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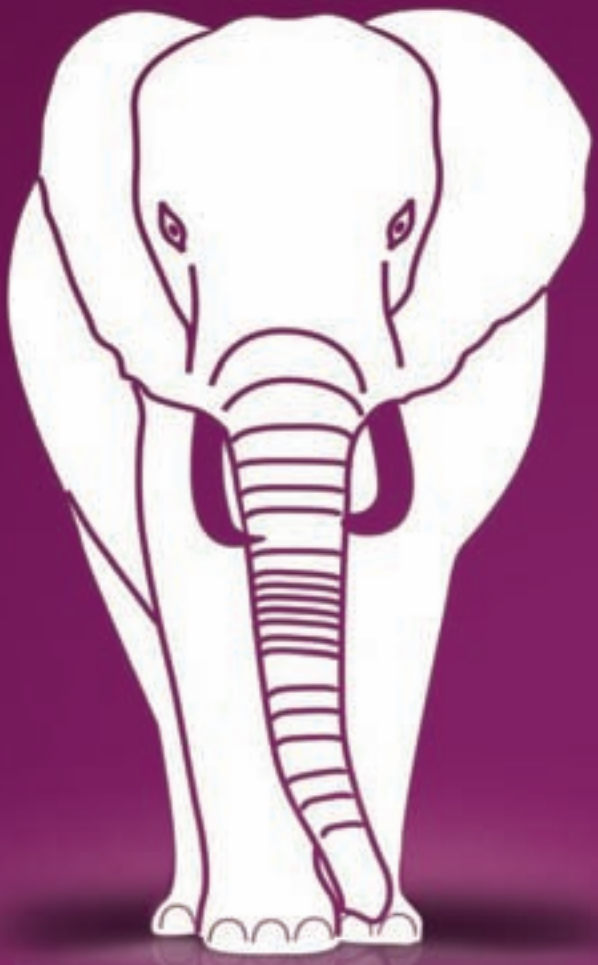
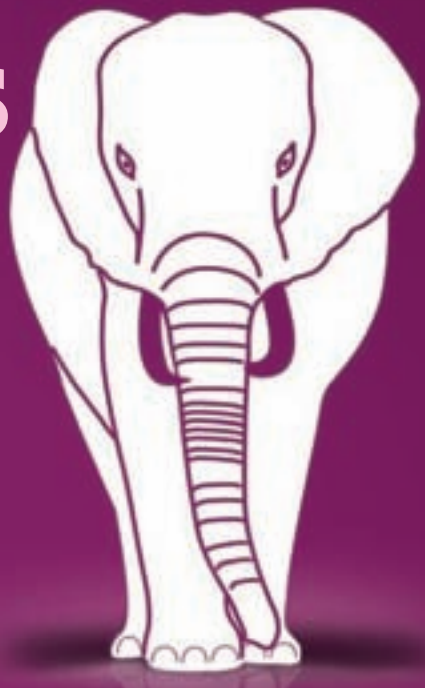


LCNSS is better than GNSS



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Columns

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This issue of Coordinates is of 44 pages, including cover

People die and will die

26/11. India's own 9/11.

India witnesses another onslaught of brutality, helplessly.

A country of more than a billion, the world's largest democracy, the rising Asian space power, nuclear power… was held to ransom.

For more than 60 hours.

By a small, but heavily armed, well-trained and highly motivated group.

An execution of meticulous planning, using advanced technologies like digital maps, satellite phones, GPS, VoIP, etc.

The entire nation was outraged and agonized.

Indeed a helpless situation.

The system which has the onus to provide security to the citizens has neither the will nor the willingness.

We must realize that we cannot match the planning, preparedness and precision of the opponents by a system that is callous, corrupt and criminal.

People die and will die in such attacks.

Bal Krishna, Editor
bal@mycoordinates.org

LCNSS is better than GNSS

Low Cost Navigation Satellite Systems (LCNSS) are designed to optimise performances over the area of interest while trying to minimise the overall costs

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Demand for Satellite Navigation technology and applications keeps on increasing in a wide range of economical, social, technological and environmental sectors. This growing interest in the development of Satellite Navigation Systems is demonstrated by the interest of several countries in starting the development of new systems or contributing to existing ones. The major rational behind is:

- Increase the performance of current systems, and or provide new services
- Ensure independence and availability of the systems

A high number of satellites is required for providing acceptable performances. GNSS systems are expensive to develop, maintain and operate. The modernisation of GPS is on going, but it is progressing slowly. The GLONASS constellation is not completely operational and is still far away from reaching the required level of performances. Galileo was started in 1999, but the In Orbit Validation Phase has not yet being completed. These facts are demonstrating the complexity associated to the deployment and operation of a GNSS.

GNSS do not only require a significant number of satellites in orbit but also a rather complex ground infrastructure (orbitography and integrity stations, uplink stations, control centres, etc.) worldwide distributed. The cost of a GNSS is limiting the capability of some countries or regions to develop their own systems. Consequently those countries need to deploy their own augmentation systems and establish agreements with other states. This situation may change if the development of Low Cost Navigation Satellite Systems (LCNSS) became a reality.

LCNSS are designed to optimise performances over the area of interest while trying to minimise the overall costs. Acceptable performances (comparable to those provided by GPS today) can be obtained with a few satellites (5 to 10) and a reduced ground segment, as there is no need to deploy Ground Stations worldwide but only over the coverage and neighbour areas.

Independence and autonomy are key concepts to be considered in the LCNSS design. However, the possibility of interoperation with other systems is a very important added value:

- LCNSS combined with SBAS: LCNSS are in principle not aimed at providing integrity or safety critical services. If required, they would be able to be provided by complementing the LCNSS by using Satellite Based Augmentation Systems.
- LCNSS combined with GNSS: LCNSS will be able to provide supplementary means for improving the performances of current GNSS systems. In particular the orbit determination and time synchronisation processes are improvable and the integrity concepts are susceptible of simplification.
- LCNSS combined with LCNSS: The addition of several LCNSS could give way to a GNSS, leading to excellent navigation performances over relatively large areas.

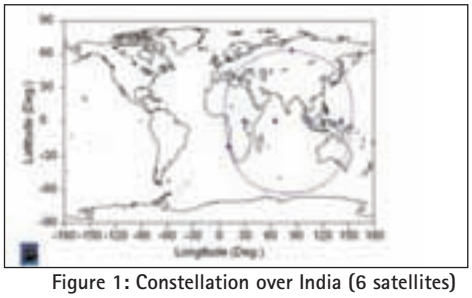

Figure 1: Constellation over India (6 satellites)

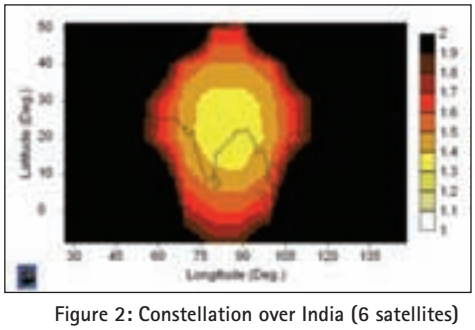

Figure 2: Constellation over India (6 satellites) HDOP, 5° masking angle

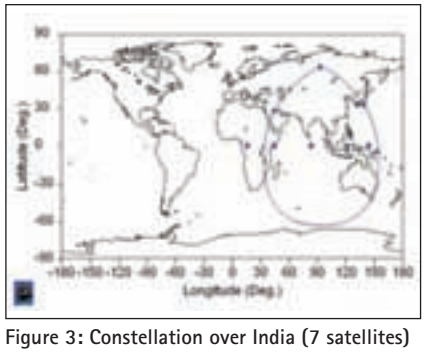

Figure 3: Constellation over India (7 satellites)

- International cooperation would be promoted by sharing the same frequencies and with the same characteristics with the ones used by the already existing systems.

GEIO satellites: A viable solution for LCNSS constellations design

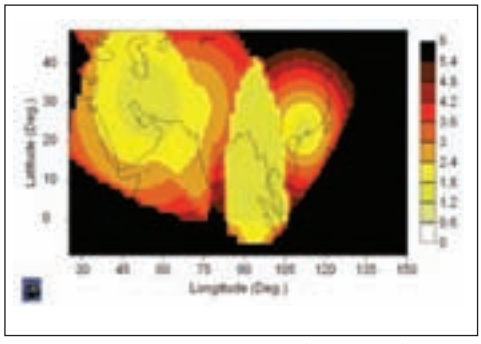

Figure 4: Constellation over India (7 satellites) HDOP, 20° masking angle

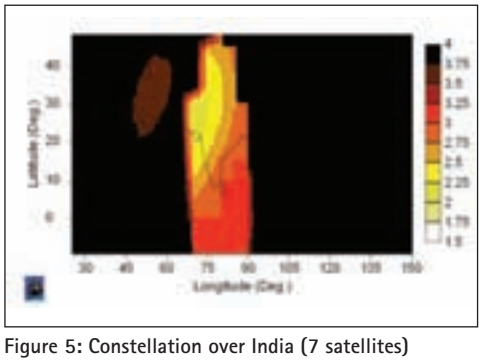

Figure 5: Constellation over India (7 satellites) HDOP, 5° masking angle, 99.9% availability level

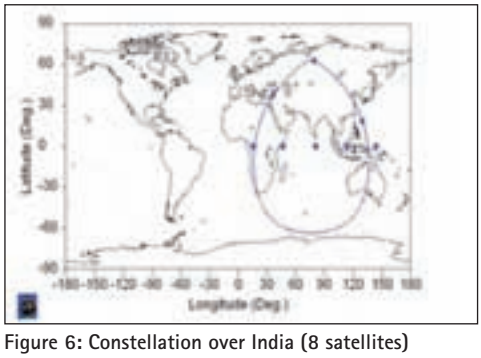

Figure 6: Constellation over India (8 satellites)

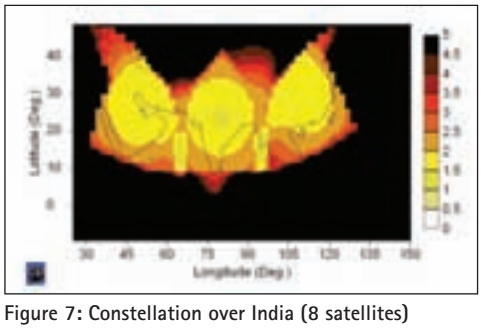

Figure 7: Constellation over India (8 satellites) HDOP, 30° masking angle

Regional LCNSS are viable using constellations of satellites in Geosynchronous Eccentric and Inclined orbits (GEIO), either by themselves or in combination with satellites in geostationary orbits.

The use of GEIO constellations is believed to be the best alternative, since these constellations allow focusing on a particular region, while the eccentricity and inclination can be optimised in order to provide the best performances over the required area.

Once the region of interest has been selected, the next step is to find the optimum constellation to provide the best navigation performances over that region. Optimum constellation means maximising the navigation performances while keeping the system associated costs as low as possible.

Polaris is a state-of-the-art tool aimed at assessing the user navigation performances at the application level. A constellation design module, which supports the design of low cost, highly efficient navigation and communication constellations, is integrated in Polaris. This module has been extensively used for optimizing Galileo constellations, and for performing the analyses presented in this paper.

LCNSS constellations over India

Constellations with 6, 7 and 8 satellites have been optimized over India, trying to maximize the level of navigation performances provided by each one of them.

Figure 1 shows the ground tracks described by the optimized constellations and the achievable navigation performance accuracy.

This constellation is composed of four geostationary satellites and two dedicated satellites in GEIO orbits. Geostationary satellites navigation payload could be integrated as a complement to the communication payload.

Figure 2 shows the worst-case HDOP performances provided over India, considering no satellite failures or outages. Worst case HDOP is below 1.5 in all points in India.

The next analysed case is a 7-satellites constellation with four of them in geostationary orbits and three in GEIO orbits. The associated ground tracks are shown in Figure 3.

The worst case HDOP performances that are provided over India, using a masking angle of 5º, when all the 7 satellites in the constellation are successfully working are slightly better than for the previously analysed case of the 6-satellites constellation. Worst case HDOP is now below 1.4. The real advantage of using a 7-satellites constellation is that also for higher masking angles (as for emulating urban environments), or in case one the constellation satellites is not available, the navigation performances can be kept at reasonable accuracy levels. With the 7-satellites constellation, HDOP over India does never exceed 3.6 for 20º masking angle, as can be observed in Figure 4 below, and does never exceed 3.5 for 5º masking angle when considering 1 satellite failure (Figure 4).

For better characterising the navigation performances of the considered constellation, Polaris can be used for computing the HDOP performances, considering realistic failure models for the constellation satellites, for any given availability level. In this case, performances have been measured for the 7-satellites constellation over India, at a 99.9% availability level (Figure 5).

Finally, the case of a LCNSS constellation over India with 8 satellites has also been analysed. It is composed of five geostationary satellites, and three additional satellites in GEIO orbits. The associated ground tracks are shown in Figure 6.

The worst-case HDOP performances that can be achieved over India, using a masking angle of 5º, when all the 8 satellites in the constellation are successfully working, are obviously better than in the previously analysed

cases. Worst case HDOP is below 1.2 in nominal conditions. Even for higher masking angles (in this case up to 30º), or in case of 1 satellite failure, the attainable performances are quite good. HDOP for 30º masking angle does not exceed 3 for any point in India (see Figure 7 below), and worst-case HDOP performances, for a masking angle of 5º, when considering 1 satellite failure are never greater than 2 (Figure 7).

HDOP performances measured for a 99.9% availability level, considering all the satellites failures modes, are excellent also. When compared with the 7-satellites constellation, the improvement in HDOP range goes from (2 - 3.25) down to (1.5 - 1.8).

Performances comparison with GPS and Galileo

Analogous results, but now obtained for GNSS, have been analysed in this section for comparison purposes.

Worst-case HDOP performances that can be achieved with GPS and Galileo, using a masking angle of 25º, without considering satellite failures, are greater than 10, almost all over the Earth surface. These results are significantly worse than the ones shown in Figure 7, for the 8-satellites constellation over India, for the more restrictive 30º masking angle.

