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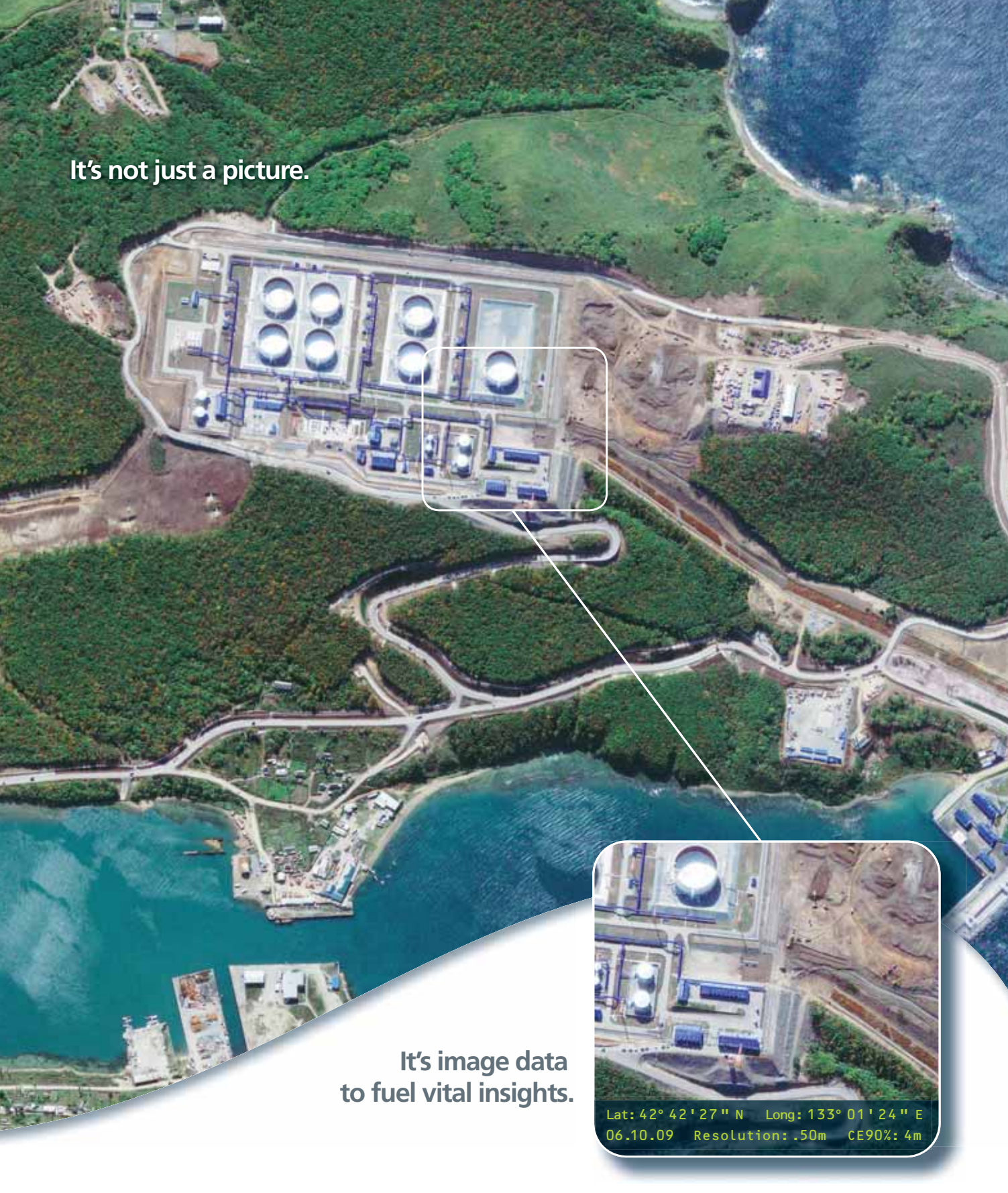

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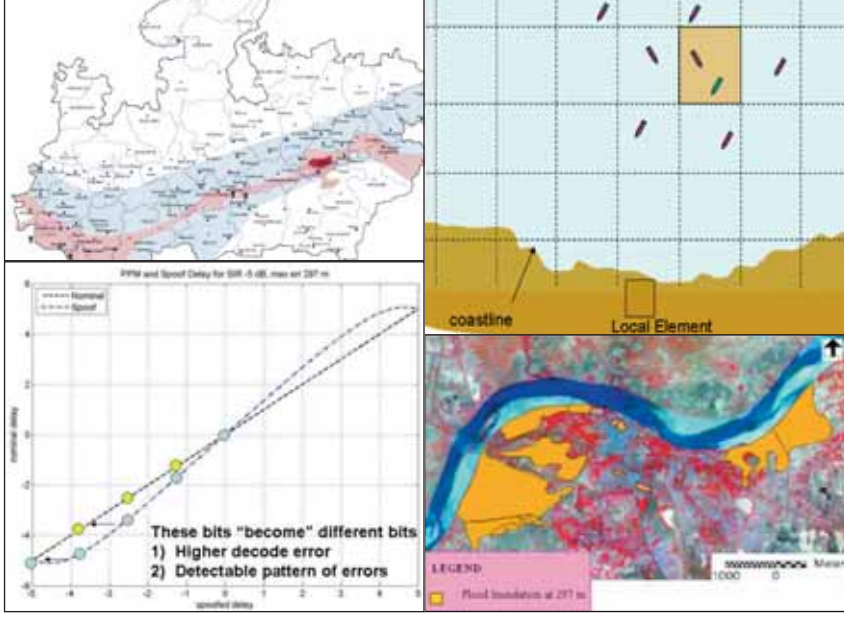

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More GPS or Smarter GPS?

Addressing GPS user problems

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While GPS offers a ubiquitous, precise, and reliable positioning and timing service to much of the world, in many cases this service falls short. Anyone who has walked into a building with a GPS receiver actively displaying a location is aware of the immediate effect of the loss of signal. While this is an extreme example, there are numerous other examples not so severe, yet just as inconvenient. Surveyors working in heavily wooded areas, aircraft operating next to terminals, and trucks trundling through tunnels all experience degradation of service in varying degrees. These deficiencies are well known by users in each of the fields employing GPS, and to the U.S. Government which operates GPS. Assured and real-time positioning, navigation, and timing (PNT) in physically impeded environments have been identified in the US National PNT Architecture (link: www.acq.osd.mil/nsso/pnt/) as a capability gap to be addressed in next generation PNT services and systems. Must users wait for these PNT improvements, or can action be taken now? The authors believe there are indeed practical steps that can be taken now to mitigate many of these issues. The steps to be taken can occur both at the national level and at the local levels in which each application is implemented.

At the national level, the U.S. Government is now poised to implement the objectives of the National PNT Architecture. In this phase the architecture team proposed that smarter methods be investigated and adopted in implementing space-based navigation services. Today the tendency is for people to use global navigation satellite systems (GNSS) in one way, namely to provide independent estimates of user position and time states. The result is that GNSS is identified as having limitations when it comes to short term outages. These outages could be due to intentional or unintentional interference, masking, attenuation, ionosphere scintillation, obscuration, and multipath. With multiple independent phenomena occurring simultaneously, the result can be repeated breaks in phase tracking and an inability to resolve carrier phase cycle ambiguities. A solution for many is to launch more satellites or add additional signals to fill in these gaps. But there are techniques which can be used that do not require more signals, but in fact make better use of the signals that already exist.

Some of these techniques, such as Integrated navigation systems – that is, integration of GNSS with inertial measurement units (IMU) or with visual sensors, – are very well known These can result in complex and expensive systems. Another path only beginning to be explored is the use of partial, even fragmented, information.

Taking advantage of partial information

Neither temporarily high dilutions of precision (DOP) nor gaps in sufficient satellite counts should readily translate

into loss of service. An overabundance of satellite signals so far has produced receiver designs having a high dependency on frequent full fixes. Justifications offered for such designs include exploitation of the full benefit from that abundance, self-sufficiency of receiver autonomous integrity monitoring (RAIM) with overabundance, and conceptual simplicity. Thus we routinely demand five satellites for fault detection and six for fault exclusion — with each subset of four having low enough geometric DOP (GDOP) to provide accurate instantaneous position. A reduction in availability necessary to support these capabilities has widened with satellite aging and vulnerability to interference. It is widely acknowledged that in future interference environments, more satellites cannot guarantee invulnerability. It is thus imperative to explore means of providing robust solutions that don't require expensive upgrades to the constellation or to users nor dramatic scientific breakthroughs.

Fortunately there are low-cost solutions, containing multiple ingredients. We identify a survey of these ingredients here, and provide the reader references to a more detailed treatment of each.

For centuries we have worked from the basis that our ancient mariners would have never reached their destinations if they had insisted on full fixes. Clearly they used partial data on many an occasion — and for a half-century we've known how to do that optimally. The first key, then, is for today's user-segment to capitalize on that self-evident opportunity. For example, allowing alternative communication paths, such as Mode-S squitters described in references 3 and 4, to send pseudoranges (with carrier phase adjustments and bandwidth-reduction methods currently in development) would instantly:

- enable usage of information that is lost in today's "all-or-nothing" demand for full fixes,
- minimize or eliminate garble in a crowded environment [see reference 5], and
- allow participants to account for effects ignored in conventional approaches.

This last item yields a host of benefits. The most obvious is accounting for not only estimator covariances (that is, correlations between - and unequal variances of - errors in different directions, plus nonuniform sensitivities to each measurement), but dynamics. There is a dramatic reduction in latency effects while providing precise streaming dynamic history from 1-sec sequential changes in carrier phase – with no need to resolve integer ambiguity, and with the ability to continue operation through gaps in phase track continuity As if all that weren't enough, 1-sec changes are insensitive to errors in instantaneous SV location; only the change over 1-sec needs to be precise and, for multi-constellation interoperability, it clearly doesn't matter whether a 1-sec change came from GPS or any other satellite group (any timing difference, just as any integer offset, cancels from 1-sec subtraction). Furthermore, ionosphere/troposphere adjustments change so little in one second that 1-sec changes need no mask angle -- a highly significant geometry benefit.

> Neither temporarily high dilutions of precision (DOP) nor gaps in sufficient satellite counts should readily translate into loss of service.

Protection against signals with large ranging errors is readily obtained. Each individual 1-sec phase change and each pseudorange can be acceptance-tested by single-measurement RAIM, which has been shown in full conformance to both Kalman estimation and rigorous matrix decomposition for parity. Thus we are free to reject any measurement at any time without rejecting every measurement at that time. For those hesitant to use that feature (e.g., due to unfamiliarity), the single-measurement RAIM tests can readily be followed by conventional (multi-SV) testing; nothing is lost.

All these issues and more have been validated in flight, with and without an IMU. We are quite confident that this is a compelling list of features – and there are still more than this limited space can contain.

Not yet flight-validated but firmly established in algorithmic form, and presently undergoing development, are ways to capitalize on these improvements for collision avoidance. Traffic Alert and Collision Avoidance System (TCAS) azimuth information lacks both accuracy and timeliness, thus necessitating last-moment disruptive, potentially dangerous, and often unnecessary climb/dive maneuvers. By communicating pseudorange measurements with adaptations as described above, repetitive dynamic trim commands could produce closest-approach separations in the horizontal plane combined with a gradual climb.

Next steps

The question is, how can the U.S. Government do more to help users overcome the limitations of GPS in their local environment? Adding more satellites (there are already 31) or improving their placement is always helpful, but the industry can do much on the user side with government help. If we are to extract maximum benefit from whatever resources exist, we must break some entrenched habits. Communicating with time-stamped measurements rather than rapidly perishable coordinates is an essential first step. Combining that information with algorithms already documented, with no proprietary rights claimed, affords

enormous improvement in accuracy, integrity, availability, and continuity of service. Methods advocated herein are best matched with fast Fourier transform (FFT)-based receiver configurations, which eliminate the need for correlators and track loops. For a more detailed treatment on this see reference 6. Equipment could be certified by standardized blind tests derived from specified scenarios with degradations intentionally inserted into data streams. Testing is another whole issue requiring more space, but rest assured: only change – not any magic - is required.

Conclusion

High satellite availability over the past several years has led the navigation community to depend on full fixes and overdetermined solutions, deemphasizing the use of dynamics. Familiarity and preoccupation with instantaneous position have allowed robustness to become a casualty of convenience. The authors believe that marked improvements are entirely within reach, without a need for straining budgets or scientific breakthroughs, by exploiting a combination of well-known methods with other techniques which, due to relatively recent appearance, are largely unknown. The U.S. Government can take the lead by having its agencies actively explore and implement these options in helping their applications evolve to improve service using today's available GPS resources.

The opinions expressed in this article are those of the authors and do not reflect those of the U.S. Government or any of its departments or agencies.

References

Robust Design for GNSS Integration, James L. Farrell, Proceedings of ION GNSS 2008, Savannah, Georgia link: http://jameslfarrell.com/wp-content/uploads/2010/05/robust.pdf

Aging SV's – We Have Solutions, James L. Farrell, Proceedings of ION GNSS 2009, Savannah, Georgia link: http://jameslfarrell.com/wp-content/uploads/2010/05/gnss09.pdf

Aircraft surveillance based on GPS position broadcasts from Mode S beacon transponders, E. Bayliss, et al, Proceedings of ION GPS-94.

GNSS Aided Navigation and Tracking, James L. Farrell, Amer. Literary Press link: http://jameslfarrell.com/published-books-gnss-aided-navigation-and-tracking/gnss-aided-navigation-and-tracking

GPS for military surveillance, G.A. van Sickle, GPS World, Nov. 1996.

Comparison of two approaches for GNSS receiver algorithms: batch processing and sequential processing considerations, vanGraas, et. al., Proceedings of ION GNSS-2005

User authentication schemes for GNSS selective broadcasting

In this paper three different solutions are proposed for the problem of location-based selective broadcasting of traffic messages

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Although at present its implementation within the full operational capability is under discussion and called into doubt due to recent changed circumstances in the overall system management, one of the initially planned features of GALILEO satellite positioning services was signal authentication ([1] and [7]). Authentication consists in confirming that a transmitted signal corresponds to the true source. In navigation systems the transmission of signals, that takes place over a radio link, is subject to eventual spoofing attacks ([5], [6]).

With authentication, a certified GALILEO receiver can use the signal and is guaranteed that no forged signal occurs ([4]), while an uncertified receiver cannot gain any assurance about this. Hence, authentication provides a security service that can be used both to accomplish a certain level of anti-spoofing capability and is a key element in a scenario where traceability is needed. For this reason the idea of signal authentication in GALILEO services has aroused in the user-segment community a lot of possible scenarios in tracking related applications.

An authenticated signal can avail future road toll payments, GNSS based insurance policy, new flight management computer and location based access control. Within these wide applications areas, secure tracking has become a new application field that is steady growing ([2] and [3]).

It is worth noting that the ideas the techniques proposed in this paper are based on, still continue to keep working even in absence of the authentication service: however, in this case the robustness of the non anti tamper solutions against unauthorized access results weakened.

Problem: position-based service

The main purpose of this work consists in to investigate some suitable functional and processing schemes in order to allow a GNSS user equipped with a radio-receiver and processing card for gaining access to restricted information.

The availability of such information is considered restricted in the sense that they are supposed to be subject to a couple of constraints:

1. the user has to be an authorized user

2. each authorized user must have access only to a subset of the complete set of data, a subset that is strictly related to the user actual position.

