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A New Paradigm for Management, Processing, and Distribution of Imagery

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Cindi Salas
GIS Manager
CenterPoint Energy

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Map Asia is an international initiative providing an apt platform for the convergence, sharing and use of Geospatial Technologies. Founded in the year 2002, Map Asia is the largest Annual Conference and Exhibition in the field of GIS, GPS, Aerial Photography and Remote Sensing in the Asia Pacific region.

The theme of this year’s conference - Maponomics - Economic Growth Through Geoinformation Technology - brings forth the utilization of mapping technology in policy making and good governance thus ensuring a boost to economic development. The economic growth, backed by application and usage of geospatial technologies enables the expansion of economic activities in a given community, which in turn raises the living standards of individuals and aids private industry to reap more benefits, adding to the countries’ national income.

Listen to the Industry leaders sharing their views on MAPONOMICS.
Known to be the Diner's Paradise, Malaysian culinary diversity originates from its multi-ethnic population of Malay, Indian, Eurasian, Chinese, Nyonya and the Indigenous peoples of Borneo.

An estimated over 15,000 flowering plant species and 185,000 animal species are found in Malaysia.

Malaysia's flowering plants include some 2,000 types of trees, including 200 different palms and 3,000 species of orchids.

The wildlife of Malaysia includes elephants, rhinos, tigers, leopards, tapirs, sun bears, orang-utans and a cornucopia of birds.

Many different cultures have had a lasting impression on making the Malaysian cultural mosaic. Chief among these is the ancient Malay culture, and the cultures of Malaysia’s two most prominent trading partners throughout history—the Chinese, and the Indians.

The harmonious mingle of the different cultures in Malaysia can be witnessed during the many religious festivals, which are marked by joy, harmony and a spirit of freedom and joy.

Public-Private-Partnership: Thought Leadership & Precedents

Public-Private-Partnership is about bringing the elements of government service and private industry profit making needs. An example could be our toll road, where the government has given a private operator permission to build the road, operate it and later on transfer it back to the state once the operator has made sufficient return on it’s investment. For the remote sensing industry, it could be that the government agency builds upon a technology, demonstrates it and later on brings in private players to run it profitably. Well, within the two decades of the emergence of satellite remote sensing, US Congress realised it’s importance for the civilian purpose and came up with a policy in 1979, which was an effort to transfer the responsibility to develop the remote sensing satellites to the private sector. In 1984, the Land Remote-Sensing Commercialization Act, initiated the process of transferring the government owned Landsat satellite programme to private sector. The above policy was not a kind of ‘Shoot and forget’, realising that the market was yet make the private sector venture into the remote sensing programme a viable option, it came up with Land Remote Sensing Policy Act 1992, which clearly states that commercialisation of remote sensing would be a long term goal of the US government. Although, this act, also marked the return of Landsat back into the public sector. But this did not lead to clipping of private sector remote sensing initiatives. As per the Commercial Remote Sensing Report for Congress 2002, the industry was yet to turn profitable and it depended largely on purchases by the federal government to remain in operation. The large purchase orders from federal agencies are not just project based, but as a part of long term strategy to create a healthy and competitive commercial remote sensing industry in US. But, the model is not bleeding US government. The cost which is far less than what they otherwise would have incurred, if they would have been handing design to launch of remote sensing satellites.

In Europe, formation of Infoterra in 2001, which last month sent it’s first radar imaging satellite, TerraSAR-X, marked the age of public-private partnership in Germany. The foundation of Infoterra is the need to capitalise on the potential offered through the growing commercial need of satellite images in civil domain. The multi-nation partnership model through SPOT between France, Belgium and Sweden, has not only seen launch of it’s own remote sensing satellites, but has even build remote sensing satellite for other countries like Korea. In UK, we have Surrey Satellite Technology [SSTL] which was formed in 1985, to commercialise the research done on small satellite engineering at University of Surrey. Today we have SSTL, which has build the first of the Galileo satellite, GIOVE-A, in addition to have designed and build remote sensing satellites for Algeria, Nigeria, Turkey, China and UK.

In Africa, we see Algeria, Egypt, Nigeria and South Africa, who are in the process or have their own earth observation satellites. Factors leading to more and more nations joining the league of satellites remote sensing could range from technical expertise to nations’ pride to commercialization of remote sensing satellite fabrication.

In Asia, we have nations leading the remote sensing satellite design and launch. But almost all of these programmes are managed by the state, from design to fabrication to imagery data sales. There is a growing requirements of satellite imagery for the civil purpose. Along with this there is also realisation that services should best be left to be managed by private companies. But not in satellite remote sensing segment, which is yet to overcome the initial awe, which we have on seeing a high resolution image! We do look at other people for precedents, so does the nations. If not the thought leadership, we can always adopt good public-private models.
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Satellite imagery used to track industrial logging

Congo: Scientists at Woods Hole Research Center (USA) have used satellite imagery acquired between 1976 and 2003 to study the development of industrial logging and road density in Central Africa. They have analysed four million square kilometres of the region, using over 300 Landsat satellite images. Researchers mapped nearly 52,000 km of logging roads within the forested region, which includes Cameroon, Central African Republic, Equatorial Guinea, Gabon, Republic of Congo, and Democratic Republic of Congo.

