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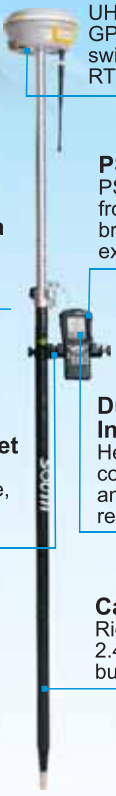

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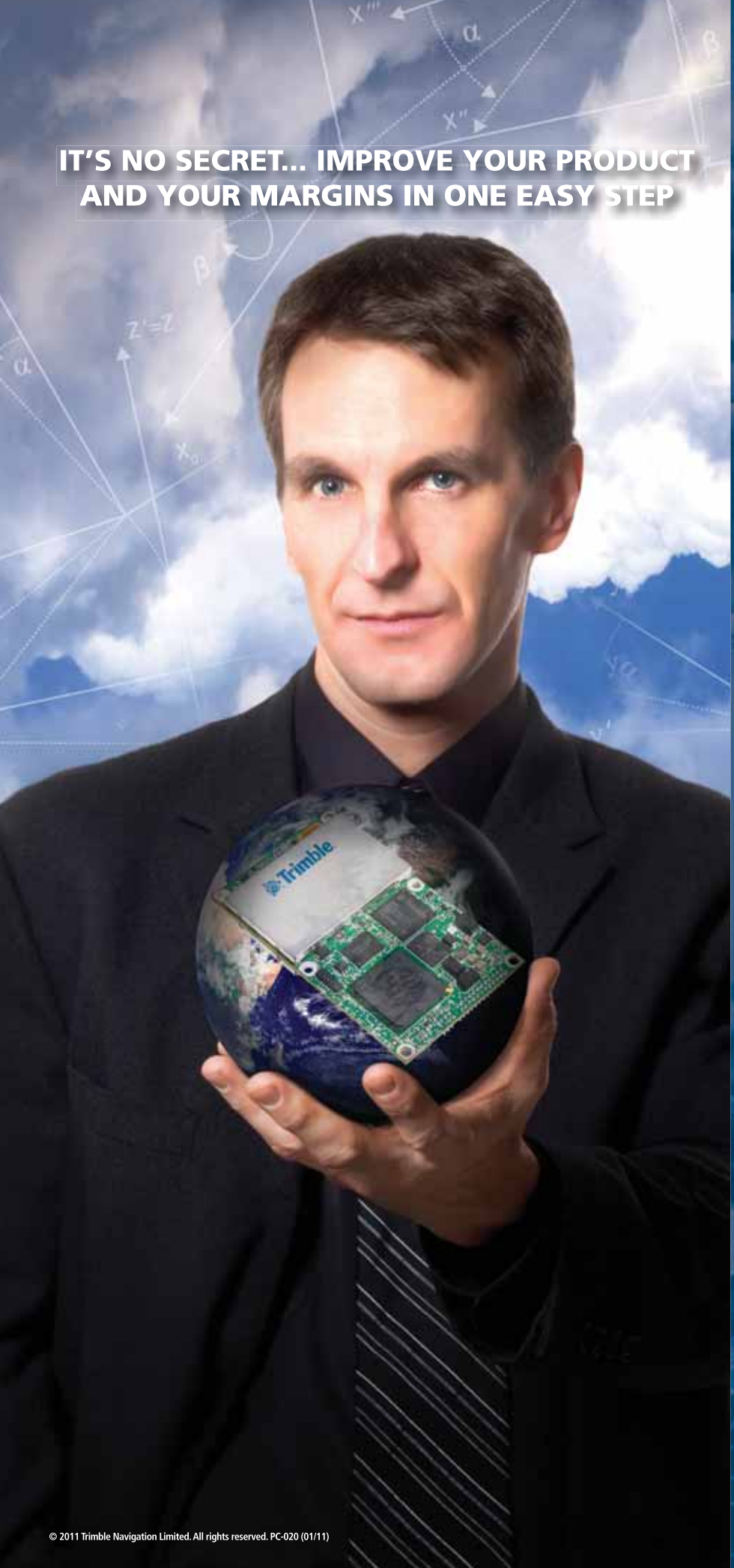

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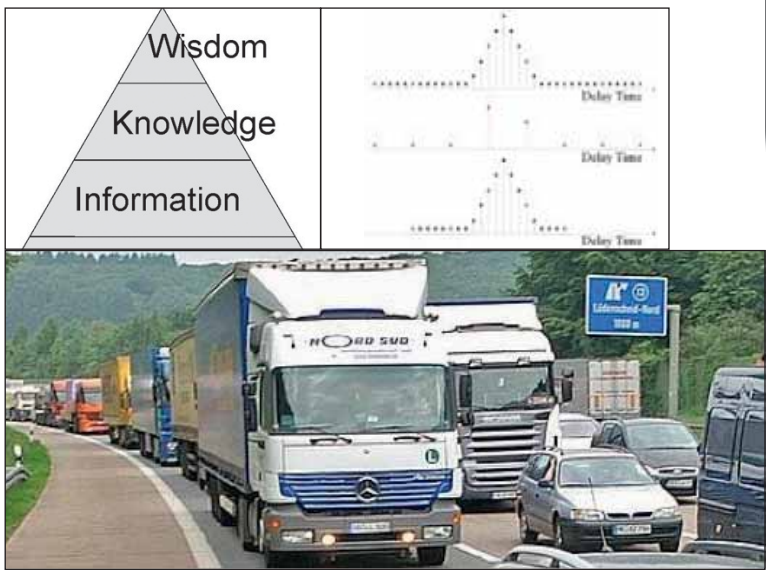

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In a logjam

It is a battle about resources, which is scarce and precious

It is about spectrum.

Stakes are high and consequences are serious.

When in January this year, the Federal Communications Commission (FCC) gave conditional approval to LightSquared,

To roll out its ground based wireless network (4G).

GPS community got nervous.

As testing indicates that LightSquared's ground-based transmissions overpower the relatively weak GPS signal from space.

Though LightSquared will function on the assigned radio band, it is close to the spectrum on which GPS operates.

And will cause interference to GPS devices.

It has triggered frantic discussions and intense debate.

And desperate search for solution.

A solution that is viable,

But not at the expense of GPS.

Also, other GNSS systems in the making should take a cue

To take precaution and avoid similar situation.

Bal Krishna, Editor
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Evolution or Revolution?

This paper aims to analyse the developments in society that influence the functioning of a cadastral organisation

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We come from a situation where the societal relevance of a cadastre was limited to the core statutory tasks of registration and maintenance of cadastral maps and providing information on land parcels and their ownership and use-rights (van der Molen, 2009). Nowadays, modern land registry organisations do not only face many new challenges, also the pace of demand for new products and services increases every year. This paper aims to analyse the developments in society that influence the functioning of a cadastral organisation and to show how the Dutch Kadaster handles these developments. The driving forces behind development are categorised and the impact on our business processes is explained. Secondly we like to show how Kadaster reacts on these developments by introducing new solutions and innovations constantly, and by adapting our organisation and company strategy accordingly. Finally, we summarize the consequences of these developments for the Dutch Kadaster and how our experiences can be of value to other registering organisations, questioning ourselves: are we in the middle of evolution or revolution, should we act or should we react?

Driving forces for developments

Cadastre and land registry organisations are an essential part of modern societies. Modern societies are partly defined by the fact that the can cope with two driving forces causing rapid development: technological push, and societal pull.

Technological development that influences our cadastral working processes are:

-Improved hardware (especially the hand held devices like PDA's and smart phones); -The high availability of base maps and aerial photographs at various scales, both commercial as governmental;

-The widely availability of GPS signal for commercial and governmental applications;

-New techniques like Lidar and the collection of 360 degrees ground imagery;

-The possibility to globalize business process services (making use of fast internet connections). The hosting of a server park, the set up of a Helpdesk or the digitizing of data can be easily done elsewhere in the world at a more convenient price, quality or time scale.

Societal developments that influence our cadastral working processes are:

-The growing ability and need to analyze complex issues; on the fly decision making is expected and asked for;

-Political changes within the country and further globalisation of national policy issues;

-Virtualization of space, ownership and decision making processes (for example an increased liability demand in the virtual world);

-More critical and ICT-literate (end-)users;

-The continuous need for cost reduction and the expectation that data and information are for free.

Recently we experienced the impact of economic and political changes world wide on the functioning of cadastre and land registry organisations. The financial crisis (2008) influenced property and credit registration world wide and political changes in Northern Africa (2011) emphasize the importance of

reliable land registration in the political redevelopment of a country or state. But also demographic, environmental and maybe even ideological changes influence the primary business processes of cadastres and land registries, as these meta¬changes have a direct influence on the role and services society demands from our organisation.

Developments effecting dutch kadaster

As a consequence of the rapidly evolving technological push and societal pull, the processes of collecting, managing and distributing data and information on land properties need continuous adaption to actual demands and insights. Without the intention to be exhaustive, this can be translates in some clear developments effecting the business processes and position of the Dutch Kadaster directly.

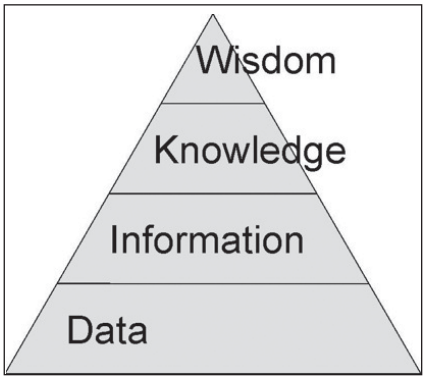

Fig 1. The knowledge pyramid.

Developing demand: From data to information to knowledge

In our primary business processes we experience an increasing demand for more knowledge intensive services. According to Ackoff (1989, see figure 1) we shift from data deliverance centre, towards information provision and knowledge centre. This means that advisory services on our information products (based on our data collection activities) become more and more important.

In the last decade much effort was put in keeping up with the demand for many new information products. Kadaster organisations transformed themselves from 'data factories' into 'information service organisations'. For example, since 2008 the Dutch Kadaster provides to its customers an index matching buyers profile in relation with he purchase classes of the property (see table 1); an information product that ten years ago would have been impossible to produce. This index is now a standard automated product of Kadaster and refreshed every month.

Many other information products could be thought of. However, much time for development is not given as new and different user demands arise swiftly (often based on a strong technology push).

People change

Our society changes into an information based society where citizens, professionals and officials become more and more informed and connected. As a consequence the status of an organisation like Kadaster changes as well; Kadaster moves, unsolicited, from an single issue authority towards a widely available service provider. Also, worldwide, the next generation is better educated in the use of high tech interfaces and the interpretation of huge amounts of information. Social media and virtual environments become part of the real live environment of individuals and organisations.

Offices become web services and location based services

Our society gets more digitalized every day and improved communication technology opens up new applications and possibilities for both citizens as professionals. The demand from office based to internet based to location based information services is a development affecting our business processes severely. Hence, spatial and administrative registrations of governments need to adapt.

Environmental management becomes more and more a 'virtual world activity'

In the demand for a more efficient and reliable government, essential information (which we define as 'key registries' in the Netherlands) is being stored digitally and connected systematically. As the concept of 'data at the source' is assumed to avoid duplication and to improve the efficiency and data quality, data management becomes a joint responsibility of different governmental organisations using all kind of commercial facilities like services, application platforms and infrastructures. The actual terminology used for this is Software-as-a-Services

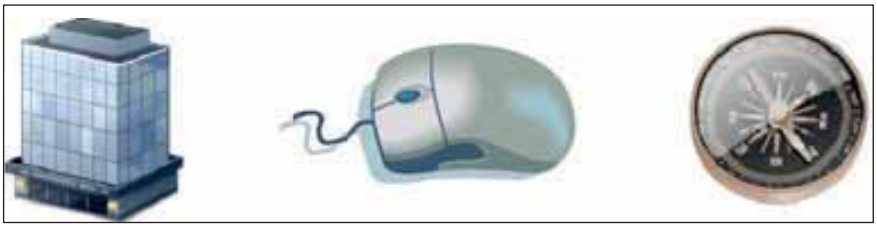

Figure 2. Development from office, to internet, to location based services using high end technology and improved user interfaces.

Age/Month	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09
< 25	100	110	86	124	63	70	79	87	88	82	110	76	82
25 – 30	100	109	78	111	55	60	66	69	72	69	95	68	75
30 – 40	100	107	71	104	57	55	58	59	61	60	78	55	61
40 – 50	100	108	72	108	53	56	56	61	60	61	80	59	64
50 – 60	100	108	73	102	54	49	55	56	56	52	70	59	61
> 60	100	101	74	99	56	50	53	52	55	51	67	52	56

Table 1. Example of an new information product: Index buyers profile and purchase classes. Based on our data we can categorize buyers on age and height of purchase price of the property. Example for the period September 2008 – September 2009 (index value September 2008 is set to 100), averaged for the Netherlands. The table shows that the financial crisis starting in November 2008 gives larges decrease of purchase prices for people elder than 50 years.

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(SaaS), Platform-as-a-service (PaaS) and Infrastructure-as-a-Service (IaaS). Good further reading on this subject is for example given by Baranski et al. (2009). The management of our national spatial data infrastructure (SDI) becomes more and more a virtual world Activity. Hence, decision making and environmental monitoring become more dependent on the virtual environments that governmental organisations maintain. Our cadastral and land registry information sources play a crucial role in these processes, as it influences personal (People), economic (Profit) and environmental (Planet) issues in society. Worldwide, this also becomes obvious in all kind of post-disaster and post-conflict situations.

Problems / demands become to complex to handle on your own

A the Dutch Kadaster we experience that the demand for plain raw data decreases while the demand for solving complex issues increases. These issues are very often not solvable with a single issue data analysis. The integration with information from other organisations or sources is unavoidable in that process. The other way around, our data becomes more and more part of analysis done by other organisations or individuals. For that reason we have to make our data and information available in such a way that our partners and others can solve their problems by integrating our data and information into their systems. This has to be done taking account for all different aspect of the national spatial data infrastructure: data, standards, technique, policy and organisations (after Rajabifard et al., 2003).

