with no direct charge. Twenty seven stations are covering whole coastal sea around Japanese archipelago and serving the steaming ships. Each station has the service area of 200 km in radius including the coastal land. Radio beacon itself stopped the function of direction finding in the August 2006 and is just transmitting the correction data for DGPS. Almost all of the GPS

receivers can accept the correction data to improve the accuracy, but it requires the extra antennas and receivers for the reception. The other DGPS service is for the car navigation systems. The cumulative shipping number of car navigation system in Japan got to 27 million on June 2007 in the last decade. In the 1990th, the GPS signal was degraded by so-called selective availability (SA). Then the announced accuracy of 100 m did not satisfy the demands of the drivers and hence the manufacturers. Thus a new private company was established in 1997 named G-PEX to supply the correction data which were multiplexed on the FM broadcasting waves. Seven reference stations are located covering all over the Japanese islands and forty FM radio stations are disseminating the correction data. About 4.5 million sets of the car navigation devices were furnished with the data reception apparatus by the end of 2002. It is about 40 % of the cumulative shipping number by that time. There is no direct charge but the manufactures pay some amount of money to the data supplying company for each device when shipping. After the suspension of SA on May 1st 2000, the accuracy of GPS without DGPS was dramatically improved to less than 10 m. The accuracy is enough for the car navigation systems, especially with the aids of the odometer, direction sensor and the technique of map matching. Then the manufactures became to conceive the less importance of DGPS. Nevertheless, the system exists, probably because the main capital of G-PEX comes from the manufactures group. But as the service by the MSAS is certificated, they decided to quit service on the end of March 2008.

It is very convenient to access the MSAS, i.e. free of charge, no extra antenna and no extra receiver. The accuracy is high enough for cars and coastal vessels, even though it is a little bit less than that by marine DGPS service according to our evaluations. We must consider some time continuation of the service by maritime beacon system in considering the maintenance expense of twenty seven stations. The accuracy of standalone GPS positioning is already enough for coastal vessels.

Quasi Zenith Satellite System (QZSS) is a Japanese Satellite Positioning System to augment the performance of GPS positioning. The first satellite shall be launched in 2010 being prepared by JAXA (Japan Aerospace Exploration Agency). And after proving the effectiveness by the first satellite, the following satellites will be launched and the full system will be furnished: i.e. the users will be able to receive the signals from the zenith continuously for 24 hours. The higher accurate SBAS with one-degree- pitch denser ionospheric data suitable to Japanese islands and surrounding seas is under examination by Electronic Navigation Research Institute (ENRI) to transmit by the L1-SAIF (L1- Submeter-class Augmentation with Integrity Function). However, the simulated experiment showed recently that the accuracy was not so much improved as was expected. The further examination will be continued. Precise tropospheric correction data service is also considered.

QZSS will also provide the data through the LEX (experimental signal with higher data rate of 2 kbps of message), compatibility with Galileo E6 signal at 1279 MHz. This channel will be devoted to the transmission of the carrier phase measurements data with charge for RTK-GPS positioning.

As for the cm-order positioning data services, there are several private companies which transmit the network RTK-GPS data via mobile phone line in Japan. They are using the carrier phase data at about 1200 electronic reference stations called GEONET (Gps Earth Observation NETwork system), being operated by Geographic Survey Institute, covering all over the Japan to observe crustal deformations.

Maritime GPS Positioning Solutions, non profit organization, is serving RTK-GPS data for the marine construction activities via VHF radio link. They establish a reference station by themselves at each operational area in Japan.

The council for High Accuracy GPS Experiment has developed the data transmission system for DGPS and RTK-GPS by utilizing the data space in the terrestrial digital TV broadcasting, which has been employed experimentally in Japan since December 2003 and will replace the analogue TV broadcasting on 26 July 2011. The system is going to be certified by Association of Radio Industries and Broadcast (ARIB).

There are still many to be developed to serve the effective data via low data capacity of 2 kbps via LEX on QZS, making the best use of the advantage of the wide service area of the satellite.

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'Inspiring' INSPIRE

The INSPIRE directive marks the beginning, not the end of SDI implementation in Europe

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THE European Union's INfrastructure for Spatial InfoRmation in Europe (INSPIRE) initiative is 'inspiring' for two important reasons. First, because Directive 2007/2/EC of the European Parliament and of the Council entitled 'An infrastructure for spatial information in the European Community (INSPIRE)' (CEC2007) breaks new ground by establishing the legal framework for the creation of a European level spatial data infrastructure and, as a result, the governments of all 27 European Union national member states must modify existing legislation or introduce new legislation to implement its provisions by May 2009. Second, because of the procedures that have been devised for the creation of implementing rules that are generally acceptable to the European stakeholder community who will have to implement them in practice. With these considerations in mind this paper considers the contents of the INSPIRE Directive and discusses the principles underlying the procedures for the formulation of implementing rules.

Context

The INSPIRE initiative was launched by the European Commission in 2001 with the objective of making available relevant and harmonized geographic information to support the formulation and implementation of European Community policies with a territorial dimension. INSPIRE deals with the spatial information that is required for environmental policies but can also be seen as the first step toward a broad multi sectoral initiative at the European level. It is a legal initiative that addresses matters such as technical standards and protocols, organisational and coordination issues, data policy issues including data access and the creation and maintenance of spatial information (Masser 2007, chapter 4). The five key principles underlying the initiative are set out in table 1.

Table 1 Key principles underlying INSPIRE

Data should be collected once and maintained at the level where this can be done most effectively
It should be possible to combine seamlessly spatial data from different sources and share it between many users and applications
Spatial data should be collected at one level of government and shared between all levels
Spatial data needed for good governance should be available on conditions that are not restricting its extensive use
It should be easy to discover which spatial data is available, to evaluate its fitness for purpose and to know which conditions apply for its use

The INSPIRE Directive

The first sections of the Directive outlines the problems that face those involved in implementing the Community's Environmental Action Programme: ' a number of problems exist regarding the availability, quality, organisation, accessibility and sharing of spatial information needed in order to achieve the objectives set out in that programme.' To deal with these problems measures are required 'that address exchange, sharing, access and use of interoperable spatial data and spatial data services across the various levels of public authority and across different sectors.' In other words 'an infrastructure for spatial information should therefore be established.'

The Directive makes it clear that 'INSPIRE should be based on the infrastructures for spatial information that are created by the member states' provided that these conform to implementing rules which ensure that their spatial information is compatible and usable in a trans boundary context. It is also emphasised that the primary objective is to facilitate spatial data harmonisation. Consequently it is stated explicitly that the Directive 'does not require collection of new spatial data.' (Article 4.4)

The Directive recognises that its implementation must be phased and that the spatial data themes 'should be accorded different levels of priority.' Table 2 lists the data sets that are listed in Annexes I and II of the Directive as priority areas while table 3 lists those included in Annex III as lower priority. The deadline for adoption of the implementing rules for Annex I data sets is set at the 15 May 2009 and the 15May 2012 for Annex II and

Table 2 Data sets listed in Annex I and II of the INSPIRE Directive

Annex I	Annex II
Coordinate reference systems	Elevation
Geographical grid systems	Land cover
Geographical names	Orthoimagery
Administrative units	Geology
Addresses	
Cadastral parcels	
Transport networks	
Hydrography	
Protected sites	

III data (article 9). From these annexes it can seen that the list of data that is required is a formidable one. While many of the data sets listed in Annex I and II feature prominently in most SDI core or framework data sets, the thematic data requirements listed in Annex III are very diverse and will involve the cooperation of many different data producers.

Formulating implementing rules

Drafting teams have been set up by the Commission's Joint Research Centre (JRC) to prepare implementing rules for the five main elements of INSPIRE: that were defined in the Directive: ie. metadata, spatial data specification, network services and interoperability, data and service sharing, and monitoring and reporting. The Commission recognises that the development of implementing rules to guide subsequent work in the member states will require the participation of a large number of stakeholders from different sectors of the GI community. To assist in the work of the drafting teams and to make the process as inclusive as possible the JRC is building up a network of Spatial Data Interest Communities (SDICs) throughout Europe. These SDICs are seen as bringing together 'the human expertise of users, producers and transformers of spatial information, technical competence, financial resources and policies, with an interest to better use these resources for spatial data management and the development and operation of spatial information services' (Annoni and Craglia 2005, 8). It is envisaged that these SDICs will work alongside the Legally Mandated Organisations (LMOs) who are formally involved with respect to one or more elements of INSPIRE implementation.