Moreover, an important additional constrain is required to be fulfilled:

3. the information are broadcast to all the users by a Local Element (LE), that is, no selective transmission is performed among authorized users by point to point data links or directional communications.

In particular, possible information that fall within the definition given above could be traffic information or marine/land vehicle positions relative to a certain geographical area. These information could be broadcast from a service provider, sited in a base station and equipped with suitable data acquisition devices (such as radars, transponders or other kinds of sensors), and digital link broadcasting facilities. A user in that area could be interested to know the vehicular traffic situation around him, that is in its immediate vicinity, in order to take decisions about where is better to go or how to behave. It is not in-

terested to know the traffic situation of the whole region and, more important, the traffic situation data related to the whole area could be considered sensitive information by the service provider or by competent authorities that would deny whole data availability to every single user for security reasons. Hence, selective delivering of information based on the user local position is necessary.

The proposed idea is that data, transmitted by way of digital data-links, are not broadcast or received by directional antennas in order to perform selective delivering depending on the local user position. Differently, software processing schemes based on both well known encryption techniques and GNSS-derived authenticated pseudoranges are proposed.

The typology of information that constitute the broadcast message are, for each user inside a predefined geographical area:

- position (longitude and latitude, height is considered irrelevant for a maritime scenario)
- heading or ground-track velocity direction
- type of vehicle.

All these data are supposed to be gathered by the service provider by external sensors.

An approach to the solution

The main requirement consists in giving a selected traffic information related to a selected area. A system user cannot have the possibility to know all the positions of the other users in the entire zone interested by the service but only in a reduced portion around him.

The idea is discussed on a maritime scenario. It is assumed that there are a ground based station (Local Element, LE) that ciphers traffic information and users on board boats/ships (Mobile Elements, ME) that have to decrypt this message.

Pseudoranges are chosen as keys for ciphering the traffic message. The entire zone interested by the service is divided into cells of equal area forming a grid (see Figure 1). In every cell must be defined a reference point, called Hot-Spot, that is taken as the reference from all the ships inside that cell. Each Hot Spot has its ranges from the GNSS satellites. The pseudoranges of the Hot Spot are defined as the keys for decrypting that part of the broadcast message where the traffic information corresponding to that cell are contained. Every boat/ship inside that cell must know which is its reference Hot Spot. Hence, based on the vehicle actual pseudoranges (that are strictly related to its actual position), the user has to obtain the pseudoranges of its reference Hot Spot.

The idea is that the broadcast message has an header, encrypted by means of a key that is available to all the users subscribing the service. The header contains the structure of the grid of the cells covering the service area: number of cells, orientation of the grid respect to the North, size of the cells. Moreover the header contain the set of GNSS Satellite Identification Number (PRN) to identify the subset of GNSS satellites with respect the pseudoranges has to be computed to. Therefore, the Local Element and all the users share the same satellites to compute their respective pseudoranges (this assumes that within the geographical area covered by the cell grid there are a set of satellites in view to all the GNSS receivers).

An important feature of the processing scheme is related to the authentication service available from GALILEO satellites, in its form of Navigation Message Authentication (NMA). One of the most important problem is that the users are moving across the area interested by the service and they can pass from a cell to another cell with a different Hot Spot. In order to avoid lack of information in the neighbourhood when an user is close to the edge of its reference cell, the traffic information, ciphered with the key of a cell, includes also the traffic information of the surrounding eight cells.

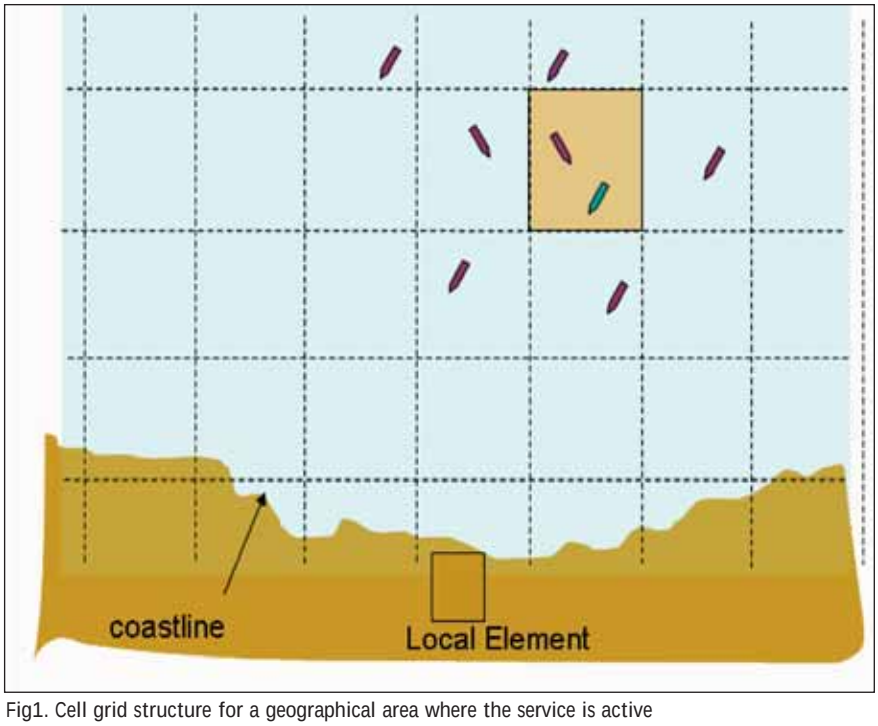

Fig1. Cell grid structure for a geographical area where the service is active

Proposed architecture

Two different types of functional architecture for the processing schemes are presented. The second part of the message, that contains traffic information, is always ciphered by means of the ranges of the Hot Spots. The differences among the three models are in what is ciphered in

the first part of the message. The first and second architecture use a symmetric key only to cipher some partial information.

The Local Element creates a grid of cells and each Mobile Element has to know its reference Hot Spot in order to generate the pseudoranges used as deciphering key.

Anti Tamper Solution

Local Element Architecture

The Local Element broadcasts a message organized in three different parts, each one is encrypted with a different key (see Figure 2).

The first part contains the pseudoranges of the map origin of the cell grid together with the PRN of the selected satellites used for position computation. This information is ciphered with a common key given to all the users of the service. It is important to underline that the map origin can be changed after every new message broadcasting. The LE, who has to be a certified Galileo user, uses the authentication signature of the satellites to cipher the ranges of all the Hot Spots. In fact, in a NMA scheme the satellites add authentication bits to the navigation message stream, and these data are available to an authenticated receiver.

The local traffic information is ciphered with a number of keys equal to the number of Hot Spots. Each key is represented by the difference between the ranges of the Hot Spot and the ones of the origin of the map. The ranges or pseudoranges are computed by using the satellites selected with the PRN part of the message. Consequently, the Local Element ciphers the local traffic information of a cell with the key corresponding to that cell.

Mobile Element Architecture

The Mobile Element (see Figure 3) must be an authorized user. Consequently, it knows the common key given to all the users of the service and can decrypt the information about PRN and map origin.

It is now presented how the mobile element can restore the other two keys.

The second part of the message contains the information related to the ranges of all the Hot Spots. All these elements are ciphered with a key generated by using the authentication signature of the satellites. In this way, only a certified user of the Galileo service can extract the authentication messages from its receiver and, together with the PRN information already decrypted, it is able to construct the second key.

PRN numbers together with selected pseudoranges are used as second key for the reference Hot Spot decryption/ selection algorithm. This program chooses the Hot Spot ranges nearest to the selected pseudoranges corresponding to the user actual position.

> A system user cannot have the possibility to know all the positions of the other users in the entire zone interested by the service but only in a reduced portion around him

Once the algorithm outputs the ranges of the reference Hot Spot, the Mobile Element is able to restore the third key. In fact it is based on the difference between the map origin ranges, given in first part of the message, and the reference Hot Spot ranges. After decryption of the selected third part of the message, the user can read the traffic information in its and contiguous cells.

An Anti Tamper device can be used. It makes inaccessible from the outside of the device the information obtained by the use of the second key.

Discrete Solution

The second proposed scheme tries to solve the problem of unauthorized access to information without the use of an Anti Tamper device.

Local Element Architecture

The idea for this solution is based on the assumption that, in a maritime scenario, ships cannot have a distance less than a certain small value. Consequently, the entire area interested by the service is divided into small cells area. These micro-cells are grouped into macro-cells which only reference to a single Hot Spot each.

In this scheme the Local Element divides the message (see Figure 4) in three parts, each one ciphered with a different key.

The first key is always common to all the users and is used to encrypt the following information:

- PRN
- map origin ranges
- size of the micro cells

The Local Element ciphers the reference Hot Spot of a macro cell through a key that it is composed by four different fields:

1. The “identification number” of the micro-cell, that it is different for every user because a single micro-cell can contain only one vehicle.
2. The boat/ship ground velocity
3. The identification type of the ship.
4. The authentication message of the selected PRN satellite.

A single Hot Spot is ciphered as many time as the number of users related to that Hot Spot.

Consequently, in this scheme, the LE is required to create as many keys as the number of users.

The traffic information, third part

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of the message, is ciphered through a key always based on the ranges of the reference Hot Spot.

The identification type of the ship assumes that there is a sort of communication between the user and the Local Element, or a system that recognizes what kind of ship is located in a specified micro-cell.

Mobile Element Architecture

In this architecture (see Figure 5), as in case a) architecture, the mobile element must be certified in order to use this service. In this way the user, through the usage of the common key, decrypts satellite PRN, the map origin ranges and the size of the cell. The receiver, in order to decrypt its reference Hot Spot, must create the second key which is made by the elements listed in the Local Element description.

The identification number of the cell is created by an internal simple discretization algorithm that use the map origin ranges and the size of the cell, decrypted by using the common key, together with the selected pseudoranges from a Galileo receiver. Also in this case the selected satellites, whose pseudoranges are in use, are given by the PRN information.

The GNSS service is assumed to deliver the authentication message of each satellite. Consequently, together with the ground velocity information, the user is able to generate the second key and to decipher which is its reference Hot Spot. Once the reference Hot Spot has been decrypted, the receiver uses this information as a key and it is able to decrypt the traffic information of its related area.

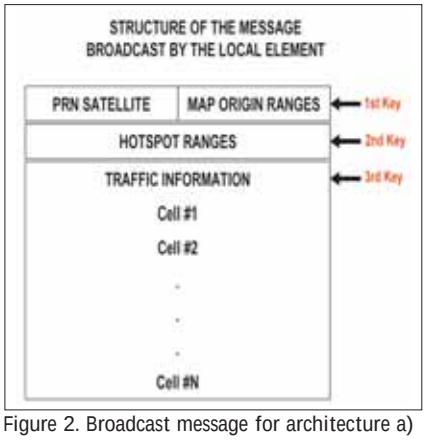


Figure 2. Broadcast message for architecture a)

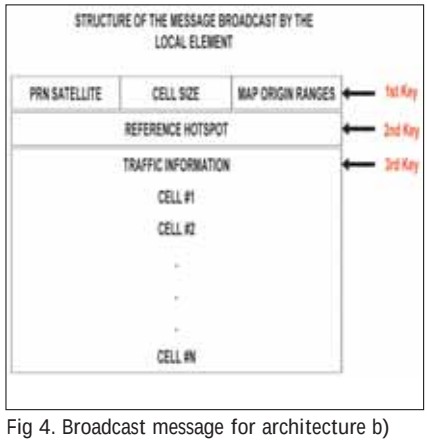


Fig 4. Broadcast message for architecture b)

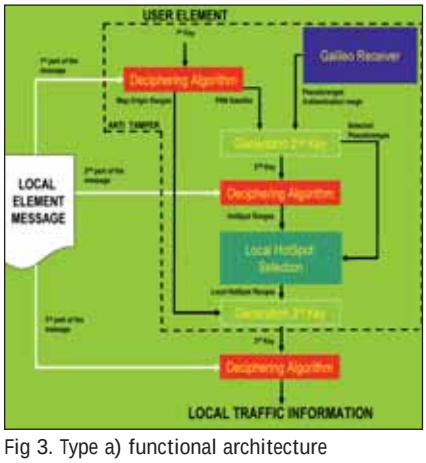


Fig 3. Type a) functional architecture

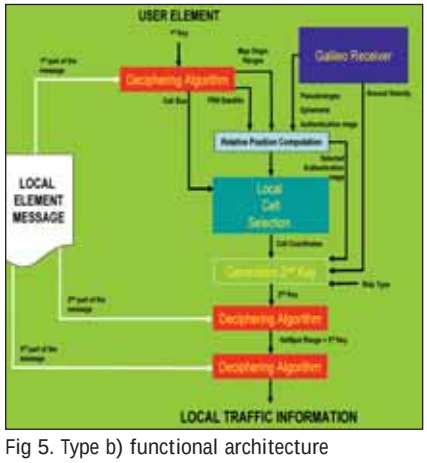


Fig 5. Type b) functional architecture

Conclusion

In this paper three different solutions are proposed for the problem of location-based selective broadcasting of traffic messages. According to the analysis achieved in the preceding sections, it is worth emphasising advantages and disadvantages of each architecture.

The first proposed functional architecture is quite secure against an eventual attack for the presence of an anti-tamper receiver. Besides, it is not very heavy from the computational burden point of view. In fact the Local Element ciphers information with a number of keys equal to the number of Hot Spots.The second proposed architecture does not contemplate the use of an anti-tamper receiver and the eventual attacks are prevented by the use of the ground velocity and the ship type inside the second key. This solution is less secure then the first while the computational effort remains similar. Moreover, a communication link between the Local Element and Mobile Elements is contemplated in order to make the vehicle type known.

References

Chris Wullems, Oscar Pozzobon, Kurt Kubic, "Signal Authentication and Integrity Schemes for Next Generation Global Navigation Satellite System", ENC-GNSS Convention, Much, 2008.

Oscar Pozzobon, Chris Wullens, Kurt Kubic, "Secure Tracking using Trusted GNSS Receivers and Galielo Authentication Service", Journal of Global Positioning System, 2005.

Oscar Pozzobon, Chris Wullens, Kurt Kubic, "Requirements for Enhancing Trust, Security and Integrity of GNSS Location Services", ION 60th Annual Meeting/U.S. Air force Institute of Technology & The U.S. Air Force Research Laboratory, Dayton, Ohio, June 2004

Logan S., "Anti-Spoofing & Authenticated Signal Architectures for Civil Navigation System", ION GPS/GNSS, Portland, Oregon, September, 2003.

Hein G., Kneissì F., Rodriguez J., Wallner, "Authenticating GNSS Proofs against Spoofs", Part I, Inside GNSS, July-August 2007

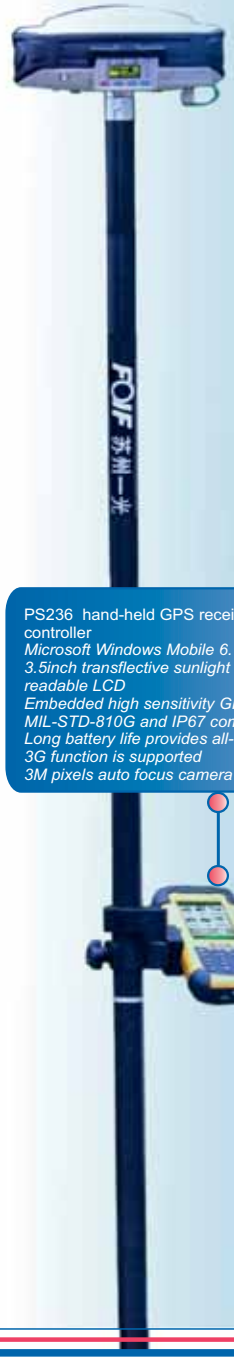
Hein G., Kneissì F., Rodriguez J., Wallner, "Authenticating GNSS Proofs against Spoofs", Part II, Inside GNSS, September-October 2007

Galilei Consortium, "The Galilei Project: GALILEO Design Consolidation", European Commission, 2003.