Solutions and innovations

Barnasconi and van der Molen (2010) and van der Molen (2009) categorize cadastral

innovations into four major areas of development, giving many examples of innovations:

-The land and real estate market

-Governance

-e-Government services

-Economic activities in general

Innovation of our products and business processes should contribute to improvements in these areas of development. Without repeating the innovations mentioned in previous papers, only the most recent developments are mentioned in this paper. At present about 12 % of our annual turnover is spent in projects focussed on the development of new products and business processes. A substantial part of that budget is spent on new and other registrations ('non-cadastral')and the renewal of existing (database)systems which is necessary as a basis for further innovation and the introduction of new services and products. Looking at the land registry and cadastral mapping part of our organisation, in which roughly 30% of our innovation budget is spent, some notable development projects are mentioned.

For more efficient data collection in the field, tablet computers have been introduced for our land surveyors. These mobile devices have been equipped with a set of software tools for error reduction, optimum route planning and on the spot access to digital information. A gradual introduction of these new techniques for more than 300 land surveyors started in 2010. In connection to this introduction 'solo surveying' is introduced (one person surveying units) and experiments are being done with GPS based tracking and tracing of our vehicles, allowing for better personnel security and planning of activities and routes.

Apart from many new information products (index buyers profiles, Kadaster 'House reports", suitable land plot acquisition for farmers, etc.), Kadaster recently introduced a dashboard on its website (http://www.kadaster.nl/perskamer/vastgoedcijfers.html) providing a monthly actual insight on a variety of Kadaster data. This information is also provided as a web service to selected partners, to be incorporated into other information services outside Kadaster.

Our web services to our professional customers are evolving rapidly. A chain integration project for property registration (so called 'KIK' project) has resulted in the possibility for the automated acceptance and mutation of mortgage deeds and deeds of transfers, both improving our services to notaries and banks. But not only the demands of commercial banks are met much better, also collaboration with national and on-line property brokers is initialised. The integration of our information services improve their commercial web based applications (e.g. www.woningwizard.nl, www.funda.nl, www.woningquote.nl).

The Key Register Cadastre, along with the Municipal Personal Records Database (GBA) is accessible via the www.MijnOverheid.nl website. After identifying themselves using their electronic ID, private individuals can consult the rights that have been registered for them in the Key Register Cadastre. This consultation is free of charge. In the event people believe they are registered incorrectly, they can report these errors via the Kadaster website, again using their electronic ID for identification purposes.

Location based services and augmented reality (AR) applications become part of societal demand. Therefore Kadaster has invested in the facilities to present it's data using augmented reality (using 3D glasses or AR technology as developed by Layar),. Also developments have started to provide our data to smart phones through modern apps (like I phone or Android Apps), rather than using texting services as we have used for 'WoningWizard'. All these initiatives have been started in close collaboration with other (commercial) parties.

In 2010 Kadaster has started a project called 'Provisional cadastral boundaries'. As the time between deed registration and parcel creation after field survey is long (from 6 to 12 months), the registration and map seems temporarily inconsistent, causing a complex database system. Hence, a solution in the cadastral update process is being developed. In the future mutation process, parcel creation will be done before deed registration with provisional boundaries and parcel area. A simple verification of geometry of

the new boundaries will be done in the terrain later on. To facilitate this process a web application (called 'Splits!') is being developed. This application allows the owner or notary to prepare a request for parcel division with provisional geometrical data of the new future cadastral boundaries, using a web based geographic information system.

Our business strategy

Looking back at the last decade, we can conclude that our systems and products have changed a lot. Not only many new services have been developed based on the same set of basic data, but also many new registrations have become part of an integrated geo-information organisation, as Kadaster is today. The traditional integrated approach of cadastre and land registry in the Netherlands (and the movement towards more positive legal status of the registration) has be extended with the national topographic mapping since the late nineties. Recently also services for addresses, buildings, cables and pipes have been added to our organisation's responsibilities. Kadaster as an organisation is moving towards a national centre for geo-information services, rather than a pure cadastral agency as the name implies.

To comply with our rapid changing environment Kadaster is evaluating it's approach and policy on a yearly basis in relation to it's long term policy which has a five years cycle. The key targets for the policy period 2011 – 2015 are defined as:

- Offering services that suit our customers needs
- Collaboration
- Cost control
- Flexibility
- Quality and continuity

The key actions for 2011 are summarized in a working plan 2011 called "Working according to your demands". In this working plan our actions are defined according to our key targets as mentioned. Being of value to our customers is done by offering high quality products at stable and affordable prices. This means that we will be looking more at how we perform our statutory tasks through the eyes of our customers; Offering services that suit our customers needs. To do so, we direct our organisation more in a customer relevant manner than in an production process relevant manner. Therefore we make a clear distinction in three different main tasks: i) Data acquisition and registration, ii) provision of information and iii) customised work and advice. To improve our data acquisition and registration we envisage further automation to achieve more efficiency, providing optimum quality at the lowest possible cost.

The provision of information will evolve to more and more online services for faster and easier access to our information products. It will be made easier to establish links between data obtained online and to import data into our customers' automation systems. Our customised work and advice is offered for more complex customer questions when our basic product range is not sufficient. This activity includes our advice on setting up cadastral and key registry systems in countries where land and property registers are less well developed or our knowledge is relevant for further development.

We recognise that our activities in the property and geographic sector form a kind of supply chain with activities performed by other parties. Therefore we move towards more collaboration with private, public and scientific partners, to meet society's expectations. Most appealing effort we make in 2011 is the collaboration with five public partners to furnish a joint web service for an integrated information infrastructure serving public information demands (called "PDOK – Publieke Dienstverlening Op de Kaart", meaning "Public Services Mapped"). But also the development of an I phone app in collaboration with a small private enterprise could be mentioned. Doing so, Kadaster plays a key role in optimizing the national spatial data infrastructure.

The recent financial crisis (starting 2008) affected strongly the real estate and credit market in the Netherlands. This resulted in the need for a new financial policy and strategy of the Dutch Kadaster. To be able to work at the lowest possible prices of our products, we strengthened our focus on cost control. Doing so, a fragile balance is strived for, between cost control, a minimum level of structural reserves and investment in innovative services to keep track with our fast changing environment.

The fluctuations in the property market ask for flexibility in our organisation. The deployment of people and resources should be made available according to the workload. This is managed by moving towards a human resource management aiming at a dynamic workforce, examination of changes in our terms and conditions of employment and a critical evaluation which tasks can be performed by others, either in house or outside of Kadaster.

Finally, we have eye for quality and continuity of our products, business processes and the knowledge of our employees. The continuous upgrading of our IT systems for (future) automated services is an essential part of this.

Looking at this business strategy it is clear that many preconditions have to be maintained or developed. Our contribution to a new set of national and international standards is a clear example of that. Though it is important to cherish the values of good land administration and the existing spatial data infrastructures, it is equally important not to re-invent the past.

Consequences for kadaster

To fulfil the demands of our customers and society, Kadaster has a strong focus on the innovation of products (the 'what?' question) and processes (the 'how?' question).

A firm investment in information technology and infrastructure is indispensible to meet up to these requirements. Nevertheless, it is clear that the solution will not be in making things bigger and bigger.

There is a limit to possibilities of up-scaling. Keywords these days are 'open source, the crowd and the cloud'.

As community driven software development reaches a quality level comparable to commercial software packages, the use of open source software becomes within reach of governmental organisations. Especially as the technical support of open source software is taken up, as a new service, by private companies. Kadaster has a cautious policy in the use of open source software, but is open for development. The use of open versus closed source software is highly related to the security level and life cycle of applications. For database management systems our closed source systems are still in place. In the field of analysis and operational tools a mixture of closed source and open source arises, while at the front end (portals, web interfaces, etc.) a majority of open source applications develops.

With respect to 'crowd sourcing' (or voluntary geo-information provision), Kadaster is a partner in several pilot projects, involving the general public in data provision for our key registries. This paper will not go into detail on possibilities and limitations. But an important restriction one should realise is that in our case crowd sourcing for cadastral purposes is not a community based initiative, but an effort to support a professional organisation in cost efficient data gathering. This requires a different attitude from both the Kadaster as from the volunteers providing this data. In the IT world 'cloud computing' is strongly believed to be the only way to keep up track with user demands for data retrieval, management and analysis. Commercial parties start offering software, platforms, infrastructures and services (as mentioned in 3.4.) in a cloud environment. Kadaster is in a phase of reconnaissance of our possibilities. It is realised that it is unavoidable and offering a lot of potential, but also that many quality and security issues are still to be solved or to be clarified , before certainly right data can be brought into 'the cloud'.

Apart from the financial investment that is required, effort is being put into capacity building of our own personnel and the clever building up of networks and alliances. Our organisation transforms from a production type organisation into a knowledge driven shared service centre, with a national and international importance. This asks for continuous adjustments to our position, personnel and functions. Coming from a national monopolist situation, we become more and more an indispensible link in a chain and an international context. Its becomes our task to co-create the evolution of land administration and spatial data information systems. We have to match users' expectations and technical possibilities with existing (and often sound) legal and business rules and processes.

Conclusions

Based on the environment and developments as delineated in this paper, it is concluded that innovation is not an option a but a prerequisite. Society goes on, whether we like it or not. This innovation concerns our information strategy, systems, services, organisation, way of working and business models. The pace of innovation is becoming so fast that solving user demands alone with existing systems is not possible any longer. We have to adopt to the concept of 'open innovation' and be open to new technological developments. The increasing pace of innovation demands can no longer be tackled by a single-party strategy.

By participating in the process of innovation and development the changes can be managed as an evolution and business processes and organisational aspects can be adapted accordingly. If not participated in this process, the pace of development will be to fast and a cadastral organisation will experience developments as a true revolution .

If cadastral organisations embrace such an open approach, they will be co-creating the evolution of land administration and spatial data information systems. If not, they risk being a spectator and follower of revolutionary land-registry developments.

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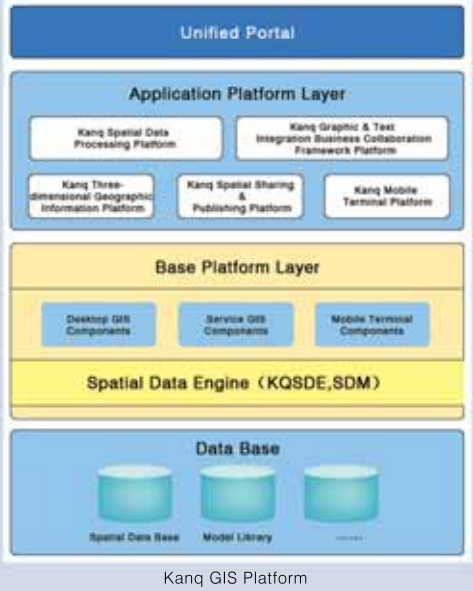

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Track me if you can!

The specialized positioning system used for the tiny insects, such as bees, has been proposed in this article

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This paper is going to provide a concept of a new system for positioning the target bees. The biologists eagerly wish to collect the bodies of the bees in order to find the causes of the colony collapse disorder (CCD) of bees. As we know it, there are several ways used to find out and trace animals. For example, the scientists set up the transponders or the GPS trackers on the top of shells of thalassians or on the feet of migrant birds by ringing. These methods make great contributions for tracking and studying in the field of the biological research. However, how to track or position small insects, like cicadas, butterflies, or bees, is still a problem needed to be solved. The obvious crux of the problem is the size and the weight of the devices which are not suitable for fitting on such a small insects.

It seems impossible to get the radar reflection signal from such a tiny target, since the surface of the target is too small. The most instinctive solution is to design a transponder which is able to reflect signals. Since the transponders need to be set up on the target insects, the size and the weight of the transponders are strictly limited. In order to achieve the requirements of the transponders, setting the operation frequency up to gigahertz may provide the possibility to creating such a small transponder.

In the article of Riley and Smith [1], a harmonic radar system was proposed to investigate the flight insects at low altitude. This harmonic radar system is used to record the flight trajectories of low-flying insects over ranges of hundreds of meters. In this system, the light weight transponders which are able to double the carrier frequency through a passive diode without the aid of on-board battery are used to fit on the insects. Because of the non-linear electrical conductivity, the diode generates a current which containes harmonic frequencies of the original carrier signal. By detecting the second harmonic signals reflecting from the transponders, the system can measure the transmission delay and get the position of the target insect.

In the previous paragraph, the harmonic radar system proposed by Riley and Smith is suitable to track the flight area of the target insects at low altitude over ranges of hundreds of meters. However, it is not suitable for positioning the target insects in the requirement of high precision since the limitation of the range resolution. According to the system structures of the harmonic pulse radar, the best resolution is about 20 m. To find a small insect in the range on 20 m by human vision is a very tough challenge. Therefore, it is necessary to develop a system with high accuracy in measuring the ranges of target tiny insects, such as bees.

The positioning system proposed in our paper is going to provide a possible solution for achieving the requirement of high resolution in measuring the range. The systems used to positioning or tracking the tiny insects usually have to face the problems of weak signal reflected from the targets. The most straight forward method to overcome this problem is to increase the output power of the radar.

However, it is only increase the search distance but not the resolution. The similar situation of weak signal exists in the global positioning system (GPS) [2]. The signals of GPS travel 20,000 km distance from the satellites to the earth's surface, causing -157dB path loss. The signal received by the users on the earth's surface is usually very weak. The spread spectrum technology is used to overcome the weak signal problem. This technology also inspires us to use the similar methodology while dealing

with the similar weak signal situation for positioning the tiny insects. In our system, a modified-BPSK modulation is adopted to overcome the problems of weak signal and the non-linear frequency doubler. A high sampling rate over to gigahertz is used to increase the range resolution. With the increase of the sample points, the curse of dimensionality happens while computing the autocorrelation values with different delays between the transmitted (Tx) and the received (Rx) signals. The reasonable improvements of algorithm will be provided to reduce the computation time.