The reasoning behind the creation of these procedures is quite simple. The key to the successful implementation of INSPIRE, and SDIs in general, is networking. Because of the number of agencies involved in the case of INSPIRE proactive networking on an unprecedented scale is needed to make it possible for as many as possible of those who will be implementing INSPIRE to participate in the formulation of implementing rules. In this way the critical mass of committed users from all sectors of the GI community that is essential for its effective implementation will be created. However, it must be recognised that although the numbers of Spatial Data Interest Communities and Legally Mandated Organisations that are currently participating in INSPIRE are impressive, there may be still a long way to go before the interests of the majority of stakeholders are adequately represented. This will depend to a large extent on the efforts that are made by the national member states to ensure the active involvement of national and sub national bodies in the implementation of INSPIRE.

Table 3 Data sets listed in Annex III of the INSPIRE Direc

Annex III	
Statistical units	Buildings
Soil	Land use
Human health and safety	Utility and governmental services
Environmental monitoring facilities	Production and industrial facilities
Agriculture and aquaculture facilities	Population distribution – demography
Area management/ restriction/regulation zones	Natural risk zones
Atmospheric conditions	Meteorological geographical features
Oceanographic geographical features	Sea regions
Bio-geographical regions	Habitats and biotopes
Species distribution	Energy resources
Mineral resources	

Some lessons

It must be borne in mind that the adoption of the INSPIRE Directive marks the beginning not the end of SDI implementation in Europe. INSPIRE is primarily an environmental initiative and work in other key fields such as transport, spatial planning and agriculture is still at the early stages of development. Nevertheless, INSPIRE can be used as a model for multi national SDI development for others to follow not only in Europe but elsewhere in the world.

The INSPIRE initiative highlights the importance of developing an overall legal framework for a supranational SDI that ensures the commitment of the national member states to the project. The same approach could be useful in large federal sates such as India where the number of stakeholders whose commitment is needed for the effective implementation of the national SDI is considerable. It also demonstrates the need for networking on a very substantial scale to mobilise the expertise that already exists in the national member states to develop implementing rules that are acceptable to the participants. As always, the devil is in the detail, but the prior commitment of the national member states to the principle should make the task of building a consensus more manageable.

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Estimates of anomalies in triangular area

This mega thrust earthquake of Dec 26, 2004 shifted several sites on Indian and Eurasian plates, which has been quantified from various GPS studies. As the relative change in triangular area between different sites is more sensitive than the relative change in their coordinates, it has been attempted to calculate the anomalies in triangular area on daily basis between 12 permanent GPS stations of C-MMACS and 16 IGS stations for a period of 60 days from 1st Dec 2004 – 30th Jan 2005.

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THE mega thrust Dec 26, 2004 Sumatra earthquake occurred due to thrust faulting on the interface of the subducting Indian and the overriding Burman plates. The rupture propagated 1300 km northwards within a duration of ~10 minutes at an average propagation rate of 2.1 km/s (Jade et al. 2005, Bilham et al. 2005). A large number of aftershocks followed the earthquake along the entire rupture plane for several days. GPS derived displacements indicate eastward motion of 12±3 mm and 6±3 mm at Bangalore (IISC) and Hyderabad (HYDE) IGS stations on the Indian plate due to this mega event. GPS sites in Northeast India suffered 3 to 5mm of southward deformation (Jade et al. 2007).

Northeast India is a highly complex tectonic zone bounded by Indo-Eurasian Himalayan thrust belt on the north and Indo-Burman range on the east. It lies far north of the Sumatra earthquake's rupture line. The objective of this work is to estimate the daily change in the triangular area between the sites and to investigate the reason for the large sudden changes in the daily triangular area .

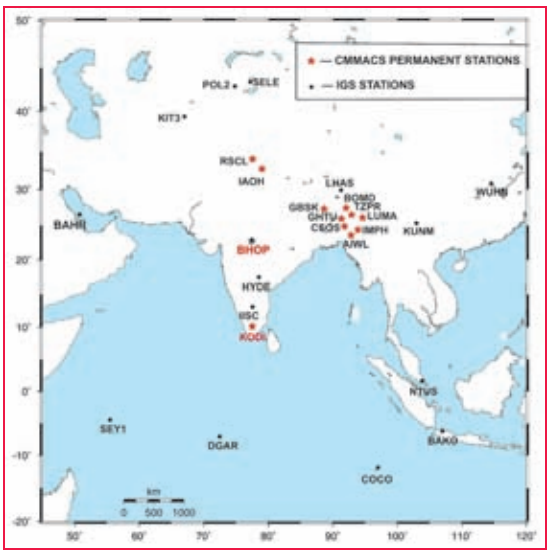

Figure1: GPS sites used in the Analysis

GPS data analysis and Strain estimation

GPS Geodesy has been recognized in providing the most precise numbers for crustal deformation worldwide. Department of Science and Technology has launched a National GPS programme for monitoring crustal deformation due to earthquake occurrence and other geodynamic phenomena. As a part of this National programme CSIR Centre for Mathematical Modelling and Computer Simulation (C-MMACS), Bangalore established 12 permanent GPS stations and over 100 campaign stations across India in collaboration with various regional institutes to quantify intra-plate and inter-plate deformation in Indian subcontinent. The northeast network consists of 8 permanent stations whose details are given in Table 1. Other C-MMACS permanent stations used in the analysis are Bhopal (BHOP), Kodaikanal (KODI), Leh (RSCL), and Hanle (IAOH) (Table1, Figure 1). The IGS stations used in the analysis are also listed in same table and figure

Daily precise geocentric coordinates in XYZ Cartesian coordinate system for all the GPS sites obtained in ITRF 2000 reference Frame using GAMIT/GLOBK software were taken as the input for the estimation of areal strain for various triangles. The IGS stations Bangalore (IISC), Kunming (KUNM), Lhasa (LHAS), and Hyderabad (HYDE) along with the Northeast permanent network stations were used for triangular area calculations. The triangular area between a set of three stations each at one of its vertices were computed for the projection planes XY, YZ and ZX (Shinji et al. 2005).

Site	Latitude (°)	Longitude (°)	Station Code
Permanent GPS Sites			
Gauhati	26.15	91.66	GHTU
Aizwal	23.72	92.73	AIWL
Lumami	26.22	94.47	LUMA
Bhopal	23.21	77.84	BHOP
Shillong	25.57	91.85	CSOS
Tezpur	26.62	92.78	TZPR
Bomdilla	27.27	92.44	BOMD
Kodaikanal	10.23	77.47	KODI
Imphal	24.75	93.92	IMPH
Panthang	27.37	88.57	GBSK
Hanle	32.77	78.97	IAOH
Leh	34.12	77.6	RSCL
IGS Sites			
Bangalore	13.02	77.57	IISC
Hyderabad	17.41	78.55	HYDE
Kitab	39.14	66.89	KIT3
Bishek	42.68	74.69	POL2
Kunming	25.03	102.79	KUNM
Lhasa	29.66	91.10	LHAS
Almaty	43.18	77.02	SELE
Bahrain	26.20	50.60	BAHR
Cibinong	-6.49	106.84	BAKO
Coco	-12.18	96.8	COCO
Diego Garcia	-7.26	72.37	DGAR
Karratha	-20.98	117.09	KARR
Singapore	1.34	103.68	NTUS
La Tampon	-21.20	55.57	REUN
La Misere	-4.67	55.47	SEY1
Wuhan City	30.53	114.35	WUHN

The daily change ratio ΔAj (Strain) of triangular area in each plane is given by

$$\Delta Aj = (Aj - Aj\text{-}1) / Aj\text{-}1$$

Where Aj is the area of the triangle for the jth day for j= 1 to 60

A MATLAB program was written for this purpose which can read an input file consisting of X, Y, Z geocentric coordinates of 3 stations with their corresponding errors. It then estimates triangular area projected in all three planes for all the available days and its daily change ratio (Strain) with errors. The estimated Strain values and respective errors are then plotted in PPM scale.