FOIF GNSS Receiver A20

More flexible system with following features:

- Fully rugged design with simple "One Button" base setup
- Equipped with industry standard GNSS engine(Trimble, NovAtel, Javad...), and proven PCC or Satel radios
- Compatible with existing popular brand GNSS systems
- It is available for wireless data link by FOIFNet transceiver
- GPRS data link reconnecting automatically as base station
- Switch from internal radio to GPRS, or both can work together
- RTK Network rover:VRS, FKP, MAC
- Modular design - simple to extend or replace the Bluetooth, radio or GPRS and SD/SIM card module
- Field software: FOIF Survey_GPS or FOIF FieldGenius



PS236 hand-held GPS receiver and controller
Microsoft Windows Mobile 6.1 OS
3.5inch transflective sunlight readable LCD
Embedded high sensitivity GPS receiver
MIL-STD-810G and IP67 compliance
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3G function is supported
3M pixels auto focus camera

GNSS antenna

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Super bright OLED display & LED

Li-ion battery, 8hrs continuous working time(RTK)

Multi interface: RS232X2, Bluetooth PPS, Ext Event USB&Ethernet supported

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Planning model for multiple hazard prone towns

This paper presents a planning model for hazard prone towns based on earthquake and flood damage assessment.

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Bhopal, India

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Maulana Azad National Institute of Technology,
Bhopal, India

Ashutosh Sharma

Due to natural disasters like earthquake and flood the whole world suffers great losses; some towns vanish at one go and for all others it takes years and decades to resume the same state. To protect the existence of such hazard prone towns and minimize the losses it is important that planners frame some guidelines for the proper development of these towns which should be included in the master plan of these towns. For development of these towns a planning model based upon earthquake and flood damage assessment has been developed which can be utilized for other similar towns of the world.

Methodology

Following methodology has been utilized to achieve the above mentioned research objectives:

Case study

Earthquake and Flood Vulnerability of Madhya Pradesh

Madhya Pradesh which lies in the heart of India suffers mainly from two major hazards, namely floods and earthquakes. All earthquake activity is confined to Narmada-Son fault zone which runs across the State. The Earthquake Hazard Map of Madhya Pradesh with highlighted high-risk zone is shown in (Figure 2). Hoshangabad is one of the towns, which comes very close to this high-risk zone. It is situated very close to two faults and hence close to a cross fault. The town is a district headquarter situated on the banks of the river Narmada. It is not only prone to earthquake but also flood. Geotechnically the town is settled on thick alluvium which is a very thick layer of sand mixed with clay and silt- which is not very compact and quite loose. This may increase the damage during minor earthquakes also. The other towns which come in this high risk zone are Jabalpur, Khandwa etc. Major institutions of the country like Geological survey of India, are working in this field. But for Hoshangabad town no study has been conducted till now.

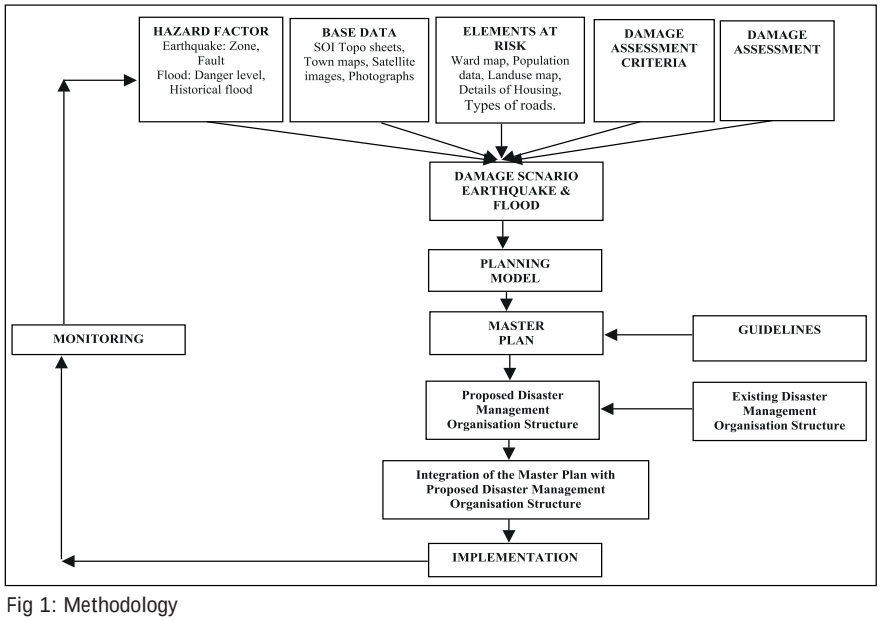

Fig 1: Methodology

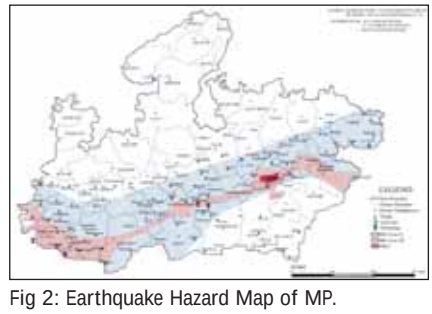

Fig 2: Earthquake Hazard Map of MP.

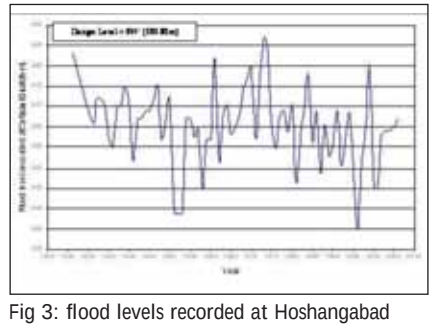

Fig 3: flood levels recorded at Hoshangabad

Disaster history in the study area

The Hoshangabad town ship is very close to the active SONATA fault, which is the root cause for seismic activities in the region. The area falls under seismic zone III, which comes under moderate seismic risk region. The region has experienced 7 earthquakes in last 150 years, among which two had magnitude more than 6.

Flood is a frequent phenomenon in the study area. In last 80 years, more than 76 times, flood had inundated the low-lying area (Figure 3). Floods in the study area are due to Narmada River and its tributaries. Data of last 80 years show that every year flooding is there up to certain extent but at least once in 10 years extreme flooding takes place.

Data collection

For detail analysis, 33 wards of the township which come under Municipal Corporation have been taken for study. The land use land cover of the city has been studied. The Municipal area covers 15,537 houses. To collect precise information about building stock distribution, a sample survey was conducted. In this regard, 5% buildings were surveyed and distribution was projected on the remaining building stock. The questionnaire developed for surveying the houses includes detailed information about material used for roof, wall and foundation, economic condition of house owner, configuration of buildings etc. The distribution of categories of houses in 33 wards of town has been taken as distribution shown in Census report 2002. The scenario has been developed only on building stock excluding other infrastructure.

The Census of India 2001 has provided housing stock of the study area with special emphasis on type of material used in wall, floor and roofs.

Damage assessment criteria

The scenario has been developed on the basis of The Medvedev Sponheuer-Karnik (MSK) Scale of Intensity. Further the categorization is improvised using the Vulnerability Atlas of India. These are:

1. A Type — Adobe, Field stonemasonry, Unburnt brick walls.
2. B Type — Burnt Brick Houses.
3. C Type — RCC and framed structure.
4. X Type — Others (Light building material GI sheet, Asbestos sheets).

Earthquake damage scenario

Based on experiences of past earthquakes, It is observed that A and B types are prone to damage at lower scale of intensity. The Hoshangabad town has 33 wards with population 97357. Based on the damage assessment criteria, survey results and 2001 census, damage Assessment at Intensity VI, VII & VIII for Hoshangabad Township has been calculated. At varying intensities the damage of total building stock is as given in Table 1.

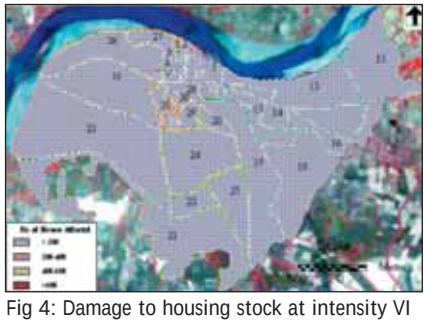

Fig 4: Damage to housing stock at intensity VI

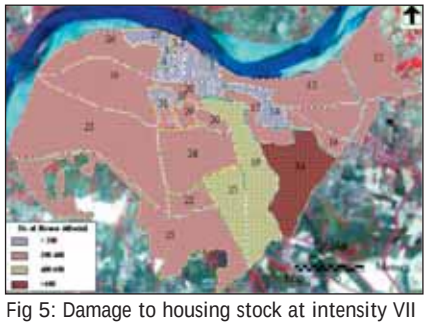

Fig 5: Damage to housing stock at intensity VII

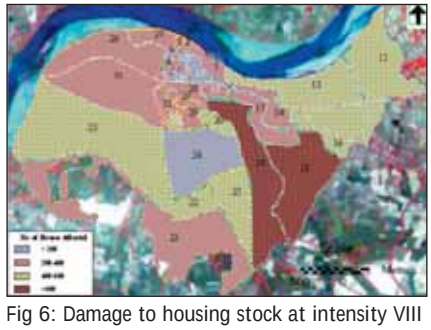

Fig 6: Damage to housing stock at intensity VIII

At varying intensities the damage in different wards can be seen in Figure 4, Figure 5 and Figure 6.

As per the Earthquake Scenario, damage to houses may extend up to 73%. In view of such colossal damage, it is necessary to take immediate steps for earthquake safety of the area.

Flood damage scenario

The damage Scenario changes with flood water levels. The increasing trend of damage is based directly on the increasing intensity of floodwater, which increases with flood levels. Looking at the historical flood levels recorded at Sethani Ghat, Hoshangabad of past 80 years, damage scenario for three most probable flood levels have been worked out with the help of survey results and flooding as observed through the years. At varying flood levels the areas which will be affected is as given in Table 2.

The various flood inundation areas at different flood levels have been represented in Figure 7, Figure 8 and Figure 9 respectively.

At varying flood levels the damage of Housing stock is as given in Table 3. The scenario has been developed only on housing stock excluding other infrastructure.

The approximate population likely to be affected at different flood levels are presented below in Table 4.

Planning model

After analyzing the earthquake and flood damage scenarios, the following planning model has been proposed:

The town should be prepared for the worst possible scenario taken here which is the flood level of 978' (298 m) which is

considered to be most likely to occur. The areas which are likely to be worst affected at this scenario are shown in Figure 10.

Parks and play grounds, wood lands and gardens should be located here. The people should be discouraged to make houses in these wards which come under flood affected low lying areas. The wards which come under flood affected low lying areas as mentioned above, which have soil conditions including the level of water table favorable to liquefaction or settlements under earthquake vibrations will have greater risk to buildings and structures so the existing structures should be relocated in the south western part of the town.

In all other wards flood resistant houses should be constructed by raising plinth level of houses above average flood level for which special permission should be taken from the municipal corporation. The density of some wards in the old city area should be frozen to avoid further congestion and to avoid major losses in earthquake or flood event.

Phase wise retrofitting of all the housing stock should be undertaken. As per the Earthquake Scenario, damage to houses may extend up to 73%. In view of such colossal damage, it is necessary to take immediate steps for earthquake safety of the area. As the area falls under Moderate Seismic Risk Zone, all the construction should be as per earthquake resistant building construction codes.

By developing the existing corridors of the city, development of safer areas should be encouraged, which will reduce further congestion of the old city areas. Development in the south-eastern side of the town should be encouraged by providing basic infrastructural facilities like roads, street lights, and water supply etc., coupled with lower land prices in these areas.

The height of Lendia Nala Bund should be increased as well strengthened and completion of the Kishanpur Nala bund with flood protection gates and pumps. Boulder pitched bund should be provided along the river (Figure 10) and there should be proper maintenance of the boulder pitched bund besides the river.

Input in to the master plan

The above mentioned model is proposed as an input in to the master plan. Since Master Plan is constituted under the Madhya Pradesh Nagar Tatha Gram Nivesh Adhiniyam, 1973, for including these inputs in the master plan some amendments should be made in the relevant sections of the Master Plan.

Conclusion

There are many other towns in the region which are earthquake as well flood prone; the methodology can be utilized to make planning model for them too. All over the world many more areas and towns are facing the similar situations, the above mentioned methodology can be utilized to make planning model for them too, to minimize the expected losses from earthquake and flood.

As per the outcome of the research, further research should be done for proper preparedness and response during earthquakes and floods. Contingency plan should be made for all the flood-affected wards. This must have the details of role and responsibility of concerned officers and peoples representative of the community. The identification of volunteers and other support groups should be properly ensured. The resources inventory should be regularly updated and circulated within the response groups. The stocking of essential food, search and rescue equipments along with identified temporary shelters must be clearly identified and should be available for emergency uses. Relief camps should be established in the hospital school/ college buildings of the respective adjoining wards which are not or least

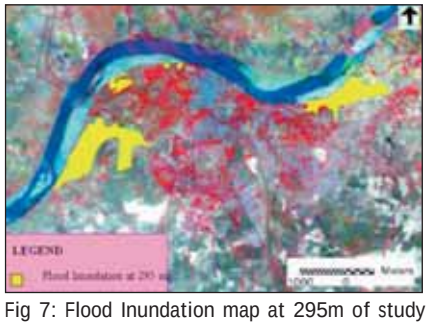

Fig 7: Flood Inundation map at 295m of study area

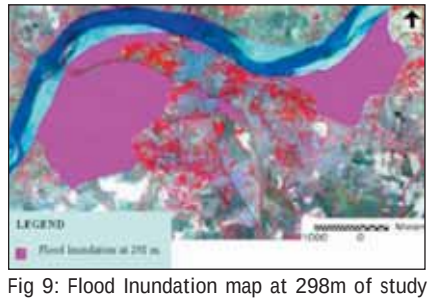

Fig 9: Flood Inundation map at 298m of study area

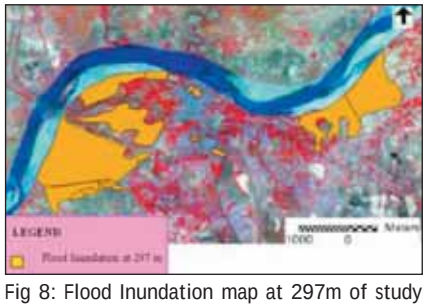

Fig 8: Flood Inundation map at 297m of study area

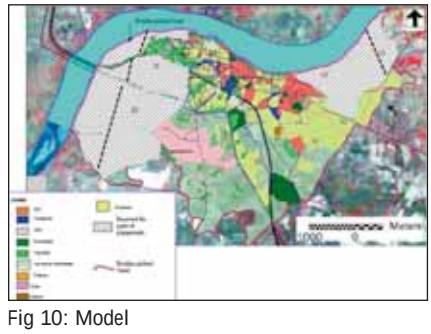

Fig 10: Model

S. No	Intensity	Affected building stock	% of affected building stock
1	VI	2138	13.76
2	VII	8329	53.60
3	VIII	11229	72.27

Table 1: Intensity and affected building stock

S. No	Flood Level from msl.	Area likely to be Affected (In Hectares)	% of Area likely to be Affected
1	968' (295m)	186.9807	7.70%
2	974' (297 m)	558.2611	23.00%
3	978' (298 m)	763.8465	31.47%

Table 2: Area likely to be affected at different flood levels

NRSC Data Centre
National Remote Sensing Centre
Phone: +91(40)2388 4422, 4423, 4425
Fax: +91(40)2387 8158, 8664
Email: sales@nrsc.gov.in
Website: http://www.nrsc.gov.in

Technology with Human Face

S. No	Flood Level above msl	Affected building stock	% of Affected building stock
1	968' (295m)	626.52	4.03%
2	974' (297 m)	1,981.73	12.75%
3	978' (298 m)	2,794.81	17.99%

Table 3: Flood levels and Housing stock likely to be affected at different flood levels.