Performances provided by GPS and Galileo, for the 99.9% availability level have also been measured. In this case, the obtained HDOP values are comparable to those provided by the 8-satellites LCNSS constellation.

Combined use of LCNSS + GNSS

LCNSS design does take into account the autonomy and the independence of the provided services. Nonetheless it is obvious that GNSS (GPS and GLONASS already, and Galileo in the near future) exist, and are working, providing accurate navigation services. So it seems interesting to investigate the potential benefits of the combined use of both kinds of navigation systems.

The significant improvement in the navigation performances is the first direct benefit of the combined use of a LCNSS together with a GNSS. If the 6-satellites LCNSS constellation over India was optimized for being used in combination with Galileo, for the 99.9% availability level, the resulting HDOP would not exceed 1.05 at any point in India.

Besides this, there are some other not so obvious advantages that can be obtained from the combined use of a LCNSS together with a GNSS. In particular, benefits in OD&TS accuracy and in integrity have been observed.

One of the major limitations of the current navigation systems comes from the characteristics of the navigation signals. The problem relies on the fact that navigation signals are not real measurements, but pseudo-measurements (the clock parameters have to be estimated together with the ranges). Moreover, the poor geometry between the on ground tracking stations and the satellites in a MEO constellation based GNSS, causes the orbits and clock parameters to be strongly correlated. In the end, the strong correlation between the clock and the orbit parameters is what is liming the capabilities of the OD&TS (Orbit Determination and Time Synchronization) processes. In practise, increasing the size of the tracking network in such a way that permanent coverage from a significant number of stations is ensured, helps mitigating the problem, but does not completely solve it.

If receptors were located on-board the satellites, as well as they are located at the tracking stations on the Earth surface, the combined use of a GEIO/GEO constellation together with a MEO constellation would be a sensible strategy for overcoming the problems related to the relative geometry between the satellite and the tracker. Inter-satellite links generated between pairs of satellites would be extra ranges that could be used for feeding the OD&TS batch processes. Note that inter-satellite links observables are not affected by neither ionospheric nor by tropospheric effects. The improvement in the observables quality, together with the orbit and clock parameters correlation reduction, would really help overcoming the limitations observed in the current GNSS.

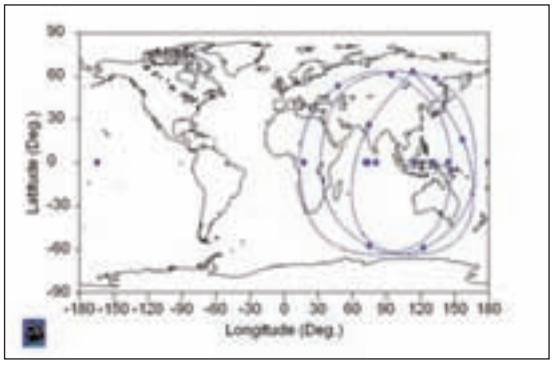

Figure 8: Combined use of LCNSS (18 satellites): India / Australia-New Zeeland / Japan-Korea

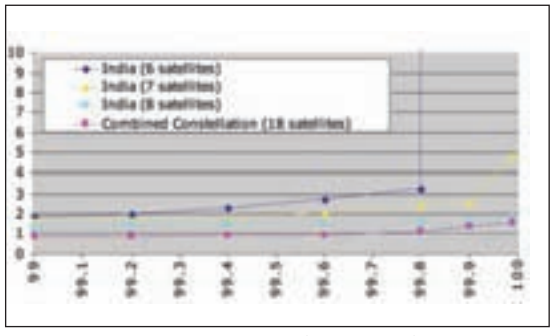

Figure 9: Combined Constellation (18 satellites) HDOP over India, at 5º, for different availability levels

An alternative to the use of the inter-satellite links as extra measurements for an on-ground OD&TS batch process is to use them for feeding a standard PVT process, which would allow the generation of navigation products almost in real time. These solutions could be either directly broadcasted to the users, as navigation solutions, or could be used for being compared with the solutions obtained in the usual OD&TS batch process. This comparison would be very useful from the integrity point of view, being the basic concept for an alternative integrity approach.

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Combined use of several LCNSS

Two (or more) LCNSS can be used together, taking mutual advantages from each other. In this section it is going to be shown that if a 6-satellite LCNSS over India is optimised for being used in combination with two other LCNSS (one of them optimised for the Australia + New Zeeland area, and another one for Japan + Korea), the level of accuracy that can be reached is even better that the one obtained with the optimized 8-satellites constellation over India.

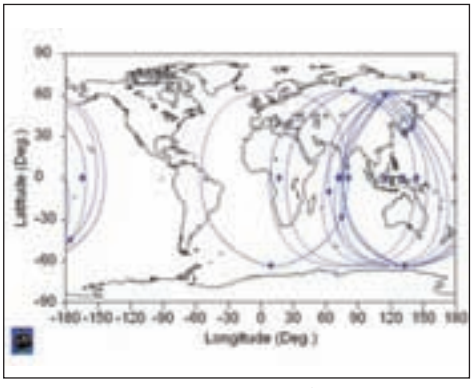


Figure 10: Ground track evolution (after 9 months without corrective manoeuvres)

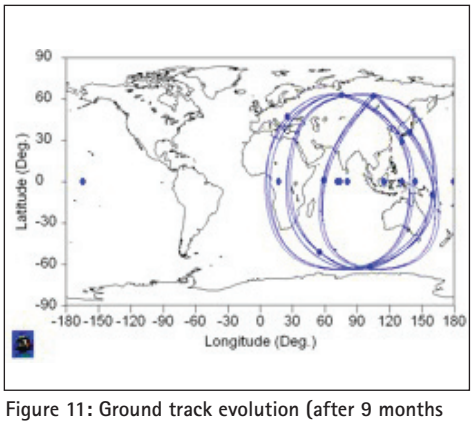


Figure 11: Ground track evolution (after 9 months without corrective manoeuvres)

The combined constellation is composed of 18 satellites: 3 geostationary satellites and 3 satellites in GEIO orbits, for each one of the three considered sub-constellations. The associated ground tracks are shown in the figure 8. The constellation optimisation process has been performed trying to simultaneously keep all the constellations performances at reasonable levels. For comparison purposes, the HDOP performances have been measured, for several availability levels, ranging from 99% up to 99.99%, for the different constellations and combinations of constellations presented in the previous sections. A curve representing the degradation of the performances for each one of the considered constellations, as a function of the availability level has been plotted, in such a way that the navigation performances of all the considered constellations can be easily compared. The obtained results are shown in Figure 9.

Stability & feasiblity considerations

Navigation performances are driven by the geometry between the user and the navigation satellites. The constellations described in this article up to the present section are all "theoretical" constellations, which once in orbit, would be affected by the following forces:

- Earth gravitational field, including tidal perturbations
- Solar, lunar and other major planets perturbations
- Solar radiation pressure, albedo and infrared radiation
- Drag perturbations (only for very high eccentric orbits)

These perturbations degrade the geometrical conditions and consequently the positioning performances too.

Let's take for example the previously mentioned combined constellation (18 satellites) composed of three sub-LCNSS. The constellation "nominal" ground track is depicted in Figure 8. If no maintenance manoeuvres were performed, the satellites orbits would be affected by the perturbations listed above, and after a certain time period, the original configuration would be degraded. This can be easily appreciated by observing the evolution of the satellites ground tracks in the figure 10.

The degradation in the constellation ground tracks evolution demonstrates the need of performing maintenance manoeuvres in order to keep the navigation positioning performances at acceptable levels.

The optimization process consists of slightly modifying the semi major axis for each individual GEIO orbit in such a way that the fulfilment of the optimization criteria is maximised.

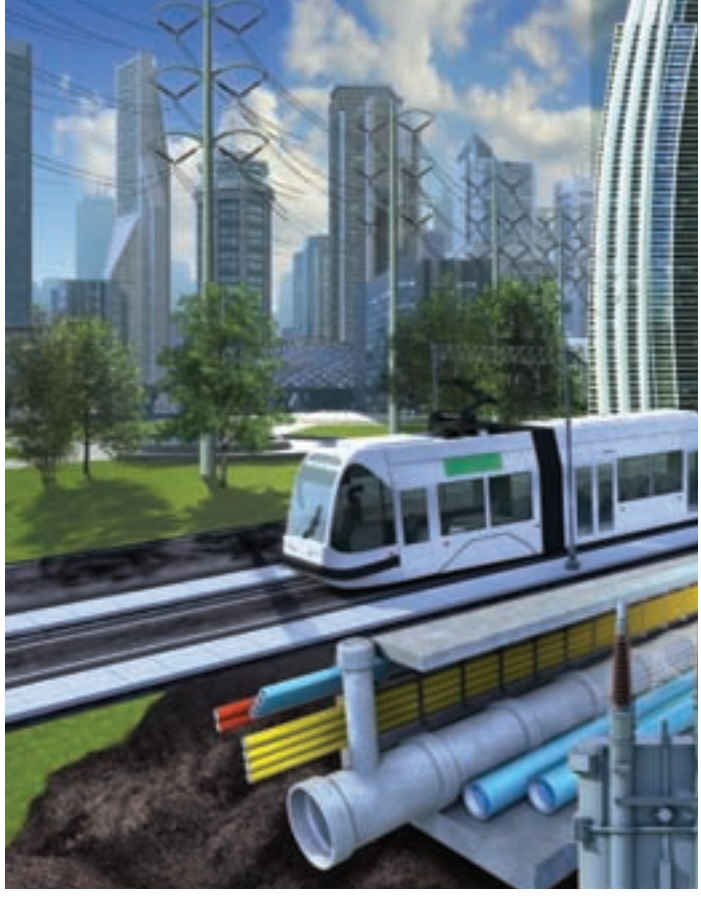
The inclination parameter has been set from the very beginning of this analysis as the optimum value (63.4º), which prevents the argument of the perigee from drifting. The plot below shows the evolution of the satellites ground tracks, for the optimised constellation (Figure 11).

It can be observed now that the geometrical configuration after 9 months has not significantly degraded.

Conclusions

- It is possible to provide high navigation performances over selected regions, with a reduced number of satellites and a limited ground segment deployment.
- LCNSS are viable using constellations of satellites in GEIO orbits plus geostationary satellites.
- Used alone or in combination with other navigation systems, LCNSS with 6 to 8 satellites have demonstrated to provide highly accurate navigation performances over the target area (India, in this case).
- Navigation performances reachable by a LCNSS combined constellation are comparable or even better to the ones provided by a GNSS.
- LCNSS are a feasible alternative to the costly GNSS.
- LCNSS can be designed taking into account stability criteria, to minimise the maintenance operations.

Engaging young minds in designing future cities



"Que Sera Sera, whatever will be, will be; the future's not ours to see, Que Sera Sera". That was the song we learned in school years ago. But, this is not a song that would make sense to a several school children today, who do have an inkling of the 'future' as they participate in a competition that encourages them to imagine how our cities should be in the future.

An 'idea' is born

The competition started nearly two decades ago in the United States as the National Engineers Week Future City Competition with the aim to provide fun and exciting educational engineering programs for school students by combining stimulating engineering challenges with 'hand-on' application to enable them to present their vision of a city of the future.

Bentley Systems, with their comprehensive portfolio for the building, plant, civil, and geospatial verticals spanning architecture, engineering, construction and operations; conceptualised the competition, and have been the driving force behind it by giving the required support in terms of training the participating teams, providing the software and sponsoring the prizes.

The 'Future' comes to India

In October of 2005, Greg Bentley CEO of Bentley Systems met with the Union Minister for Science & Technology and Earth Science, Mr. Kapil Sibal to discuss replicating the competition in India. "Mr. Sibal was very excited about the possibilities and gave us the vision and support to move forward" said Mr. Bentley after the meeting.

In the year 2006, Bentley Systems was thus able to bring this innovative program to India as the Future Cities India 2020 Competition with active sponsorship from the Department of Science and Technology.

Scott Lofgren, global director of Bentley Systems, Inc.'s BE Careers Network, speaking on how the Future Cities India 2020 program will help to introduce India's youth to the engineering profession, said, "The infrastructure demands on cities in India are staggering, and few world examples exist to show us how to meet them. Compounding the challenge of the demand for more and better performing infrastructure is the shortfall in the number of new infrastructure engineers, architects and planners who will be needed to design, build and operate this infrastructure in the future. We believe it is essential to encourage the next generation to get involved and understand the career opportunities that the infrastructure professions present.

The Indian challenge – learn and compete

Given that school curriculum in India is quite structured and exam oriented it was a challenge to incorporate a competition that would require the students to break free from their books and theory and step into the realm of the 'real world'. Understanding that the students will need help and support, the Future Cities India 2020 Competition, is first a learning exercise and then a competition. A teacher and guide, Apeejay School, Noida, says, "It is altogether a different kind of exposure which students get through this project. Other competitions are based on what they have learned as part of their curriculum and Future Cities project takes them to the future actually."

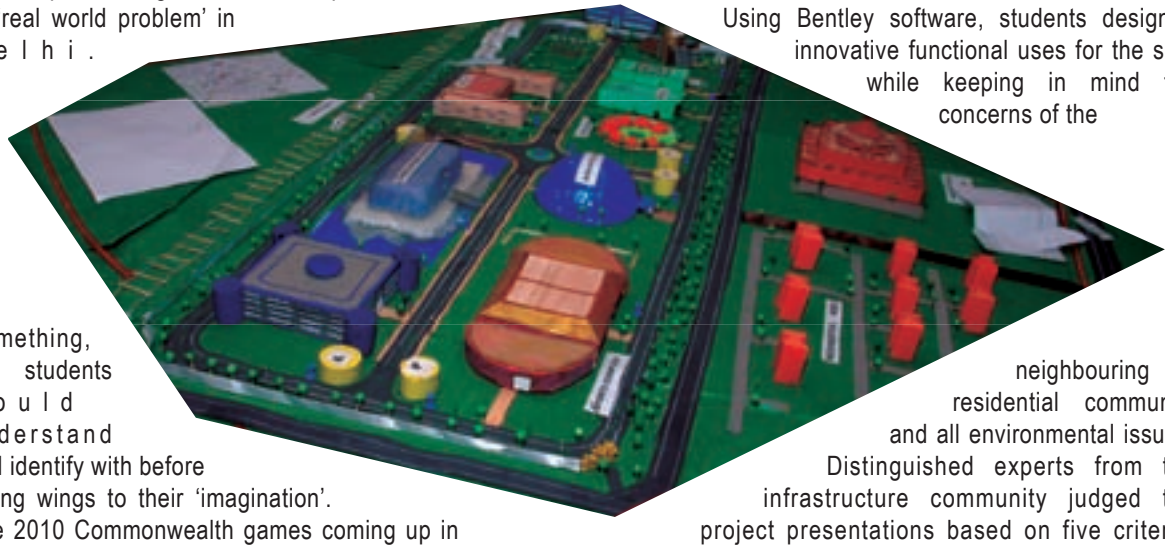
The Future Cities India 2020 Competition is a national level competition that focuses on the use of science and technology development process to solve real world challenges, incorporating real world data and using globally recognised professional software. With the help of teachers as counsellors and technical professionals as mentors, the students are guided to provide realistic, innovative solutions while learning a marketable skill.