Results and Discussions

The results indicate no significant change in areal strain due to Dec 26, 2004 mega earthquake. This may be attributed to the fact that these sites are quite distant from the rupture plane. This can also be attributed to the almost constant relative shift in coordinates of the stations. But these results do show significant anomalies in the daily triangular area for some of the triangles for a particular day. After a detailed investigation we could map these anomalies to the local seismic events that have occurred within these triangles, the details of which are given below.

The GAUHATI-KUNMING-AIZWAL (GHTU-KUNM-AIWL) shows (Figure 2) an areal strain of ~0.28 ppm on 9th Jan 2005 in XY projection plane where the average anomaly fluctuates between ±0.1 PPM. Similarly, all the three plane projections (XY, YZ and ZX) of GAUHATI-LUMAMI-AIZWAL (GHTU-LUMA-AIWL) show large anomalies of 0.2 PPM, -2 PPM and –0.1 PPM on 9th Jan 2005 where the threshold lies between ±0.1 PPM, ±1 PPM and ±0.025 PPM respectively. This may be due to the M4.7 shallow earthquake at 25.12ºN 98.86ºE with depth 36 km which occurred on 7th Jan 2005 [http://eqint.cr.usgs.gov/neic/cgi-bin/epic/]. This event is within GHTU-KUNM-AIWL triangle and closer to GHTU-LUMA-AIWL triangle (Figure 2). This indicates possible contraction in GHTU-KUNM-AIWL and GHTU-LUMA-AIWL triangular area (XY plane).

Similarly, IISC-AIWL-HYDE (Bangalore-Aizwal-Hyderabad) shows (Figure 3) a dilatational strain of –0.22 PPM and –4.25 PPM in XY and YZ planes on 19th Jan 2005 where the threshold lies within ±0.1 PPM and ±2 PPM respectively. A compressional strain of 0.38 PPM is traced in YZ plane of IISC-KUNM-HYDE on 19th Jan 2005. This may be due to M5.0 earthquake (Depth = 104 km) at 22.97ºN 94.70ºE on 18th Jan 2005 [http://eqint.cr.usgs.gov/neic/cgi-bin/epic] in Central Burman Molasse Basin (Figure 3). The Central Burman Molasse Basin lies within IISC-KUNM-HYDE triangle and closer to IISC-AIWL-HYDE triangle.

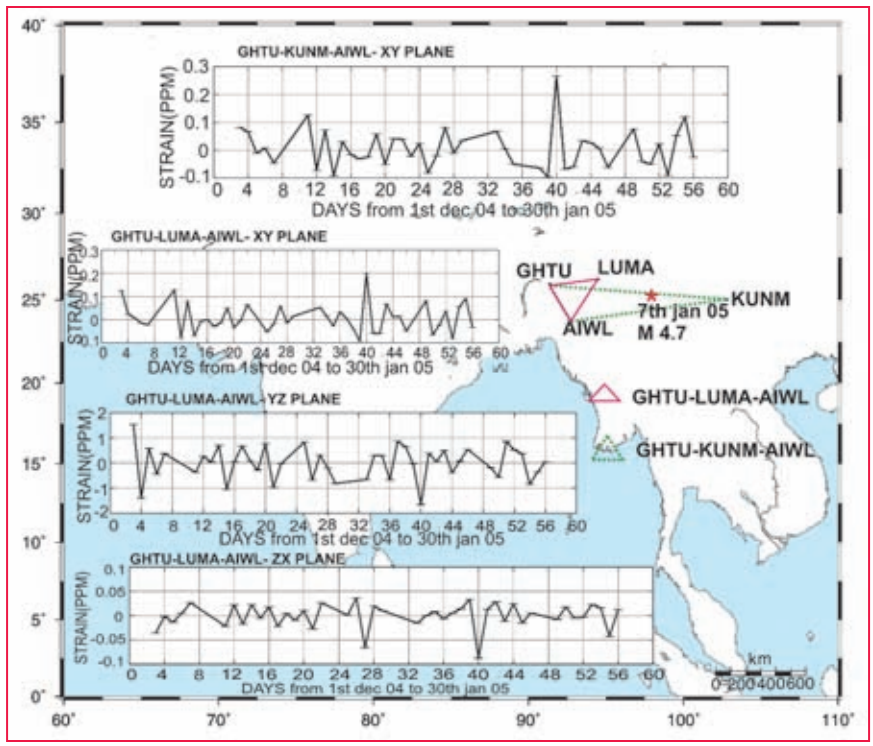

Figure 2: Anomalies in the daily triangular area of GHTU-LUMA-AIWL triangle, GHTU-KUNM-AIWL triangle and the corresponding strain (PPM)

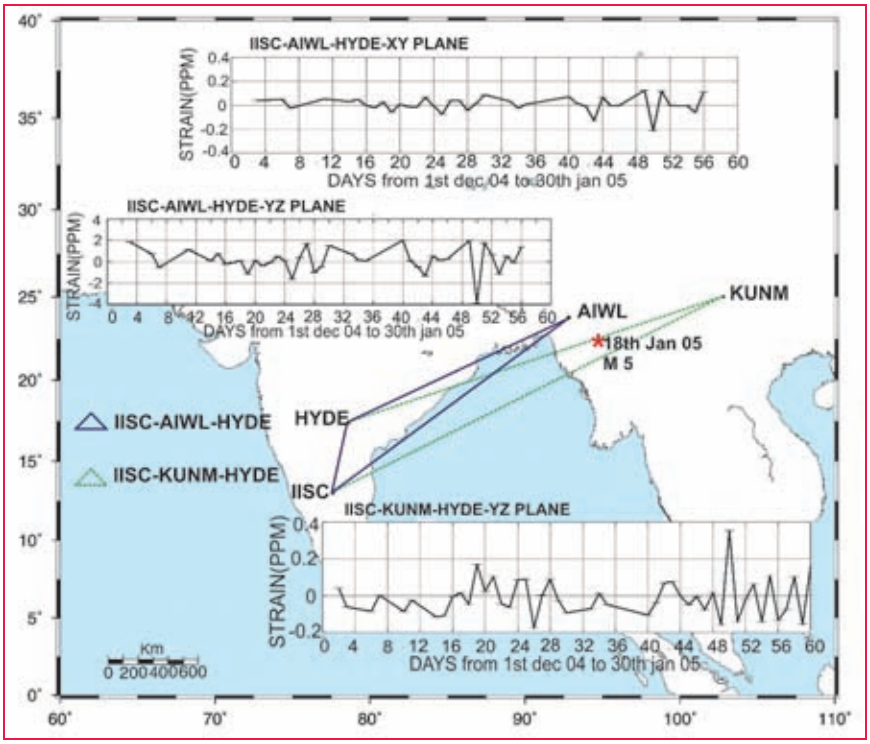

Figure 3: Anomalies in the daily triangular area of IISC-AIWL-HYDE triangle, IISC-KUNM-HYDE triangle and the corresponding strain (PPM)

All triangles involving Lumami (Figure 4) at one of their vertices such as LUMA-HYDE-KODI, GBSK-LUMA-AIWL, and GHTU-LUMA-AIWL show a slightly high dilatational strain on 27th Dec 2004 in ZX projection plane. The probable source of this deformation is M4.7 tremor of shallow depth 66 km at 24.85ºN 101.69ºE which occurred very close to Lumami and Kunming on 26th Dec 2004 (Figure 4).