S. No	Flood Level from msl.	Likely Population to be Affected	% of Likely Population to be Affected
1	968' (295m)	3,844.42	3.95%
2	974' (297 m)	12,435.39	12.77%
3	978' (298 m)	17,748.58	18.23%

Table 4: Population likely to be affected at different flood levels.

affected or having large open spaces. The availability and location of resources required for search, rescue and relief should be well documented. The database preparation, their updating should be done at regular interval. Ward level road network should be demarcated on map. This helps in selecting the shortest rout during crisis time for relief work. The individual houses and structures with detail information should be marked on maps so as to work out the damage potential at micro level. All lifelines and infrastructures with their priority should be demarcated on the ward maps.

References

Acharya, S.K., Kayal, J., Roy, A. and Chaturvedi, R.K. (1998), 'Jabalpur earthquake', Journal of Geol. Soc. of India, 51, 295-304.

Arya A. S. (2000), 'Recent developments toward earthquake risk reduction in India', Current Science, 79.

BMPTC (Building Material & Technology Promotion Council., (2004), Building a New Techno-Legal Regime for Safer India, Ministry of Home Affairs National Disaster Management Division Government of India, New Delhi, India.

BMPTC (2002), Techno Legal Aspects of Earthquake, Windstorm and Flood Hazards and Land Use Zoning, Report of the Expert Group on Natural Disaster Prevention, Preparedness & Mitigation having bearing on Housing and related Infrastructure, Report Submitted to Ministry of Urban Affairs & Employment, Government of India.; New Delhi, India.

Burby Raymond J. (1998), Cooperating With Nature: Confronting Natural Hazards with Land Use Planning for Sustainable Communities, Joseph Henry Press; Washington, DC.

Chaturvedi R.K. (2000), 'Seismo-tectonic evaluation of Son-Narmada Valley: Recommendations for future studies', GSI Spl. Pub. 51, 197-204.

Earthquake Engineering Research Institute. (1999), Lessons Learned Over Time, Learning From Earthquake Series, Volume II, Innovative Earthquake Recovery in India, Oakland, California.

Fukuoka Shoji (1998), Floodplain Risk Management, A.A.Balkema. Rotterdam; Brookfield.

Geological Survey of India. (1998), Geological Map of India (1:2 million scale).

Geological Survey of India. (2000), Jabalpur Earthquake, A Geoscientific Study, Spl. Publication No. 51, India.

NCHSE (National Center for Human Settlement and Environment), (1995), Perspective Urbanization Plan for M. P.-2021, Bhopal.

NCPDP (National Centre for Peoples' Action in Disaster Preparedness) for GSDMA (Gujarat State Disaster Management Authority), (2003), Capacity Building Program for Long-term Preparedness.

Sanderson David. (2000), 'Cities, disasters and livelihoods', Environment & Urbanization, 12, 2.

Scawthorn Charles. (2005), History of Risk Model Development, Kyoto University.

At a Glance

- Infotech Enterprises America has acquired Wellsco.
- ITT Visual Information Solutions has acquired Creative Software Systems GmbH.
- Trimble acquires Accubid.
- MDA Geospatial Services to be RapidEye distributors in Canada.
- PT Barrata is the distributor of PCI Geomatics in Indonesia.
- Global Survey appointed new ERDAS distributor in New Zealand.
- ScanEx to distribute SPOT 4 satellite data over the territory of Russia and Belarus.
- The National Geographic Society signs a nonprofit site license agreement with ESRI.
- OGC and ISPRS have signed a MoU
- South Africa and Russia to collaborate in the area of earth observation.
- JAXA and ADB agree to promote satellite technology
- Egypt and Saudi Arabia have signed a MoU on remote sensing and space sciences cooperation.
- GeoEye reported total revenues of $81.0 million for the second quarter of 2010
- Vexcel Imaging, GmbH reported a total of 30 sales for its UltraCam digital aerial camera systems during the company's 2010 fiscal year.
- For the second quarter ended June 30, 2010, Hemisphere GPS reported an 8% increase in revenues.

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Timing
Exchange
Camera
Voice Rec
Support
System
Locks
Set parameters and select operation. You can save settings in files.
You can also assign settings to F1 to F5 keys.


Settings
GNSS
Advanced
Communication
Antenna
Actions
Save Settings
Photo & Voice
Recall Settings
Assign Current Settings to Fn Button and Name it (SUR)
F1
F2
F3
F4
F5
Name
SUR
Cancel
Define automatic operations of Front and Bottom cameras
and Voice Recorder during the start-stop operation period.
Apply


GNSS
GPS
GLONASS
Galileo
SBAS
Receive Data (Rover)
Transmit Data (Base)
Record Data
VRS Networks
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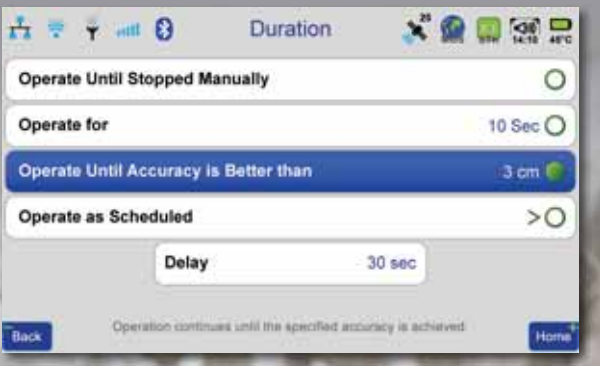
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RTK - CMR+
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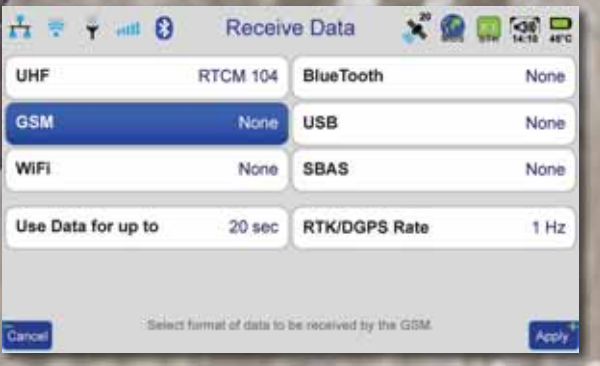
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Actions
Point Survey
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Stake Survey
Trajectory Survey
Monitor Structure
Stop&Go Survey
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done after stakes are planted in the Stake-out phase.
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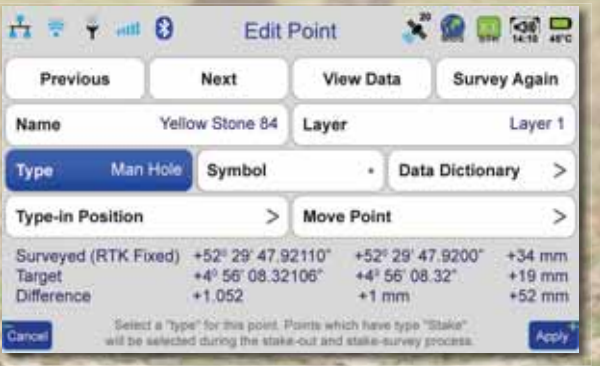
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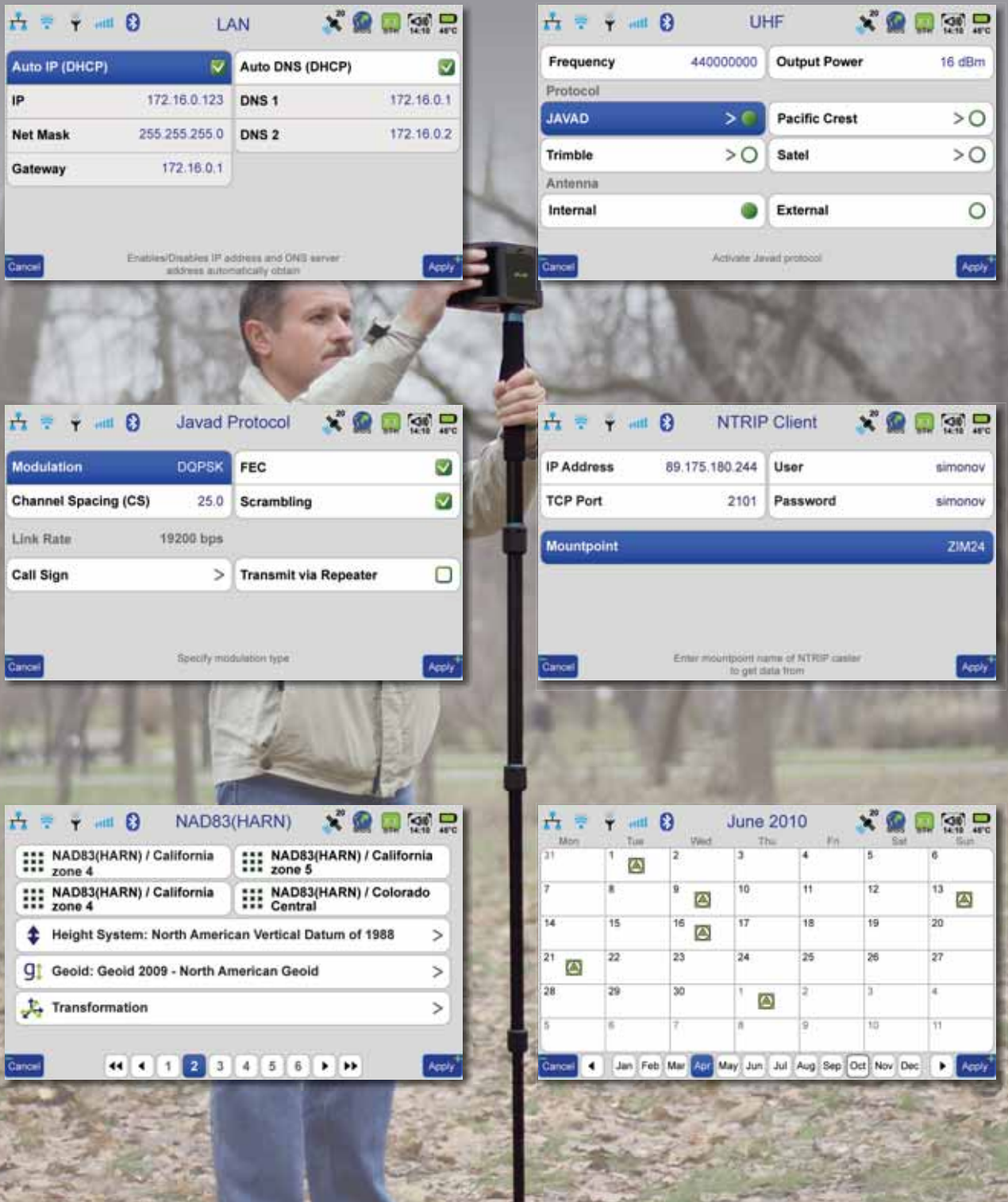
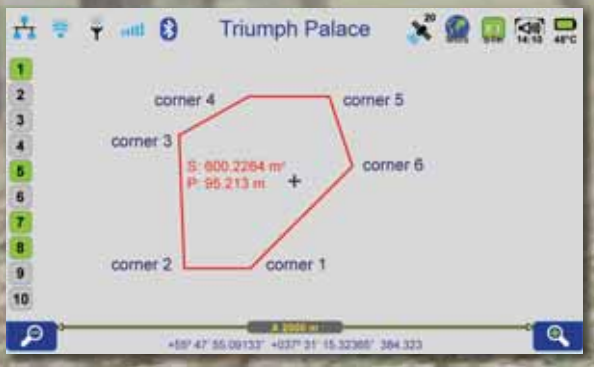
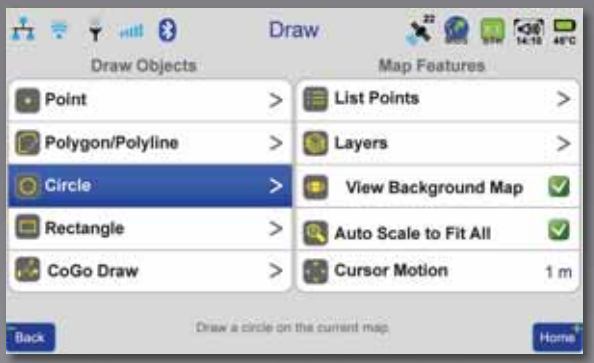


Speak for themselves

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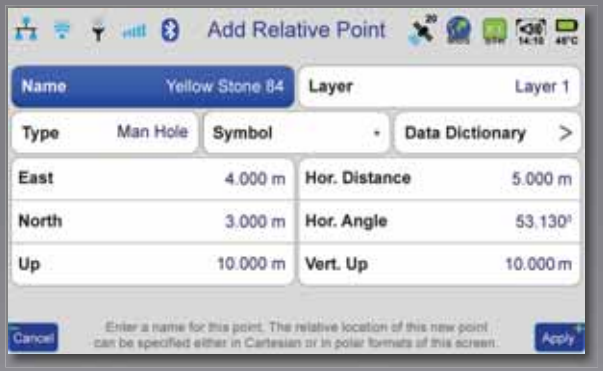
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Satellites
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GPS8 41 102 H 46 30 30 – –
GPS9 14 286 H 37 10 10 – –
GPS11 13 82 H 37 – – – –
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GPS17 30 156 H 45 29 29 44 –
GPS19 8 28 H 37 11 11 – –
GPS26 46 298 H 37 – – – –
GPS27 27 288 H 42 20 20 – –
GPS28 71 86 H 49 39 39 – –
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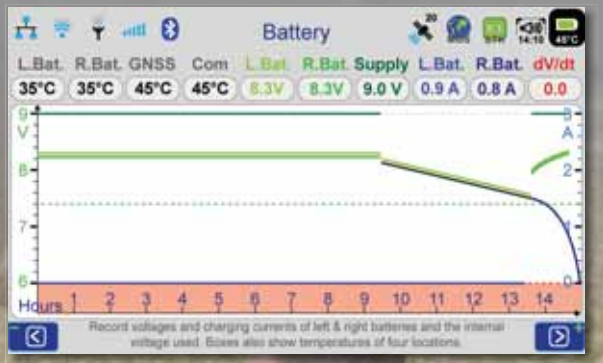
Internal battery status, temperature and discharge history


Battery
L.Bat. R.Bat. GNSS Com L.Bat. R.Bat. Supply L.Bat. R.Bat. dV/dt
35°C 35°C 45°C 45°C 8.3V 8.3V 9.0 V 0.9 A 0.8 A 0.0
V
A
Hours
Record voltages and charging currents of left & right batteries and the internal voltage used. Boxes also show temperatures of four locations.