"It is altogether a different kind of exposure... Future Cities project takes them to the future actually."
- A teacher, Apeejay School Noida

The competition also encourages the students to develop, design and integrate the functionality of their ideas while fostering an interest in maths, science, engineering, architecture and facility planning through a hands-on, real-world application. “India has earned a reputation for developing a highly skilled workforce to support its technical outsourcing industry. It is now time for us to direct our many talents inward, and address projects at home that will help secure India’s future. The Future Cities India 2020 program will engage some of India’s finest young minds in designing world-class infrastructure for economic growth and improved quality of life in our cities” said Mr. Kapil Sibal.

The future unveils in Delhi

Given that in its inaugural year the competition was open to schools based in Delhi, the next challenge for the competition organisers was to pick a theme or ‘real world problem’ in Delhi.



Something, the students would understand and identify with before giving wings to their ‘imagination’. The 2010 Commonwealth games coming up in Delhi proved to be the ideal backdrop for this ‘flight of imagination’ not just in the first year of the competition, but also in the second.

In 2006-07, 15 teams from eight schools in Delhi competed to design ‘a roadway between Lakhsmi Nagar and Noida Turning railway stations capable of accommodating the increased traffic expected during the Commonwealth Games 2010’. The project design from Team 1 at the Apeejay School, Sheikh Sarai, Delhi was judged the best by a panel of distinguished experts from the infrastructure community.

Dr R Siva Kumar, Head, Natural Resources Data Management Systems (NRDMS), a Division of DST, which was the sponsor of the programme, said, “We have asked the students to ‘imagine’- and sometimes children can come up with very different and new ideas. We are not expecting them to come up with 'suitable' designs – we want them to just think about these real world problems and come with ideas. And at times, so they do come up with something very innovative. The idea behind such competitions is not to seek the solutions of real word problems but it intends to sensitise students with real world issues and make them aware of the role of technology in addressing them.”

In 2007-08 with the theme “Site Development of proposed Commonwealth Games Village, Delhi after 2010”, 14 teams from ten high schools in the National Capital Region competed to develop conceptual solutions for the redevelopment of the Commonwealth Games 2010 international zone, where temporary structures – everything from media centers, entertainment facilities, and practice grounds to a commercial center and transportation system – will be dismantled at the conclusion of the Games.

Using Bentley software, students designed innovative functional uses for the site, while keeping in mind the concerns of the neighbouring residential community and all environmental issues. Distinguished experts from the infrastructure community judged the project presentations based on five criteria: project design solution report, computer model, expenditure summary report, physical model, and team presentation.

The winners, Team 1 from Apeejay School, Noida were awarded scholarships and trophies, and the teachers and technical professionals who served as counsellors and mentors also received awards and recognition. Members of the winning team included Ajaypat Jain, Anshul Singh, E R Subramanian, and Gagan Anand, and said, “We were honoured to be a part of this competition. We worked hard and gave our best and were amazed to get the final output of our research and case study. We had been appreciated by judges and audiences from various organisations for our best solution of the problem statement. It was a wonderful journey throughout.” Second place honours went to Team 1, DAV Public School, Gurgaon.

“This program will engage some of India’s finest young minds in designing world-class infrastructure”

- Kapil Sibal

The 'idea' becomes a reality

The programs vision to, "Create a geospatial literate community focusing on Science and Technology that contributes to the betterment of the urban/rural infrastructure of India while integrating Science & Technology with the development process", is now well and truly on its way to be realised as the competition grows with each passing year. "It is a good initiative. It will help to create awareness - among the students, their teachers and parents. Today the competition has 16 schools with teams of 4 members each - so the numbers are growing. With a competition like this the children get excited and get encouragement. Once you approach students with initiatives like this, it has a great multiplying effect. They discuss about technology among themselves, with their peers and parents also" says Dr Siva Kumar.

Now in its third year, the competition's outreach may well be beyond just the students in its fold, as this year's competition challenge focuses on Indian

Railways' plans to redevelop 22 of its centuries-old railway stations into world-class facilities. Students must create a conceptual design plan to upgrade the New Delhi Railway station, the first facility on Indian Railways' redevelopment schedule.

Additional co-sponsors this year include McGraw-Hill Education and The American Centre. 15 teams are now in the race to design and present a conceptual solution to the 'redevelopment of New Delhi railway station', focussing on three main requirements: use the existing land and infrastructure to the best advantage; accommodate internal access zones, with separate parking zones at Paharganj and Ajmeri Gate terminals; and use environmentally responsible materials. The winning team will be announced and honoured in an awards ceremony in January 2009.

Bhupinder Singh, Senior Vice President, Bentley Software, said, "We are excited to be a part of this in the competition. Future Cities India 2020 is a tribute wonderful program, and appreciate the incredible maturity, talent, and vision the students have displayed to all the creative minds that have developed innovative design solutions to help address India's real-world infrastructure needs."

Added Scott Lofgren, "Future Cities India 2020 is the catalyst we can use to inspire young minds to consider the profession. Of course, not all of the participants in our program enter the engineering ranks, but some will, and they will help India and the world be better prepared to meet the growing demand for new and improved infrastructure."

The 'idea' takes root

The truth of Mr. Lofgren's ideas is echoed in the words of a winning team member from Apeejay, Noida, when asked whether this exposure would guide his choice of a career in the future, "Absolutely this competition gave me a direction and exposure to the practical aspects related to engineering and architectural phenomenon and did help us to correlate our daily practices in engineering point of view. Now, we feel attached with the engineering world ahead. "

If the competition's vision "Reach out & involve Every School in the Country" is ultimately realised, our students will definitely be better prepared as 'our future citizens'. To conclude golden words from a student of the Apeejay Noida wining team, "We would only say- have the vision, follow the dream and put it into action!"
- Shubhra Kingdang, Coordinates

The Future Cities India 2020 Awards

For the winning team and first runner-up:

Scholarship, trophy and certificate

Special Awards:

Special Awards for Best Team - Physical Model
Special Awards for Best Team - Computer Model
Special Awards for Best Team – Environmental Solutions

Participation Prize:

All student participants of the national finals get certificates
Teachers/ Engineer Mentors get awards and recognition.
Free 1 year subscription of Bentley Professional Software to the participating Schools of National Finals.

www.futurecitiesindia2020.co.in

"This program is a tribute to all the creative minds that have developed innovative design solutions"
- Bhupinder Singh

"The ideas and approaches developed by students will certainly have an impact"

Scott Lofgren,
Global Director,
Bentley Systems
BE Careers Network

What challenges did you face while implementing Future Cities India 2020 competition in India?

It wasn't that we faced challenges, but rather, we saw the need to make some changes to the program in order to customize it to the needs of India. However, we received assistance from two of the people who started the Future City Competition in the U.S., so we were able to build on those successes. The competition was new when we brought it to India, so we did have the normal start-up tasks like informing the schools, recruiting mentors, and so on. Also, the school calendar year in India is slightly different than it is in the U.S., so we had to tailor the schedule. Future Cities India 2020 is geared to high school students rather than middle school students, the competition uses real-world engineering software, as opposed to SimCity, the gaming software used in the U.S. program, This meant that we had to ensure there were computers to run the software.

There are many infrastructure-related challenges in Delhi, how do you decide on the specific themes?

We look for a challenge that is relevant to the students, one that can inspire them to find a solution they would like to see implemented. Another factor is that each student's time commitment is limited to about 100 hours of teamwork. Selecting a challenge that can be completed in that amount of time is an imperative in the selection process.Every year we document about five possibilities and then pick the most appropriate from among them, taking into account the Bentley software products that would best assist the students. After consultation with government officials and local engineering companies, a challenge is selected.

How did you decide to have the focus on high school students for this competition?

We developed the competition in collaboration with Shri. Kapil Sibal, Minister for Science & Technology & Earth Sciences, and he suggested that we focus on 11th grade students. The ability of these students to grasp and solve real-world problems, using real-world data and software used by engineers worldwide, was evident. In addition, students in this grade level are eager to win scholarships and, therefore, are highly motivated to compete.

Are there any plans to take the competition to other cities in India?

We still plan to expand the competition, but expansion within India is contingent on sponsorships or partnerships with the Department of Science & Technology, nongovernmental organizations, and commercial firms. We are actively working on our partnerships.

Are there any plans to extend the competition to graduate-level students ?

Expanding the competition to include universities is being considered. The timetable of semesters makes the scheduling of the competition more challenging. We are working with IIT Delhi, Civil Engineering Department on a demonstration project for university students. Our plan is to demonstrate the project at the Jan. 17, 2009, finals.

Will it be possible to use the ideas that have come up during these competitions in actual projects?

Every year we have very distinguished judges evaluate each team's work. It includes representatives of national and city planning authorities, commercial engineering firms, and educators. The ideas and approaches developed by these student teams will certainly have an impact on the solutions to the various challenges that are actually implemented, as well as on the way engineering is taught in the schools.

BE Careers Network – Supporting the 'future'

The BE Careers Network offers a comprehensive and economical software program, a balanced learning approach including online self serve training, and a professional network that promotes a brighter future for students, the profession, and the world. It helps to integrate Bentley products, the tools of the designer and engineering trades, into the classroom.For students, the it helps to prepare for a career in the AEC/geospatial industry. The program offers students a comprehensive software portfolio, 24x7 OnDemand self study technical training, professional networking, and much more to compliment their education as well as offer a competitive edge when looking for a job.For the industry, it is focused on producing career ready graduates, by collaborating with the industry to ensure the programs in middle schools, high schools, community college/trade schools, and universities match the industry needs. *www.becareers.org*

Couldn't we predict the Wenchuan Earthquake with GPS?

The prediction of earthquake has been one of the most difficult sciences which are not yet solved

Shunji Murai
Professor and President, Japan Society of Photogrammetry and Remote Sensing as well as President, Japan Association of Surveyors.
sh1939murai@nifty.com

Harumi Araki
President, Environmental Geology Incorporated who obtained a Japanese Patent (No. 3763130) on Prediction of Earthquake together with Prof. Murai in January 2006
arakey@mbf.ocn.ne.jp

The Wenchuan Earthquake occurred in Sichuan Province, China on the 12th May 2008 with M 8.0 in Richter Scale and 10km depth which resulted in more than 90,000 dead and missing. It is reported that the total loss is

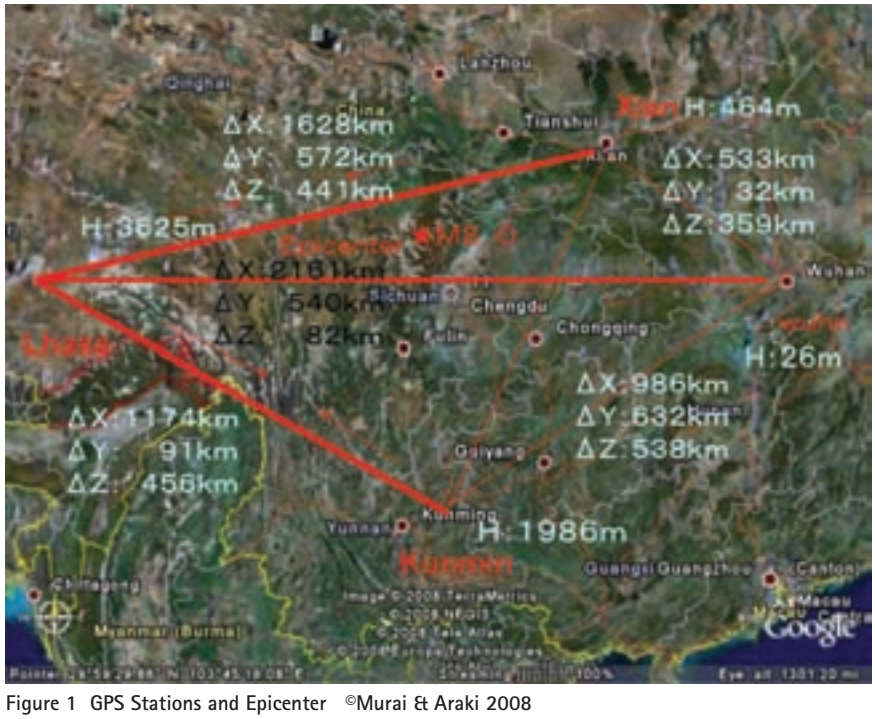


Figure 1 GPS Stations and Epicenter ©Murai & Araki 2008

more than 170 Billion US Dollars.

Why couldn't we predict the earthquake? The prediction of earthquake has been one of the most difficult sciences which are not yet solved. The authors have traced many past earthquakes happened in Japan with use of GPS data since 2000. There were 162 earthquakes with more than M6.0 around Japan including offshore for eight years from January 2000 to December 2007. We found some kind of pre-signals to all those earthquakes in GPS data in terms of daily change of triangle area connecting fixed GPS stations constructed by Geographic Survey Institute (GSI) of Japan.