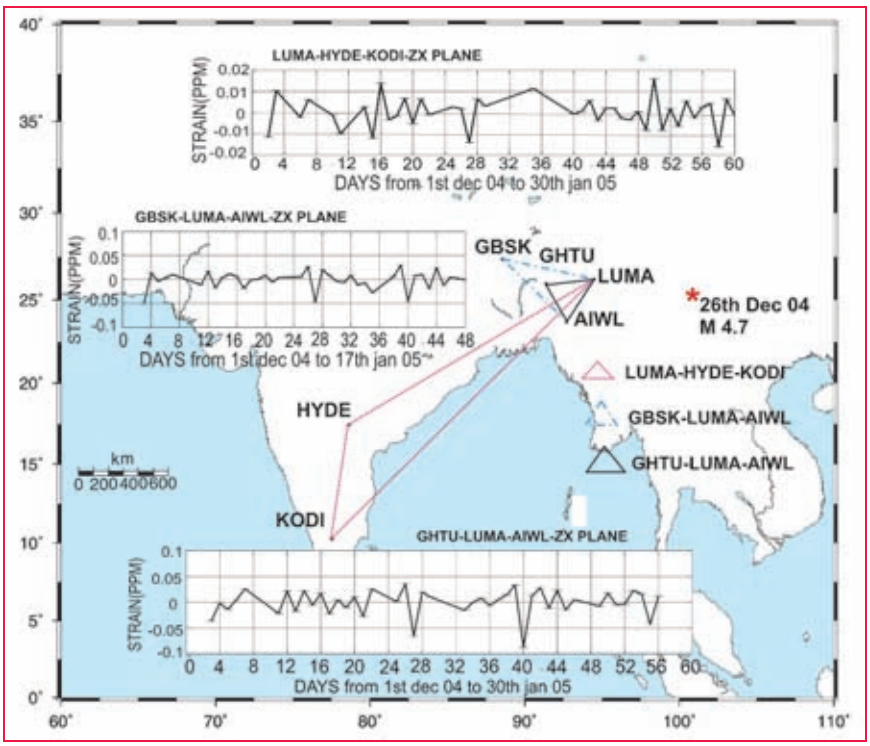

Figure 4: Anomalies in the daily triangular area of LUMA-HYDE-KODI triangle, GBSK-LUMA-AIWL triangle, GHTU-KUNM-AIWL triangle and the corresponding strain (PPM)

The error values have been computed for the areal strain computations of all the triangles and are found to be insignificant when compared to the anomalies. The rest of the triangles do not show any significant daily change ratio.

Conclusion

As the relative change in triangular area between stations gives dilatational strain which is more sensitive than the relative change in coordinates, such a study can be utilized for a better understanding of deformation of a region due to local tectonic events. This analysis when done on a daily basis at all GPS permanent sites would generate long time series of strain in XY, YZ and XZ planes which would give more insight in to the deformation regime in the region. These strain changes in the region can then be related to the focal mechanism of local events which may give further insight in to complicated regional deformation processes.

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A strategic approach to data sharing

For geo information management in petroleum pipeline construction

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Works in planning and control department division of Iranian Oil Pipeline Telecommunication Company (IOPTC).

RECENT advances in information and communication technology (ICT) have resulted in a changing environment with many interdependencies between organizations. There are various data services produced and consumed within the process of enhancement of pipelines project. This happens along the various phases; feasibility study, land allocation, execution and operation. Problems in data sharing arise from the fact that data services are not properly documented resulting in difficulties in updating data, data duplication and long administrative inter–organisational procedures[1]. This article presents a method for elaborating the trade-off between existing situation and the desired future in case of improving conditional data sharing.

Figure 1: Designers, planners and decision-makers are trying to minimize threats by choosing the best alternative for new pipeline stream.

Introduction

Iranian Oil Pipeline and Telecommunication Company (IOPTC) is one of the distributed companies having eleven main subsidiaries located in different geographical locations. Oil travels a long distance from oil wells to refineries and distribution points all over the nation through underground pipelines. Its mandate can be broadly categorized in four main activities, namely project profile, project execution, operation and maintenance. Because of the reasons mentioned below, Project profile is our main challenge and it influences other activities.

The first and foremost is the challenge of developing the petroleum pipelines network. New Oil Pipeline Project (NOPP) and Relocation Potential Pipeline Project (RPPP) need verification of feasibility study that shows conflict between technical design and environmental aspect. However, it can be resolved with minimal effect on the project schedule (Figure 1). Obviously, to come up with an inter-organizational agreement, the long administrative procedure is one of reasons that the data sharing is not taking place as it should.

The pipeline external corrosion is a great threat caused by natural chemical interactions. American Petroleum Institute (API) suggests other risk factors such as pipe material and manufacturing process, highly CORROSIVE SOIL, and highly volatile products. In addition, landslide rock-fall, earthquake and flood are the most serious geological hazards affecting on-route selection of new pipeline. So far, only feasible routes have been approved by decision makers. The Proposed Route is selected to minimize technical difficulty, environmental impact, land conflict and cost. Environmental Protection Agency (EPA) Region III suggests that when establishing the frequency of assessment, three risk factors should be taken into consideration; specific product differences, location related to the ability of the operator to detect and respond to a leak (Figure 2).

Objectives

The objective of the new pipeline project profile based on data sharing are;

- To understand current GI situation of the IOPTC and stakeholders
- Investigate the opportunity and bottlenecks in relation to institution and management issue;

Figure 2: Natural chemical interaction, Natural hazards

To enhance IOPTC performance and develop existing informal data sharing according to the following requirements:

- All stakeholders should have access to the information
- The information should be easily understood
- Consultation report and result should be accessible
- Mitigation measure along the pipeline route

Investigation on existing practice

Table 1 represent MODELS that all stakeholders (company professional, Beneficiaries of the project, Data provider) can cooperate in an efficient way to achieve inter-organizational goals.

- Model (No: 1) developed by two managerial and institutional aspects is based on Taxonomy of Spatial Data Sharing adapted from Calkins and Weatherbe 1995.
- Models (No: 2, 3, 4) are running as reference models of the case study aim to achieve comparative advantage elements.
- Model (No: 5) is based on inter-organizational relationship adapted from taxonomy spatial data sharing model.

Trade–off between existing and target practice

An appropriate plan, data management and technology will affect the trade-off between existing and target practices. Each aspect of Geo–information use is to be compared alongside a corresponding guiding principle. Both planning process (internal) and Technology (external) pressure is against the guideline that is supported by GI-policy. If any aspect of Geo-Information use is not in line with the guideline, future investigations need to be made. (Figure 3)

Planning Process (internal pressure)

Collection and maintenance

The aim is to keep a record of what data is needed to perform a certain task, and where it is being sent to. Because of the Geo-Information value, the planning process needs to find what data is required? Where that data might be sent? And an event history to record what happens with that data?

Update, standards and metadata

Planning process needs to define standards by adding metadata element to meet up-to-date data. Data can be confusing or misleading if you don't know who, what, why, when, where, and how it was created.[2]

Real-time data availability

If the data and the relevant Geo-

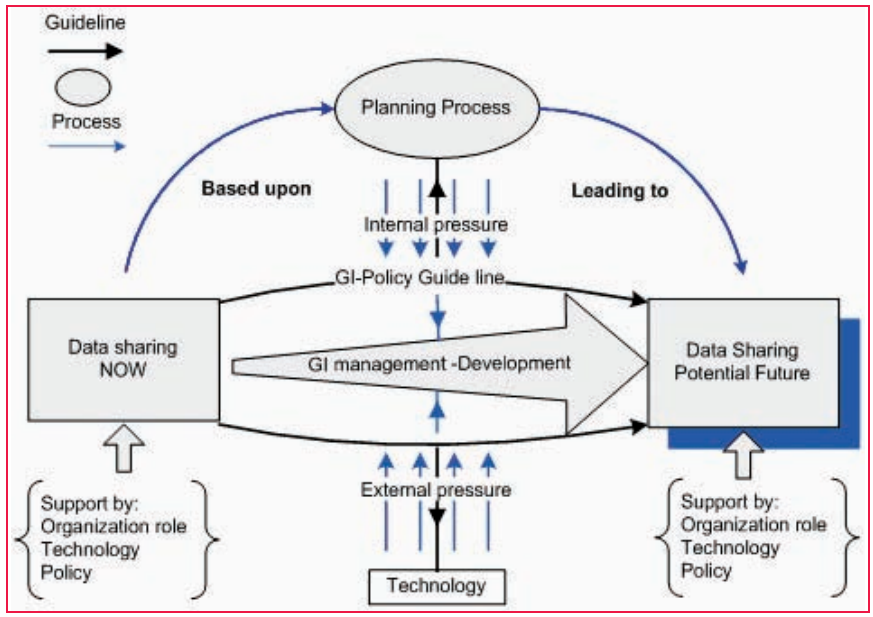

Figure 3: Sharing in transition (model adapted from Brian Wilson – system thinking 2006)

Information is recorded to the specific system of NOPP/or RPPP centre, it will be very easy to track and trace the progress of inter-organizational interaction without recollecting data. It can reduce the loss of data in data sharing and speed up data analysis.