Support
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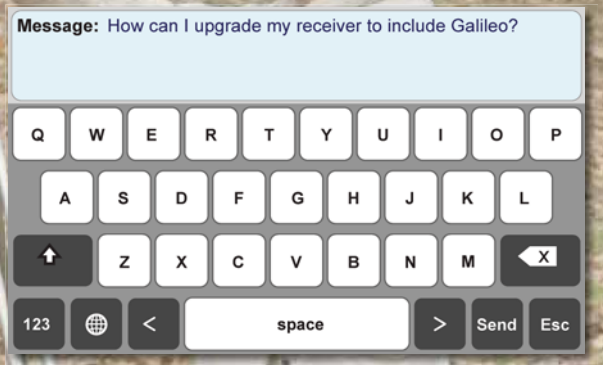
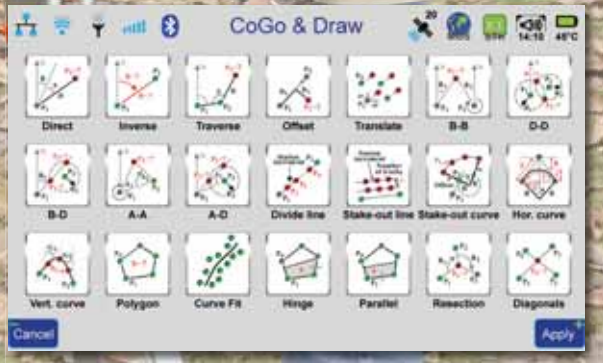
Update OAF
Check Hardware
Send Files to JAVAD
Questions & Answers
Cancel
Connect to JAVAD GNSS server to check the health of your TRIUMPH V.S. hardware and software
Apply


Message: How can I upgrade my receiver to include Galileo?
Q W E R T Y U I O P
A S D F G H J K L
Z X C V B N M
123
space
Send
Esc


Update Firmware
Update Channel
Auto
Ethernet
WiFi
GPRS
Update Now
Schedule Updates
Mon
Tue
Wed
Thu
Fri
Sat
Sun
At: 08:00
Do not wait for confirmation
Cancel
Firmware update starts at time specified at "Start at" on days that have been checked.
Apply


CoGo & Draw
Direct
Inverse
Traverse
Offset
Translate
B-B
D-D
B-D
A-A
A-D
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Assessing the Security of Navigation System

A case study using enhanced Loran

This article assesses the security of eLoran and discusses how its features can be utilized to provide defenses against likely attacks

Sherman Lo
Stanford University, USA

Benjamin Peterson
Peterson Integrated Geopositioning, USA

Per Enge
Stanford University, USA

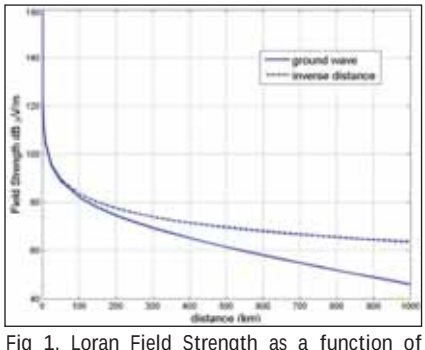

Fig 1. Loran Field Strength as a function of distance from transmitter

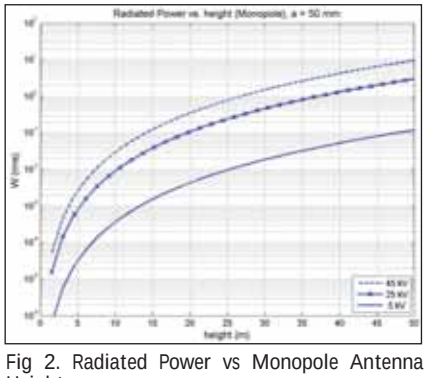

Fig 2. Radiated Power vs Monopole Antenna Height

Global Navigation Satellite Systems (GNSS) have become increasingly interwoven into the fabric of our infrastructure and economic system. However, as the services provided by GNSS become more important for safety of life and economically critical infrastructure, subversive elements will be increasingly tempted deny or spoof its signals. Given that GNSS has well-acknowledged vulnerabilities, it is becoming recognized that mitigations and back-ups are necessary [1]. Indeed, we are hopefully moving to a robust, comprehensive approach to position, navigation and timing (PNT) architecture. An element that should be central to the consideration is security. This article uses Loran as a case study for a systematic examination of navigation security. The study of interest as Loran is oft considered as a good complement to GNSS for improving overall PNT security and availability.

Loran, in particular the next generation Enhanced Loran (*eLoran*), has many properties that make it a good complement to GNSS. It has similar outputs and performance as GNSS. As it is an area navigation (RNAV) system, it can be used to drive the same interfaces as GNSS. *eLoran* is being developed to provide performance levels that can support non precision approach (NPA), harbor entrance approach (HEA), and stratum 1 frequency and precise timing. At the same time, it is an independent system and has failure modes that differ from GNSS. The attractiveness of Loran as part of a full PNT architecture has been recognized by entities such as the US Department of Homeland Security (DHS) and the General Lighthouse Authority (GLA) of England, Ireland, and Scotland [2][3].

While having a back up implies security through redundancy, the *eLoran* system can provide even more security to PNT. Its characteristics make many of the attacks significantly more difficult than in GNSS. Its higher power makes it more robust to on-air attacks. The system can carry signal authentication messages to dissuade other attacks. Its dissimilar characteristics makes attacking Loran technically different from attacking GNSS. *eLoran*, in this context, is extremely attractive as a part of a comprehensive PNT architecture. This article assesses the security of *eLoran* and discusses how its features can be utilized to provide defenses against likely attacks.

Navigation Security

Navigation security is increasingly important for two reasons. The first is the increased adoption and integration of navigation technologies. Navigation security is needed to ensure that the PNT outputs we count on are indeed reliable. The second is the global increase of information technology threats. Secure navigation can serve as a building block for protection of information and assets. These two distinct points can be encapsulated as “security for navigation” and “security from navigation”, respectively.

This article focuses primarily on the “security for navigation” as it is a prerequisite for “security from navigation.” To understand navigation security, it is important to understand the threats and attacks that may be inflicted upon it.

This section discusses attacks and Loran characteristics that may be useful for security. It categorizes the various possible attacks and introduces common defenses. It describes specific Loran

features and how they apply to security against attacks. More background on navigation security measures and Loran are available in literature [4][5][6].

Attack Models & Common Defenses

Attack models are useful for the assessment of system robustness and are a standard tool used by the security community. In assessing the security of a radio-navigation system, we divide the attacks into two major categories - on-air and off air attacks. On-air attacks are ones where the adversary attempts to compete with or overwhelm the broadcast signal. Off air or direct injection attacks are ones where the adversary directly inputs into the receiver.

On-air attacks can come in several forms. One common category of GNSS attack is jamming. Jamming is the broadcast of RF power that interferes with a receiver's ability to track the genuine signals resulting in denial of service (DoS). Many incidences of GNSS jamming have been reported. The other major category of on-air attack is broadcast spoofing where a competing signal is transmitted so that the user receiver generates an incorrect position. This threat is real and there have been anecdotal accounts of GNSS spoofing as well as spoofer demonstrations [7][8]. Different spoofing techniques exist. The transmission of simulated signals is one spoofing method. Spoofing techniques can also utilize the genuine broadcast signal. A simple example is relay spoofing or meaconing where the actual broadcast is received at one location and repeated at another. A more sophisticated version is to variably delay the components (signals from different transmitters) of actual broadcast and rebroadcast the signal to generate false ranges ("delay and relay" or selective delay). Another version is to modify the actual broadcast signal. Forms of direct injection attacks are similar to those of on-air spoofing attacks. They typically need a complicit or oblivious user as they require direct access to the receiver. Given this, they are simpler to implement than on-air attacks as the spoofed signals do not need to compete with the broadcast signals. Furthermore, the spoof "broadcast" is simpler to implement compared to its on-air brethren.

Several defenses against these attacks are possible. A physical defense is one possibility. Strong signal broadcasts represent a physical barrier against on-air attacks as the adversary needs to overcome the power of the genuine signal. This is one advantage of Loran. Another way to increase genuine signal power relative to an adversary is to use directional antennas. Another example of a physical barrier is tamper proofing. This may prevent injection attacks if the antenna and receiver represent one tamperproof unit.

A second type of defense comes from signal design and authentication. Some features can be used to deter spoofing or cause on-air spoofing effects to be detectable depending on how it is conducted. One such feature is data authentication where the recipient can verify that the provenance of the information in the signal. Another method is hidden or location dependent marker. The technique provides information that is hidden in the signal that can only be known to the genuine source. The information is later revealed so verification is possible. A related technique is the use of location dependent marker. Another defense is hidden signal, an example of which is the GPS P(Y) code. If adversaries cannot determine the broadcast signal, then they cannot spoof it. Table 1 categorizes these attacks and potential defenses.

Loran Features for Security

There are many features of Loran that are useful in providing security to the signal. Foremost is its signal frequency and power. The Loran is a low frequency (LF) transmitted at a power level of 400 kW or more. At 100 kHz, the signal has a wavelength of three kilometers thus requiring a large antenna to transmit efficiently. Even a quarter wavelength antenna is physically difficult to realize. Thus, the most common Loran antenna in service is a 625 foot (190 m) top loaded monopole (TLM). Antennas as tall as 1350 feet (411.48 m) have been used. The high signal power, necessary to overcome atmospheric noise at long ranges, makes the signal more difficult to jam and spoof. These features make it difficult for adversaries to set up portable, inconspicuous, on-air attacks. Smaller antennas are significantly more inefficient.

eLoran will incorporate a data channel. The data channel utilizes pulse position modulation (PPM) to add data to the nominal Loran pulse. The data channel is designed to provide system information and differential Loran corrections. It can enhance security by providing authentication information to validate the data and source of the signal. A version of the authentication message system has been tested [9]. Furthermore, the data modulation itself can be useful in detecting on-air spoofing as discussed later.

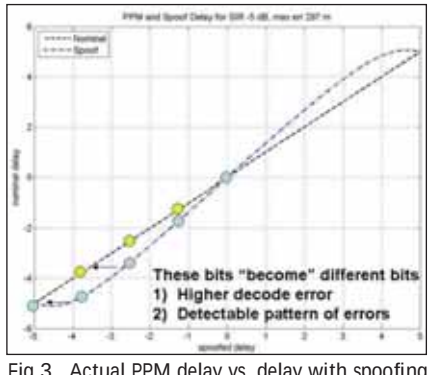

Fig 3. Actual PPM delay vs. delay with spoofing (usec)

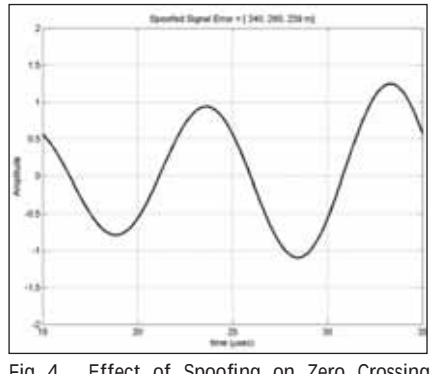
Fig 4. Effect of Spoofing on Zero Crossing Tracking Points

Attacks	Physical Defense	Signal-Processing Based Defense
Jamming (DoS)	Signal Power, Directional Antenna	Increasing receiver sensitivity
On-air Spoofing	Signal Power, Directional Antenna	Signal and data cross checks, Hidden (Location) Markers, Hidden Signals
Direct Inject Spoofing	Tamper Proof	Authentication, Hidden (Location) Markers, Hidden Signals

Table 1. Attack Scenarios and Defense Options

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Another difference between Loran and GNSS is that the former shares its frequency using time division multiple access (TDMA) while the later does it using code division multiple access (CDMA). That Loran is a pulsed broadcast also has security implications. This characteristics makes it more susceptible to "delay and relay" spoofing as signals from different stations are easily separated in time.

On-Air Attacks: Jamming & Spoofing

Jamming a signal involves overcoming the broadcast power of the signal. A general straight forward jamming broadcast is transmission of roughly equal received power at the carrier wave frequency. Due to distance, the received Loran power is significantly less than 400 kW radiated by the transmitter. The power falls off at greater than the nominal square of the distance due to attenuation for propagation along the ground [10]. This can be seen in Figure 1 which uses the nominal groundwave model from [11]. A 400 kW transmitter 300 kilometers away is received with roughly the equivalent power as a 40 W transmitter 5 km away. These are equivalent to a transmitter radiating 4 kW to a user 0.5 km away. The 300 km distance serves as a reasonable value for distance between a user and a close transmitter.

Spoofing a Loran signal by overcoming the transmitted signal is even more challenging than jamming. Part of the difficulty lies transmitting a Loran signal from a short, high Q, antenna. Short, high Q antennas have bandwidths that are much narrower than the signal bandwidth. Thus broadcasting a Loran signal from such antennas is more inefficient than transmitting a pure tone [12]. As a result, spoofing by broadcasting a tonal or near tone signals and affecting the measured time of arrival (TOA) is likely preferred it can be achieved with less power than that needed for jamming.

Antenna Model

The ability to radiate the power from a very short antenna is examined. A very short antenna is one whose height is much less than the transmitted wavelength. As the Loran wavelength is 3 km, even a 100 m antenna may be considered very short! Assuming a short monopole antenna on a perfect ground plane is used, the standard radiative resistance is given by Equation 1. If radiative resistance is the sole governing factor, then radiating the power levels in the previous section would only require currents on the order of ten amperes. However the reactance also be considered.

$$R_r = 40\pi^2\left(\frac{h}{\lambda}\right)^2\Omega \quad (1)$$

For a very short antenna, the reactance of the antenna is mostly capacitative. Equation 2 gives the reactance of a short monopole antenna where Δz is twice the antenna height (h) and a is the wire radius [13]. A similar result can be gained from empirical derivations. Equation 3 is the capacitance from a vertical wire of length h and diameter d with k being an empirical factor related the height above ground of the low point of the wire [14]. The reactance derived from Equation 3 is seen in Equation 4 and is essentially the same as Equation 2 for wires close to the ground ($k \sim .44$).

$$X_A = \frac{1}{2}\left\{\frac{-120\lambda}{\pi\Delta z}\left[\ln\left(\frac{\Delta Z}{2a}\right)-1\right]\right\}\Omega \quad (2)$$

$$C = \frac{24.16h}{\log\left(\frac{2h}{a}\right)-k}10^{-12}F \quad (3)$$

$$X_A = \frac{-30\lambda}{\pi h}\left[\ln\left(\frac{2h}{2a}\right)-\ln(10)gk\right]\Omega = \frac{-1}{\omega C} \quad (4)$$

The voltage difference in a short antenna is effectively governed by the reactance. The current flow is simply the voltage difference divided by the magnitude of the impedance. This is given in Equation 5 where R_{ohmic} (given in Equation 6) is the ohmic resistance (losses) in the antenna. For simplicity and conservativeness, this term is ignored.

$$I = \frac{V}{|Z|} = \frac{V}{\sqrt{\left(R_r+R_{ohmic}\right)^2=X_A{}^2}} \quad (5)$$

$$R_{ohmic} = \frac{2h}{2\pi a}\frac{R_S}{3} \quad (6)$$

From the result, the radiated power can be calculated given an assumed voltage difference and an antenna radius. A reasonably conservative assumption for a maximum voltage potential is 45 kV. Results for an antenna radius of 5 cm at maximum voltages of 5, 25, and 45 kV are seen in Figure 2. The results have some dependency on antenna radius with the general trend being radiated power increases with antenna diameter. Table 3 shows the antenna height needed to achieve the required radiated powers from the scenarios discussed for three different antenna radii.