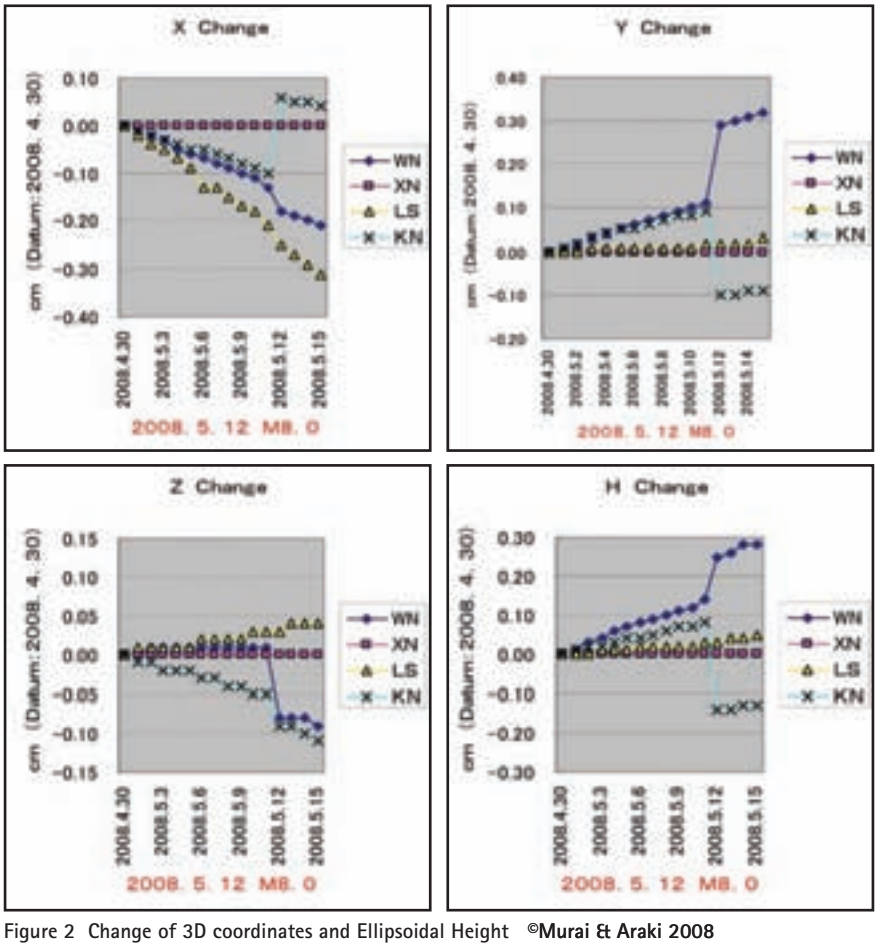


Figure 2 Change of 3D coordinates and Ellipsoidal Height ©Murai & Araki 2008

Wuhan	X	Y	Z	H
2008.4.30	-2267749.5404	5009154.2754	3221290.6753	25.8773
2008.5.1	-2267749.5405	5009154.2755	3221290.6753	25.8774
2008.5.2	-2267749.5406	5009154.2756	3221290.6754	25.8776
2008.5.3	-2267749.5407	5009154.2757	3221290.6754	25.8777
2008.5.4	-2267749.5409	5009154.2758	3221290.6754	25.8779
2008.5.5	-2267749.5410	5009154.2759	3221290.6754	25.8780
2008.5.6	-2267749.5411	5009154.2760	3221290.6754	25.8781
2008.5.7	-2267749.5412	5009154.2761	3221290.6754	25.8782
2008.5.8	-2267749.5413	5009154.2762	3221290.6754	25.8783
2008.5.9	-2267749.5414	5009154.2763	3221290.6754	25.8784
2008.5.10	-2267749.5415	5009154.2764	3221290.6754	25.8785
2008.5.11	-2267749.5417	5009154.2765	3221290.6754	25.8787
2008.5.12	-2267749.5422	5009154.2783	3221290.6745	25.8798
2008.5.13	-2267749.5423	5009154.2784	3221290.6745	25.8799
2008.5.14	-2267749.5424	5009154.2785	3221290.6745	25.8801
2008.5.15	-2267749.5425	5009154.2786	3221290.6744	25.8801

Table 1 3D coordinates and height at Wuhanbefore and after the WenchuanEq. ©Murai & Araki 2008

Though limited number of GPS stations near the origin of the Wenchuan Earthquake is available, we tried to find pre-signals from GPS data which are provided by International GPS Service (IGS) and Scripps Orbit and Orbit Permanent Array Center (SOPAC).

Four GPS stations are selected; Wuhan (WN), Xian (XN), Kunmin (KN) and Lhasa (LS) for the processing as shown in Figure 1. We found critical pre-signals in daily change of distances and triangle areas, six days before the Wenchuan Earthquake.

How much did GPS stations move at and after the Earthquake?

Though the change of 3D coordinates of GPS stations are not useful for the prediction as known from our experience, it would be interesting to know how much GPS stations moved after the Earthquake.

Figure 2 shows the change of 3D geocentric coordinates (X, Y, Z) and ellipsoidal height (H) at four GPS stations every three days from 2008.4.30. It is shown that Wuhan moved drastically in all directions after the Earthquake. Table 1 shows the 3D geocentric coordinates and ellipsoidal height at Wuhan GPS stations which moved largest. The biggest change was 2mm in Y direction at the earthquake. Kunmin showed the large reverse movement (from positive to negative or from negative to positive) in X, Y and H directions after the earthquake.

How much did the distances between GPS stations move?

The daily changes for six combinations of distances connecting the four GPS stations were checked for 15 days from 2008.5.1 to 2008.5.15. Out of six combinations, the two distances between Wuhan and Lhasa and between Kunmin nad Lhasa showed the largest daily change with more than 3 sigma on the 6th May, six days before the earthquake though the distance between Wuhan and Kunmin showed the biggest change on the day of the Earthquake as

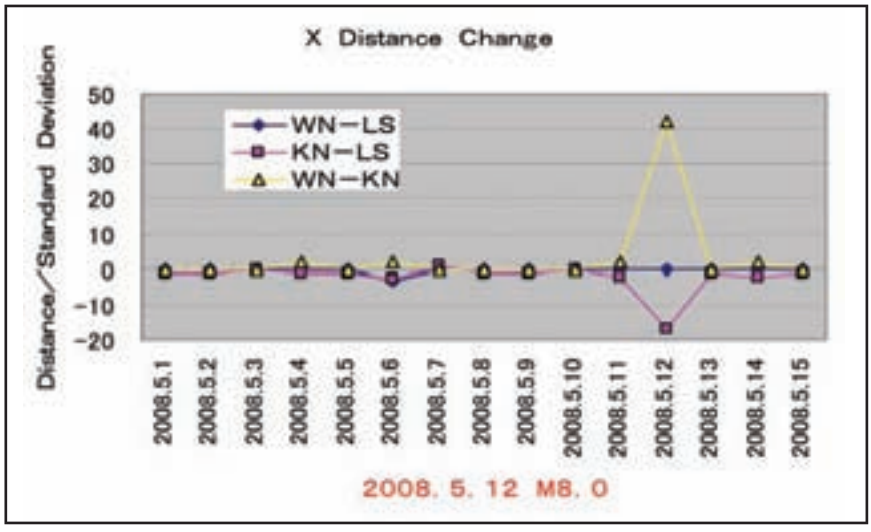


Figure 3 Change of X direction distance at three base lines ©Murai & Araki 2008

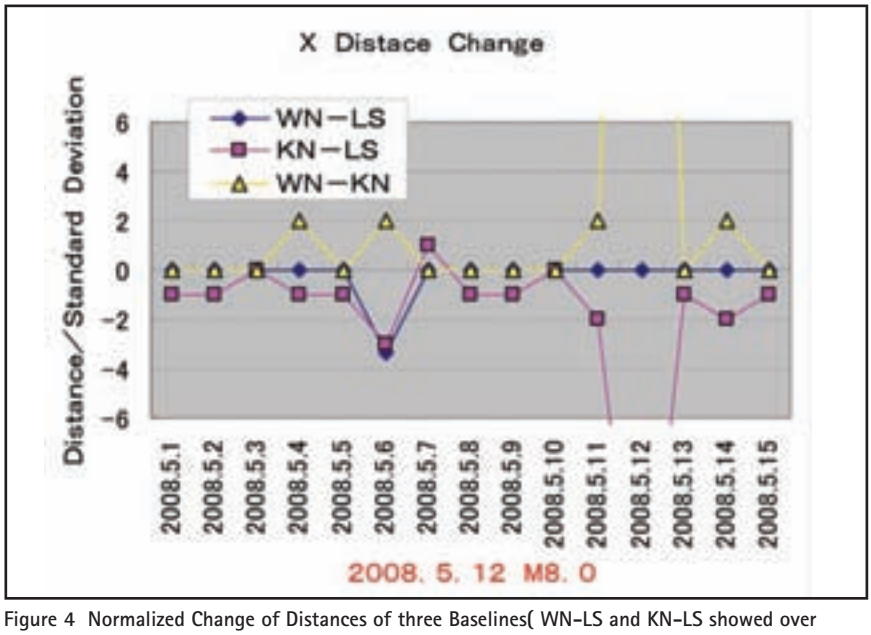


Figure 4 Normalized Change of Distances of three Baselines(WN-LS and KN-LS showed over 3 sigma) ©Murai & Araki 2008

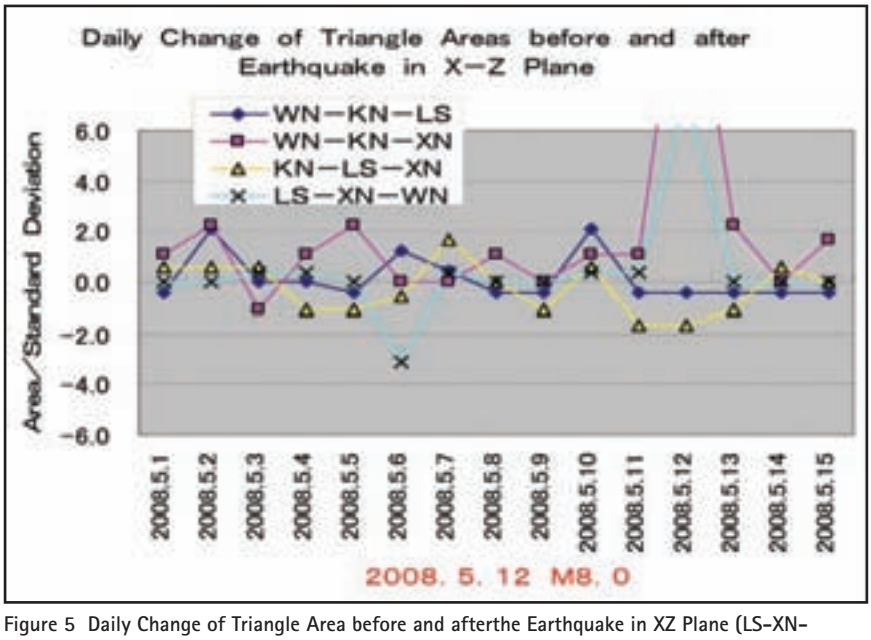


Figure 5 Daily Change of Triangle Area before and afterthe Earthquake in XZ Plane (LS-XN-WN showed over 3 sigma)v ©Murai & Araki 2008

shown in Figure 3. The vertical axis shows normalized value of distance divided by the standard deviation. Figure 4 showed the detail of the daily distance change in X direction for the distance between Wuhan and Lhasa and between Kunmin and Lhasa, which showed the drastic change of larger than three sigma on the 6th May, six days before the earthquake.

The problem of the distance abnormality will not to be able to identify where the relevant earthquake may occur.

How much did the triangle areas connecting GPS stations change?

The four combinations of triangles connecting four GPS stations were checked whether any pre-signals were found or not before the Earthquake. The triangles were checked for XY, XZ and YZ planes for 15 days from 2008.5.1 to 2008.5.15.

Figure 5 shows the XZ plane in which the triangle connecting Lhasa, Xian and Wuhan showed 3 sigma abnormalities on the 6th May 2008. This triangle includes the epicenter of the Wenchuan Earthquake as shown in Figure 1. Though this triangle is so large with the longest side of more than 2000km, it would be valuable to know around where an earthquake may happen within a critical triangle area.

Conclusions

Pre-signals of the Wenchuan Earthquake existed in the daily change of distance between GPS stations; Wuhan to Lhasa and Kunmin to Lhasa with larger than 3 sigma on the 6th May 2008, six days before the Earthquake. Similar pre-signals larger than 3 sigma existed in the daily change of the triangle area; Lhasa-Xian-Wuhan on the 6th May 2008, also six days before the Earthquake. The epicenter of the Wenchuan Earthquake is included in the critical triangle.

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"NSDI must be used by common man"

Dr R Siva Kumar CEO National Spatial Data Infrastructure on status and directions of NSDI in India

Dr R Siva Kumar
CEO NSDI & Head
NRDMS Division
Department of
Science & Technology
Government of India

We are not hearing much about NSDI? What is the status of NSDI?

The vision behind NSDI is to make data available and accessible. Keeping this objective in mind policies and framework are formulated. Various aspects of digital data standardization are being looked into and consensus being developed. Right now we are laying the foundation. We are working on consensus. It is not easy as there are many different organisations involved. We are working hard to get the standards implemented.

Don't you think it is taking too much time?

NSDI is a long term project and it needs continuous and consistent effort. We need to engage relevant and important organizations. We are fortunate that participating organisations are contributing to the goals of NSDI actively and constructively. It will take time. When we see how long it took the other countries, and where we are today - 'we are not badly off, we are satisfied."

What is lacking?

There is gap between the data and users. The available data mainly suffices the needs at national and regional level. However, data is also required at village level. The challenge before us is "how to create data that can be used for common man". Ultimately, these data are to be used at village, community and individual level. Given the data needs at village level, I feel a a combination of both bottom up and top down approach would be more appropriate. If that happens, that will be the success of NSDI. The second point is that policy and the framework have been created. The data still has to come.

Recently ISRO Chairman announced "Bhuvan". Bhuvan seems to be positioned as India's answer to Google? Don't you think it is also a DOS version of NSDI?