The details of our system will be provided in the following sections. The basic positioning method will be discussed. The modified-BPSD modulation will be illustrated. In addition, the high sampling rate for the high ranging resolution will be mentioned and discussed how to deal with the related huge numbers of simple points. Some indoor experimental results will be provided. At the end of this article, the possible improvements and future works will be discussed.

Positioning method

In order to get the positions of the target insects, the range-bearing method is adopted. This positioning strategy is widely used in military radar systems and relative radar systems for tracking or positioning insects [1], [3]. The system can provide the information of the azimuths and the ranges of the target insects. However, there are some known limitations of the system needed to overcome. The first limitation is the accuracy of the azimuth. While the reflected signal is detected, the azimuth information can be obtained through the rotation servo system. The resolution provided by the rotation servo directly affects the accuracy of the azimuth. In addition to the effect of the rotation servo, the beam width of the antenna is also the major factor which causes the accuracy variation of the azimuth. No matter which factor causes the inaccuracy of the azimuth, the variation of 1 degree in the azimuth information cause about 1.75m variation at the 100m range distance. This relation can be expressed as Equation (1) and shows in Figure 1.

$$\Delta E = R\Delta\theta \quad (1)$$

where ΔE is the variation caused by the azimuth variation $\Delta\theta$ at the range distance R. The relative researches about reducing the effect of the azimuth variation have been discussed in several articles with different methods.

In this article, the focus is on the second limitation about the distance ranging errors. The basic method of ranging the distance of target has to be briefly illustrated in order to discuss this topic. The range information of the range-bearing method is obtained by calculating the signal delay time which is caused by the transmitted signal traveling from the radar to transponder and the reflected signal traveling from the transponder to the radar. The traveling times of transmitted signal and reflected signal are usually considered equal to each other. The velocity of the radio signal transmitted in the air is almost the same with the radio signal transmitted in the vacuum environment, $c=3x10^8$ m/sec. By timing the velocity of the signal, the range information can be easily found out in Equation (2)

$$R = c \times \Delta T/2 \quad (2)$$

For example, the increase of 1 microsecond (μsec) delay represents the increase of 150m in the ranging distance, and the increase of 1 nanosecond (nsec) represents the increase of 15cm (0.15m) in the ranging distance. It shows the importance of obtaining an accurate signal delay time.

The pulse radar system is widely used in the field of military and in the some insects tracking system [1]. After transmitting the trigger pulse, the radar system provides the ability to measure the signal delay though a signal power detector and a serial-to-parallel register. However, the hardware structure of the pulse radar system limits the measurement accuracy of the delay time. Therefore, a part of the methods proposed in this article is to increase the sampling rate of the analog to digital convertor (ADC) in order to give the higher accuracy of the delay time. The relative issues will be mentioned in following sections.

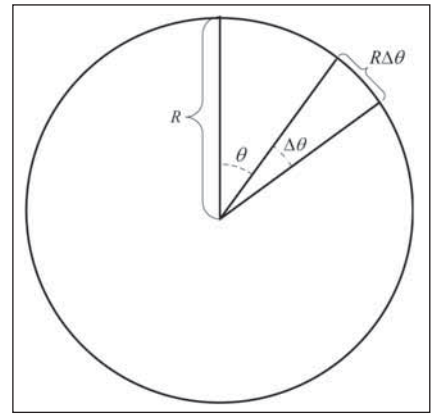

Fig 1. Azimuth variation

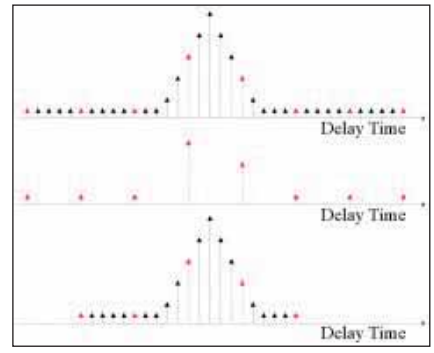

Fig 2. Sub-Sampling reduction

Modified-BPSK modulation

As mentioned in the introduction, the systems used to positioning or tracking the tiny insects usually have to face the problems of weak signal reflected from the targets. The similar strategies used in GPS to deal with the weak signal problem are also adopted in our system. There are two major methods of the original GPS design which are adopted in the proposed harmonic radar system. The first one is the pseudo-random-noise (PRN) code which is applied to provide the ability of the code division multiple access (CDMA) [4] which allows several users to share a single bandwidth. Here, the autocorrelation properties of PRN code are used to measure the delay between the transmitted signal and the received signal. The operation is similar to the acquisition operation on the GPS receivers. The details of autocorrelation will be illustrated in the next section.

The binary phase-shift keying (BPSK) modulation is the second major method adopted here. In our application, there is only PRN code need to be modulated onto the carrier but the navigation information. For the most part of communication systems using the BPSK modulation, the transmitted signal can be formulated as Equation (3)

$$\begin{aligned} s(t) &= \sqrt{P}x(t)\cos(2\pi f) \\ &= \sqrt{P}\cos(2\pi f + \phi(x)) \end{aligned} \quad (3)$$

where P is the signal power for signal carrying PRN code $x(t)$ on carrier frequency f; $\phi(x)$ is the phase shift of the PRN code $x(t)$ with the following relation

$$\phi(x(t)) = \begin{cases} 0, & x(t) = 1 \\ \pi, & x(t) = -1 \end{cases}. \quad (4)$$

In the general cases, the transmitted signal can be easily demodulated to obtain the baseband information, such as the PRN sequence. Nevertheless, it will cause the disappearance of the phase-shift keying (PSK), once the transmitted signal $s(t)$ passes through the non-linear frequency doubler in our proposed system. This can be explained by Equation (5)

$$\begin{aligned} s^2(t) &= P\cos^2(2\pi f + \phi(x)) \\ &= \frac{P}{2}[1 + \cos(4\pi f + 2\phi(x))] \\ &= \frac{P}{2} + \frac{P}{2}\cos(4\pi f + \phi'(x)) \end{aligned} \quad (5)$$

where the phase-shift keying $\phi'(x)$ becomes

$$\phi'(x(t)) = 2\phi(x(t)) = \begin{cases} 0, & x(t) = 1 \\ 2\pi, & x(t) = -1. \end{cases} \quad (6)$$

After demodulating the signal $S^2(t)$ by timing a sinusoid signal with $2f$ Hz frequency, there is not any PRN sequence remaining. Therefore, the modified-BPSK modulation is proposed to overcome the problem happening in the harmonic radar system. The cause of this problem is that the non-linear device is used to double the carrier frequency of the transmitted signal. It can be solved by modifying the PSK pairs from $\phi \in \{0,\pi\}$ to $\phi \in \{0,\pi/2\}$ It likes a half part of QPSK. The PSK pairs of the PRN code in Equation (4) can be rewritten into

$$\phi(x(t)) = \begin{cases} 0, & x(t) = 1 \\ \pi/2, & x(t) = -1 \end{cases}. \quad (4.1)$$

And the phase-shift keying $\phi'(x)$ of the signal after passing through the non-linear frequency doubler becomes

$$\phi'(x(t)) = 2\phi(x(t)) = \begin{cases} 0, & x(t) = 1 \\ \pi, & x(t) = -1 \end{cases} \quad (6.1)$$

It can be seen that the modified-BPSK modulation keeps the PRN code existing in the carrier after the transmitted signal passing through the frequency doubler. And the PRN code can be retrieved by using the original structures of BPSK demodulator at the $2f$ Hz frequency.

High ranging resolution

In order to improve the ranging accuracy of the harmonic radar system, the spread spectrum techniques are adopted in our system. The autocorrelation properties of the PRN code make the alignment between the transmitted signal and the received much more precisely. Besides the good properties of the autocorrelation, the high sampling rate is also a crucial factor to increate the accuracy of the delay time between the Tx signal and the Rx signal. For instance, the 10 MHz sampling frequency provides the accuracy of 100 nsec, which means the 15m ranging resolution. And the 1 GHz sampling frequency provides the accuracy of 1 nsec, which means the 15cm ranging resolution. Nevertheless, there is no free lunch while pursuing the accuracy performance. The higher sampling rate provides the higher ranging resolution and also gets much more data needed to deal with in searching the maximum value of the autocorrelation value. Therefore, there are two methods in the following two subsections.

Floating point operation reduction

Before discussing the floating point operation reduction, the calculation of the basic autocorrelation between the Rx and Tx signals have to be reviewed in the following formulations.

$$r_{ab} = \frac{\sum_{i=1}^{n} a_i' b_i'}{\|a'\|_2 \|b'\|_2} \quad (7)$$

where r_{ab} is the autocorrelation value between the Rx vector $a = [a_1\ a_2 \ldots a_n]$, $a_i \in \{-1,1\}$ and the Tx vector $b=[b_1\ b_2 \ldots b_n]$, $b_i \in \{-1,1\}$. The a' vector and the b' vector are defined as

$$\begin{aligned} a' &= [a_1' \quad a_2' \quad \cdots \quad a_n'], \quad a_i' = a_i - \mu_a \\ b' &= [b_1' \quad b_2' \quad \cdots \quad b_n'], \quad b_i' = b_i - \mu_b \end{aligned}$$

where μ_a and μ_a are respectively the means of the vector

a and the vector b determined as below

$$\begin{aligned} \mu_a &= \sum_{i=1}^{n} a_i \\ \mu_b &= \sum_{i=1}^{n} b_i. \end{aligned} \quad (8)$$

As Equation (7) and (8) showing, the calculation of the autocorrelation depends on a lot of floating point operations. And the numbers of the floating point operations cannot avoid the curse of dimensionality while increasing the numbers of sampling points with the high sampling frequency. In order to reduce the computation time of the autocorrelation value, it is necessary to reduce the numbers of the floating points operations. By analyzing Equation (7) and (8), some floating point operations can be rewritten in the form of the integer operations as

$$(\|a'\|_2)^2 = n - \left(\sum_{i=1}^{n} a_i\right)^2 \Big/ n, \quad (9)$$

$$(\|b'\|_2)^2 = n - \left(\sum_{i=1}^{n} b_i\right)^2 \Big/ n, \quad (10)$$

$$\sum_{i=1}^{n} a_i' b_i' = \sum_{i=1}^{n} a_i b_i - \left(\sum_{i=1}^{n} a_i \sum_{i=1}^{n} b_i\right) \Big/ n. \quad (11)$$

In Equation (9), (10), and (11), the sums of the vector a and the vector b are only necessary determined once, even with different circular shift delays of the Tx signal vector a. There is only one term needed to be determined in Equation (11), $\sum_{i=1}^{n} a_i b_i$. By using the new expressions, the most of the floating

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operations are avoided to increase the computation speed without sacrificing the accuracy of the autocorrelation value obtained in Equation (7).

Sub-sampling reduction

Although a huge numbers of floating point operation have be avoided in the last sub-section, it still needs a lot of computation time spending on searching the maximum autocorrelation value with different delay between the Tx and Rx signals. Once the sampling frequency rises to certain level, the huge number of sampling points will make it difficult to do a full search on every sampling point. Nevertheless, the strategy used in the GPS acquisition loop shows that only 16 sampling points on each chip are enough to search the meaningful maximum autocorrelation value. Although the obtained delay corresponding to the maximum autocorrelation value is quite inaccurate, it provides the help of reducing the search range in the different delays. After finding the rough delay, it only needs to search the nearby range of the rough delay as showing in Figure 2.

Experiment results

The focus of the experiments is on verifying the ideals of the modified-BPSK combining with the harmonic radar system and the strategies to deal with a huge number of sampling points. In order to verify the proposed ideals quickly, the carrier frequency is chosen at 2 GHz frequency. The relative devices of 2 GHz can be manufactured by the printed circuit board (PCB) techniques in the lab. The FPGA board manufactured by Xilinx is used to generated the PRN code with almost the same specifications with the coarse/acquisition (C/A) code used in the GPS as listed in Table 1.

Table 1. Specifications of the PRN cod

Chip Width	1 µsec
Chipping Rate	1.023 MHz (Mcps)
Code Length	1023 chips

The sampling rate of the ADC is set to 2 giga-samples per second (GSa/s) by using the oscilloscope manufactured by Agilent to capture 4 million sample points simultaneously from the Tx signal before modulating and the Rx singal after demodulating.

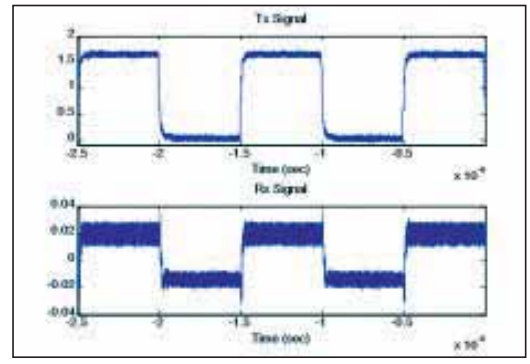

Fig 3. Tx signal and Rx signal

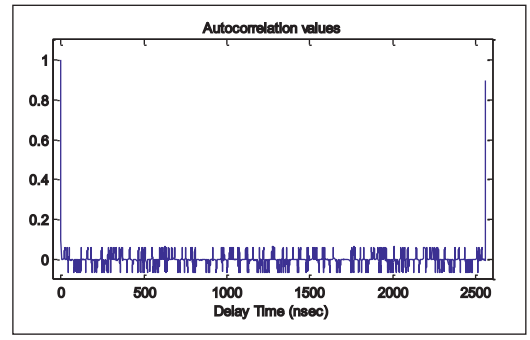

Fig 4. Autocorrelation with different delays.

In Figure 3, it shows that the modified-BPSK modulation is successfully implemented in the harmonic radar system. The baseband signal can be retrieved from the second harmonic carrier signal in 4 GHz frequency. By using the algorithms illustrated in the previous section, the maximum autocorrelation value between the Rx and Tx signals with different delays can be found out in 1 second and the respective results are shown in Figure 4.