The analysis indicates that, unless an attacker is quite close, an on-air attack would require antenna structures that are quite significant - over 15 meters in the most optimistic case at 5 km. At ½ km, the antenna heights are more achievable but they will likely be noticed if they are at that distance to the user.

The analysis applies specifically to very short antennas and it does not consider other factors such as top loading which also improves performance. As antennas get larger, the reactance is lower than suggested by Equation 2 due to inductance. In fact, measurements

Proximity of Attack	5 km	0.5 km
Jamming	40 W	0.4 W
Spoof 30 m error	160 mW	1.6 mW
Spoof 150 m error	4 W	40 mW

Table 2. Spoofing Scenarios and Required Power

Scenario (5 & ½ km)	a = 2.3 mm	a = 25.4 mm	a = 50 mm
Jamming (40 W, 0.4 W)	90 m, 27 m	78 m, 22 m	73 m, 21 m
Spoof 30 m error (160 mW, 1.6 mW)	21 m, 6.1 m	17 m, 4.7 m	16 m, 4.2 m
Spoof 150 m error (4 W, 40 mW)	49 m, 14 m	42 m, 12 m	39 m, 11 m

Table 3. Attack Scenarios and Required Monopole Antenna Heights for different radii (a)

of an operating Loran antenna show a reactance of -25 Ω, much less than calculated by the equation [12].

The analysis assumptions represent an optimistic case from the attacker's perspective. It assumes away many losses such as ohmic and matching losses. It assumes no transmitter inefficiencies. It also assumes a perfect ground plane which an attacker is unlikely to approximate due to the amount of preparation needed to set this up.

Detecting On Air Spoofing

Spoofing can be detected on modulated Loran pulses especially if its effect is large. Spoofing as described previously, overlays the broadcast Loran signal with a tonal signal which alters the determined time of arrival (TOA). However, this form of attack leaves residuals that can be detected.

One detection method is to examine PPM pulses. Since the TOA of PPM pulses are not known *a priori*, the effect of the overlay cannot be predicted. Given tonal spoofing, the spoofer effects depend on the data symbol on carried by the PPM pulse. Hence, the spoofer cannot control the outcome. Using 9th pulse modulation as an example, spoofing a 300 m error will result in certain symbols being shifted by one while others will be unchanged as seen in Figure 3. The spoofing is detectable since the symbol errors are systematic and occurs at a high rate. The discrepancy can be checked by the receiver by comparing its actual error rate to expected error rate. With cross checking of modulated pulses, the maximum range error that can be induced is about 250 m or less.

Spoofing also leave other traces on the signal that can be checked. One detection method is to examine multiple tracking point. A short monopole is narrowband and hence difficult to "instantaneously" turn on and off. As a result, spoofing will likely affect multiple Loran cycles. Even if the relative phase between a likely spoof signal and the Loran signal is maintained, the Loran signal envelope changes resulting in a different spoofed "error" at each tracking point. The deviation can be derived by both analysis and simulation. Figure 4 shows an example from simulation. In the figure, spoofing a 239 m error on the 30 microsec (sixth zero crossing) tracking point results in a 280 m error at the 25 microsec (5th zero crossing) and a 340 m error at the 20 microsec point.

Another means of spoof detection is the use of magnetic (H) field antennas. These antennas allow for the determination of received signal direction [15]. A single, on-air spoofing antenna can only generate signals from one direction. Hence a receiver designed to use an H field antenna will be able to distinguish the spoofer from the true system which would have signals coming from multiple directions. Furthermore, the receiver can check the consistency of the incoming signal directions with its calculated location.

Direct Injection Attacks

Resistance to on-air attacks is only one form of robustness. Direct injection attacks such as when the receiver is connected to a spoofing simulator also can pose a navigation security issue. Such an attack likely involves a complicit user with an incentive to deceive the navigation system. Examples include avoiding restricted zones or road toll charges. Such attacks circumvent the physical difficulties mentioned in the previous section. Other security features are necessary to mitigate such attacks. Two useful techniques for Loran to counter these attacks are: 1) authentication and 2) location dependent or hidden markers.

In the context of navigation, ideal authentication verifies the signal source and that the signal has not been maliciously delayed. The former may be provided by schemes based on data or source authentication techniques. Authenticated time dependent data reduces vulnerability to attacks where the signal is captured, stored and rebroadcasted. A symmetric key based data authentication protocol, Time Efficient Stream Loss-tolerant Authentication (TESLA), has been suggested for use in navigation [16] [17]. TESLA has been test implemented on Loran [9]. Another category of data authentication techniques that can be used is cryptographic signatures. Cryptographic signatures use a public-private key pair. They require distribution of a public key that is confirmed to be from the true system and a mechanism for revoking and redistributing public keys should a private key be compromised. While these systems require more processing (orders of magnitude) and longer keys than symmetric key systems, the gap can be narrowed with newer techniques such as those based on elliptic curves [18]. Both methods may be modified for *eLoran* and other low bandwidth navigation systems with some performance loss [19] [20].

Even with data authentication, the signal can still be delayed and quickly rebroadcast. Location dependent information and other hidden markers may be used to compliment data authentication and reduce the threat. For Loran, cross rate interference (CRI) provides one means. CRI cause different data bit errors depending on location. Receipt of the full message allows the Reed Solomon error correction to identify these interfered or "hidden" bits. Data authentication and time dependent data are needed so that a spoofer cannot generate a valid message *a priori* and the user can cross check the "freshness" of the message. The result is that a spoofer cannot generate the full sequence of data until after it receives the full message delaying its ability to rebroadcast. The delay from needing the full message and the time dependent information makes it difficult to trick users with reasonable knowledge of time. The weakness of CRI is that it has slow spatial decorrelation. The attacker can be several kilometers away and still experience the same CRI effects. It may be possible to augment the Loran broadcast specifically to improve the performance of the concept.

Conclusions

The article examines navigation security by using *eLoran* as a case study. It discusses the possible attacks that could affect the signal and user. It determines the vulnerability level and looks at available mitigations.

In analyzing on-air attacks, the article

quantifies the amount of power needed to jam or spoof Loran signals and determines the feasibility of an attacker to achieve these levels. While the required power is orders of magnitude larger than that need to jam GNSS, it is still not very large.

The difficulty in attacking Loran lies in generating the required radiated power from a short antenna. The analysis shows that generating a few milliwatts of output at low frequency on a small antenna requires significant input voltage. Hence, on-air jamming and spoofing is tremendously challenging and requires significant infrastructure to achieve. While certain forms of spoofing are easier, they still represent a significant challenge to an attacker. Even if the equipment issues can be overcome, spoofing effectiveness is limited in terms of the error inducible and detectability.

For direct injection attacks, the article examines potential defenses that are or could be incorporated into the system. It discusses techniques to aid the authentication of the Loran signal and its use with location based makers. These represent the major defense against direct injection attacks.

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The views expressed herein are those of the authors and are not to be construed as official or reflecting the views of the U.S. Coast Guard, Federal Aviation Administration, Department of Transportation or Department of Homeland Security or any other person or organization.

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Bibliography

"Vulnerability Assessment of the Transportation Infrastructure Relying on the Global Positioning System," John A. Volpe National Transportation System Center, August 20, 2001.

Press Office, U.S. Department of Homeland Security, "Statement from DHS Press Secretary Laura Keehner on the Adoption of National Backup System to GPS," February 7, 2008

General Lighthouse Authorities of the United Kingdom and Ireland, Research and Radionavigation, "The Case for *eLoran*," Version 1.0, May 2006

Scott, L., "Anti-Spoofing & Authenticated Signal Architectures for Civil Navigation Systems", Proceedings of the Institute of Navigation GPS Conference, Portland OR, Sept 2003

Kuhn, Markus G., "An Asymmetric Security Mechanism for Navigation Signals", 6th Information Hiding Workshop, 23-25 May 2004, Toronto, Canada, Proceedings, LNCS 3200, pp. 239–252, Springer-Verlag.

Bowditch, Nathaniel, "Chapter 12: Loran", The American Practical Navigator, Paradise Cay Publications, 2004

Forssell, Borje, "The Dangers of GPS/GNSS", Coordinates, February 2009

Humphrey, T. E., Ledvina, B. M., Psiaki, M. L., O'Hanlon, B. W., and Kintner, Jr., P. M., "Assessing the Spoofing Threat: Development of a Portable GPS Civilian Spoofer," Proceedings of the Institute of Navigation GNSS Conference, Savannah, GA, Sept 2008

Qiu, Di, Lo, Sherman, Peterson, Benjamin, and Enge, Per, "Geoencryption Using Loran," Proceedings of the Institute of Navigation National Technical Meeting, San Diego, CA, January 2007

International Radio Consultative Committee, "Ground-Wave Propagation Curves for Frequencies Between 10 kHz and 30 MHz", CCIR Recommendation 368-7, Geneva last updated 1992.

Lo, Sherman and Enge, Per, "Analysis of the Enhanced LORAN Data Channel", Proceedings of the 2nd International Symposium on Integration of LORAN-C/Eurofix and EGNOS/Galileo, Bonn, Germany, February 2001, pp. 159-168

Hardy, T., "The Next Generation LF Transmitter Technology for (e)LORAN," Proceedings of the Royal Institute of Navigation NAV08/International Loran Association 37th Annual Meeting, London, UK, October 2008

Stutzman, Warren L., Thiele, Gary A., *Antenna Theory and Design*, Second Edition, John Wiley & Sons, Inc, New York, 1998

Jordan, Edward C., *Electronmagnetic waves and radiating systems*, Second Edition, Prentice-Hall, Englewood Cliffs, NJ, 1968

Johannessen, Erik, "Loran's Role in Future PAT," Proceedings of the 35th Annual Convention and Technical Symposium, Groton, CT, October 2006 (Presentation only)

Wullems, C., Pozzobon, O., Kubik, K., "Signal Authentication and Integrity Schemes for Next Generation Global Navigation Satellite Systems," Proceedings of the European Navigation Conference GNSS, Munich, July 2005

Perrig, A. Canetti, R., Tygar, J.D., and Song, D., "The TESLA Broadcast Authentication Protocol," CryptoBytes, 5:2, Summer/Fall 2002, pp. 2-13

National Security Agency (NSA), The Case for Elliptic Curve Cryptography, 2009, http://www.nsa.gov/business/programs/elliptic_curve.shtml

Becker, Georg, et. al., "Efficient authentication mechanisms: A Radio-navigation case study," Proceedings of the Institute of Navigation GNSS Conference, Savannah, GA, September 2009

Lo, Sherman and Enge, Per, "Authenticating Aviation Augmentation System Broadcasts", Proceedings of the Institute of Navigation/Institute of Electrical and Electronics Engineers Position Location and Navigation Symposium 2010, Indian Wells, CA May 2010

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To find out more about Dimensions 2010, visit **www.trimbledimensions.com**

GLONASS to be completed by Jan

In the period before January, Russia is going to accomplish the orbital constellation of GLONASS. This would allow GLONASS to cover the entire world. Head of the Russian Space Agency Anatoli Perminov has told this to a ceremony to lay the foundation stone of the GLONASS headquarters, recently. The building will also house an office of the IT and satellite navigation agency of the UN. An upgraded version of GLONASS will be before 2020. *The Voice of Russia.*

Acoustic tests on new Glonass-K Satellite completed

Acoustic tests on a new generation Glonass-K navigation satellite, set for launch later this year have been completed successfully at a plant in southern Russia. "These types of experimental tests were carried out to confirm the resilience of the Glonass-K satellite to the acoustic pressure which will be applied on it when it is orbited," a statement by the plant said. *http://en.rian.ru*

Russia to launch 3 Glonass Satellites

A Proton-M carrier rocket bearing three Glonass-M navigation satellites will be launched from the Baikonur space center in Kazakhstan in September. *http://en.rian.ru*

GPS devices may be costlier in Russia

An import duty of up to 25% on GPS navigation equipment could be in place from January 2011 according to Sergei Ivanov, Deputy Prime Minister, Russia. "It is time to introduce if not prohibitive then at least some import duties on GPS equipment," said Ivanov. However, the official said there would be no ban on devices working with the US Global GPS, though Russia had threatened to do so. "If GLONASS-GPS equipment is imported than the duty will remain at zero level," he said. "This way we will stimulate not only domestic but also foreign producers (to manufacture GLONASS equipment)." *www.autonews.com*

Goulburn Valley Water improves efficiency with customized GPS Software

Goulburn Valley Water, Victoria, Australia provides urban water and wastewater services to 121,000 people in 54 towns and cities in an area stretching from the outskirts of Melbourne to the Murray River. With 58,000 water meters spread over 20,000 square kilometers (12,000 square miles), checking water readings and maintaining meters is a time-consuming and costly exercise.

Goulburn Valley Water intends to reduce that cost by accurately capturing the locations of all 58,000 meters, and replacing hard to access meters with smart meters, which will enable the organization to obtain hourly flow data from to gain an accurate snapshot of the water network. "With smart meters we'll be able to get a snapshot of the network at a particular point in time, whereas at the moment we can't. It's physically impossible to read every meter in a town at the same time", says Noel Squires, Information Systems Manager at Goulburn Valley Water. Currently, meters are read every four months.