We must understand that when we talk about NSDI we are not talking only about mapping or satellite imageries. It goes much beyond that. Here we need to include various layers of information. At the same time initiatives like Bhuvan help us to meet our goal. Such initiatives are complementary in nature and only help us to meet our ultimate goal.

What do you need from industry in terms of hardware and software?

The market for GIS, in India has been vendor driven. The capacity building is an issue where industry can play an important role. The capacity building so far has been specific to packages - there has been no broadbased capacity building. Since there are not many GIS courses at graduate level, this vacuum can be filled in by industry. Another point is that industry needs to assure jobs, unless that happens, students will not join these courses even if such courses are available. Therefore the industry has to go for campus recruitment and 'on the job trainings' and adopting academic institutions

What about Open source GIS?

We are part of it and we are OGC compliant. More and more people are talking about it. They are taking the software from the web and using it. We are supporting the Open Geo foundation. We believe that open source tools should be available. But, we must understand that the utility of data comes only with availability.

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ALPHA

- Internal battery
- Charger
- GSM
- Bluetooth

for: TR-G3, TR-G2T, TR-G3T

Front panel connectors:

Power Input + serial port A + USB + Antenna

Back panel connectors:

Can have up to 3 connectors of 1-PPS · Event Marker · IRIG · GSM Antenna (without Bluetooth antenna).

When Bluetooth antenna is installed only one extra connector can be installed.

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

DELTA

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

Front panel connectors:

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

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

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

Back panel connectors:

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

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

SIGMA

- Internal battery
- Charger
- Modem
- GSM

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

Front panel connectors:

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

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

Back panel connectors:

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

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

GPS + GLONASS + Galileo

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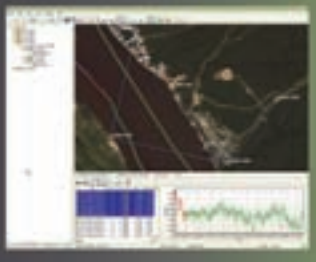

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- *Bluetooth*
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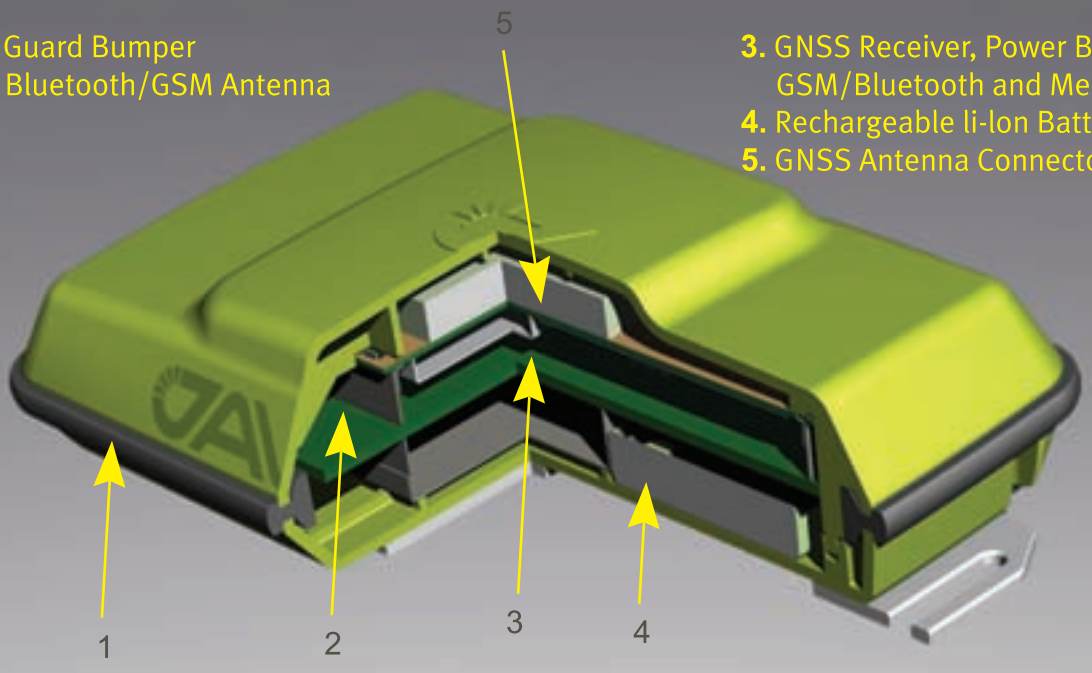
- *charger*



216-channel TRIUMPH

Tracking Specification

Tracking Channels
GPS L1/Galileo E1/GLONASS L1

Signals Tracked
L1 C/A, Code & Carrier

Power Specification

Battery
Internal Li-Ion battery (3.7 V, 1.05 Ah) with internal charger

Operating time	Standby mode
	Call mode
Input Voltage	+4.5 to +6.5 volts

GNSS Antenna Specifications

GNSS Antenna	Internal
Antenna Type	Microstrip (Zero Centered)
Ground Plane	Antenna on a flat ground plane

Radio Specifications

GSM/GPRS Module
Internal GSM/GPRS quad-band module, GPRS Class 10

GSM/GPRS Antenna	Internal

I/O

Communication Port
Bluetooth V2.0+EDR Class 2 supporting SPP Slave and Master Profiles

External Power port	1 port
GSM Status Indicator	One LED

Performance Specifications

Static, Fast Static Accuracy
Horizontal: 5 cm + 0.5 ppm * base_line_length
Vertical: 5 cm + 0.5 ppm * base_line_length

Kinematic Accuracy
Horizontal: 5 cm +1 ppm * base_line_length
Vertical: 5 cm +1.5 ppm * base_line_length

RTK(OTF) Accuracy
Horizontal: 5 cm +1 ppm * base_line_length
Vertical: 5 cm + 1.5 ppm * base_line_length

DGPS Accuracy	< 0.25 m Post Processing, < 0.5 m Real Time
Cold Start	<65 seconds
Warm Start	<5 seconds
Reacquisition	<1 second

Memory & Recording

Internal Memory
Up to 256 MB of onboard non-removable memory for data storage

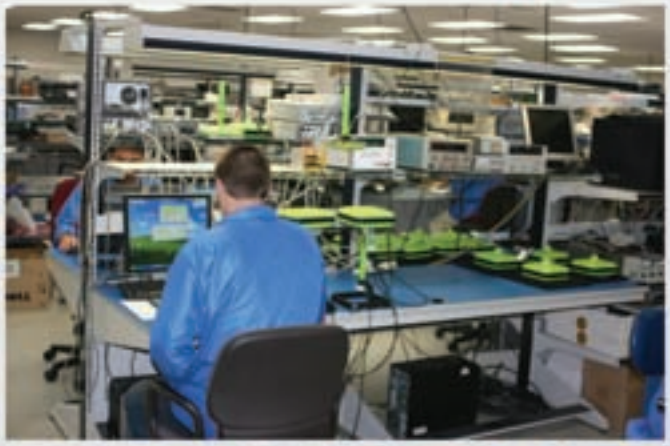
Raw Data Recording
Up to 100 times per second (100 Hz)

Data Type
Code and Carrier from GPS L1/Galileo E1/GLONASS L1

Environmental Specifications

Enclosure	Aluminum extrusion, waterproof
Operating Temperature	-40° C to +55° C
Dimensions	W: 79 mm x H: 33 mm x D: 131 mm
Weight	210 g

Quality Manufacturing



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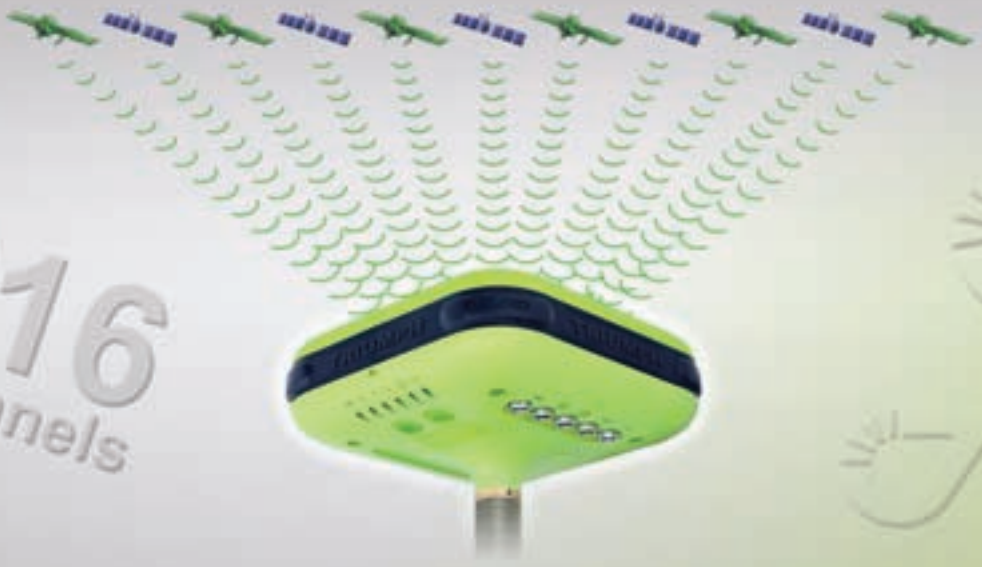

Bridging the gap between open and institutional mapping

As geospatial technology becomes an integral part of our daily lives, our 'worldview' grows and the world becomes a 'smaller' place. The technology itself has many facets, managed and used by a growing number of people. To understand how the interactions are taking shape among the various players of geospatial technology, the Space Applications Centre (SAC), Ahmedabad hosted the XXVIII INCA International Congress, under the theme 'Collaborative Mapping & Space Technology', from 4-6 November 2008, at Gandhinagar.

Maj. Gen Tanwar, Dr. PK Srivastava, Prof. Armin Gruen, Prof. AR Dasgupta, Dr. Ashok Kaushal (L to R) at panel discussion

The Indian National Cartographic Association (INCA) is a non profit professional body of cartographers, established in 1979, at Hyderabad, India. Besides the annual international conference the association also holds a nation wide Map Quiz for school children. Two special lectures, one in the memory of Raja Todar Mul, who revolutionised the land revenue and collection system in the reign of Emperor Akbar; and the other in the memory of Prof. SP Chatterjee are now a hallmark of the congress.

Mr. Narendra Modi, Chief Minister of Gujarat, elaborating on the tremendous impact of technology, especially geospatial technology on e-governance, said, 'Hope it will be widespread and available to all', as the Chief Guest at the inaugural function of the Congress. Mr. Modi also distributed the prizes to the winners of the INCA Map Quiz 2008.

Dr. G. Madhwan Nair, Chairman ISRO, released the Souvenir cum Abstract of the congress, as the guest of honour and also delivered the Todar Mul Memorial Lecture under the title 'Benefits of Space to the Society'. Echoing Mr. Modi's words in the context of congress Dr. Nair suggested that the forum needed to discuss the Map policy and how the data can be made available 'more freely'.

The three days of the congress were packed: with parallel technical sessions in three halls of the venue, the Cambay Spa & Resorts. The technical sessions were conducted under seven themes and included special sessions, plenary sessions as well as a youth forum. The sessions were informative and thought provoking, and the congress proved to be a platform for the stalwarts as well as the budding talent in the profession. The exhibition halls – one focussing on the private industry and the other on the government organisations – served as ideal meeting and discussion points for the delegates.

The panel discussion, 'Open vs Institutional mapping' brought to fore the issue on everyone's mind – 'availability of maps', in the concluding session of the congress. The five panellists represented the full spectrum of interests and views. Maj. Gen Tanwar, from Survey of India, said an assessment should be done to evaluate the map needs of the people. Dr. PK Srivastava, SAC, and President INCA, said there was a need to improve the quality of the maps 'whether in an open of closed way'. Prof. Armin Gruen, Swiss Federal Institute of Technology, Zurich, who also delivered the keynote address at the inauguration, felt that both the high end and low end trends of mapping would develop, but mixing the data would not be a good idea. Prof. AR Dasgupta, Distinguished professor, BISAG, who also delivered the Prof. SP Chatterjee Memorial Lecture, said, 'open (mapping) is here to stay, but open cannot replace everything'. He also felt that the common man will not wait for maps, they will get them from wherever they can. Dr. Ashok Kaushal, Country Manager India, PCI Geomatics, said that the distinction between data and software is now blurring and the value of the web should be recognised. With active participation and questions from the audience the conclusion was 'Let us live with both and let us say AND – Open and Institutional mapping'.

At the valedictory session awardees of the Young Researcher grants were announced.

The XXVIII INCA International Congress thus proved to be the ideal forum to raise the various issues facing the geospatial community in India and abroad. As INCA prepares for the next conference to be hosted by the National Atlas and Thematic Mapping Organisation (NATMO) in Kolkota, we also hope that it will become a forum to bring solutions to problems faced by the geospatial community at large.

Meeting the demands of real-time positioning

SWEPOS™ Positioning Services

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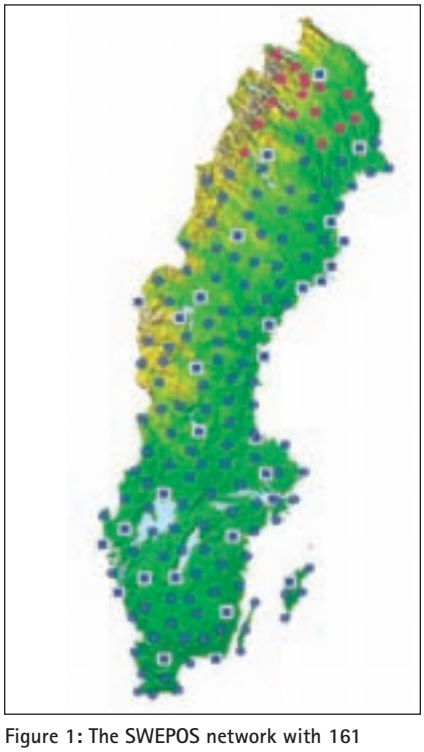

Figure 1: The SWEPOS network with 161 permanent reference stations for GNSS. The red dots in northern Sweden are planned SWEPOS stations.