Conclusions

The specialized positioning system used for the tiny insects, such as bees, has been proposed in this article. In order to achieve the purpose of positioning the target accurately instead of only tracking the target in a rough area, the ranging techniques of the pulse radar system are improved by using the spread spectrum technology which is inspired from the GPS and the other communication system. The autocorrelation properties of the PRN code help us to overcome the weak signal problems and increase the ranging accuracy. The modified-BPSK modulation makes the spread spectrum technology become possible to combine with the harmonic radar system. The two algorithm strategies are proposed to reduce the computation time while searching the maximum autocorrelation value between the Rx and Tx signals with different delays in a high sample rate which is used to increase the ranging resolution. According to the experiment results, the ranging accuracy of the proposed harmonic radar system is indeed in the range of 1m.

The preliminary results of the ranging distance are much better than the original harmonic radar system. However, there are still a lot of problems needing to be considered such as the azimuth variation problem still needs to be overcome.

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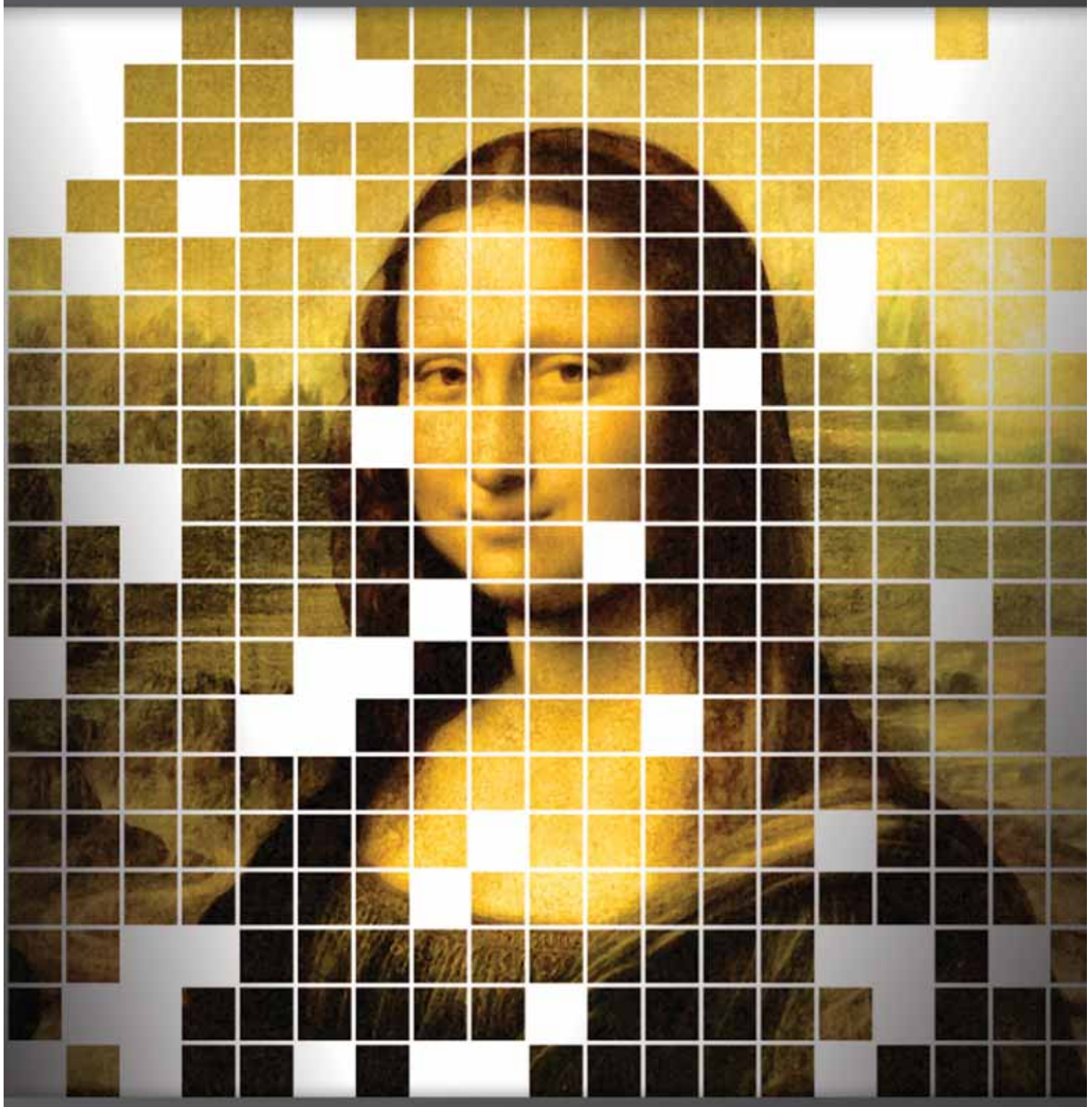

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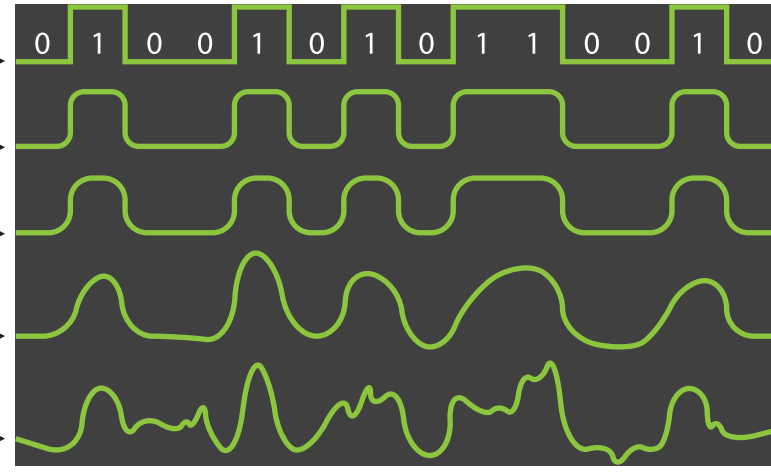
GNSS is affected more by inteferences

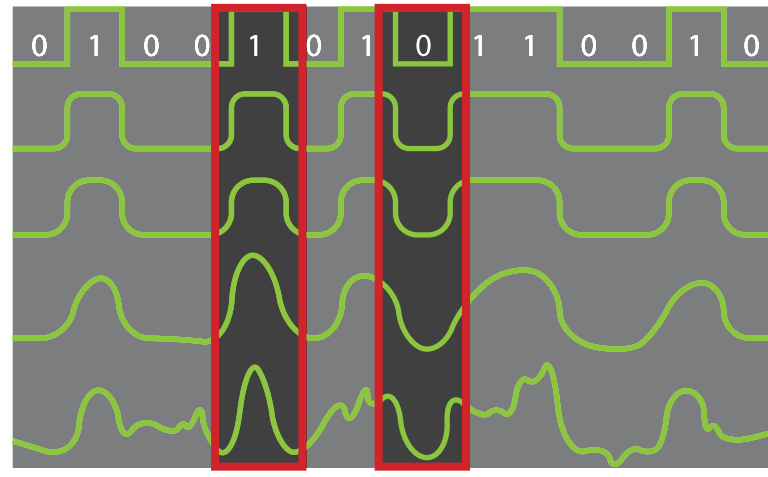
High precision GNSS receivers are more sensitive to interferences because GPS digital signals are used for “ranging”.

Clean digital signal

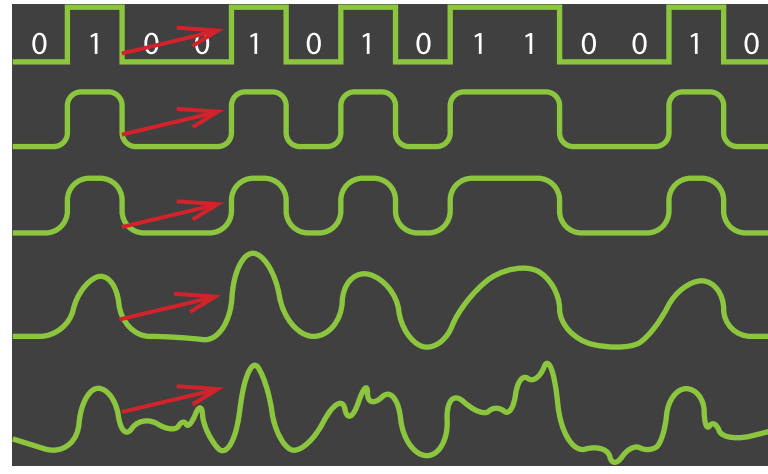
Deformed signals by filtering and interferences



Communication devices recover “1”’s and “o”’s of a digital signal in all signal examples shown in this graph.



GNSS receivers need to measure distances by marking the arrival times of signals. Hence signals need to have clean and sharp edges to clearly mark the arrival times.



Policy to encrypt P-codes is outdated

Encrypting P-codes has made GPS 1,000 times more vulnerable to interferences, especially for high precision applications. Encrypting should be done only where and when needed.

Policy to Encrypt P-codes is over 30 years old.

Then it was against Soviet Union. We had missiles targeted at each other. Now Soviet union is gone and Russia is our friend.

Then Russia did not have GNSS. Now Russia has its own GLONASS with un-encrypted P-codes.

Then there was “Iron Curtain”. Now Presidents Obama and Medvedev signed 3-year visa exchange programs.

Then the concept of using GPS for high precision application did not exist. Now GPS is used in high precision applications with huge economical benefits.

Then there was no concept of broadband usage (like LightSquared). P-codes encryption makes GPS much more vulnerable to LightSquared.

Then P-codes were the only codes for military usages. Now U.S. Military has a new plan for its signals.

Since its inception, GPS in general and P-codes in particular was never used to attack U.S. national security.

GLONASS P-codes never encrypted and Russians national security did not suffer. Reliable RTK is not possible without combining GPS and GLONASS.

Since the inception no benefit came from encrypting P-codes, but all precision users suffered by a factor of 1,000.

P-codes encryption, bad science and bad politics

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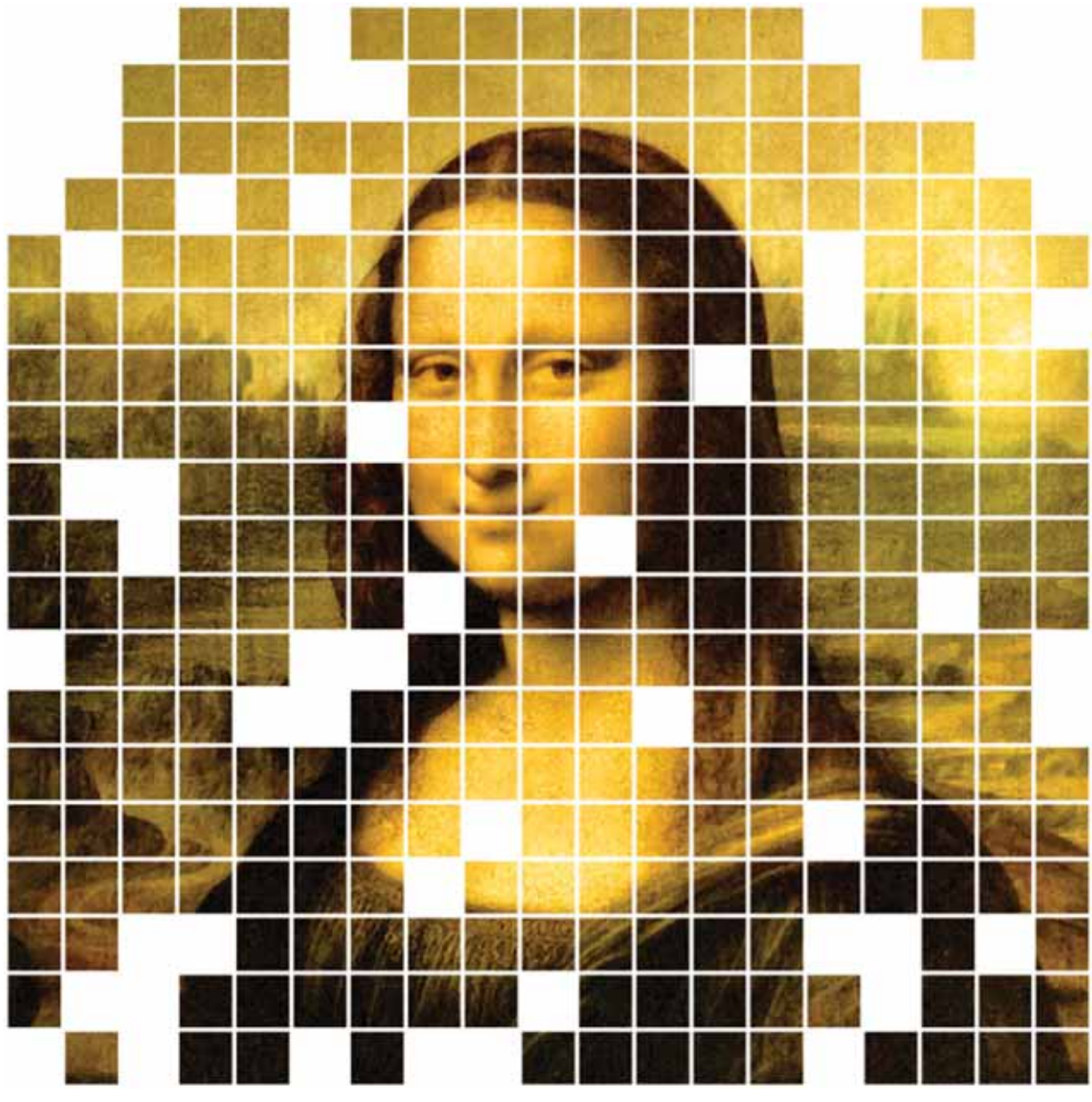

Encrypting GPS P-codes is a step backward in providing the best of this excellent work of science and art. As the leader in GPS technology, we consider P-codes encryption as being neither good science nor good politics.