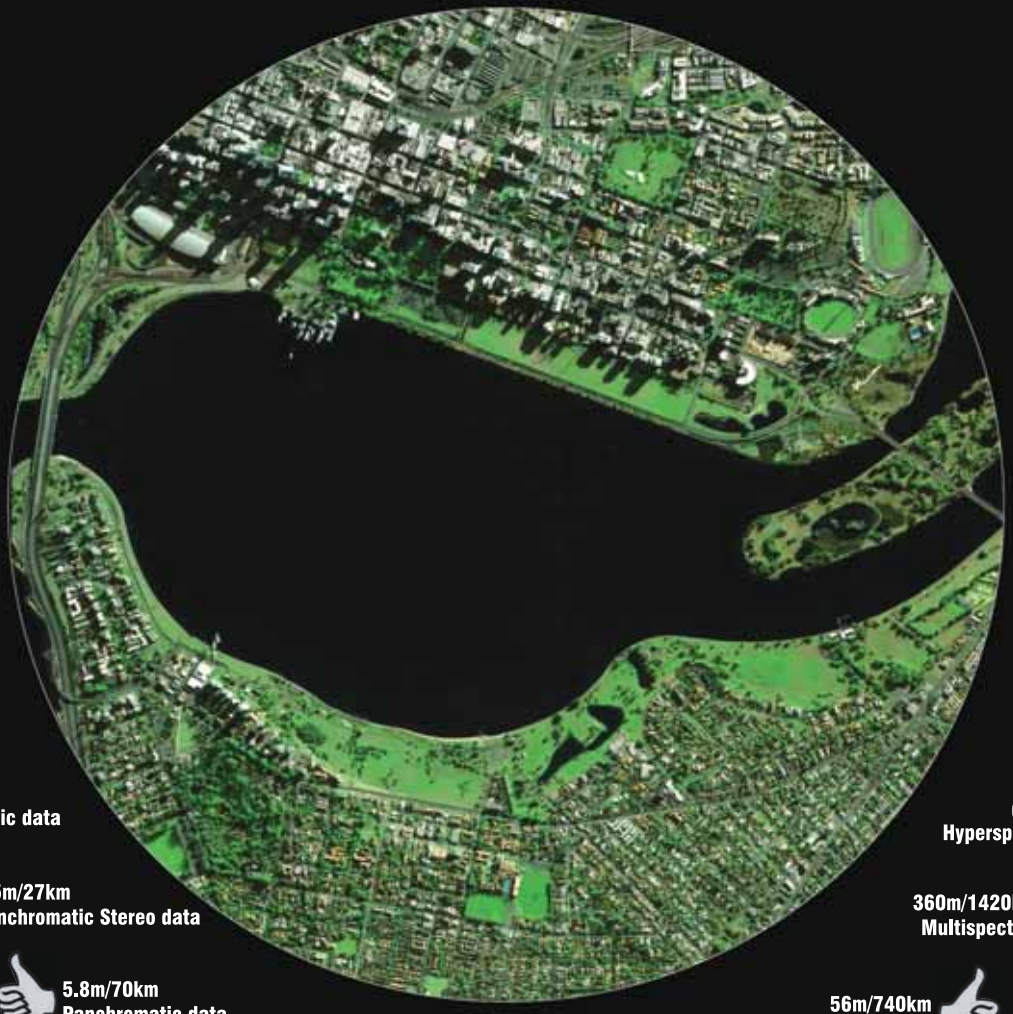
The first step in the project is to find all of the existing meters and record an accurate location so that they can find them again. To do this, Goulburn Valley Water equipped their meter reader field crew with Trimble® GeoExplorer® 2008 series GeoXH™ handhelds and Zephyr™ antennas mounted on rangepoles.

For the GIS data collection solution they turned to Thinking Windows, who with the help of the Trimble GPS Pathfinder® Tools Software Development Kit (SDK) produced an application named Aquire for Goulburn Valley Water.

The Aquire software was a tremendous success for Goulburn Valley Water. With it, the organization is now considering changing the meter reading process so that the meter reader picks up the location of the meter as well as the actual reading.

Satisfied with their meter location solution, Goulburn Valley Water is now contemplating other uses of high accuracy GIS data. The GPS Pathfinder Tools SDK is likely to be an integral part of any future solution, as it enables the simplification of data collection, allowing field crews to stay productive. "You never know when there's something you're going to need the location of" says Squires. He too, believes the GPS Pathfinder Tools SDK has been crucial to their success: "It's the Swiss Army knife of GPS. It's brilliant!" *www.trimble.com*

Indian Remote Sensing Satellites (IRS) offering a bouquet of data services



1m/9.6km
Panchromatic data

2.5m/27km
Panchromatic Stereo data

5.8m/70km
Panchromatic data

5.8m/23km
Multispectral data

23m/140km
Mulstispectral data

64 channel
Hyperspectral data

360m/1420km
Multispectral

56m/740km
Mulstispectral data

36m/140km
Mulstispectral data

Perth Australia as seen by IRS

"Globally distributed through a network of 20 international ground stations and 20 resellers".

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SEAGAL Project Collaboration Centre Opening in SE Asia

The Collaboration Centre on satellite navigation in South East Asia, whose setup has been co-funded by the EU, will open in Hanoi (Vietnam) on October the 1st at the presence of the Ambassador of the EU to Vietnam, Mr. Sean Doyle.

The Opening will be preceded by the Third International SEAGAL Workshop on Satellite Navigation and its Applications (September 28th-30th). The Workshop will focus on the "state of the art" in satellite navigation. The new Collaboration Centre is the joint product of the work of leading European and Asian technical universities. The Centre is focused on satellite navigation technology, with particular emphasis on the European Galileo system. The aim is to involve all the ASEAN countries, starting from Vietnam in this first phase. The common goal is to start a new European-Asian collaboration in the satellite navigation, one of the most profitable technologies of the next future. The Centre set up is co-funded by the 7th Research Framework Programme of the European Union, dedicated to research and innovation. European Union believes in this technology and it is investing €5 bln in its new Global Navigation Satellite System, Galileo.

New documents about GPS released

The new IS-GPS-200E, IS-GPS-705A, and IS-GPS-800A documents have been approved for public and are available at www.gps.gov/technical. A new section has been added on U.S. government continuity commitments for semi-codeless GPS users. *www.ngs.noaa.gov*

Kinematic GPS challenge

The National Geodetic Survey (NGS) is conducting a 12-year project to re-define the vertical datum of the US. This project, referred to as GRAV-D, Gravity for the Redefinition of the American Vertical Datum. It is accomplished by flying airborne gravity missions over the continental and coastal US. Gravity solutions require accurate sensor positioning and accelerations, which in turn requires precise and accurate GPS solutions for the aircraft. *www.ngs.noaa.gov*

GPS IIR Satellite surpasses 10 years on-orbit

The fifth GPS IIR-5 satellite, designed and built by Lockheed Martin has reached 10 years of successful on-orbit operations. The satellite was launched on July 16, 2000, and is one of 30 GPS spacecraft currently on-orbit. *www.lockheedmartin.com*

USAF announces Civil Navigation Test Vectors

The first-ever GPS IIF space vehicle was successfully launched from Cape Canaveral AFS in May 2010. The GPS Wing historically executes an extended on-orbit checkout period for each new GPS space vehicle family to evaluate navigation signal performance and to baseline satellite operating characteristics. The GPS IIF satellite is currently in the middle of its checkout process, and civil signal monitoring is an integral part of the GPS Wing's L-Band Signal-in-Space (SIS) performance assessment. The GPS Wing, in cooperation with the FAA and U.S. Coast Guard Navigation Center (NAVCEN), developed a small set of CNAV test vectors which will be broadcasted during this performance assessment. *www.navcen.uscg.gov*

Honeywell Completes CDR

Honeywell announced that its On Board Computer, Reaction Wheel Assembly and Inertial Measurement Unit, which are part of the USAF GPS III program, have successfully completed Critical Design Reviews. *www.honeywell.com*

ITT navigation payload passes key milestone

ITT has announced that it has passed a key milestone with the successful completion of the Critical Design Review for the Navigation Payload Element (NPE) the company is developing for the U.S. Air Force's GPS III. ITT integrates and tests the components in the NPE on to the GPS III Space Vehicle flight panel. The NPE consists of several transmitter units and the mission data unit, Atomic Frequency Time Standard; passive RF components and various harnesses and cables. *www.itt.com*

GPS to streamline Lankan Railways

The ICT Agency of Sri Lanka (ICTA) and the Sri Lanka Railway Department (SLR) and gTrack Solutions Private Ltd. signed a MoU recently to use GPS and GSM Technologies that would greatly enhance the railway transport management in Sri Lanka. *www.dailymirror.lk*

China launches fifth Compass Satellite

China successfully launched its 5th orbiter into space as a part of its indigenous satellite navigation and positioning network. The satellite will join another four satellites in orbit to form the COMPASS network that will eventually consist of 35 satellites. *www.chinaview.cn*

Veripos extends GNSS networks

Veripos has extended the Baltic sector of its European multi-source Differential GPS service network with the establishment of new reference station facilities in Stockholm. Meanwhile, a new station has also been added to the Americas regional network serving offshore users in North, South and Central America as well as the Caribbean with installation of similar facilities in San Diego for enhanced coverage of eastern sectors of the Pacific. *www.veripos.com*

INRIX expands traffic network

INRIX has expanded its European real-time traffic coverage to 18 countries. It now cover more than 1 million kilometers of motorways, city streets and secondary roads, throughout Europe. *www.inrix.com*

NAVTEQ's private Beta programme

NAVTEQ announced a private beta programme to preview NAVTEQ JourneyView™, to be launched in early 2011. It will give customers an opportunity to preview the data and provide feedback that will ultimately influence final product specifications. *www.navteq.com*

PBBI Location-based DaaS offering

Pitney Bowes Business Insight has introduced the Geosk™ Platform - a location-based Data-as-a-Service (DaaS) offering. It has a comprehensive geospatial data catalogue and delivers it via a cloud-based portal that lets customers pay as they go. *http://go.pbinsight.com*

IDV Solutions new Partner Program

IDV Solutions announced a new partner program enabling new partners to join an existing network of companies who provide leading public and private sector clients with Visual Fusion solutions for business intelligence, security management, market analysis, supply chain management, and more. *www.idvsolutions.com*

Masternaut's iPhone vehicle tracking

Masternaut has launched Rapide app, a web-based vehicle tracking service for the Apple iPhone and iPad. Managers can use this information to monitor the exact movement of their entire fleet, with instant updates tracked by GPS. *www.masternaut.co.uk*

GPS-based crash avoidance system

Ford is developing the Automatic Braking Intersection Collision Avoidance System that uses wireless and GPS technologies so automobiles can literally speak to each other and mitigate accidents. The software would use this information to warn the driver of a potential collision and even begin braking. *www.ford.com*

Get directions using eyeglasses!

Japanese engineers at the University of Electro-Communications' Nakajima Laboratory have created a prototype device that places GPS navigation technology into a pair of wearable glasses. The glasses, known as the 'Wearable Personal Navigation System', house a battery, a microcomputer, a magnetic directional sensor and a number of LED lights. *www.pcworld.com*

Navagis announces MobileRecon app

Navagis MobileRecon application is meant for iPhone, Android, and Blackberry, which works seamlessly to deliver geo-located and time-stamped video, audio, photographs, text, and data from the field directly onto Google Earth Enterprise *www.navagis.com*

At a Glance

- The USGS has awarded an Indefinite-Delivery, Indefinite-Quantity contract for GPS/GNSS receivers and antennas with a five year ordering period and a $3.9M ceiling to JAVAD GNSS.
- GeoEye has won a $3.8 billion contract award from NGA.
- Hemisphere GPS announced the supply of its LV101 GPS compass to TECHNOMASTER.
- DigitalGlobe has entered into a $3.55 billion agreement with NGA.
- Antonio Carlos Salmán Gonzalez has received the ESRI Lifetime Achievement in GIS Award.
- URISA announced that Singapore's OneMap has won the 2010 Exemplary Systems in Government Award in the enterprise systems category.
- Patent applications for satellite-based technologies have doubled in the last five years, according to patent and trademark attorney Withers & Rogers.
- Arianespace to launch GSAT 10 for India.
- A geospatial book titled "Why 'Where' Matters: Understanding and Profiting from GPS, GIS and Remote Sensing" is to be published soon. www.geoeconomy.com
- SuperGIS Desktop 3 from SuperGeo Technologies supports French and German now.
- OGC® and OSGeo will develop conforming documentation for key OGC standards and geospatial open source application descriptions.
- DLR inaugurates first ground station in Canada

Galileo update

U.S. and EU announce improved performance from combined GPS and Galileo receivers

The US, the European Union and its Member States announced the conclusion of an initial phase of consultations affirming user interoperability and enhanced performance of combined GPS and Galileo receivers performance under the auspices of their 2004 Agreement on the Promotion, Provision and Use of Galileo and GPS Satellite-Based Navigation Systems and Related Applications.

A working group designed to enhance cooperation for the next generation GPS and Galileo completed an assessment of the global, combined performance for GPS SBAS receivers using the EGNOS and the GPS WAAS supporting safety-of-life applications. The results confirmed improved availability for a wide range of aviation services in both hemispheres and significantly improved robustness to GPS satellite outages. The working group also completed an assessment of receivers integrating planned interoperable GPS III and Galileo open civil services. The study compares GPS, Galileo, and GPS/Galileo combined performance for three receiver types using four study cases. http://pnt.gov

EGNOS transition towards Safety of Life service

ESSP, the designated EGNOS system operator and provider of its Safety-of-Life (SoL) service, launched the procedure to remove the 'MT0' warning from the EGNOS Signal in Space on 2 August 2010, in order to start broadcasting EGNOS integrity messages.A transition work plan is being prepared in cooperation with ESA and industry, aimed at enabling the start of the SoL service in November of this year, as planned. This could include the carrying out of further tests. Once the Safety-of-Life service is declared operational, pilots will be able to use the EGNOS APV approaches for landing without needing ground-based navigation equipment and achieve performances similar to those provided by Instrument Landing Systems (ILS Cat. I). www.gsa.europa.eu

Atomic Clocks for 14 Galileo Satellites

SELEX Galileo has signed a €30 million contract with Surrey Satellite Technology LTD (SSTL) to supply PHM atomic clocks for all 14 Galileo FOC (full operational capability) satellites. The PHM-Passive Hydrogen Maser- clock is the most stable for space applications and has been tested successfully in GIOVE-B. www.selex-sas.com

European Satellite Navigation Competition 2010

The seventh edition of the European Satellite Navigation Competition has ended with a great variety of innovative ideas. The previous record of inventive suggestions and participating countries has been remarkably exceeded: this year 357 progressive ideas came from no less than 44 countries. The ideas will now be evaluated by experts from all over the world and the winners will be awarded in October.www.galileo-masters.eu

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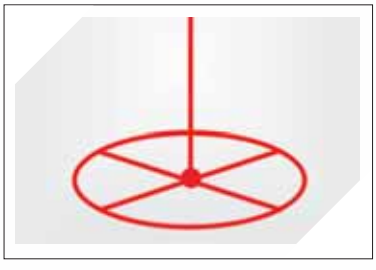

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DigitalGlobe: High-resolution imagery for handheld GPS, releases Ortho Product Series

DigitalGlobe is to provide high-resolution imagery for DeLorme's Earthmate series, including the PN-30, PN-40 and PN-60 models. Hikers, climbers and other outdoor enthusiasts will be able to update their GPS device with accurate imagery. Its Ortho Vision line is designed for professional users in need of quality images for analysis and identification. Images classified as Ortho Vision Premium will feature less than 3% cloud cover; geometric breaks less than one meter and tonally balanced imagery in addition to no haze, pollution or fog. *www.digitalglobe.com*

Food grain output in India seems stagnant for 10 years

A nine-member team of scientists from NASA, the Boston University and the Indian Institute of Tropical Meteorology, Pune, analyzed the satellite remote sensing data from 1982-2006 and has confirmed that the growth rate of food grain production in India has been stagnant in the last decade. *http://economictimes.indiatimes.com*

Remote Sensing Applications (e-Book)

National Remote Sensing Center, India has brought out a book on "Remote Sensing Applications" covering land, water, atmosphere and natural disasters. The book has been compiled and edited by P.S. Roy, R.S Dwivedi and D. Vijayan. The book can be viewed/downloaded at *www.nrsc.gov.in/Remote.html*

Topcon's IP-S2 HD Mapping System

Topcon Positioning Systems has released the IP-S2 HD Mapping System – a vehicle-mounted surveying and mapping system featuring a high-definition LiDAR scanner. It includes high-precision GNSS receivers, IMU, vehicle wheel encoder, 360-degree digital cameras and Velodyne's HDL-64E S2.2 LiDAR scanner. *www.topconpositioning.com*