Technology (external pressure)

The current status of technology offers many opportunities. From the Geo-Information management point of view, the planning process will use information technology to collect information very quickly. This will include the following components.

Optimum technology

Technology is articulated by hardware, software, operating system and communication protocol. How to store the required information? How to access and prepare access routines? Obviously information technology has become an important aspect in developing countries to achieve economic progress and the relative success in this area [3]. With growing data sets and more complex maps, data upload speeds can limit the use of the system [4]. Therefore, a user friendly information technology should be chosen.

Dataset framework

Framework data and information comprising themes that are continually needed and used by managers is another critical requirement. According to Frank 1992, [5] an organization contemplating sharing of spatial data needs to carefully define spatial objects, attributes, and data quality associated with these objects.[1]

- Acquired data is used as a backdrop
- Acquired data is used to get started quickly
- Data is acquired for long-term usage
- Data is centrally held in a spatial database and accessed on demand.

Building the matrix of change

The Matrix Of Change system consists of three matrices and a set of stakeholder evaluations. It detects harmonizing and interfering practices and presents an overview of an interlocking organizational system.

Matrix construction then proceeds in four steps; Critical process, definition of system interaction, transition interaction and definition of survey stakeholder (Figure 4).

Critical process

First list is the existing goal, business practice and ways of doing NOPP/ RPPP profiles. However, it is rare that all-important practices can be identified in advance. A second list will describe the target practice. Identifying the most important process can be quite difficult but certain analyses, such as SWOT analysis result can help. Processes

Table 1: Conceptual frameworks for data sharing

No	Proprietor	Classification Idea	Framework Component Of Data Sharing	Strengths
1	Calkins And Weathrebe 1995	Development of a Taxonomy for research into spatial data sharing	- Characteristics of the organization, - Characteristics of the Data - Characteristics of the Exchange - Constraint and impediment	Framework recognises organizational issue and nature of exchange
2	Kenvay 1995	More detailed structure to measure effectiveness and enhance decision making of data sharing	- project environment - sharing classes - need for shared data - opportunity to share data - willingness to share data - incentive to share data - impediment to shared data - technical capability - resource for sharing	Very comprehensive list of factors that can be rated based on existing exchanges
3	Azad And Wiggins 1995	Typology based or inter organizational relations and dynamics	- Organizational autonomy is a critical issue in data sharing	Attempts to classify organisation dynamics and behaviour (Oliver1990)
4	Wiliam J. 1995	Why we can not share data?	Institutional inertia	Frame work recognises institutional issue

5	IOPTC Research Concept 2007	Based on inter-organizational relation adapted from taxonomy spatial data sharing model	- Geo information institutional Issue
			  - metadata standard
			  - Data use policy
			  - Digital processing (e-work)
			  - Network connection
			- Geo information managerial Issue
			  - Database management System
			  - Online data process
			  - Web-based application
			  - Organization ICT knowledge
				Attempts to classify organizational elements based on experience of field work result

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- Analytical Report on Housing Amenities

Atlas (Book)
- Administrative Atlas (State volumes showing district, tahsil and village boundary maps)
- India Administrative Atlas, 1872–2001 India (A Historical Perspective)
- Housing Atlas–India 2001
- Language Atlas – 1991 – India

GIS Products
- Census Info India ver 2.0 (with data and maps)
- Administrative Boundary Map (on paper) showing India, State, District, Sub–district, Town
- Sub–district map showing village boundary

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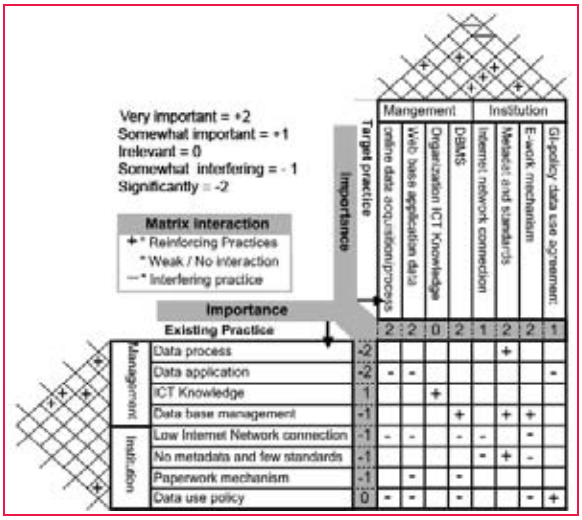

Figure 4: Matrix of Change, Matrices Linked

can also be classified by function as well as strategic initiative, regardless of the level of detail analysed.

System interaction

After defining the existing practice, it is time to create horizontal triangular matrix of existing practices to identify COMPLEMENTARY and COMPETING practices. An increment in one complementary practice increases returns to the other. For example, the Data Collection function in the existing system prepared data that increases the processing time, thus impeding the process of data collection. These practices were reinforcing. In contrast, a dip in a COMPETING practice, increase returns to other. A data use policy would shift some strategic decisions to other layers, in turn, decreasing the data process time.

Transition interaction matrix

This matrix is obtained from combining the horizontal and vertical matrix. It helps determine the degree of difficulty in shifting from existing to target practices. Paper mechanism function interferes with web-based application data and DBMS. GI-POLICY DATA USE AGREEMENT complements the use of DATA USE POLICY. However, DATA USE POLICY interferes with E-WORK MECHANISM, DBMS, WEB BASE APPLICATION DATA, and ONLINE DATA ACQUISITION PROCESS.

Survey stakeholder (principle of value)

The stakeholder evaluations provide an opportunity for persons within the organization to state the importance of these processes to its activity. For instance, the respondent in this case feels strongly that, among existing practices, data process and data application method should be discontinued in the current situation. Each major area in the Matrix Of Change serves many roles and addresses different aspects. Taken together, they offer useful guidelines on where, when, and how fast to implement change.

Determine the value of elements (principle of coherence)

A simple mechanism gives an indication of which change will ultimately add the most value. The formula target and the existing value give an approximation of the net value to be gained by changing practices. The TORNADO–PLOT process connects the importance rating across categories of existing and target issues.

Principles of value suggest which changes are important, but principles of coherence suggest which sequence to adopt (Figure 5). The value first suggests paying more attention to the knowledge about ICT technology and GI-policy and then focuses on the Internet connection and implementing high-speed Internet network connection followed by Database Management System.

Discussion

Matrix of Change can be utilized to address transition between the existing and target practice. Based on this concept and the output analyzed by Tornado Plot process, the approach is expected to facilitate the performance of a feasibility study by introducing the following components in Geo-Information processing.

- Providing access to the online data acquisition system will reduce time taken in the data request process and make data available all the time among stakeholders.
- Developing data standards will solve data heterogeneity and increase information quality
- Developing metadata will facilitate the process of data discovery, evaluation and access, and to increase the transparency of data sharing among stakeholders.

As with all development concepts, data sharing obstacles and data sharing benefits always go along with growth of organizations. However, data sharing has continued to be a popular presentation at local, regional, and national GIS conventions. So we thought that some of these ideas might help other communities get started, navigate through obstacles and continue toward success[2].