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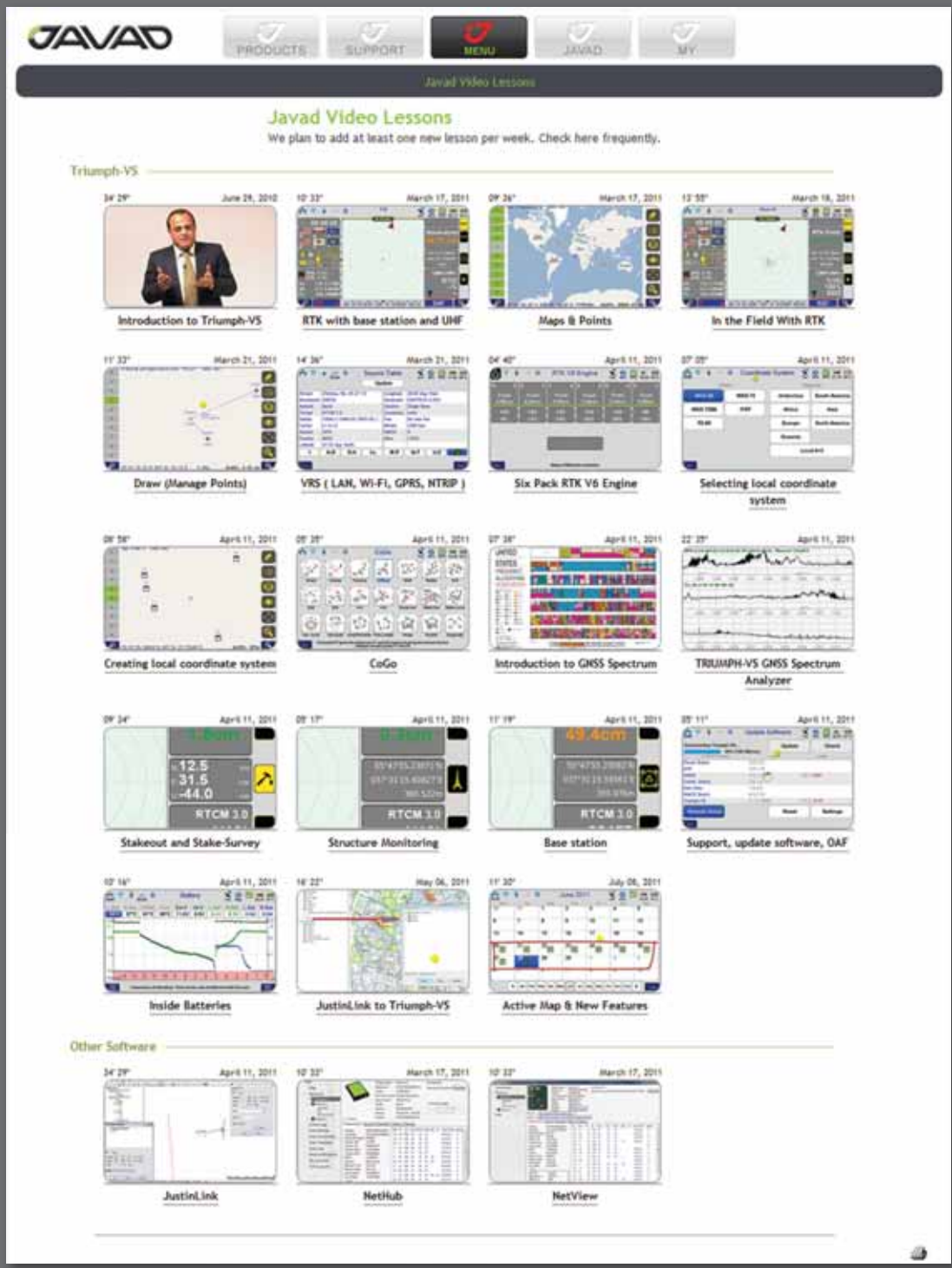

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How to measure traffic jam?

As traffic jam is getting a bad reality in our times, realistic information on the traffic situation together with optimized routing to reduce overall waiting time on the trip become more and more valuable all over the world. But how to validate, if the information provided is reliable and trutsworthy?

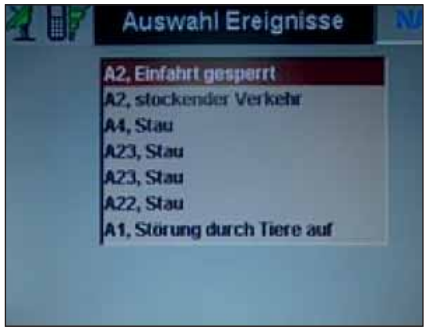
Martin Grzebellus
Managing Director
NavCert GmbH, Germany

In many countries traffic information is distributed via radio broadcast and provides information on location and length of traffic jam. Only if a road is completely blocked then a deviation is recommended. In most European countries TMC (Traffic Message Channel) is used to provide in a digital way all available information on road situation directly into radios equipped with TMC. As this information is based on alerts from police or other drivers, the experience is that the information about a traffic jam is available after some time. However typically a traffic jam is still reported for at least 20 minutes after free flow occurs. As such the attitude is to stay on the road with the jam, pass the jam and hope that time delay will not be too long.

These free services are complemented by paid services which are offered by car manufacturers, navigation provider or dedicated service companies. They claim that they provide a higher quality. In addition to location and length of the traffic jam they deliver also the expected delay time. Now it should be possible to drive not only the longest, shortest or most economic route but also one with the shortest driving time, if the information is reflecting ground truth.

In order to improve the quality it is necessary to monitor the status and to identify if a change is increasing or decreasing the overall quality. For traffic information systems no common criteria do exist. As such we have defined KPIs (Key Performance Indicators) to assure that the user expectation is measured. First it is important to know if a traffic jam exists or not. So the first KPI is the jam accuracy. This parameter identifies the ratio between jams reported correctly and the number of all actual traffic jams. To avoid that a traffic information system is achieving a too high scoring by just indicating for all roads the existence of traffic jam the second KPI is the message delivery ratio. This is defined as the ratio between correctly reported jams and number of all reports by the specific information system. From a user perspective to be informed only about the existence of a traffic jam is not sufficient. The user expects to get guidance on his actions based on the existence of the traffic jam. A typical scenario is that due to the information – traffic jam on a highway – drivers decide to leave the highway and take a detour on cross country roads or even urban roads with the expectations to be faster than staying on the highway.

However the underlying assumption is that there is no traffic jam on the intended detour as the traffic information system does not report any incident for these roads. Thus it is important to know the coverage of the traffic information system with respect to road coverage. This KPI is defined as the identification



of incidents for various road classes, to measure if only highways or also roads of minor classes are monitored. The most important information to the user however is the reliability of the provided information with respect to the reported length of a traffic jam and the expected delay time. This jam reliability is defined as the ratio between reported length and delay to actual length and delay.

The monitoring of KPIs allows the qualification of achieved results over a period of time. The challenge however in the context of traffic information systems is how to measure the KPIs as the objects to be measured are not static nor can they be evaluated inside a laboratory. The methods used should provide the same objectivity as those achieved within a laboratory. For test laboratories the standard for quality management systems, the ISO/IEC 17025:2005 defines the requirements on the competence of testing laboratories to carry out tests. Emphasis is put in this standard aside of general quality management aspects to the validation of test methods especially if the laboratory has developed its own and on the estimation of the uncertainty of measurement in order to assure the reliability of the test results. This standard refers to the ISO 5725 which deals with the accuracy (trueness and precision) of measurement results.

Looking to the measurement to the above defined KPI it is required to some extend to know the accuracy with which the measurement of an incident takes place. The measurement can be performed in two different ways, one being an observer and the other being part of the system both having its specific pros and cons. To validate the existence of a reported incidence at a given time, one has to be outside of the incident to confirm the existence of the incident. As being part of the system as a driver it cannot be validated if a reported incident does exist or not at the reported moment. Only at a later time arriving at the location of the reported incident, one can being part of the system identify if the information provided was correct or not, as the incident might have changed in the meantime – disappearance or new incident at the reported location. However typically today the ground truth is collected by cars, driving on roads with specific equipment on board, to monitor speed and location during the trip.

If a traffic information system provides information (length and expected delay) of an incident, the independent observer can better measure the length of the incident at the time the information was provided. As part of the system the length of an incident is measured by passing by the incident. As such the length cannot be measured prior to being part of the incident. During the time required to pass the incident, the length might have changed resulting into deviation between measured and reported length not implying in any case a wrong reported value. However even an independent observer is not able to measure the reported duration of the delay because both measurement methods require to wait that a vehicle is passing the incident from start to end location. Again in this situation the reported duration may change due to system and measurement extrinsic factors.

The major disadvantage of the independent observer is that he only has a limited observation area and that this area cannot be adjusted ad hoc to allow flexible adjustments of test areas. Typically a high position like a bridge is used to monitor in real time traffic either via a camera or via a person. In best case the view allows to monitor the road for a length of one kilometre. There is a new innovative approach to measure ground truth via satellites. The measurements from the satellite allow identifying individual vehicles on selected roads. The speed of the vehicles can be identified individually with a resolution of about 5 km/h or better. As such one has a snapshot available which can be used to calibrate existing equipment like road loops to assure that the provided results on the speed of the vehicle is correct. It can also be used to validate the user experience of the length of a traffic jam at a given time. At the time being the results are quite promising but a long way have to be progressed to achieve required reproducibility and reliability.

We have now identified KPIs which reflect the achieved quality and based on ISO/EN 17025 a proper methodology for measurements has been identified. However an optimum way to measure cost effectively ground truth does not exist. A way forward is to perform an audit of the service provider offering traffic information. In this audit are analyzed to assure that the received input will generate the expected output. This is complementing the ISO 900. As such in all phases in which data processing takes place have to be analyzed:

- Data collection
- Data fusion
- Data processing
- Data provided by third parties
- Integration of traffic information
- Verification of traffic information
- Qualification of traffic information
- Storage of traffic information

As a result the overall process will be optimized by identifying critical paths and validation of (complex) processes. Weak points are identified and can be eliminated increasing the overall performance.

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National GIS
Views and Voices

The Planning Commission has proposed the establishment of National GIS (NGIS) through Indian National GIS Organization (INGO). It has formed Interim Core Group (ICG) to prepare a blueprint of the NGIS. Readers may recall the views of Dr Shaliesh Nayak, Chairman, National GIS Interim Core Group (ICG) and Dr Mukund Rao, Member Secretary, ICG (Coordinates - July 2011). To carry forward the discussion, we present here the views of some of the ICG Members. The views, though diverse, contribute significantly in building a strong foundation for an important initiative like NGIS

"A well defined concept of NGIS is needed"

K R Sridhara Murthi
Senior Expert, Office of Adviser to Prime Minister on Public Information Infrastructure and Innovation

What according to you is the need for a National GIS?

GIS is an important tool that forms the basis of a decision support system. Such a system plays a catalytic role in a growing economy like India and helps transform the governing system to facilitate a better citizen-government interface. Utilizing the power of GIS would be an advantage not only in terms of making informed decisions but also for improving efficiencies and responses from delivery system. In this scenario, the National GIS is the need of the hour. The concept goes well in the backdrop of remarkable developments over last couple of decades in all related fields in the country - for example, many development programmes of the Government of India, evolution of enviable range of remote sensing satellites and their applications, rise of industrial capabilities, web revolution, environmental trends having bearing on policies, progressive digitization of maps by the Survey of India and initiatives of the Spatial Data Infrastructure, to name a few.

What are the challenges to accomplish NGIS?

The most important challenge is to have a sound system concept, well-defined in terms of goals, components and interfaces of NGIS properly defined. The other challenge is to evolve an appropriate organizational focus which enables the system to perform intended functions through policy empowerment. The third aspect is to initially create an integrated set of data assets satisfying standards and build capacity of the human resources that can generate value out of these assets. The overall architecture of the system should be able to provide necessary access, data integrity, security and application support. Ultimate challenge, when the system begins to deliver, is to evolve a sustainable stake holding interface between public and private sectors in maintaining and growing the system.

What role do you see of present NSDI in this initiative?

The NSDI has spearheaded a lot of awareness in terms of development of standards. Essentially it has evolved as metadata infrastructure. NGIS concept extends beyond NSDI and in fulfilling the mission of NGIS several stake holders including NSDI are working together.

How to deal with the reluctance of data providers in the context of data sharing?

We have to understand why there is a reluctance of sharing of the data. There may be some concerns of data providers and those concerns need to be appropriately addressed. In the transformed environment and scenario of technology advances, data sources are diverse and data centric approach is giving its place to information centric approach. When a common man accesses Google map information, he does not bother about the source of data. Hence advantage lies in balancing policies towards exclusivity of data with the broader goals. In the current scenario, delivery or governance is demanded by the user or public and NGIS aims to help such delivery. There is increasing trend of decentralization in governance system and need of the hour is a vehicle that is transparent, user friendly and responsive to citizen needs. The aim is to create such an environment where it can happen. NGIS will not decide the policies of its users or data providers. It is they who decide. NGIS will help users to decide better and faster. Hence for a national system like NGIS, I do not perceive data is not the ultimate challenge, although we seem to be weighed down by past baggage. Data providing agencies would be able to realize that NGIS will enable them to realize higher value of their data to the benefit of the citizens of this country. You would notice that several agencies have already improved or reformed the access policies for data. Along with issues of access, with transparent policies, we also need to address the issues related to standards, data integrity and security.

What about the funding of NGIS?

The National GIS is proposed to be established with funding by the Government of India. In addition, standards would be evolved taking cognizance of international trends, conducive policy atmosphere would be created and capability of seamless GIS framework would be convincingly demonstrated. Once that happens, the private sector investment can be encouraged in developing in various applications and services. It is hard to expect that any single private agency will invest and develop the totality of data assets for the entire country like India. Initial funding has to come from the government, at the least.

Do you think we need to be more careful with the use public fund in current difficult economic scenario?