SWEPOS™ is a network of GPS/GLONASS reference stations which began as a co-operation between the National Land Survey of Sweden and Onsala Space Observatory. The early design phases of SWEPOS were made in 1992. It was already then stated that the network should be of both scientific and practical benefit to the professional GNSS users and the public. The purposes of SWEPOS are mainly to [1]:

- Provide GNSS raw data to post-processing users
- Provide GNSS corrections to real-time users
- Act as high-precision control points for GNSS users
- Provide data for scientific studies (e.g. crustal motion)
- Monitor the integrity of the GNSS systems
- Act as the basis for the Swedish national reference frame, SWEREF 99

During early stages of development, SWEPOS consisted of 21 stations covering the whole of Sweden with an average in-between distance of 200 km. During this period a group of governmental agencies contributed to the financing of SWEPOS. Since 1999, SWEPOS has developed to meet the demands on real-time positioning with centimetre accuracy, mainly through co-operative efforts by the National Land Survey, Onsala Space Observatory and the SWEPOS users. Today both the development and operation of SWEPOS are the responsibilities of the National Land Survey.

Design of the SWEPOS network

All 161 SWEPOS stations are equipped with dual-frequency GPS/GLONASS receivers and choke-ring antennas of Dorne Margolin design. The GNSS antennas are mounted under clear acrylic radomes. Data is collected every second, using a 5 degree elevation mask. The stations are connected to a control centre located at the head quarters of the National Land Survey (in Gävle, Sweden) via leased TCP/IP connections, which are monitored at all times.

The original 21 SWEPOS stations, which are all still in use today, are mounted with concrete pillars directly on bedrock. These belong to so called SWEPOS Class A stations (blue squares in figure 1), along with 9 newer stations with similar monuments in terms of stability. All equipment, apart from the antenna, is redundant and located in specially designed cabins (figure 2).

The remaining 131 stations have mainly been equipped in a simplified way, with antennas mounted on rooftops (figure 3) and with less redundancy. These stations belong to SWEPOS Class B stations (blue dots in figure 1), which were established primarily for the use of network RTK. A complete network computation of all SWEPOS stations is done on a daily basis with the Bernese GPS Software, in order to monitor the stability of the Class B stations.

A broad spectrum of Swedish organizations uses GNSS data from the SWEPOS network to increase productivity and efficiency in their respective fields, covering both scientific and production work. Examples of scientific applications include studies of crustal motion and estimations of the water vapour content in

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the atmosphere. The SWEPOS positioning services, however, are mainly targeted at production applications (e.g. see figure 4).

SWEPOS and EUREF/IGS

The National Land Survey and Onsala Space Observatory have been active in international GNSS projects for many years. The European countries have collaborated in building up a network of permanent GNSS stations as well as in computing national realisations of the adopted European three dimensional reference system ETRS 89. This work is done under the IAG Sub commission for Europe (EUREF). EUREF is also engaged in the establishment of a common vertical reference system based on the national levelling networks and the European GPS campaign EUVN. The realisation of ETRS 89 in Sweden is called SWEREF 99 and is defined by the original 21 SWEPOS Class A stations [2].

The SWEPOS stations Visby, Onsala, Borås, Mårtsbo, Vilhelmina, Skellefteå and Kiruna are included in the European network of permanent reference stations (EPN) and the International GNSS Service (IGS). These stations are also participating in the pilot projects for real-time distribution of GNSS data over the Internet - EUREF-IP and IGS-RTPP.

SWEPOS positioning services

SWEPOS provides GNSS data for the following positioning services:

- SWEPOS Automated Processing Service
- SWEPOS Network RTK Service
- SWEPOS Network DGNSS Service
- The DGPS service Epos (operated by Teracom)

SWEPOS Automated processing service

SWEPOS Automated Processing Service has been developed in order to facilitate the use of SWEPOS data for automatic high-precision static point positioning. The user does not have to perform the computation in a post-processing software himself/herself. Instead the Bernese GPS Software and an in-house developed web application on the SWEPOS web site are used for the computations.

The user submits an observation file containing dual frequency data along with information about the used GNSS antenna in RINEX format to the service. When the processing is completed (typically after 5-10 minutes) the web page is updated and a text file with a summary of the processing along with quality parameters is sent to the user by e-mail. From 2-3 hours of observation time, centimetre level accuracy for both horizontal and vertical components can be obtained.

Typical applications for SWEPOS Automated Processing Service are computations of reference positions for single-base RTK or terrestrial measurements and connection of various local (municipal) reference frames to the Swedish national reference frame. Further development of the processing service is under way, especially to meet the demands from construction projects with high-accuracy surveying over short time spans. This includes optimizing processing algorithms for a dense reference station network.

SWEPOS network RTK service

The SWEPOS Network RTK Service was launched in 2004, following the successful completion of several pre-study projects. The SWEPOS network has during recent years been extended step by step through establishment projects. The coverage area for the service approximately coincides

Figure 2: One of the first SWEPOS stations, belonging to Class A.

Figure 3: A SWEPOS station with a roof-mounted antenna, belonging to Class B.

Figure 4: Two increasingly common production applications for SWEPOS positioning services are machine guidance and detail surveying (e.g. for mapping purposes)

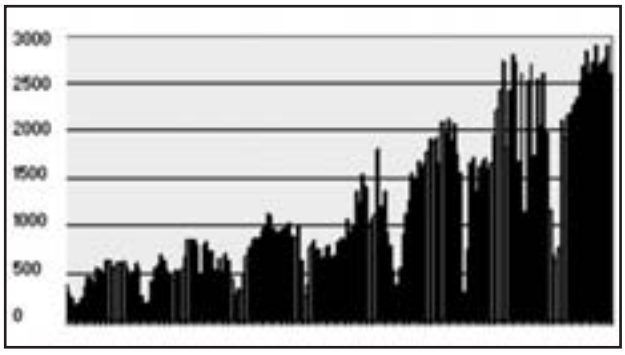

Figure 5: Total user connection time (in hours) per week for the SWEPOS Network RTK Service, from mid summer 2004 to late 2007.

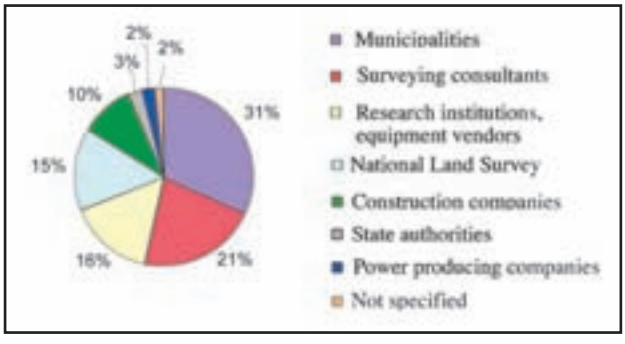

Figure 6: SWEPOS Network RTK Service users, per organization category (early April 2008).

with the blue dotted area in figure 1. The SWEPOS Network RTK Service is based on the virtual reference station concept, with two-way communication between the RTK users and the SWEPOS Control Centre. GSM and GPRS (mobile Internet) are used as communication links, and users have the option to receive correction for either GPS or GPS/GLONASS. Given the average in-between station distances in the SWEPOS network of about 70km, the expected position accuracy is on the centimetre level.

Data for the SWEPOS Network-RTK service is charged according to a subscription system based on unlimited or per-data access. Participants in the establishment projects have received a one-time discount if they have signed a subscription after the end of project. The number of registered users of the Network RTK service is now well over 1000, with the goal to have 1500 users within the next three years. The network RTK service is widely used for data capture in mapping applications, but also in several other areas such as cadastral surveying and for building and construction work (e.g. machine guidance). Figures 5 and 6 demonstrate some user statistics from the Network RTK Service.

SWEPOS network DGNSS service

SWEPOS single frequency Network DGNSS Service was launched in April 2006. This service runs on the same platform as the SWEPOS Network RTK Service. The expected position accuracy is at the decimetre level. The data for the SWEPOS DGNSS Service is charged according to a similar subscription system as the Network RTK Service.

Typical applications are found within farming, forestry and GIS data capture.

The Epos service

The Epos service is a DGPS service for metre accuracy, run by the Swedish company Teracom. The service is based on single-base DGPS corrections from a number of SWEPOS stations, distributed via FM radio. Epos was launched in 1994 when Selective Availability (SA) was activated in the GPS system.

User experiences

During February 2008 a survey of the users of the SWEPOS Network-RTK service was carried out by questionnaire. We received close 400 answers from the 900 users. Most of the users were very satisfied with the performance of the service and considered it to be worth its price. The users were also very satisfied with the support from the personnel at the control centre.

The survey indicated that almost 50 percent of the users can perform all their positioning with the Network RTK service. The present horizontal accuracy of the service meets the demands from most of the users, but a higher vertical accuracy than the present is required by 40% of the users. Better information about failures in the operation of SWEPOS through SMS messaging and the SWEPOS web site, and improved performance of the mobile Internet link (GPRS) were common proposals from the users. Other proposals concerned various improvements of user equipment, e.g. some standard for the internal position accuracy that is indicated in the GNSS rovers, and better initialization algorithms when you have many satellites available above the horizon.

The users of the SWEPOS services expect high availability and high service performance. But this is a combination of the performance of the GNSS satellites, the GNSS rover equipment, the SWEPOS system and the cellular phone network. Because of the many links in the chain, it is at times hard to locate the reason behind a failed initialization of the user rover equipment. Notably, the coverage of the cellular phone network is still is a severe bottleneck in the rural parts of Sweden

For the future the users expect that the SWEPOS Network RTK service is an improved tool in their toolbox which can be used in almost all their positioning needs because of increased number of signals and satellites, improved accuracy of the positions and improved coverage of mobile Internet. Of course the users also expect a reduction in the subscription fees for the services.

One final note: many of the users of SWEPOS Network RTK service do not belong to the conventional surveying community. This has led to the development of a field manual for network RTK measurements with the SWEPOS service [3] which is distributed to all new users. The major Swedish GNSS equipment vendors also provide ready-to-go packages for the SWEPOS positioning services. These packages are tailor-made for different applications, and minimize the need for new users to master all aspects of their equipment in order to use the positioning services.

Future plans

The remaining extension of the SWEPOS network will be carried out during 2009 (see figure 1). As with previous establishment projects, this will be a co-operative effort between a number of private and public participants, in order to create a viable user base for future contributions to operation and maintenance costs.

A likely scenario in the near future will be an increasing demand for flexible solutions, primarily for real-time positioning in advanced applications (e.g. services fit for large-scale construction projects). Special attention will be paid to the use of the SWEPOS Network RTK Service for machine guidance and other forms of high-precision navigation.

The infrastructure of SWEPOS will continue to be modernized, in order to benefit from further enhancements of present GNSS, such as the introduction of the new GPS L5- and GLONASS L3-frequencies, as well as the development of new satellite systems such as Galileo.

Concluding remarks

A multi-purpose network of permanent reference stations is beneficial for both users and providers of national geodetic infrastructure. It facilitates the development of services for positioning and non-safety-of-live navigation, and also the successful integration of GNSS technique into a wide range of applications. The professional use of these techniques is increasing very rapidly outside the conventional surveying community, which in turn spurs the development of more user friendly equipment and positioning concepts.

The long-term plan for SWEPOS, which was developed in the early 1990s, will be completed in coming years. Further information about the SWEPOS network can be found at: www.swepos.com

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Canalys: EMEA Q3 GPS phone shipments overtake PNDs

According to Canalys, shipments of PNDs in the Q3 to Europe, the Middle East, and Africa fell to 4.3 million from 4.8 million in Q2, while shipments of GPS-enabled smartphones soared, rising from 4.7 million to 10.4 million. Based on its latest research, the firm estimates that global shipments of PNDs in Q3 2008 rose 14% compared to Q3 2007, with North America and Asia Pacific still seeing considerable volume growth of 49% and 25% respectively. The risk to PND vendors is likely to rise further as the economic situation forces more consumers to take a hard look at their discretionary purchases/ *www.canalys.com*

Tele Atlas Urban Maps launches to deliver Pedestrian-Specific content

Tele Atlas announced the availability of Tele Atlas® Urban Maps, which delivers out-of-car content such as enhanced views of sidewalks and footpaths, 2D representations of notable structures and building footprints that better orient pedestrians in city centers. *www.teleatlas.com*

Sagem Orga, Blue Sky Positioning debut A-GPS SIM Card

Sagem Orga has embarked on a partnership with BlueSky Positioning to integrate Assisted-GPS positioning technology on SIM cards for mobile phones. It incorporates a GPS receiver and a proprietary antenna into the SIM card, enabling mobile operators to deploy both legally-mandated and commercial applications for all mobile handsets, with no need for software or hardware changes. The SIM card also relies on A-GPS for positioning. *www.sagem-orga.com*

Social Networking driving LBS adoption, says ABI

While many LBS applications are adding features allowing the sharing of real-time experiences via fixed social networking sites such as Facebook and MySpace, fully fledged mobile location-based social networking sites will also gain momentum with more than 82 million subscriptions expected by 2013, says ABI Research. It says, mobile location-based social networking will become a key driver for the uptake of LBS as it provides a unifying framework for a large set of applications such as friend finders, local search, and geotagging. *www.abiresearch.com*

DoCoMo's entry to set off race for mobile applications in India

Mobile applications such as 'Imadoco' and 'Osaifu-Keitai' could become an Indian rage soon.