Decision making

The new concept with online data acquisition, metadata and standard, digital work and web-based

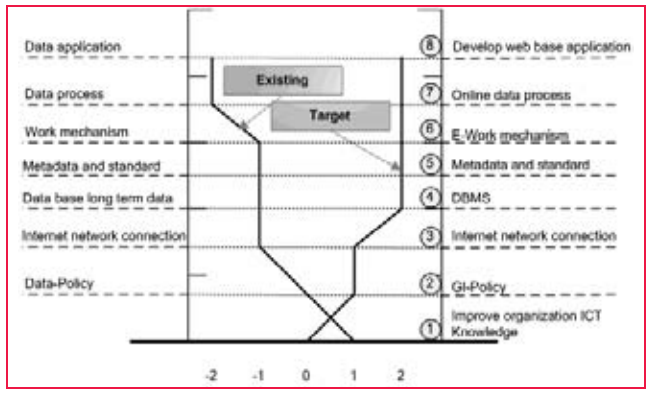

Figure 5: Tornado plot: left is existing value and right is target value

application, the following potential results of the model aim to help communities in decision making.

- Cheaper data collection
- Eliminate data duplication
- Provide timely and updated information
- Store data for future steps of project

Development of business activities should be done in accordance with company professionals and beneficiaries of the project, Data provider's goal of "no damage to the environment, free of risk and safe operation". Using the experiences of other countries/ organizations could be of significant value. So any practice, which is proposed by Data and Process View, needs to be evaluated operationally, technically and economically before implementation. Therefore, the following recommendations are related to developing data sharing strategies of Oil Pipeline Company.

Pre-conditional work

- A detailed study on cultural issues must be conducted prior to the implementation. Development of professional training program on the other hand is a necessity to ensure the human capability for Geo-Information management.
- Data is a valuable asset of IOPTC. Thus, having an accurate, complete, reliable, up-to-date and accessible digital data is the first precondition for successful future strategies.
- Manageable and sustainable technology should be utilized when developing data sharing strategies for any activity.

Future research

- Capacity building and strong data use policy for implementing user friendly Geo-Information Portal can be the next future research.
- Investigation on pipeline networks and geo spatial information aims to determine the place and its accurate reference within multi-layer maps of underground oil petroleum pipeline network

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Topcon GNSS first to add China's Compass signal

Topcon Positioning Systems (TPS) is the first to announce to have successfully tracked signals from the Chinese Compass satellite constellation. It also developed the world's first GNSS technology to pick up signals from GPS, GLONASS, the planned Galileo satellite system.

Leica fieldPro v2.0

With its newly launched Version 2.0 of Leica fieldPro, accurate 2D/3D "as-built" documentation has never been easier. With such mobile CAD software and Leica Geosystems sensors, all information is captured on-site, in real-time and in its final deliverable CAD format, no post-processing back in the office. When you leave site the full scope of your work is done.

Leica Geosystems has also announced next-generation software for quickly creating accurate topographic maps from laser scan data. The new software, Leica Cyclone II TOPO, is intended for standard CAD techs and does not require specialized skills in 3D or laser scanning.*www.leica-geosystems.com/hds*

TerraSAR-X capability in ERDAS IMAGINE®

Leica Geosystems Geospatial Imaging has announced the Beta release of the TerraSAR-X processing capability for ERDAS IMAGINE® Radar Mapping Suite 9.1. This feature will also be included in the upcoming release of ERDAS IMAGINE 9.2.

Ashok Leyland announces iBUS concept

Ashok Leyland has announced iBUS , a new vehicle that has been designed with a focus on solving entrenched problems that affect most existing transit buses in the country. A GPS system enables vehicle tracking and the display of dynamic route information on LCD screens. These can also support infotainment packages including live data and news. *www.automotiveworld.com*

Septentrio signs distribution agreement with Navigation Solutions

Septentrio has signed an agreement with Navigation Solutions Europe B.V. for distribution of its products in the Netherlands, Belgium and Luxembourg.

Second phase of Royal Thai Air Force C-130 upgrade

Thai Aviation Industries has awarded Rockwell Collins the second phase of a contract to upgrade the Royal Thai Air Force's (RTAF) fleet of C-130 aircraft with an integrated Communications, Navigation, Surveillance/Air Traffic Management solution. It will deliver the upgraded solution based on the company's Flight2™ avionics system, which includes an Ethernet-based Integrated Processing Center with flight management capabilities and large format multifunction LCD's.

Trimble solutions for the mechanical, electrical and plumbing trades

Trimble announced the new Trimble MEP layout solution for the mechanical, electrical and plumbing trades. Using the solution, contractors can take a digital CAD design file or 3D Building Information Model (BIM) into the field to simplify the layout of conduit, pipe, duct and cable trays. It is used with the Trimble SPS610 Robotic Total Station to provide precise positioning on the job site. Conventional layout methods using tapes are no longer needed.

Trimble has also introduced Wireless Data Controller for the LM80 Layout Manager Connecting the Office and Job Site It creates a digital replica of the building blueprint in the field. It connects to both mechanical and robotic total stations for accurate, fast and simple building layout. Designed for use on the building construction job site, the new wireless data controller for Trimble LM80 Layout Manager is rugged. It includes wireless communications, Bluetooth connection capabilities, a highly visible screen, and a fast processor.

Magellan introduces flat-panel portable vehicle navigation device

Magellan has introduced the Maestro Elite 3270, featuring flat-panel touch-screen display in the portable vehicle navigation industry. The touch-panel integrates the newest display technology for a highly responsive screen and an elegant look. Magellan is the first GPS manufacturer to eliminate the plastic bezel housing common to portable navigation devices. *www.magellangps.com*

Pitney Bowes MapInfo enhances AnySite Solution

Pitney Bowes MapInfo has announced the newest versions of AnySite, a powerful mapping and reporting application, and its Segmentation plug-in. Both solutions provide businesses in retail, restaurant, real estate and financial services to visualise and analyse their customer and sales data, competition and markets. *www.webitpr.com*

Navigon and ViaMichelin seal a PND deal

Navigon and ViaMichelin have announced a partnership to develop a new co-branded range of PND. It will be launched in France in the second quarter of 2008. It will offer optional Michelin's travel guides and will benefit from the convergence with the ViaMichelin website that offers a one click export function to the current range of PNDs. *www.gpsbusinessnews.com*

Newly independent Fugro aerial mapping

The Aerial Acquisition division (better known as FLI-MAP) of Fugro-Inpark

BV, is shall be a separate company under the new name of Fugro Aerial Mapping BV. The new company will be headed by Huug Haasnoot MSc and concentrate services on Lidar, photogrammetry activities, and other airborne methodologies

GeoRaster Loader for Oracle 10g and 11g by PCI Geomatics

PCI Geomatics has announced the release and free availability of Geomatica GeoRaster Loader, a desktop product used to load image data and associated metadata into Oracle 10g and 11g.

Is ArcGIS Server slow?

Alta4 Geoinformatik AG has developed a software designed to analyze the performance of mapping services, running under ArcGIS Server. With help of the AGS PerformanceTool, the administrator is able to measure the presentation time of the single map elements in various scales. As a result the user receives a detailed PDF-Report and also able to identify the flaws and specifically optimize the mapping service.

HP News

Launches Scitex Help Desk

HP has launched the first Scitex Support Centre in India. It has a simple process for users to reach directly at a toll free number-1860-500-6666 to access the service for service support solutions.

Integrates with MacDermid ColorSpan

HP has announced completion of portfolio integration of recently acquired MacDermid ColorSpan, Inc., a leading supplier of UV-curable inkjet printers, within HP's Imaging and Printing Group. The acquisition enables HP to provide lower-cost, wide-format platforms and UV technologies. It is further strengthening its Print 2.0 strategy to digitize analog prints by extending the company's overall digital creation into the sign shop and quick-printing market.

Galileo update

Norwegian Prime Minister opens new Antarctic satellite station

"The Norwegian satellite station TrollSat is a milestone in satellite surveillance of the environment", Prime Minister Jens Stoltenberg said. It offers better and quicker access to vital climate, environment and weather data. The data will be used in research and in other environment surveillance. He also laid the foundation stone for the Galileo station next to TrollSat. The station will be ready in 2009. The Galileo station in the Antarctic will be part of the European navigation system Galileo, which will be operational in 2013 and be based on space satellites. *www.norwaypost.no*

Berlin denies Galileo satnav costs will skyrocket

Berlin officials denied claims that the cost of the European Union's controversial homegrown satellite navigation system, Galileo, were set to skyrocket. The German magazine Der Spiegel had said that instead of costing 3.4 billion euros (5 billion dollars) to build, as budgeted by Brussels, it was bound to cost at least 5 billion euros. Even 10 billion euros (nearly 15 billion dollars) was possible, the weekly said.