If you compare the economic scenario with a decade before and if you compare the Indian economy with other countries at present, I feel that the Indian economy is more stable, robust, vibrant and promising. It offers more comfort and encouragement. However, we have entirely different kinds of challenges to address. These are sustainability of the growth rate and inclusive development. There perhaps is a need to show how GIS could be a wonderful tool that not only can help us to sustain the growth but can also accelerate it. This is logical as eighty percent of the decisions related to governance have geographical context. If that usefulness is aptly demonstrated, funds may not be a problem.

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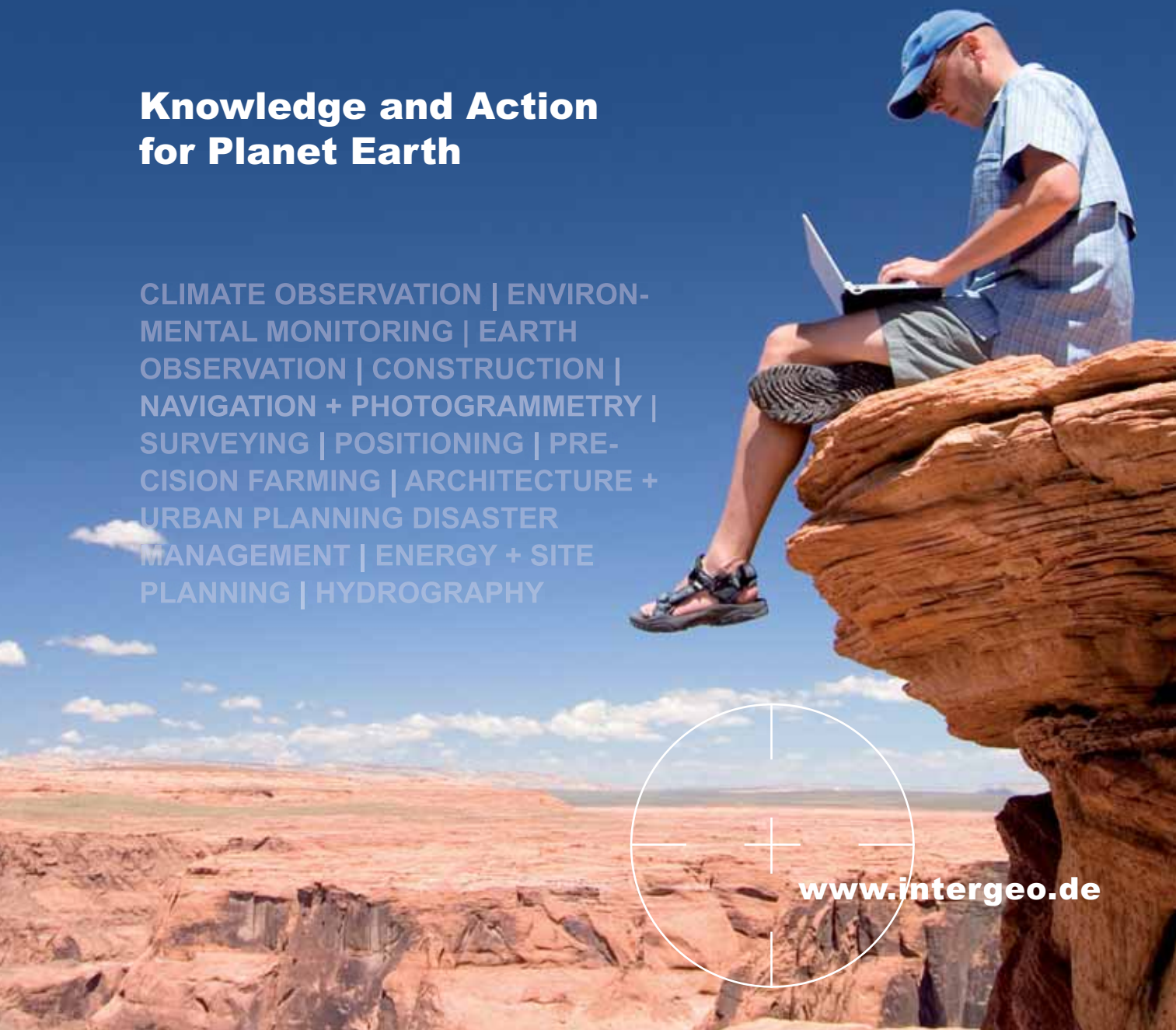

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"The mandate of INGO needs to be carefully drafted"

Dr Vandana Sharma
Deputy Director General,
National Informatics Centre

Do you think India needs National GIS?

The Planning Commission has proposed the establishment of National GIS (NGIS) through Indian National GIS Organization (INGO). It visualizes incorporating GIS in all aspects of planning and development. The concept is still in the initial stage of discussions. Such an initiative will definitely give a boost to GIS activities and a variety of GIS based solutions are likely to emerge to address many governance issues like bringing transparency and accountability in decision making. More importantly, it will make GIS data available and accessible. In this context, I feel that INGO should be mobilized.

What are the challenges in making NGIS a reality?

We must understand that while creating a GIS, several layers of information are required. In government, these layers of information are sourced from various ministries. In this context, such an initiative needs multi-ministerial approach. Moreover, some organizations have strong legacy of geospatial data generation. And many of them have been incorporating GIS in their activities. The mandate of INGO needs to be carefully drafted. It should not be at variance with the existing mandates of the other organizations. Also, it is imperative to build a consensus in order to achieve optimum impact of such an important initiative. The major challenge in making NGIS a reality shall be to define and enforce standards at various levels.

How do you see NSDI initiative in India in context of National GIS?

National GIS certainly complements the NSDI. A considerable work has been done by NSDI, which NGIS would like to leverage upon. NSDI has played a key role in bringing awareness about the importance of Spatial Data Infrastructure in this country. Apart from focus on issues such as Meta data, exchange format, open formats etc. NSDI has been successfully able to develop an environment where there is participation from multiple organizations in forums such as the annual workshop, meetings, discussions etc. A number of issues have been identified for which draft notes have been submitted at higher levels. It will be an advantage for NGIS to learn from the NSDI experiences.

Where do you see NIC in NGIS?

NIC is a premier organization in the country which has been providing e- Governance Solutions for informatics-led development in government ministries and departments to facilitate planning and programme implementation to further the growth of economic and social development. The importance of spatial information was well recognized long back and a number of steps were initiated which included development of high scale Delhi map along with addressing the need on availability of country wide digital maps. The concepts of National GIS was supported by Planning Commission during 2005 which addressed harmonization of information from different sectors through the concept of standards for identified 23 layers. As out come of this project NIC hosted the first National Web GIS model created around largest spatial data repository. The National GIS incorporates versatile NIC Map service with seamless all India maps from 20 Million to 18K scale providing locations of over 6 lac villages with habitations linked with census data. Various innovative features in this portal provide "Mash up"; a facility to overlay NIC maps with external services e.g Google, Bing etc. along with DEM information apart from features such as measurements, shortest path calculations etc. This portal has gained sufficient attention from the user community and work is underway in implementing different data sharing models with different sectors as per the requirements.

As regards NGIS, we shall be happy to demonstrate and contribute to the cause. Currently NGIS is at the conceptual stage and role of NIC is expected to be more significant as it moves to operational stages. However, the exact mandate and role will evolve in due course after consultations.

Do you think that current policy scenario provide the conducive atmosphere for NGIS?

I do not think that policy is posing any major challenge. Though it needs to evolved, still at NIC we have been able to take many successful initiatives in the given policy framework. There are many things that still can be done and are being done.

NSDI and National GIS go hand in hand

Swarna Subba Rao
Surveyor General of India

What is your opinion on National GIS?

The National GIS is a welcome initiative. It is still in the process of consultation and development. The mandate, organizational structure and functionalities of National GIS will emerge in due course.

What role you envisage for you're the Survey of India in this initiative?

The main objective of the Survey of India remains to map the country suitably and to provide base maps for expeditious and integrated development. The National GIS is an initiative of the Government of India. As the part of the Government of India, we are very much part of this initiative. The SoI see its role as spatial data provider and we will continue to provide the spatial information in the required format.

How do you see this initiative in the context of NSDI in India?

In the government we ensure that organizations do not end up duplicating the work of the other organizations. The mandate of National GIS should be framed in a manner that it does not come in conflict of the exiting mandate and set up of the NSDI. Instead it should synergize the work of NSDI. We will ensure that both coexist and complement each other.

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"Academic research should focus on modeling"

Prof NL Sarda
Professor, IIT-Bombay

Why NGIS?

The proposed National GIS would help in leveraging geospatial data to become a part of planning, governance and nation building. Geography is the context of most of our decisions as they affect earth resources. It is extremely important to showcase and demonstrate the capability of such systems in planning, monitoring and decision support. The proposed National GIS, when implemented, will change the ways of planning and governance in a positive way.

How academia is going to be benefitted by NGIS?

It has not always been easy to get the data for academic research. Even if data are available, they are from different agencies and with consistency issues in scale, format and uptodate-ness. It is expected that NGIS would be able to provide seamless and updated data.

What is the role of academia?

The role of academia has been the capacity building in education and research. Academia will contribute in developing manpower, technologies and innovative solutions at least at the prototyping levels. Equally important would be to focus on multi-disciplinary and multi-dimensional research and on developing models for understanding complex earth and environment related processes and their various parameters and correlation among them. Academia should be allowed to play an independent role in developing such models for various applications especially on issues pertaining to disaster and environment management. In addition, the research should focus on technology on data collection, processes and accessibility.

How NGIS is different from NSDI?

The NGIS is the next logical step of the NSDI. The NSDI has focused on creating a platform which data can be shared by geosource data agencies to publish their metadata. It has created standards and emphasized importance of sharing for inter-operability for cross-discipline applications. However, there is no explicit responsibility with the NSDI to provide these data seamlessly and temporally in a single platform. That is proposed as the main objective for N-GIS. N-GIS will also assist in developing and hosting applications to realize its objective of leveraging geo-spatial data in DSS.

Do you think that the data access would be hassled with security issues?

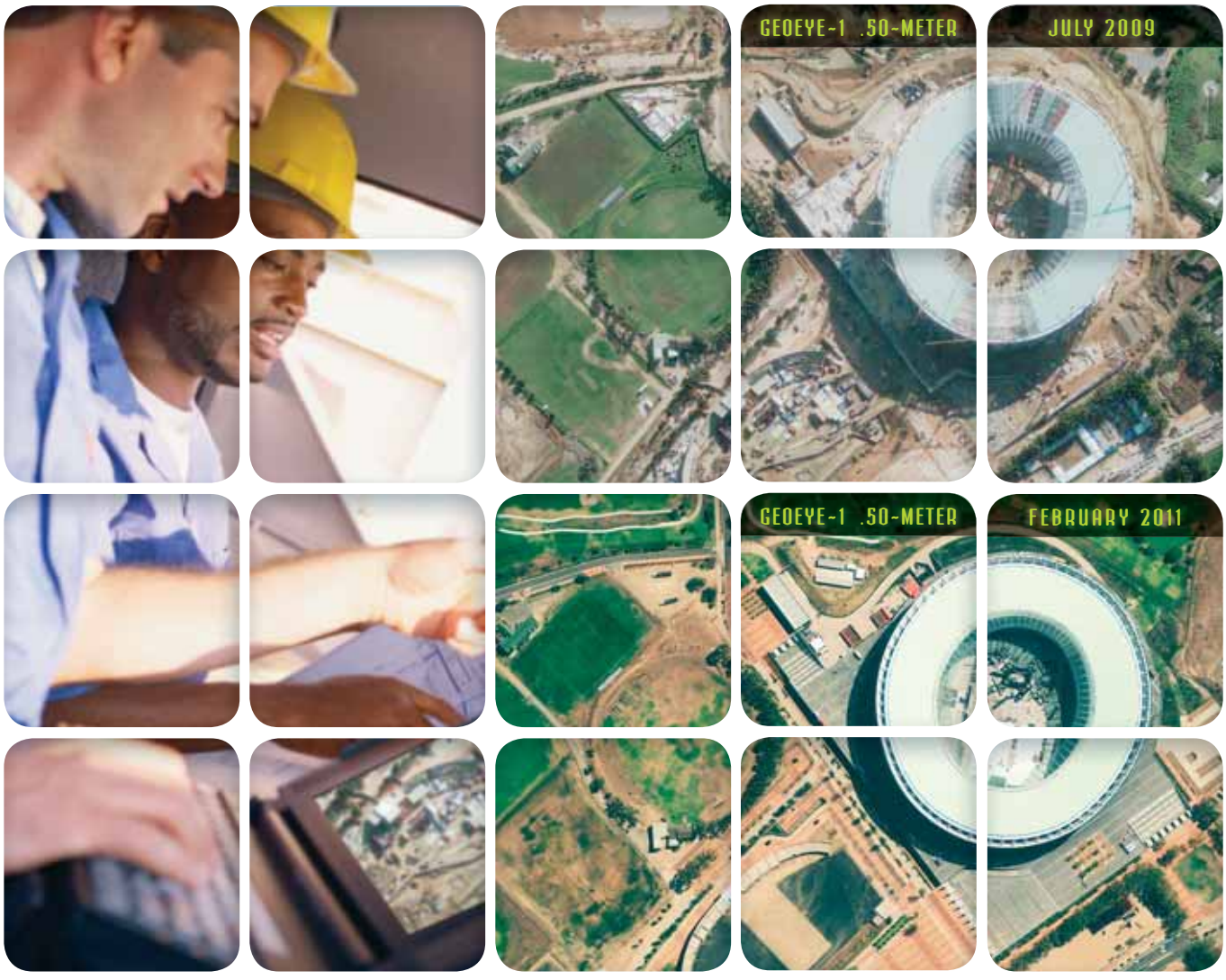
The data access control would naturally be in conformity with data related policies at national level. It should be linked with nature of the data, type of data, purpose of the use and also on the credentials of users or user agencies. I anticipate multiple criteria for allow access to the data.

What are the challenges?

The most important challenge would to provide current and updated geo-spatial data in a standard format since this will involve coordination and participation of multiple data-collecting agencies. N-GIS will have to also play pro-active role in defining state-of-art applications for various user organizations.