The first one is a service that allows you to know the exact location of your friends and family using GPS on mobile phone, the latter is a mobile commerce platform. NTT DoCoMo's entry, at a time when the country is on the verge of rolling out 3G services, could trigger a new phase of mobile applications and services. The Japanese company is expected to share its expertise in developing consumer-friendly applications with Tata Telservices for the Indian market. w*ww.thehindubusinessline.com*

Instant Global News Mapping Website launched

Trackthisnow.com is a website that tracks news articles on any topic across the world in real time. The service at the moment tracks 236 countries world wide and presents it on a view of the world map and plans are on to enable tracking at the city level as well. The site uses web 2.0 to find news from different countries and uses Google Maps for plotting the coverage. The software is currently tracking in access of over 8000 publications. *http://trackingtheworld.com*

Survey of India approves Tele Atlas Maps

The Indian government has approved an agreement between Survey of India (SOI), and Tele Atlas Kalyani India, a joint venture between the Kalyani Group and Tele Atlas. The current map release from the company is the first ever to be screened and approved for public release by the SOI. The SOI says the new maps are in full compliance with the regulations of the Government of India and the provisions of the controversial National Mapping Policy. *www.teleatlas.com*

SatNav Tech to distribute Destinator for Symbian

Intrinsyc has signed an agreement with SatNav Technologies Pvt. Ltd. to distribute the re-launched Destinator for Symbian software to be used on various models of Symbian smartphones sold in India. The application includes the SatNav ONE-India map that covers all major cities of India along with a detailed national and state highway network. *www.satnav.com*

Qualcomm adds WiFi positioning to GPS platform

Qualcomm has licensed Skyhook Wireless's Wi-Fi Positioning System (WPS), a method of combining large professional wardriving databases with geographical latitude and longitude. WPS can be used to provide a location with a few dozen feet in urban areas or combined with GPS in the form of assisted GPS to speed up a satellite lock. *www.qctconnect.com*

TomTom debuts Online Route Planner, expands HD Traffic

TomTom is introducing a free online route planner; initially it will be accessible only for a selected group

of users taking part in a closed beta test. It is available in six languages: English, French, German, Dutch, Italian, and Spanish. *www.tomtom.com*

Celcom Selects NeuStar to deliver Interconnected Mobile IM Services

NeuStar, Inc., has been selected by Celcom (Malaysia) Berhad, to deliver a range of "interconnect-ready" mobile Instant Messaging (IM) services to Celcom's customers. Celcom will now be able to extend interoperability to other operator networks in Malaysia using NeuStar's Interconnect Platform (ICP) and Hub, thus enabling any mobile phone user in Malaysia to communicate with any mobile phone user through mobile IM. *www.neustar.biz*

SkyTraq introduces Ultra Low Power AGPS Receiver

SkyTraq has introduced the Venus634LPx GPS receiver, which features improved cold start sensitivity of -148dBm, better tracking sensitivity of -161dBm, lower full-power tracking current of 23mA, and smaller LGA44 package of 10mm x 10mm x 1.1mm. The device contains all the necessary components of a GPS receiver, including GPS RF front-end, 65 channel GPS/AGPS baseband processor, 0.5ppm TCXO, RTC crystal, LDO regulator, and passive components. *www.skytraq.com.tw*

Vixxi provides E911 address support with Reverse Geo-Coder

Vixxi Solutions has concluded testing of its Reverse Geo-Coder technology, which can pinpoint the nearest physical address of a mobile emergency caller based on coordinates derived from GPS or position determination equipment. The technology enables public safety answering points to receive the address information of wireless emergency callers by obtaining the caller's device coordinates, either indoors or out, and reverse-codes that point into the closest physical address of the caller, then sends it with the data record to the PSAP. *www.vixxisolutions.com*

Galileo update

EU developing 'militarised' space policy which could trigger 'arms race'

The European Space Agency is accused of developing technology to dominate the "high ground" of space, including a multimillion pound EU Satellite Centre in Spain. The Transnational Institute, a Dutch think-tank, said: "EU-financed communication and spy satellites are slowly becoming reality and in the long term the inclusion of space-based missile defence and other more offensive uses of space are real options for an increasingly ambitious EU military space policy." The report said French ambitions for the "militarisation of space" have led to arguments with Britain - particularly over Galileo, the much-delayed European global positioning system. President Nicolas Sarkozy of France, who currently holds the Presidency, said in June that space agenda was one of his priorities. Galileo would be vital in any European deployment of the sort of GPS-guided artillery now being used by the US in Iraq and Afghanistan

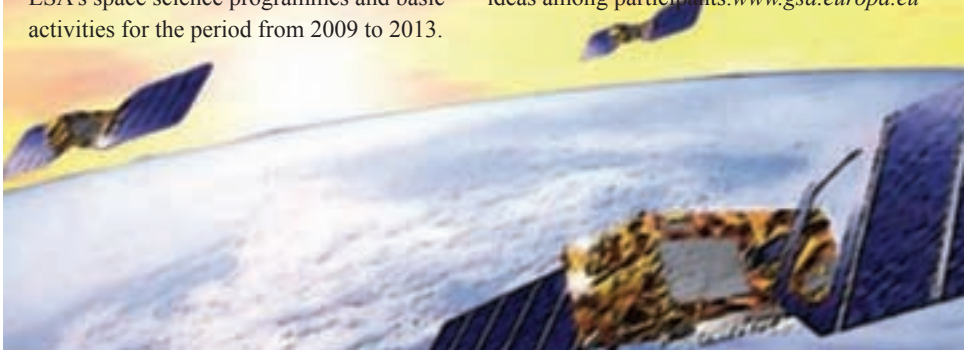
Space ministers give green light to new programmes

Europe's space ministers met at the Council Meeting at Ministerial Level of the European Space Agency (ESA), which took place in The Hague, the Netherlands, on 25 and 26 November. During the meeting, the ministers, from ESA's 18 Member States plus Canada, adopted four resolutions. Among other topics, these covered the role of space in delivering Europe's global objectives and established the level of resources for ESA's space science programmes and basic activities for the period from 2009 to 2013.

The ministers also approved the continuation of a number of ongoing optional programmes and the initiation of new programmes. The ministers gave the green light to a wide range of scientific initiatives including ESA's subscriptions for the programme behind the European Global Navigation Satellite System, which is set to work on improvements to the Galileo system. The new budget for the ESA reflects a substantial increase over previous years. Member States reportedly agreed on a EUR 10 thousand million figure to cover the next three to five years. *www.esa.int/SPECIALS/Ministerial_Council/*

Growing Galileo event: Preparing for FP7's second call

With the European Commission's 7th Research Framework Programme's (FP7) second call for proposals about to be launched, the GSA is hosting Growing Galileo 2009, a conference and information day that will help participants make winning proposals. Growing Galileo 2009 will be held 27-28 January in Brussels. It will focus on the funding opportunities for satellite navigation project proposals available under the FP7. A total of €40 million is available through FP7's second call for Galileo and EGNOS research and development projects. With a focus on the upcoming second round of FP7 calls, Growing Galileo 2009 is an opportunity for participants to network and form partnerships with other organisations. Those attending will learn about the projects accepted for funding under FP7's first call for proposals, launched in November 2007. Presentations from GNSS industry experts and market leaders will stimulate brainstorming and the exchange of ideas among participants.*www.gsa.europa.eu*



New GIS software from India

The Space Applications Centre and Scanpoint Geomatics in Ahmedabad have released a new product, IGIS. It has been developed to a requirement from Indian Space research Organisation for a GIS software that could ingest data from its satellites and turn out information products. It contains an integrated image processing engine and a GIS. *www.scanpointgeomatics.com*

Intelligent Map System in Singapore

The Singapore Land Authority is considering its response to tenders for a government-wide intelligent map system, which closed on 17 November. The system will provide an interface enabling government agencies to build map services. As a result, all Singapore government map data will be presented to the public with a consistent look and feel. Individuals will also be able to access the maps for personal use. *www.sla.gov.sg*

British Police preparing for Olympics

British Transport Police is implementing ERDAS APOLLO 2009, to build a transportation security monitoring system for Olympics in 2012. The system will disseminate gridded data to remote locations quickly, regardless of bandwidth integrating imagery in British Transport Police's mapping solution. *www.erdas.com.*

Properties to be mapped in Bangalore

With the newly introduced property survey based on GIS, the Bruhat Bangalore Mahanagara Palike is confident of bringing more properties under the tax system. Out of 850 sq km to be covered, 200 sq km has been surveyed. Upon completion of verification, it will be possible to track what property exists on a road, in a ward or zone with exact dimensions and details of ownership and land use. Even vacant plots and under-construction buildings can be identified and recorded. *www.bmponline.org*

PTCL and LMKR ink deed for deployment of GIS solution

Pakistan Telecommunications Company Limited (PTCL) and LMK Resources (LMKR) signed an agreement for the deployment of a turnkey GIS solution, which will enable PTCL to better manage Access and Transmission Networks and inside plant infrastructure including its copper and optical fibre network. *http://dailymailnews.com*

GIS contributes to solving crime

Microsoft and ESRI together are driving Homeland Security to effectively help protect citizens. An intended product of this collaboration is the FusionX Appliance, which will enhance the abilities of fusion centre directors at the strategic and tactical level, enabling them to visualise patterns and trends to help prevent future acts of terrorism and crime. Through the intake of raw data such as fire, police and citizen reports, it will allow for geocoding and mapping of the data to help detect man-made acts of terrorism and crime. *www.esri.com*

Updated OGC Reference Model

The Open Geospatial Consortium (OGC) announced the completion and availability of Version 2.0 of the OGC Reference Model (ORM). The ORM provides a framework for the ongoing work of OGC, and a guide for those who seek to implement interoperable solutions and applications for geospatial services and data. *www.opengeospatial.org*

High-tech survey of Bihar's landscape

Bihar Remote Sensing Application Centre (BIRSAC) has prepared digital maps of 20 districts of Bihar having details of boundary of districts with those of block and village borders. BIRSAC has also incorporated maps of major roads, railway tracks and rivers. The state Water Resource Development department too has roped in the services of BIRSAC for mapping of rivers. *http://timesofindia.indiatimes.com*

PIL demands removal of country's images from Google Earth

Public interest litigation was filed in the Bombay High Court in India, has taken exception to easy access to satellite images of the vital installations in the country through Google Earth. The petition filed by Mumbai-based lawyer Amit Karkhanis has demanded removal of images of the country from Google Earth. The petition is filed against the backdrop of terror attacks in Mumbai. The petition is likely to come up for hearing on December 18.

GeoEye's coming soon

Geoeye-1 will begin commercial operations on or about 1 January 2009. The satellite, which was launched on 7 September 2008, sets a new benchmark for commercially available high resolution imagery. With the launch of the new satellite, the price of future Ikonos imagery acquisitions will be reduced. *www.geoeye.com*

Indian space policy: Aiming higher

The Indian Cabinet announced $375 million in funding for 15 Polar Satellite Launch Vehicle missions from 2009 through 2012. These missions, labelled C14-C28, will be used to fulfil the needs of the nation, which include remote sensing, navigation and space science as well as for "sustaining production at Indian industry." The Indian Space Research Organisation expects to complete five of these missions before 2009. *www.southasianmedia.net*

DigitalGlobe and NAVTEQ join forces to support application developers

DigitalGlobe and NAVTEQ announced a new relationship aimed at supporting thousands of software developers using NAVTEQ® map data who want to include high-resolution satellite and aerial imagery from DigitalGlobe in their applications. As part of the agreement, DigitalGlobe will provide developers access to sample imagery free of charge for a limited term. *www.digitalglobe.com*

Coastal navigation upgrade

The UK's General Lighthouse Authorities (GLAs) have awarded a £4m contract to VT Communications for the upgrade of 14 Differential Global Positioning Service reference stations. The upgrade includes adding the capability to use modernised GPS signals that will be needed for tracking the future satellite navigations systems, Galileo and GLONASS. *www.vtplc.com*

Outdoor GPS market to hit $1.7b by 2013

According to ABI Research study, outdoor GPS market will generate $1.7 billion in annual revenues by the end of 2013, driven by innovations in user interfaces and integration in community sites. The future uptake of topographic maps-based outdoor GPS navigation will be driven by hybrid solutions such as crossover portable navigation devices and multi-mode mapping converged solutions, as well as pedestrian navigation, the study predicts. *www.abiresearch.com*

UK govt seeks India patent for satellite navigation system

The UK government is seeking a patent in India for a defence invention called 'modulation signals for a satellite navigation system', which can measure satellite signals. The satellite navigation system of the Defence Ministry is broadly based on the technique used in the GPS, which operates by using a number of frequencies, according to the patent application. A patent for the invention has already been approved by Geneva-based World Intellectual Property Organisation, a UN agency. *www.tmcnet.com*

Iran launches second rocket

Iran has successfully launched the first example of its Kavosh 2 rocket on 19 November 2008. This is the second homemade rocket launched by Iran this year and is a part of program to develop the ability to put satellites into low-Earth

orbits. Iran has plans to put a series of remote sensing and communications satellites into space by 2010 to aid natural disaster management programs and improve telecommunications.