Water resources conservation in China using ERDAS IMAGINE

The Ministry of Water Resources, China recently announced a project that uses ERDAS IMAGINE to facilitate conserving and protecting China's water resources. It is being used to identify the areas where the water is being adversely affected by soil erosion. *www.erdas.com*

FARO introduces break resistant SMR

FARO Technologies announced the release of its break resistant spherically mounted retroreflector as a part of their newly expanded line of laser tracker targets. These new targets are available in three models: standard accuracy, long range, and high performance. *www.faro.com*

Global Forest Monitoring service

DMCii's Global Forest Monitoring service uses satellite imagery to produce easily-understood maps of forest cover change. The service's wide-area forest surveys can be updated annually, monthly - or more often still for areas judged most at risk – delivering the timely data necessary for operational management. It is based around a constellation of six satellites known as the Disaster Monitoring Constellation which work together to provide rapid mapping services. *www.dmcii.com*

Cooperation to promote satellite technology application

JAXA, Japan and the ADB has agreed to cooperate in providing technical assistance to ADB supported projects using satellite data and will work on capacity development on the use of satellite data through the training of persons from national institutions in Asia and the Pacific region. *www.jaxa.jp*

Image analysis toolbox for ESRI® ArcGIS® platform

ITT Corporation announced the third phase of its software technology with the ArcGIS. Building on the multi-year integration of the two platforms, this latest phase will give ArcGIS users the ability to access ENVI tools for analyzing geospatial imagery directly from within the ArcGIS desktop and server environments. *www.itt.com*

DALSA announces expanded capabilities

DALSA announced expanded capabilities including backside illumination (BSI) in custom image sensors for aerospace applications in earth observation and remote sensing. New technologies in multispectral filters allow DALSA to capture images from not only the traditional RGB visible color bands but also a number of near-infrared bands in a single compact and cost effective package. The new custom back side thinning capability enables the high quantum efficiency. *www.dalsa.com*

African observatories will gather biodiversity data

Scientists are pooling remote-sensing satellite data and GIS services for two pan-African digital observatories that will provide accurate and readily accessible information on biodiversity and forest cover for policymakers. Under a grant the European Commission's Joint Research Centre is supporting the development of the observatories. One is the Observatory for the Forests of Central Africa; the other is the Digital Observatory for Protected Areas. *http://allafrica.com*

Inventory of Russian forest using space technologies

Satellite imagery based on the State Forest Inventory Program on behalf of the Russian Federal Forestry Agency is being acquired by ScanEx Research & Development Center. VHR data from SPOT 5 and Formosat-2 satellites (resolution: 2,5m) covering a territory of more than 128 million ha will be delivered in the coming months. *www.scanex.ru*

"Global Geospatial Initiative"

In an effort to assist emerging, and disaster-stricken, economies to more effectively enter the global marketplace, The Gadfly Project is introducing its Global Geospatial Initiative. This program will make cutting edge geo-based technologies available, at a fraction of the cost, to regions and nations that cannot afford such systems. TGP will provide the services and training that will allow these entities to develop new GIS, web maps, and geo-management practices. *www.thegadflyproject.org*

OpenDragon Geoinformatics Software

OpenDragon, from Global Software Institute is available for free download by users anywhere in the world. It offers a full suite of image analysis and raster GIS capabilities including image enhancement, supervised and unsupervised classification, geometric correction, measurement and statistics, vector capture and display, slope, aspect and buffer calculations and multi-criterion decision making. It also includes the OpenDragon Toolkit. *www.open-dragon.org*

Geospatial mapping to detect areas without schools

The Indian Government has proposed to undertake geospatial mapping of the states with regard to the unavailability of primary, secondary and higher education institutions to ensure that no areas are left without schools and colleges. This exercise will help the Government to get information for setting up institutions as per the requirement, so that no area is left unattended. *PTI*

Disaster Relief Mapping in Pacific Rim

DeLorme is currently assisting the Government of Australia and the Association of Southeast Asian Nations in the development of a disaster relief mapping service in the Asia Pacific Rim. It will provide precise electronic maps that would serve as a base for overlaying critical information during disaster response operations in the region. *www.delorme.com*

Geo-coded population census in Bangladesh

Bangladesh is going to use digital enumeration maps and a geo-coding system for the first time in holding the 5th Population and Housing Census in the country. Digital enumeration maps and the computerized geo-coding system will be used to collect the data and disseminate results simultaneously in hard and soft formats as well as on the web page. Over 70,000 maps, made by aerial photographs, containing each mouja and union across the country would be used in conducting the census. *www.bssnews.net*

Lagos gets GIS unit for power supply

In a renewed effort to boost power supply in Lagos State, Nigeria the management of the Power Holding Company of Nigeria has inaugurated a GIS unit in the State. It aims to monitor all power related problems in the state for prompt routine maintenance and repairs. *www.tribune.com.ng*

Autodesk Certification availability

Autodesk announced the expanded availability of the Associate Certification exam to 165 countries through an alliance with Pearson VUE Testing Centers. This partnership provides opportunities to Autodesk customers and partners in markets where certification has not been previously available, enabling them to certify their 2D and 3D technology skills and remain competitive in the global marketplace. *www.autodesk.com*

Seeking map data in response to Pakistan floods

Google's Crisis Response team has provided satellite imagery and KML layers to assist relief efforts in past disasters. In Pakistan, however, the cloud cover over the impacted areas has inhibited the ability to make this valuable content available. The Crisis Response team is looking to collect and aggregate imagery and user generated KML, or other map data, with the goal of making this content more accessible to both crisis responders and the general public. *http://google-latlong.blogspot.com*

New mobile GIS bundle reduces deployment risk

General Dynamics Itronix is offering its Duo-Touch® II tablet PC together with ESRI's ArcPad mobile GIS software. It is small, robust and lightweight, making it ideal for many mobile environments. It includes wireless connectivity, fast processing and integrated security features. *www.gd-itronix.com*

Citizen Self-Services and INSPIRE regulations

The requirements of the 2009 INSPIRE regulations mean that all public authorities and public data holders are required by the end of 2010 to record specific location-based data in an online register. The INSPIRE Directive mandates how public sector organizations across Europe should share geospatial data, and is estimated to be worth $243 million per annum. *www.pbinsight.com*

Google corrects map border error

Google has corrected the map it had posted on the Net of the borderline between Viet Nam and China after a complaint by the Ministry of Natural Resources and Environment's Department of Survey and Mapping in Vietnam. *http://vietnamnews.vnagency.com.vn*

Intergraph debuts new Incident Management Solution

Intergraph introduced the Incident Management version 9.1 which will provide police, fire, EMS and security agencies the ability to optimize agency resource allocation and improve response coordination to better save lives and protect property in the communities they serve. *www.intergraph.com*

Odin series handheld receiver by UniStrong

UniStrong (Beijing, China) has released Odin series handheld receiver for GIS data collection. It comes with Windows Mobile operation system, rugged and suitable for field work. It has integrated Bluetooth/GPRS/WiFi, 3 Megapixel digital camera, high capacity Li-ion battery and supports SD card.*www.unistrong.com*

Trimble and Critigen extend agreement

Trimble and Critigen announced an extension of the business partner agreement originally established in 2004. Critigen will serve as system integrator and provide data management and visual business intelligence solutions to support Trimble's technology and products in the utilities, state and local government, and environmental management markets. *www.trimble.com*

Hemisphere GPS announces new GPS Antennas

Hemisphere GPS released A52 and A21 – two new antennas. A52 is a multi-GNSS (GPS L1/L2/L5, GLONASS L1/L2, Beidou, SBAS, OmniSTAR, and Galileo E1/E5a and b) precision antenna that is ideal for various applications. A52 can be used in challenging environments as it has superior multipath mitigation, a stable phase center, and strong SNRs even at low elevations. *www.hemispheregps.com*

RCMRD and UNOOSA sign agreement

The Regional Center for Mapping of Resources for Development (RCMRD), Ethiopia and UNOOSA signed a cooperation agreement making RCMRD the ninth member of the network of regional support offices which support the implementation of the activities of the UN-SPIDER programme in their respective regions in a coordinated manner by taking advantage of the expertise and capabilities being offered. *www.un-spider.org*

New Surveyor General of India takes charge

Mr Swarna Subba Rao has taken over as the Surveyor General of India. He joined the Survey of India as a Deputy Superintending Surveyor in 1983. "The priority is to re-establish our identity and crusade to provide spatial data as per the needs of the market and I do hope to bring about the change long deserved by the Survey of India," said Mr Rao. He added, "We still have the best of manpower and some changes to set the house in order by redesigning the technical aspects should enable the department to once again become a leader in providing data that would not only be the best but also fastest." He also said that the market needs spatial data to suit its requirements and the Survey of India will now work towards catering to market trends. This will require a changed mindset as well as putting into place systems that churned out data in the latest formats. *www.hindu.com*

New OEMStar™ firmware release

NovAtel released Version 1.011 firmware for their lL1 OEMStar GNSS receiver. It provides improved PDP and GL1DE® filter performance, improved satellite tracking in low signal level environments, improved SBAS performance when operating outside of the standard grid map, and improved time to first fix. *www.novatel.com*

Trakm8 selects u-blox GPS & GSM

u-blox and Trakm8 announced a new, advanced remote vehicle monitoring system which relies on u blox' leading GPS and wireless module technology. The solution includes all hardware, software, and system integration services. *www.u-blox.com*

POS LV V5 by Applanix

Applanix released the POS LV Version 5. Now with a POS Computer System (PCS) that is half the size of the previous version, ruggedized and fully sealed, the POS LV V5 delivers accurate, uninterrupted positioning and orientation information from a moving vehicle. *www.applanix.com*

GNSS Spider v4.0

Spider v4.0 is a part of the new reference station software update that also includes Leica SpiderWeb v4.0 and Leica SpiderQC v4.0. It also includes advanced support for the new GR10 "plug'n'play" reference station receiver, enhancements for GNSS monitoring applications, and numerous other new features, improvements and optimizations.

PowerDigger 2D

Leica PowerDigger 2D expands Leica Geosystems' patented unique PowerSnap concept, providing total flexibility and interchangeability of machine control panels and sensors between machinery such as excavators, dozers and graders.*www.leica-geosystems.com*

Text satellite messaging GPS handheld device

DeLorme unveiled the Earthmate PN-60w and the Earthmate PN-60. The PN-60w comes with SPOT Satellite Communicator, making it the first handh eld GPS with type and send outbound text satellite messaging. The Earthmate PN-60w also lets users send text messages to recipients' cell phones and email addresses and to social networking sites. *www.ibtimes.com*

StreetMapper 3D Laser Mapping

StreetMapper is now available with four unique system specifications offering users around the globe a flexible solution for gathering accurate 3D laser measurements on the move. Ranging from dedicated survey vehicles to portable systems that can be checked in as standard luggage

at the airport it can be tailored to meet virtually any surveying requirement on or off road. *www.streetmapper.com*

New GPS chip on the market

Inventek Systems has launched its new SiRFstar IV GPS receiver. The ISM420 SiRFstar IVTM SIP GPS Module is produced for portable, hand-held, embedded and consumer applications. It is based on CSR's new GSD4e chip - a 48-channel GPS receiver. It will track signals as low as -163dBm and can use SBAS such as WAAS or EGNOS. *www.inventeksys.com*

ATHENA Program update

ATHENA Program involves GNSS and Structural Monitoring for non-profit organizations, with the latest future proof Leica GR10 and Leica GMX902 GNSS receivers and the Leica AR10 and Leica AS10 GNSS antennas. ATHENA stands for 'Advanced Technology for Higher-Education and Non-profit Associations' and has the clear objective of introducing the latest GNSS Reference Station and Monitoring technology to the academic and research communities.

Spectracom launches GSG-54 8-Channel Simulator

Spectracom has introduced a new eight-channel GPS constellation simulator, the Pendulum GSG-54. It is designed to provide a wide-range of capabilities for in-line production testing of devices integrating GPS receivers. *www.spectracomcorp.com*

Google extends Germans' opt-out deadline for Street View

Responding to a firestorm of protest in Germany over its disputed Street View navigation service, Google would extend a deadline for allowing people to opt out. Uniquely for Germany, Google launched a campaign giving citizens concerned about safety or privacy four weeks to tell the company to have pictures of their homes or businesses pixelled out before they are published. *www.spacemart.com*

Surrey launches e-commerce website

Surrey Satellite Technology US launched "Surrey Online" - an e-commerce website that handles online sales of SST-US commercial satellites and related products. *www.sst-us.com*

CartoPac 3.1 released

CartoPac Field Solutions released CartoPac 3.1, an enhanced edition of the suite of custom mobile GIS field data collection solutions for efficient data capture and integration with enterprise asset systems. *www.cartopac.com*

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September 2010

GDI APAC
28 - 30 September
Kuala Lumpur, Malaysia
www.geospatialdefenceasia.com

International Astronautical Congress 2010
27 Sep - 01 Oct
Prague Czech Republic

www.iac2010.cz/en

Geospatial Intelligence Summit
28-30 September 2010
Vienna, Austria
www.jacobfleming.com

October 2010

INTERGEO
5 - 7 October
Cologne, Germany
www.intergeo.de

3rd Int Conf on Geoinformation Tech for Natural Disaster Management
19-20 October 2010
Chiang Mai, Thailand
http://www.egeoinfo.net/git4ndm2010/

GSDI-12 World Conference
19-22 October
Singapore
www.gsdi.org

CANEUS - Shared Small Satellites CSSP Int. Workshop
20 - 22 October
Tuscany, Italy
www.caneus.org/sharedsmallsats

GEOINT 2010
25 - 28 Oct
Nashville, Tennessee, USA
http://geoint2010.com

International Symposium on GPS/GNSS
26 - 28 October
Taipei, Taiwan
http://gnss2010.ncku.edu.tw

November 2010

ACRS 2010
1-5, November
Hanoi, Vietnam
www.a-a-r-s.org/acrs/

Trimble Dimensions 2010
8 - 10 November
Las Vegas, USA
www.trimble-events.com

XXX INCA International Congress
10 - 12 November
Dehradun, India
www.incaindia.org

ITN 2010
11-12 November
Lingotto Fiere – Turin, Italy
http://www.itnexpo.it/eng/

Tracking & Positioning
17-18 November
Amsterdam, the Netherlands
www.thewherebusiness.com/tracking/

2nd Asia Oceania Regional Workshop on GNSS
21-22 November 2010
Melbourne, Australia
www.multignss.asia

European Lidar Mapping Forum
30 November – 1 December
The Hague, Netherlands
www.lidarmap.org/ELMF/

March 2011

The Munich Satellite Navigation Summit 2011
1 – 3 March
Munich, Germany
www.munich-satellite-navigation-summit.org

November 2011

TransNav 2011
15-17 June 2011
Gdynia, Poland
http://transnav.am.gdynia.pl

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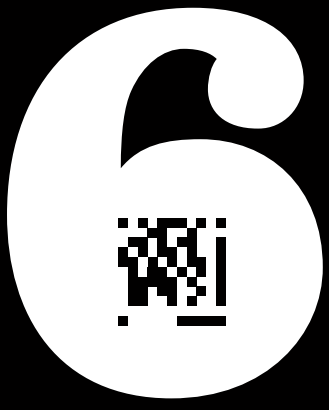

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