What would be your parameters to measure the success of NGIS?

Bringing the data from various multiple agencies to one platform itself will be a major success. I will consider NGIS successful if it is able to make these data seamlessly available. It is equally important to ensure that these data are used for critical application purposes.



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Indian Remote Sensing Data Policy

The Goverment of India has released new remote sensing data policy

Recognising that Remote Sensing data provides much essential and critical information - which is an input for developmental activities at different levels, and is also of benefit to society; **Noting** that a large number of users - both within and outside government, use Remote Sensing data from Indian and foreign remote sensing satellites for various developmental applications; **Taking into consideration** the recent availability of very high-resolution images, from foreign and commercial remote sensing satellites, and noting the need for proper and better management of the data acquisition/ distribution from these satellites in India; **Recognising** that national interest is paramount, and that security consideration of the country needs to be given utmost importance;

The Government of India adopts the **Remote Sensing Data Policy (RSDP) - 2011** containing modalities for managing and/ or permitting the acquisition dissemination of remote sensing data in support of developmental activities.

Department of Space (DOS) of the Government of India shall be the nodal agency for all actions under this policy, unless otherwise stated.

1. For operating a remote sensing satellite from India, license and/ or permission of the Government, through the nodal agency, shall be necessary.

   a. As a national commitment and as a "public good", Government assures a continuous and improved observing/ imaging capability from its own Indian Remote Sensing Satellites (IRS) programme.

   b. The Government, through the nodal agency, shall be the sole and exclusive owner of all data collected/ received from IRS. All users will be provided with only a license to use the said data, and add value to the satellite data.

   c. Government reserves the right to impose control over imaging tasks and distribution of data from IRS or any other Indian remote sensing satellite, when it is of the opinion that national security and/ or international obligations and/ or foreign policies of the Government so require.

2. For acquisition/ distribution of remote sensing data within India, license/ permission from the Government of India, through the nodal agency, shall be necessary.

   a. Government reserves the right to select and permit agencies to acquire/distribute satellite remote sensing data in India. DOS shall be competent to decide on the procedure for granting license/ permission for dissemination of such data, and for the levy of necessary fees.

   b. To cater to the developmental needs of the country, the National Remote Sensing Centre (NRSC) of the Indian Space Research Organisation (ISRO)/ DOS is vested with the authority to acquire and disseminate all satellite remote sensing data in India, both from Indian and foreign satellites.

      i. NRSC shall enter into appropriate arrangements with DOS for acquiring/ distributing data from IRS within the visibility circle of NRSC's receiving station(s).

      ii. NRSC and/ or Antrix Corporation Ltd., shall be competent to enter into agreements with foreign satellite operator(s) for acquisition/ distribution of foreign satellite data in India. However, NRSC will distribute the data as per terms agreed to with Antrix Corporation Ltd.

   c. NRSC shall maintain a systematic National Remote Sensing Data Archive, and a log of all acquisitions/ sales of data for all satellites.

3. For acquisition and distribution of IRS data for use in countries other than India, the Government of India, through the nodal agency, shall grant license to such bodies/ agencies of those countries as are interested in the acquisition/ distribution of IRS data, as per specific procedures.

   a. The Antrix Corporation Ltd. (of DOS) is vested with the authority for receiving the applications for grant of license for acquisition/ distribution of IRS data outside of India; to consider and decide on the granting of license within the policy considerations of the Government, and to enter into licensing agreements with the prospective users on behalf of the Government. Antrix Corporation Ltd. shall also be competent to levy such fees for granting licenses as may be considered appropriate by it. It shall also be responsible, where necessary, for rendering any further help/guidance needed by the license.

   b. The Government reserves right to impose restrictions over imaging tasks and distribution of IRS data in any country when it is of the opinion that national security and/ or international obligations and/ or foreign policies of the Government so require.

4. The Government prescribes the following guidelines to be adopted for dissemination of satellite remote sensing data in India:

   a. All data of resolutions up to 1 m shall be distributed on a nondiscriminatory basis and on "as requested basis".

   b. With a view to protect national security interests, all data of better than 1 m resolution shall be screened and cleared by the appropriate agency prior to distribution; and the following procedure shall be followed:

      i. Government users namely, Ministries/ Departments/ Public Sector/ Autonomous Bodies/ Government R&D institutions/ Government Educational/ Academic Institutions, can obtain the data without any further clearance.

      ii. Private sector agencies, recommended at least by one Government agency, for supporting development activities, can obtain the data without any further clearance.

      iii. Other private, foreign and other users, including web based service providers, can obtain the data after further clearance from an interagency High Resolution Image Clearance Committee (HRC), already in place.

      iv. Specific requests for data of sensitive areas, by any user, can be serviced only after obtaining clearance from the HRC.

      v. Specific sale/ non-disclosure agreements to be concluded between NRSC and other users for data of better than 1 m resolution.

5. This Policy (RSDP-2011) comes into effect immediately, and may be reviewed from time-to-time-by Government.

New Remote Sensing Data Policy

The new policy removes restrictions on all remote sensing data up to 1 m resolution, that is, all satellite remote sensing data of resolutions up to 1 m will now be distributed on a non-discriminatory basis and 'on request'. The 2001 policy required data up to 5.8 meter resolution to be protected. Meanwhile, for data better than 1 m resolution, private agencies need clearance from an interagency High Resolution Image Clearance Committee (HRC). However, government bodies can obtain such data without any further clearance. RSDP-2011 comes into effect immediately.

New CMD of Antrix

The Indian Space research Organisation (ISRO) appointed Dr V S Hegde as the full time Chairman and Managing Director of its marketing wing, Antrix Corporation, in a bid to boost its commercialization drive. In addition, V Koteswara Rao has been appointed the scientific secretary of ISRO, while H N Madhusudana was appointed the associate scientific secretary. Hegde was ISRO's scientific secretary since January 2010. He was involved in earth observation satellite (EOS) programmes in his earlier assignments.

GeoEye, ScanEx sign agreement

GeoEye signed a multi-year, multi-million-dollar agreement with its Russian partner, ScanEx Research and Development Center, to provide more than 50 million square kilometres of high-resolution commercial satellite imagery for international customers in Russia and its neighbouring countries. *www.GeoEye.com*

Vietnam selects Belgian consortium for EO satellite

The Government of Vietnam has selected Belgian consortium which is led by SPACEBEL, a software engineering company operating in the Space and Earth monitoring applications sectors, for its second microsatellite for earth observations, 'VNREDSAT-1B'. VNREDSAT-1B, planned for launch in 2016, will be combined with the first remote sensing microsatellite, to provide Vietnam with a regular and quick monitoring of the environment in South-East Asia. *www.spacemart.com*

Israel to enhance processing of satellite imagery

In an effort to improve intelligence capabilities, the Israeli Air Force (IAF) aims to develop technology that will automatically process, analyze and catalogue footage taken from the country's spy satellites. Israel operates two types of satellites in space: electro-optic satellites, which use a high-resolution camera to take pictures of targets of interest; and SAR satellites, which use radar systems to create high-resolution images in all weather conditions, even through clouds and fog. *www.jpost.com*

Report recommends against LightSquared MSS deployment

A new report prepared by the National Space-Based Positioning, Navigation and Timing Systems Engineering Forum concludes that the planned deployment of a satellite and terrestrially based national broadband service by LightSquared "poses a significant potential for harmful interference" to GPS services. It recommends LightSquared should not begin service as planned for terrestrial operation in the 1525MHz to 1559MHz Mobile-Satellite Service (MSS) band due to harmful interference to GPS operations. According to the report, tests have shown there to be "significant detrimental impacts to all GPS application" looked at for the report. The report also calls on the government to conduct more thorough studies on "the operational, economic and safety impacts" of operating the company's network. These studies should look at the compatibility of ATC (Ancillary Terrestrial Components) architectures in the MSS L Band with GPS applications. *http://broadcastengineering.*

Javad calls for end to P-Code encryption

To solve the LightSquared versus GPS controversy, Javad Ashjaee, president and CEO of JAVAD GNSS, has appealed directly to President Obama to discontinue the encryption of P-code, the restricted military GPS signal. His comments came in the context of the LightSquared/GPS interference imbroglio, as part of his solution to the conflict over spectrum. "This policy is not helping national security. It is hurting both precision users and the broadband project. We need more broadband, for global, fast, and inexpensive real-time kinematic (RTK) GPS." Javad Ashjaee, a pioneer in high-precision GNSS equipment, made the remarks during a panel discussion at the Esri Survey Summit, and expands upon them in a video posted on his company's website: "A Solution for LightSquared." In the video, he calls the LightSquared saga "a good thing, because it brings the issue of in-band interference to many GPS users, especially surveyors and high-precision users."

IFEN's GNSS Simulator selected by SAC India for IRNSS program

The Space Applications Centre(SAC) in Ahmedabad of the Department of Space, India has selected the NavX®-NCS Professional, a multi-constellation and multi-frequency GNSS RF navigation constellation simulator from IFEN GmbH, as the new reference simulator for its IRNSS development and testing.

Chronos signs agreement with UK Government

Chronos Technology has signed a Framework Agreement with the UK Centre for Protection of National Infrastructure (CPNI) to provide tools and guidance for the impact assessment of GSM/ GPS Jamming Devices. CPNI provides integrated security advice (combining information, personnel and physical) to organisations which make up the national infrastructure. It will deliver tools to allow CPNI to develop a better understanding of the impact of these jamming devices on national infrastructure. *www.cpni.gov.uk*

China launches 9th navigation satellite

China has launched ninth navigation satellite as part of its GNSS, Beidou or Compass. China will form its GNSS network with 35 navigation satellites to reduce dependency on GPS. The network will provide services for Asia-Pacific regions by 2012 and global services by 2020. *news.xinhuanet.com*

US-India to cooperate on flight navigation systems

As part of efforts to upgrade air traffic management in the country, the Airports Authority of India (AAI) has launched the process of implementing a critical safety system that uses the GPS for safe navigation of flights. This is part of the implementation of the GPS Aided Geo Augmented Navigation (GAGAN) system that would improve air navigation. A MoU to implement the ground-based augmentation system (GBAS) as a pilot project at Chennai airport was signed by the AAI and the US Trade Development Agency (USTDA) here recently.

US Air Force replaces GPS 2A-11 with GPS IIF-2

The United Launch Alliance Delta 4 rocket blasted off with the Air Force's GPS IIF-2 (renamed as SVN-63) payload from the Cape Canaveral Air Force Station, Florida, US. The SVN-63 replaced the GPS 2A-11 satellite that just celebrated its 20th birthday in orbit, exceeding the wildest expectations for longevity. This launch marked the 50th successful GPS launch on a Delta vehicle. Meanwhile, Boeing, manufacturer of the satellite, announced that it has received the first on-orbit signals from the GPS IIF-2 satellite. The next GPS launch is tentatively targeted for September 2012.*www.space.com*

MIT to develop system to prevent mid-air collisions

The Federal Aviation Administration (FAA) asked researchers at Massachusetts Institute of Technology (MIT) to create an algorithm for a new tracking system to predict and prevent collisions between small aircraft. The new system broadcasts GPS data between aircraft. *www.upi.com*

IAG selects Chris Rizos as President

International Association of Geodesy (IAG) selected its new President, Professor Chris Rizos. At present, he is Head of School of Surveying & Spatial Information Systems (SSIS), University of New South Wale (UNSW) in Sydney, Australia.

Duties on devices without GLONASS

Import duties on equipment that does not support GLONASS, can be introduced as early as January 2012 according to Deputy Prime Minister Sergei Ivanov, RBC. He added that if the device supports both systems – GPS and GLONASS, the customs duties will not be charged. *www.daily-autonews.com*

Mobile apps save $ 17.6 bn annually

The use of mobile apps by small businesses saved approximately USD 17.6 billion annually, estimates a survey conducted by the Small Business and Entrepreneurship (SBE) Council. The most popular type of application used was GPS navigation, with 68 percent, followed by apps for contact management at 46 percent and remote document access at 41 percent. The study, which drew on the responses of 304 owners of companies with 20 employees or fewer, found that 51 percent of respondents believe the use of apps on their smartphones and iPads made their companies more competitive. *www.sbecouncil.org*

SAP forays into geospatial market

SAP AG will collaborate with Google to enhance its business analytics software with location-based data capabilities, allowing people to interact with real-time information via Google Maps. The plans continue a strong history of collaboration between the companies, most recently on advances for the SAP StreamWork application such as inclusion in the Google Apps Marketplace, integration with Google Docs and OpenSocial adoption. *www.sap.com*

LBS for enterprise clients in India

Tata Teleservice Ltd. in India launched Workforce Tracking Services that enable companies to track on a real time basis the location of their employees. It also gets updates on route deviation or over speeding of the vehicle if any. Tata will also offer enterprise customers a host of applications leveraging its LBS platform, including Vehicle Tracking Services, Asset Tracking Services, Workforce Management Solutions. In addition to the traditional GPS, it offers LBS powered by Assisted GPS (A-GPS) and Mobile Network Based Location Technologyto deliver seamless and accurate tracking services. *www.ciol.com*

Voiced-based GPS navigators in India

MapmyIndia has announced a seven-year strategic partnership with Nuance Communications to offer street level turn-by-turn voice navigation on its next-generation navigation devices. The new devices would give voice guidance with accurate pronunciation of Indian street and road names.