Maritime GPS in Malaysia

The Malaysian government is to establish a differential GPS network along its coast. Its marine department has awarded the contract for the work to Spanish technologist GMV, and the Malaysian aerospace engineer Astronautic Technology S/B. The network will conform to the standards of the International Association of Lighthouse Authorities, the world body that oversees standards for differential GNSS corrections. www.asbt.my

Iowa DOT and Leica Geosystems to launch RTK GPS Networks

The Iowa Department of Transportation (DOT) is implementing one of the world's largest networks of GNSS Continuously Operating Reference Stations (CORS) which will provide authorized public and private users near-instantaneous GPS satellite corrections for accurate and precise positioning anywhere in the state. Provided by Leica Geosystems, the IaRTN network includes a total of 80 stations. Each station will include a Leica GRX1200 GG Pro GNSS receiver with Ethernet capabilities. The satellite referencing network will utilize more than 40 currently operational satellites, as well as another 40 or more that will become operational with system upgrades and additions to the GPS and GLONASS systems as well as Galileo satellites. *www.leica-geosystems.com*

Lockheed Martin-led team completes GPS III Integrated Baseline Review

The Lockheed Martin team developing the next-generation GPS spacecraft, known as GPS III, has successfully completed an Integrated Baseline Review with the US Air Force. GPS III will improve position, navigation, and timing services for the warfighter and civil users worldwide and provide advanced anti-jam capabilities yielding superior system security, accuracy and reliability. *www.lockheedmartin.com*

Russia to put 3 Glonass Satellites into orbit

Russia will put into orbit three Glonass navigation satellites on December 25, 2008 from the Baikonur space center in Kazakhstan. The system currently consists of 19 satellites, of which 16 are operational, two are undergoing maintenance, and one is one due to be withdrawn. *http://en.rian.ru*

June '09 launch for South Korean Satellite

South Korea will launch a maritime communication and meteorological satellite in June 09 said the country's Ministry of Land, Transport and Maritime Affairs. The COMS satellite developed jointly by the Korea Aerospace Research Institute and EADS Astrium in Europe, will be placed in a geostationary orbit. *www.kari.re.kr*

GPS/WAAS approaches outnumber ILS at US airports

GPS/WAAS-based approaches have surpassed the number of traditional Category-I Instrument Landing System - based approaches at US airports, according to the Federal Aviation Administration. Since the WAAS signal is broadcast from space, there is no need for ground-based equipment to be installed and maintained at an airport, such as that needed for an ILS, the administration noted. Furthermore, safety is improved as more aircraft are provided with vertically-guided approaches and improved flight planning options enabled by WAAS. *www.faa.gov*

www.southinstrument.com
www.southsurvey.com

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SOUTH

U-blox supplying GPS for Longcheer chinese handsets

Chinese mobile phone designer Longcheer Holdings Ltd will integrate Swiss chip maker u-blox' single chip UBX-G5010 GPS receiver into a series of handsets. The models built incorporating the device, the G600, G800, and G630 have just become available while the G801 and G900 are expected to begin shipments to the Chinese market later in this quarter. *www.u-blox.com*

Leica Geo parent acquires Rinex Technology

Leica Geosystems' parent company, Hexagon Group, has acquired Australian company Rinex Technology, which specializes in GPS hardware and software for agriculture equipment guidance and implement control. Leica will market and sell the existing Rinex product line, which will work with the current mojoRTK auto-steer system and will be serviced by Leica's Virtual Wrench technology. *www.hexagon.se*

Infoterra launches new high definition land cover mapping product

Infoterra Ltd, has launched LandBaseTM, its new high definition land cover mapping product. It combines the latest object based classification technology and digital aerial imagery to provide a land cover product, which allows viewing down to 1:5000 scale/property level. This enables the extraction of meaningful land cover data for a range of applications including; environmental and habitat management, change detection, flood modelling and infrastructure planning. *www.infoterra.co.uk*

Spirent Communications supports Quazi Zenith Satellite System

Spirents GSS80000 RF constellation simulator now supports the Japanese Quasi Zenith Satellite System (QZSS) in addition to GPS, Galileo, GLONASS and SBAS. Support will be initially for L1 C/A code and L1 SAIF QZSS signals. www.spirent.com

Gaardian Consortium Wins GPS/eloran integrity research project

GAARDIAN (GNSS Availability, Accuracy, Reliability and Integrity Assessment for Timing and Navigation) a business and academic consortium led by Chronos Technology has received a grant from the government sponsored Technology Strategy Board for a £2.2m research project that will improve the safety and security of location based applications such as marine navigation and road transportation. Over the next 30 months, the consortium will be developing a system for mission and safety critical applications that will certify the accuracy, reliability and integrity of Positioning, Navigation and Timing systems. *www.chronos.co.uk*

DAT/EM Systems International introduces TouchPad and TouchScreen

DAT/EM Systems has released new TouchPad and TouchScreen key devices, which will allow operators to quickly and efficiently issue command sequences during map compilation. The touch-responsive interface, which has no moving parts, can either display a virtual keypad or work with existing DAT/EM Keypad overlays. Easily programmable, the Touchpad can display key diagrams both horizontally and vertically. *www.datem.com*

SOKKIA releases GSR2700 ISX Firmware V3.500/2.120

SOKKIA TOPCON, has released the GSR2700 ISX firmware V3.500/2.120 and the GSR Family Config Tool V8.4.2 for the Allegro CX™ data collector, which features improved network RTK support for third-party reference networks and advanced ambiguity resolution under multipath. It provides GPS and GLONASS satellite tracking capabilities, now in additional languages for audible notifications. *www.sokkia.com*

TerraGo® and BAE Systems extend the reach of Image Analysis Software

TerraGo Technologies and BAE Systems, announced a collaborative agreement under which BAE Systems' SOCET GXP® v3.0 customers can now create, mark up and export geographically rich image data and maps to a GeoPDF® file directly from the SOCET GXP workspace. *www.terragotech.com*

CARIS Survey Processing Software for Italy

The Italian Hydrographic Institute has selected CARIS HIPS and SIPS software for its hydrographic survey processing. IIM will now have access to integration of Geocoder in HIPS and SIPS for processing multibeam backscatter, which will enable users to produce better quality mosaics. *www.caris.com*

Autodesk : Incheon as Second City of its Digital Cities Initiative

Autodesk is working with the Incheon Free Economic Zone and the Incheon Urban Development Corporation to cooperate in the creation of Asia's first Digital City for Incheon, Korea. The Digital City is created around a detailed 3D city model that allows users from the public, city government, construction and business communities to leverage technology solutions so they can visualize, analyze, and simulate real-world city scenarios to improve decision making and provide a common environment for sharing information. *www.autodesk.com*

NovAtel: rugged GPS, GLONASS antenna for agricultural market

NovAtel Inc. has unveiled its Smart-AG antenna, an L1 GPS and GLONASS receiver plus antenna system housed in a single, low-profile, rugged enclosure. The Smart-AG can achieve consistent sub-meter accuracy and is designed for both manual guidance and auto steer installations in agricultural applications. *www.novatel.com*

PCI Geomatics completes acquisition of Geospace Inc.

PCI Geomatics has acquired Geospace Inc., a provider of geospatial information and solutions. Both will create a greater product offering to consumers. *www.pcigeomatics.com*

Trimble introduces Juno Series of economical GPS Handhelds

Trimble has introduced lightweight field computing devices with integrated GPS technology - the new Trimble Juno SB and Juno SC handhelds. It include wireless LAN and Bluetooth connectivity, a 3 Megapixel camera, a 533 MHz processor, 128 MB of onboard memory, a MicroSD/ SDHC memory card slot, an all-day battery and a 3.5 inch display. Both can achieve 2 to 5 meter GPS positioning accuracy postprocessed or in real-time with SBAS, EGNOS, and MSAS. *www.trimble.com*

Miniature MEMS inertial sensing technology

Xsens Technologies has released MTi and MTi-G, its miniature MEMS based Attitude and Heading Reference Systems. The MTi is a miniature, gyro-enhanced Attitude and Heading Reference System (AHRS). Its internal low-power signal processor provides drift-free 3D orientation as well as calibrated 3D acceleration, 3D rate of turn, and 3D magnetic field data. The MTi-G includes an integrated GPS and static pressure sensor as well, which makes it better suitable for orientation measurement in situations with (long term) accelerations.

Stora Enso releases EnsoMOSAIC 7.1

Finland-based Stora Enso has released version 7.1 of EnsoMOSAIC automatic image processing software for digital aerial cameras. Visual quality of orthomosaics is improved by applying seam lines for mosaic resampling. A stand alone Seam Line Editor was released simultaneously with the core software. EnsoMOSAIC v7.1 links with EnsoMOSAIC 3D, which is capable for stereoscopic data extraction for elevation models, contours, 3D digitizing and visualization. *www.ensomosaic.com*

OnPOZ Precision Positioning releases its new GNSS Post-Processor.

OnPOZ Precision Positioning, a VGI Solutions division, announces its new EZSurv™ GNSS Post-Processing version that offers full compatibility with Glonass satellite signal. EZSurv™ is compatible with most of the raw GNSS data formats on the market. It computes high accuracy geodetic results. The software allows seamless data post-processing between different receiver brands. It also offers a survey and GIS data collection software to record reliable raw GNSS data in the field.

INTERGEO® 2008

Bremen, Germany September 30 – October 2, 2008

The three days of INTERGEO, which was held at the Bremen Exhibition Centre this year, have confirmed that the world's largest congress trade fair for geodesy, geoinformation and land management has a special place in the industry.

"INTERGEO is a very important event to show our latest developments and is an important spear point in our European marketing activities. It is a great opportunity to meet experts in various market segments and it opens doors to new business opportunities and partnerships. The INTERGEO is a platform to expand our business and a is carrier to bring our corporate message of precision and reliable positioning instruments across, says Martijn van der Wel, Marketing Manager of SOKKIA EUROPE.

Jurgen Kliem, general manager of Trimble's Survey Division, continues: "INTERGEO 2008 was truly a success for Trimble"

Claire Geffroy, Senior MarCom Manager of Magellan Professional, gave another reason why the congress trade fair has become an established part of companies' schedules:

"Users can meet directly with the equipment manufacturers, they can share their needs and receive a live feedback about the solution they should select. Intergeo is also the place where users come to compare the state of the art survey and mapping solutions, they want to know the benefits and the return on investment of their future equipment". That is why many of the 15,000 visitors were prepared to travel a long way to attend the fair. At the 14th INTERGEO, some 80 percent of visitors travelled more than 100 kilometres to be a part of the event in Bremen.

The share of first-time visitors came to almost 30 percent. As a result, exhibiting companies were not only able to cultivate their image and promote customer services – they were also able to win new customers. The exhibitors were delighted with the high profile of the visitors, many of whom come to INTERGEO as decision makers. In fact, many companies wait until they have attended the trade fair each year before making decisions on investments. More than 85 percent of exhibitors said that they had achieved their aims.

This was also the case for Cathy Lefebvre, Marketing Coordinator of PENTAX Technologies Europe, who was very happy with how things went at the fair: "For PENTAX, the INTERGEO exhibition is quite important. It is the yearly event that attracts many manufacturers and decision makers. Year after year we notice more interest from the international scene, which enables us to make fruitful deals and get connected with new successful partners".

Some 90 percent of exhibitors said that they intend to visit the fair in 2009 too. 13 percent of those questioned plan to increase the size of their stands in Bremen.

INTERGEO 2009 will be held from 22 to 24 September in Karlsruhe. For more information, go to www.intergeo.de.

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28-29 January, Noida, India
www.esri.india.com

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20–21 January 2009
Singapore City, Singapore
http://www.esri.com/events/apuc/index.html

Intergeo East
27-29 January 2009
Istanbul, Turkey
www.intergeo-east.com

February 2009

Trimble Dimension 2009
23-25, February 2009
The Mirage, Las Vegas, USA
http://www.trimbleevents.com/dimensions09

March 2009

Munich Satellite Navigation SummitConference
March 3-5, 2009
Munich, Germany
www.munich-satellite-navigation-summit.org

GEOFORM+'2009
10-13 March
Moscow, Russia
nmr@mvk.ru
www.geoexpo.ru

iGEOMAP 2009
March 20-21,IISc, Bangalore, India
www.igeomap.org

April 2009

GEO Siberia 2009
21-23 April
Novosibirsk, Russian
nenash@sibfair.ru
www.geosiberia.sibfair.ru

May 2009

International Conference on Integrated Navigation Systems
25-27 May
Saint Petersburg, Russia
www.elektropribor.spb.ru

BE Conference 2009
11-14 May
Charlotte, NC, USA
www.bentley.com

June 2009

GSDI 11 World Conference
15-19 June 2009
Rotterdam, The Netherlands
http://gsdi.org/gsdi11/

TRANS-NAV 2009
8th International Navigational Symposium
June 17-19, 2009, Gdynia, Poland
http://transnav.am.gdynia.pl

August 2009

SEASC 2009,
4-7 August 2009
Bali, Indonesia
www.bakosurtanal.go.id/seasc2009/04/

September 2009

ISDE 2009
9-12 September 2009
Beijing, China
www.digitalearth-isde.org

INTERGEO 2009
22-24 September 2009
Karlsruhe, Germany
www.intergeo.de

ION GNSS 2009
22-25 September
Savannah, Georgia
www.ion.org

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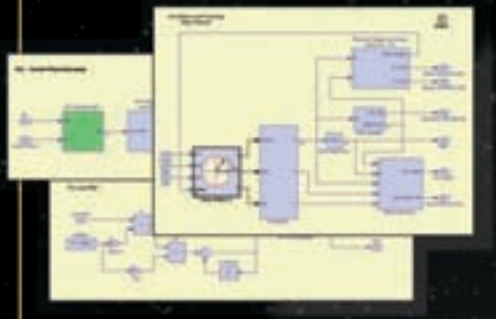

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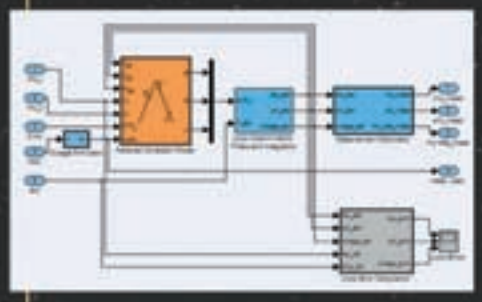

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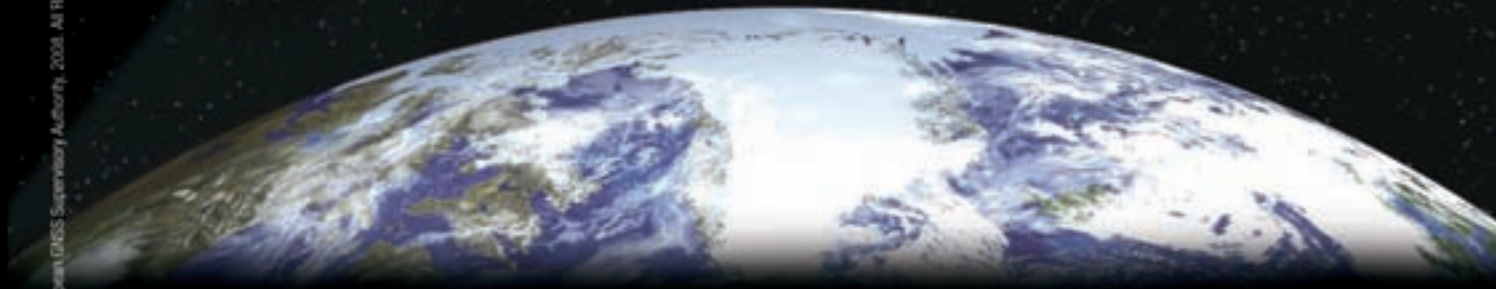

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