Spiegel added that a secret German government study concluded the overall cost would rise by 1.5 billion euros even under optimum conditions. Any delay or unforeseen technical difficulty would only add to the cost. A spokesman at the Transport Ministry in Berlin, which is overseeing the project, responded, "The government has no information about any billion-euro gaps."

NovAtel to establish Galileo Monitoring sites in Canada

NovAtel Inc was recently awarded a contract valued at CDN $667,861 by the Canadian Space Agency to establish sites in Canada to monitor the Galileo GIOVE test satellites. The work includes a parallel cooperative effort to integrate the NovAtel Galileo Test Receiver (GTR), into the GIOVE-A Galileo Experimental Sensor Station, to upgrade the GTR capabilities and to field these GESS stations in Canada. *www.earthtimes.org*

Pioneering Galileo Satellite begins third year in orbit

The first satellite in Europe's Galileo satellite navigation programme has achieved two years of highly successful in-orbit operation. GIOVE-A secured a crucial Galileo frequency filing with the International Telecommunications Union (ITU) and supported the development and validation of technology crucial to the future of Galileo.

The 660kg satellite was developed by SSTL for the European Space Agency to broadcast Galileo signals from space and claim the frequencies filed with the ITU for Europe. SSTL designed, built and tested the first Galileo satellite through a 30 month programme and within a 28 million Euro budget, and launched the satellite on schedule on 28th December 2005. *www.gpsdaily.com*

Garmin takes on iPhone

Garmin's Nuviphone aims both to compete with the iPhone as well as to bring Garmin's experience with GPS navigation to the forefront. It has a 3.5-inch touchscreen interface, straightforward navigation, a host of Google apps allow it to search for local businesses, check traffic etc. Any photos or videos taken with the built-in camera are automatically geotagged for positioning. *www8.garmin.com*

BlackBerry Pearl 8110 launches with Vodafone Sat Nav

The BlackBerry Pearl 8110 smartphone primed with GPS navigation capabilities is launching to Vodafone customers. It combines the email and messaging functions with the multimedia features that consumers have come to expect. *www.pcadvisor.co.uk*

CSR partners Samsung to lower costs of embedded GPS Solutions

CSR has collaborated with Samsung Electro-Mechanics Co to reduce costs of embedded GPS solutions. The products enable LBS to mobile phones, media players and personal navigation devices, while taking the guesswork out of GPS RF design and allowing OEMs an exceptionally short route to market.*www.wirelessdesignasia.com*

China unicom launches new positioning service

China Unicom Ltd has launched a new positioning service - intelligent navigation service jointly with Shanghai CTH MAX Infotech Co., Ltd. Based on mobile phones and GPS terminals of vehicles, the service is featured with path planning service based on real-time traffic information. It integrates data application of China Unicom's two networks, CDMA and GSM, with the GPS.

LG LN790 GPS 4.3" Screen portable navigation device

LG's LN790, is a new device in high end GPS market with a bright 4.3-inch screen and includes a media player for audio, image, and video files. The 3D and 2D maps included with the device cover all 50 U.S. states and Canada.

Nokia eyes GLONASS signals for AGNSS handsets

Nokia is investigating use of GLONASS signals in new products that could reach the market in the near future. It has conducted extensive study of the suitability of including GLONASS in network assisted-GNSS (AGNSS) solutions in addition to GPS. Nokia predicts that 30-40 percent of cellular handsets sold within three to four years will use AGNSS. *www.insidegnss.com*

MapmyIndia signs up with General Motors for in-car GPS navigation

MapmyIndia Navigator, the recently launched in-car GPS navigation device will now come equipped as a standard accessory in all variants of General Motors' premium cars in India. It becomes the first GPS navigator in India to be available as a standard accessory with a car. *www.mapmyindia.com*

PND market expanding in Japan

According to the new research report by ROA Group, the number of PND is increasing in the Japanese market, reaching 1.87 million units by 2010. The total number of navigation devices in the Japanese market is estimated to reach 7.49 million units by 2010. *global.researchonasia.com*

Mio and qualcomm collaborate to develop GPS devices

Mio Technology and Qualcomm have announced a collaboration to develop connected PNDs. These PNDs will have Qualcomm's QST1100 chipset to deliver GPS capability within cellular devices.

Chinese vice-premier urges scientific outlook

Chinese Vice-Premier Zeng Peiyan has urged authorities responsible for statistics, surveying and mapping, food and tobacco to implement the government's scientific outlook on development and innovate to improve accuracy and authority. Related authorities should improve their surveying and mapping work to provide a quality service for the country's construction, he said. *http://news.xinhuanet.com*

China finishes updated database in 2010

China has finished 40% of the updates of its largest national geographic information database and will complete the entire project by 2010, according to State Bureau of Surveying and Mapping. It is a 1:50000 national basic geographic information database that covers the whole country with the largest scale and highest precision up to date. Social and economic development, as well as geographic change has led to changes in the database. The Bureau planned to finish another 14% of the project in 2008.

Environmental atlas for Pune, India

The Maharashtra Pollution Control Board (MPCB) has got into a mission mode and prepared an environmental atlas for the Pune district. It will serve as a ready reckoner for industrialists and entrepreneurs with information on sites with relevant environment information in the district. The District Environmental Atlas will soon be put up on the MPCB website. *www.expressindia.com*

Digitised cadastral maps for India

Information Kerala Mission, have taken the initiative to prepare digitised cadastral administrative maps of urban local bodies and grama panchayats in the state for planning and administrative process. It has been made using GIS and with the aid of the Survey and Land Records Department having administrative boundaries of the local bodies along with survey and land record details. *www.newindpress.com*

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GPS applications to hit 900m units by 2013

The use of GPS technology in consumer, business, and industrial applications, such as telematics and asset tracking, will expand the market to more than 900 million units by 2013, market research firm ABI Research said. Personal Navigation Devices for in-car use will be increasingly complemented by converged solutions based on GPS-enabled handsets for pedestrian navigation and Location Based Services. However, GNSS technologies will have to be combined with other positioning solutions such as assisted-GPS, Wi-Fi, and dead reckoning to address the indoor coverage issue. *www.abiresearch.com*

Ifen begins shipping Galileo/ GPS RF simulator

Germany's Ifen GmbH recently began shipping its GNSS RF navigation simulator, NavX-NCS. It is the first product from Ifen, which supports all present and future Galileo and GPS frequencies (E1/L1, L2c, E5ab/L5, and E6) in one box. It can also accommodate high-precision applications, addressing four frequencies simultaneously.

In Russia, space exploration takes back seat to GPS

A top Kremlin official has ordered that space exploration be put on the back burner until the country's GPS rival actually begins working. According to First Deputy Prime Minister Sergey Ivanov "Working on such large-scale and correspondingly wasteful projects (as Moon or Mars missions) purely to satisfy our own ambitions or to achieve some kind of fantastic goal is something we have no right to do," said Ivanov. *http://blog.wired.com*

Russia decommissions five unhealthy GLONASS satellites

GNSS signal observers have noted that Russia decommissioned five GLONASS satellites, while three satellites launched December 25 have yet to be fully commissioned.

The Russian navigation satellite constellation currently has 13 satellites operating and set to healthy.

Chinese satellite navigation system monitors dangerous chemical transport

China has begun use of a domestically-developed monitoring system to oversee dangerous chemical transport based on the country's Beidou satellite. The system provides all-day data to the navigation satellite, which in turn gives corresponding operational order, according to experts who researched and developed the system. *http://news.xinhuanet.com*

Low-cost GPS device gives hope to fishermen

The Indian Coast Guard, ISRO's Ahmedabad-based Space Application Centre and Faridabad-based VXL Technologies Ltd have jointly developed a low-cost GPS transmitter-based fisheries alert system for use by fishermen at sea. The system shall be invaluable in distress situations at sea. Fishermen have been handed over five of the transmitters who are operating mechanised boats in Chennai. *www.business-standard.com*

SATNAV among top eight in India

According to Dataquest magazine, which has listed top eight companies in India to WATCH OUT for in the year 2008 has selected SATNAV as one of them. The selected companies are expected to be hot in 2008 and these are the ones that are expected to significantly define the trends in their respective areas in India.