Galileo update

Astrium awarded Galileo Full Operational Capability Ground Control Segment Contract

Astrium has been selected by the European Space Agency (ESA) and the European Union (EU) as prime contractor for the Galileo Full Operational Capability Ground Control Segment. The contract value is 73.5 million euros. The Ground Control Segment (GCS) contract covers the provision of GCS facilities for the operation of the constellation of Galileo. The contract, which will be led by an Astrium team out of the UK, covers the provision of a new facility at Fucino (Italy) and the expansion of the existing Ground Control Centre at Oberpfaffenhofen (Germany). The deployment also includes the provision of a temporary GCS back-up facility at the Fucino Galileo Control Centre for the four In-Orbit Validation satellites, and the provision of two further Telemetry, Tracking and Command (TTC) stations on Reunion and Noumea. *www.spacedaily.com*

GIOVE missions serving as Galileo's radiation watchdogs

Many experts forecast the space weather to be stormy. After years of inactivity, the Sun is waking up, perhaps profoundly affecting Earth's space environment and the satellites orbiting through it - including the imminent Galileo constellation. Our parent star makes its presence felt in a variety of ways, from the solar radiation all life relies on to the steady stream of the solar wind, made up of ionised nuclei and electrons. Then there is the sudden eruption of billions of tonnes of highly energetic charged particles during solar storms - two of which occurred last month. It typically takes a couple of days for these solar streams to reach our vicinity, where their interactions with Earth's magnetic field can cause spectacular low-latitude auroras, sometimes damaging electrical infrastructure. "The frequency of solar storms varies with the 11-year solar cycle, reflected by the amount of sunspots visible," says Stefano Binda, an ESA engineer in the Galileo project. "Right now we are in the upwards phase, with maximum solar activity predicted between 2012 and 2014. "This is an issue of concern for all satellites and therefore also for Galileo, as we begin launching this October and are scheduled to begin operations by mid-2014, right in the heart of the 'solar max'."*http://www.spaceref.com/news/viewpr.html?pid=34169*

EC against terrestrial use of satellite spectrum

The European Commission (EC) added its name to the list of opposes to LightSquared's plan to use satellite band frequencies for a ground network of broadband transmitters in the US. Analysis by the European Space Agency (ESA) found that signals from LightSquared's network may cause "harmful interference" to the Galileo system. *bloomberg.com*

European Commission wants individual nations to fund GMES

The EC, in a surprise move, is proposing that its satellite-based Earth observation program be removed from its seven-year budget starting in 2014 and instead be funded by voluntary contributions from individual European governments. The decision to take the Global Monitoring for Environment and Security (GMES) effort off the commission's books just as it begins operations drew immediate criticism from a group representing European geo-information companies. In a July 19 statement, the European Association of Remote Sensing Companies (EARSC) says the commission's decision will leave GMES stillborn. *http://www.un-spider.org*

UN geospatial expert committee

The United Nations Economic and Social Council (ECOSOC) voted to establish a committee of experts on global geospatial information management to coordinate international dialogue on spatial data infrastructures and enhance cooperation in that field. According to the latest report of the Secretary-General on global geospatial information management, the rapid technological advances in geospatial information and related technologies have made this kind of information readily available. However, there is currently no global multilateral or intergovernmental mechanism that can play the important leadership role of setting the agenda for the development of global geospatial information and promote its use to address key global challenges. The Secretary-General proposed that the UN take the lead role and serve as the coordinating entity of the global geospatial information community, hence the decision to create the committee. The committee is mandated, among other tasks, with providing a platform for the development of effective strategies on how to build and strengthen national capacity on geospatial information, especially in developing countries. *www.un.org*

USDA, Esri offer cloud-based geospatial service

The US Department of Agriculture (USDA) and Esri partnered in the implementation of a fully cloud-based geospatial portal. USDA's prototype portal, Enterprise Spatial Mapping Service (ESMS), is built with Portal for ArcGIS, managed by Esri, and hosted on the Amazon cloud within USDA's secure environment. *www.esri.com*

GIS market in APAC to grow at 14%

The GIS market in the Asia Pacific (APAC) region is expected to grow at a CAGR of 14 percent, according to a market research conducted by TechNavio, a market research firm. In addition the report, Geographic Information System (GIS) in APAC 2010-2014, indicated that the market is currently being driven by government and public sector adoption of this technology. In spite of the demand for GIS solutions in the APAC region, integration issues with cloud technologies are hindering the growth of this market. The GIS market in the APAC region has also been witnessing increased utilization of GIS for transportation management. However, barriers faced by vendors in the integration of GIS and cloud technologies could pose a challenge to the growth of this market. *classic.cnbc.com*

Radiation mapped in Japan

Using Geiger counters, a group of tech-minded citizen scientists in Japan measured fallout in the disaster area (March 11 earthquake and Tsunami). They assembled thousands of radiation readings plotted on maps (http://safecast.org/) that they hope will one day be an invaluable resource for researchers studying the impact of the meltdown at the crippled nuclear complex. *www.msnbc.msn.com*

China will not bar Google services

China's industry regulator will not shut down online mapping services provided by Google Inc and Microsoft Corp, according to the State Bureau of Surveying and Mapping (SBSM), China. This is the first time, the regulator has firmly denied that it intended to close the companies' online mapping services - has banished concerns that Google may have to cancel its service in China, which has been losing market share. *www.chinadaily.com.cn*

Qatar geo-tagging project

Qatar's Civic Ministry rolled out an ambitious project of replacing existing number plates on buildings with metal plates containing electronic chips, which will show information like the building's location, and numbers for water, electricity and telecom connections. The project is designed to help emergency services. The electronic chips will be linked to a database of buildings being created by the Geographical Information Systems Centre (GISC) in Qatar. In turn, the GISC will link the database to more than 60 public service agencies, including utilities, Civil Defence and medical emergency units. *www.thepeninsulagatar.com*

Single-enclosure GPS anti-jam antenna for military land vehicles

NovAtel in collaboration with QinetiQ has developed GAJT (pronounced "Gadget"), the world's first single-enclosure GPS anti-jam system small enough for light armored and other land-based military vehicles. GAJT combines NovAtel's and QinetiQ's outstanding technologies in a stand-alone, rugged enclosure that mounts to the exterior of vehicles. Intentional jamming of GPS can completely deny a position solution to users over a broad area. GAJT is a seven element controlled reception pattern antenna (CRPA) that nulls jammers, ensuring GPS positioning capabilities are retained during combat, training or other vehicle-based missions. *www.novatel.com*

ProMark 100 GNSS Receivers helps map Underground Bunkers

Beneath the surface of this tropical paradise in the city of Townsville on Australia's Sunshine Coast lies a still hidden maze of tunnels and underground bunkers, once said to be used by General Douglas MacArthur. Learning the secrets of this labyrinth that was a major WWII staging point for battles in the South West Pacific is the passion of Kevin Parkes, of Geo Positioning Services, a local Ashtech dealer.

Parkes main tool is historic aerial photography, coupled with hours of research in the National Australian Archives and the National Library of Australia. To that he adds geophysical surveys of the infrastructure. Parkes is undertaking the geophysical surveying and mapping using an Ashtech ProMark™ 100 GNSS receiver and a Willy Bayot PPM Mk 3 magnetometer. *www.ashtech.com*

GNSS receiver smaller than business card

NovAtel Inc. has introduced the newest member of its OEM6 next generation receiver family: the OEM615. At only 46 x 71 x 11 millimetres and weighing 24 grams, the diminutive OEM615 provides

world-class precise positioning in a familiar, compact form factor. It tracks existing and planned GPS, GLONASS, Galileo and Compass signals. With 120 dynamic channels configured to track GPS + GLONASS L1/L2 now, it offers future-ready performance for constellations and signals yet to become operational. *www.novatel.com*

Hemisphere GPS Earthworks X100

Hemisphere GPS has released Earthworks X100, an excavator grade control system for small to medium-sized contractors. It displays bucket position relative to desired grade. This instant feedback improves the operator's accuracy and efficiency when digging foundations, trenching, cutting a slope and in many other excavation applications. The system can be upgraded to either Earthworks X200 or X300, the full 2D and 3D excavator grade control systems capable of shaping dual-slopes and more complex design surfaces. *HemisphereGPS*

Leica enhances processing speed of XPro 5.1

Leica Geosystems has announced enhancements to its superior line sensor workflow Leica XPro. Users of Leica XPro 5.1 can now benefit from the conceptual changes within the workflow to double the processing speed and to deliver Info Clouds that include - additionally to Point Clouds - spectral and time information. The new software version offers an one-click 'from Raw to Product' processing option for applications as disaster management, where the production and delivery speed of orthoimages play a crucial role. *www.leica-geosystems.com*

Leica RCD30 60MP multispectral camera

Leica Geosystems has released Leica RCD30 medium format camera. It is the first 60MP medium format camera that can record co-registered multispectral four-band imagery in RGB and NIR.

Trimble new RTX technology

Trimble has introduced RTX technology (Real-Time Extended), which combines real-time data with innovative positioning and compression algorithms to deliver better than 4 centimeter (1.5 inch) repeatable accuracy with as little as one minute convergence in selected areas. The new technology utilizes real-time data from a global reference station infrastructure to compute centimeter level positions based on satellite orbit and clock information.

Envelope Control to ArcMap with Desktop 2.3 Release

Blue Marble Geographics has announced the release of the latest version of the Blue Marble Desktop v2.3. It adds key functionality enhancements that grant users the ability to edit and share custom coordinate transformation work both in the Blue Marble Desktop and with Esri's ArcMap via the Geographic Calculator Extension for ArcMap. *www.bluemarblegeo.com*

MicroSurvey Releases STAR*NET V7

MicroSurvey has announce the largest, most significant update to STAR*NET to date. STAR*NET new Version 7 brings an incredible amount of workflow enhancements to help speed up this part of the process. MicroSurvey purchased STAR*NET in 2010 and has worked tirelessly bringing dozens of enhancements and other requests into the new version. Every surveyor who currently has a copy of STAR*NET is strongly advised to get this update. Surveyors not yet using STAR*NET to correct and clean up their data before mapping, should start with Version 7. Build confidence by ensuring your field data is both accurate and correct.

Septentrio and Altus strategic relationship

Belgian GNSS Technology Leader Makes Investment in Septentrio Satellite Navigation NV and Altus Positioning Systems have announced expansion of their strategic relationship to pursue growth opportunities in the high-precision satellite-based surveying sector. Under the agreement, Septentrio is making a substantial investment in Altus through its U.S. subsidiary, Septentrio Inc., which is jointly owned by Septentrio Satellite Navigation NV, and by the Belgische Maatschappij voor Internationale Investering - Société Belge d'Investissement International (BMI-SBI) / Participatiemaatschappij Vlaanderen (PMV), a Belgium-based investment consortium.

Topcon total stations for London Crossrail project

Topcon Europe Positioning B.V. received an order for more than 100 high precision robotic total stations for the Crossrail project in London, UK. The order for 105 instruments is believed to be the single largest order globally for 0.5" total stations from any manufacturer. The Crossrail project is to provide new east-west rail connections underneath Central London. *www.topconpositioning.com*

MARK YOUR CALENDAR

August 2011

7th International Symposium on Digital Earth
23-25, August
Perth, Australia
www.isde7.net

Scientific and Fundamental Aspects of the Galileo Program
31 August – 2 September
Copenhagen, Denmark
www.congrex.nl

September 2011

ICG-6: Sixth Meeting of the International Committee on GNSS
5-9 September
Tokyo, Japan
www.unoosa.org

53rd Photogrammetric Week
Stuttgart, Germany
5 – 9 September
www.ifp.uni-stuttgart.de

Middle East Geospatial Summit
13 - 15 September
Doha, Qatar
barbora.kuckova@flemingeurope.com

UAV-g 2011: Unmanned Aerial Vehicle in Geomatics
14 – 16 September
Zurich, Switzerland
www.geometh.ethz.ch/uav_g

ION GNSS 2011
20-23 September
Portland, USA
www.ion.org

INTERGEO
27 - 29 September
Nuremberg, Germany
www.intergeo.de

Geospatial Defence & Intelligence Asia Pacific
27 - 30 September
Kuala Lumpur, Malaysia
www.geospatialdefenceasia.com

October 2011

ACRS 2011
3-7 October
Taipei, Taiwan
www.acrs2011.org.tw

AfricaGIS 2011
10-14 October
Cairo, Egypt
www.eis-africa.org/EIS-Africa

November 2011

The 3rd Asia Oceania Regional Workshop on GNSS
1 - 2 November
Jeju Island, Korea
www.multignss.asia/workshop.html

Joint International Symposium on Deformation Monitoring
2 - 4 November 2011
Hong Kong, China
JISDM.2011@polyu.edu.hk

IMTA Global Conference & Trade Show
10-11 November
Bangkok, Thailand
www.imtamaps.org

2011 Precise Time and Time Interval Systems and Applications Meeting
14-17 November
Long Beach, California USA
www.pttimeeting.org

Regional Geographic Conference – UGI 2011
14-18 November
Santiago, Chile
www.ugi2011.cl

spatial@Gov – Positioning Australia
15 – 17 November
Canberra, Australia
www.cebit.com.au/spatial

International Symposium on GPS & GNSS
15-17 November
Sydney, Australia
www.ignss.org

Surveying & Spatial Sciences Conference 2011
21 – 25 November
Wellington, New Zealand
www.sssc2011.com

Best Practices for Risk Reduction and Rapid Response Mapping
22 – 25 November
Beijing, China
www.unoosa.org

ENC 2011
29 November-1 December
London, UK
www.enc2011.org

ELMF 2011
29 – 30 November
Salzburg, Austria
www.lidarmap.org/ELMF/

December 2011

United Nations International Meeting on GNSS
12 – 16 December 2011
Vienna, Austria

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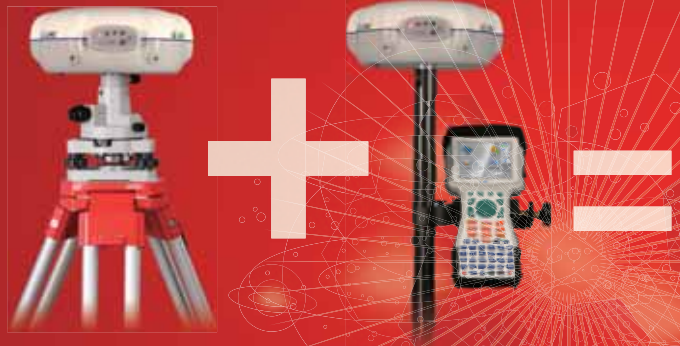

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