Australia piloting GPS-based control of vehicle speed

Australia, has begun trials this month on a GPS-based speed limiting device for vehicles. Titled the "Australasian Intelligent Speed Adaptation Initiative" the technology keeps track of where the vehicle is located, and the speed limit at that location. If the GPS signals from the vehicle indicate a higher rate of speed than is posted on that section of road, an audible warning sounds. If the driver ignores the warning, the gas pedal gets more difficult to depress. The final stage is a technology bypass of the driver so that no amount of pedal-mashing will accelerate the vehicle.

NOAA to ensure GPS accuracy

NOAA will lead an international effort to pinpoint the locations of more than 40 global positioning satellites in Earth orbit. NOAA personnel will compile and analyse satellite orbit data from 10 analysis centres worldwide to ensure the accuracy of GPS information. For the next four years NOAA's National Geodetic Survey will serve as the Analysis Centre Coordinator for the International Global Navigation Satellite Systems Service, a voluntary federation of more than 200 organisations that provide continuous global satellite-tracking data. *www.ngs.noaa.gov*

Is Iphone's Wi-fi based location finder better than GPS?

Steve Jobs recently announced that the iPhone will feature Skyhook Wireless' Wi-Fi location technology in a joint development with Google. It is easy to write this off as a stop gap solution for GPS, as this is a first step towards the next generation of cellular location technology. According to Senior Research Analyst at IMS Research, GPS is a more accurate technology, when you start moving into inner city urban canyons and indoors, just getting a fix with GPS becomes the issue, not accuracy, as anyone with autonomous GPS will reluctantly admit. GPS fundamentally struggles in these environments.

Indo-Norwegian pact on developing TOPAZ

An Indo-Norwegian agreement was signed to collaborate in developing an operational ocean modelling and data assimilation system for the Indian Ocean—the TOPAZ Indian Ocean forecasting system. The parties from Norway are the Nansen Environmental and Remote Sensing Centre (NERSC) and the University of Bergen (UoB), while the Indian National Centre for Ocean Information Services (INCOIS) and Nansen Environmental Research Centre-India (NERCI) Kochi are from India. According to a press release issued here, the TOPAZ Indian Ocean system has been implemented, assessed and used by a group of scientists of Bergen and Kochi. *www.hindu.com*

Israeli satelite placed in orbit

India has launched an Israeli satellite 'Polaris' from the spaceport at Sriharikota by a homegrown Polar Satellite Launch Vehicle (PSLV) and successfully placed it in the intended orbit, ISRO said. The PSLV-C10 lifted off from the First Launch Pad (FLP) at the Satish Dhawan Space Centre at 0915 hours with the ignition of the first stage.

Japanese mapping satellite flops

The "Daichi" satellite by Japan went up about two years ago to collect data to create maps of remote parts of the country. But according to Geographical Survey Institute, the images received are blurry and could not be used for the detailed mapping planned. But the images won't go to waste as it will be used as background data for land use determination and the like. *http://afp.google.com*

Sikkim has the largest number of glaciers in India

Sikkim, comprising 0.5 per cent of India's landmass, has 84 glaciers, the largest number as compared to any other state or union territory. The present number of glaciers at 84, with the mapping exercise still underway to find about out more ice caps in the state has grown by about four times over the past six years as the figure of glaciers stood at 21 at that time, according to a senior scientist of the science and technology department, which has been carrying out mapping of the glaciers and other landscapes of the state. The glaciers have been mapped by using remote sensing application system and capturing data through satellite, he said. *www.hindu.com/*

GeoEye launch delayed

The GeoEye-1 satellite is unlikely to be launched before 22 August at the earliest. GeoEye Inc in the US informed the Securities and Exchange Commission of the latest delay on 12 January. Under a contract with Boeing Launch Services and United Launch Alliance, the satellite was scheduled for launch in April from the Vandenberg Air Force Base. The delay has been caused by unspecified problem on a military satellite. Both satellites are to be launched on Detla-2 rockets, but the military craft will not be ready until June.

Remote sensing applications for agriculture get European parliament approval

The European Parliament adopted a non-binding report on remote sensing applications developed within the CAP with 594 votes in favour, 23 against and 54 abstentions. The EU's agricultural policy takes account of the social structure of agricultural and the natural disparities between the various agricultural regions of the EU. Hence there is a need for information on land condition and crop use. Remote sensing applications help provide some of this information. Between 2003 and 2007 a pilot project on remote-sensing techniques was initiated. *www.newsdesk.se/*

ISRO offers free access to RS data in SAARC

Pakistan, Bangladesh, Afghanistan and other SAARC nations will have access to free-of-cost remote sensing data collected by various satellites launched by the Indian Space Research Organisation (ISRO) during major disasters in the region, according to an official of home ministry. The official said since the satellite imaging of the region also involves the security concerns of the neighbouring countries, it would be discussed with each nation concerned. The idea was discussed in a workshop recently, to use geo-informatics in risk-mapping, risk assessment and risk monitoring under diverse geographical, socio-economic and cultural settings. Indian Sexperts specifically mentioned how remote sensing images taken even by commercial satellites clearly captured the tsunami along the eastern coast (2004), Kashmir earthquake (2005) and Bangladesh cyclone 'Sidr' (2007). *http://timesofindia.indiatimes.com/India/*

CARTOSAT-1 satellite data agreement

Euromap GmbH (Germany) and ANTRIX Corporation (India) have agreed to expand Euromap's participation in the Indian Remote Sensing satellite program with the reception and distribution of high-resolution stereo imagery from the Cartosat-1 (IRS-P5) satellite. Under the terms of the new three year agreement, Euromap will have the exclusive distribution rights in Europe to receive and distribute Cartosat-1 data collected over Europe and North Africa. Euromap represents the only receiving and distribution facilities for IRS satellite data in Europe.

ISRO plans satellite series for civilian applications

India plans to create a chain of nine earth observation satellites which will be used for civilian applications such as identifying potential fishing zones or mapping streets in cities. They will be placed in the so-called low earth orbit or around 700km above the earth's surface by the Indian Space Research Organisation (ISRO). The agency will launch the satellites, also known as remote sensing satellites, over the next five years beginning June with Oceansat-2, a satellite that has devices that can track wind velocity on the surface of the sea and which can be used to identify fishing zones.

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http://www.gsdi.org/gsdi10/

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February 25-29, 2008
New Orleans, LA
PWitt@NavTechGPS.com

March 2008

CeBIT
March 4-9, Hannover Germany
www.cebit.de

GEO 2008
3 - 5 March 2008, Manama, Bahrain
www.geobahrain.org

WALIS Forum 2008
March 12-14
Perth, Western Australia
forum@walis.wa.gov.au
http://www.walis.wa.gov.au/forum

April 2008

GEO-SIBERIA 2008
April 22 – 24, 2008, Novosibirsk , Russia
strutz@sibfair.ru
http://geosiberia.sibfair.ru/eng/n

Space Show 08
Toulouse, France
22-25 April, 2008
contact@toulousespaceshow.eu

May 2008

IEEE/ION PLANS 2007
Co-sponsored by IEEE and
Institute of Navigation
May 5-8, 2007
Monterey, California, USA
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/earthconference2008/ en/main_fr.htm

FIG Workshop E-learning
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ITC, Enschede, The Netherlands
fig-elearning2008@itc.nl
www.itc.nl/fig_elearning2008

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ESRI's 28th annual International User Conference
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www.esri.com

Septemeber 2008

Institute of Navigation's Satellite Division ION GNSS 2008
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www.ion.org

CARIS 2008
September 22 - 26, Bath, United Kingdom
www.caris.com/caris2008

November 2008

International Symposium on GPS/GNSS 2008
11 - 14 November, Tokyo, Japan
gnss@gnss2008.jp
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