The report highlights the rapid expansion of the logging frontier in the Congo Basin. In Central Africa alone, 600,000 square kilometers of forest -- 30 per cent -- has been conceded for logging, whereas only 12 per cent is protected. Prior to this work, there were few reliable data sets available to monitor both legal and illegal logging. The study provides a synoptic view of industrial logging in Central Africa, enabling conservation agencies, government agencies, scientists, industry officials, and others to better gauge how the expansion of logging is impacting the forest and its inhabitants, and how better planning might mitigate damage.

WebGIS platform to support refugee monitoring in Darfur

Sudan: INTERSOS, an independent non-profit humanitarian organization, has developed an Open-Source WebGIS platform to support refugee monitoring in West Darfur (Sudan). The WebGIS application was developed with technical support from research center ITC-irst and its MPA Solutions.

The information system developed by INTERSOS will monitor the humanitarian situation and provide timely data regarding displacements of refugees, internally displaced persons (IDPs) and the involved camps and villages. Web GIS contain sectoral information in a unified geodatabase and can be consulted on-line. The goal of presenting the data online is to strengthen the capacity to share information with UNHCR (United Nations High Commissioner for Refugees) as well as with other UN agencies and NGOs integrating all the agencies in a wide-spread collaborative information sharing system.

Enterprise GIS for city of Cape Town

South Africa: The local government of the city of Cape Town has launched Enterprise Resource Planning (ERP) system based on ESRI’s ArcGIS platform, after the amalgamation of seven local authorities in the city. The application is offering functionality within a multi-user environment and an effective spatial data management platform for its users. Initially, the city developed the database for electricity and property and subsequently added the Water Services geo-database to the GIS.

One of the applications developed by City council is a custom-designed billing system to help streamline the accounting process. Then, the city integrated a GIS infrastructure. After this development a number of other departments such as Planning and Valuations have also started implementing GIS.

Nigerian online mapping portal launched

Nigeria: Third Dimension Technologies has launched an online mapping service for Nigerians.

This website is an online resource for finding and sharing geographic content including maps and data. The online mapping application could be found at http://www. ceasarweb.com/cm/maps/default.asp

The website provide tools such as: search for addresses, find information and location of services; My nearest search tool (This will allow user to search for closer street addresses); nationwide route planning module (Here one can plan route nationwide); and search for maps of any palce nationwide.

Satellite imagery to help African water project

Tunisia: Algeria, Libya and Tunisia have kicked off an ambitious water project
called GEO-AQUIFER that will use satellite imagery to support the monitoring and sustainable management of their common, transboundary groundwater resources.

Recognising the overexploitation of the shared resource called the North-Western Sahara Aquifer System (SASS, after its French acronym), these three countries initiated together with the Sahara and Sahel Observatory (OSS) a consultation mechanism at ministerial level. This consultation depends on objective, timely, area-wide and consistent information. GEO-AQUIFER will use products and services based on satellite data, such as land-use and land-cover maps, change maps, surface water extent and dynamics, digital terrain...
models, and derive information on water consumption for irrigation.

The project is co-funded by OSS and the African Water Facility (AWF), which is managed by the African Development Bank (AfDB). OSS is the executive agency for the project, key partners are the national water ministries. ESA is involved as member of the steering committee. It has a lifetime of 18 months, with final results being planned for late 2008.

**MDG Mapper tool to monitor developmental projects**

**South Africa** Economic Commission for Africa has developed a tool named MDG Mapper for one of the African states for visualizing and exploring Africa’s progress in its developmental projects those were initiated in the name of Millennium Development Goals in 2015 (MDG). MDG Mapper is providing functionalities to thematically map MDG project progress, view raw and derived data, chart the indicator and producing a set of summary statistic-sand metrics of spatial association.

**Google Driving Directions enhanced with NAC System**

**Canadian** NAC Geographic announced the release of the NAC Enhanced Google Driving Directions - an integration of Natural Area Coding System and Google Driving Directions through Google APIs. The NAC Enhanced Google Driving Directions allows users to use a Natural Area Code (NAC) in addition to latitude/longitude coordinates, street addresses, POIs and ZIP/postcodes to specify start, stop and end locations. If a user doesn’t have Universal Address of a given location, then he can obtain it on Universal Address Lookup Service and NAC Enhanced Google Maps.

**GSFC’s Wallops Flight Facility develops Gismo**

**USA** Recognizing the need to standardize mapping data at the facility and provide tools for distributing maps to its users, Wallops Flight Facility has developed the Geographic Information System for Managing Operations (Gismo). NASA has directed all its facilities to use ArcGIS as their standard GIS software package.

Applying industry database design standards and implementing a Web mapping interface available via the Wallops intranet, Gismo would provide managers with the ability to create maps, publish them as map services, and quickly make them available to authorized users through its secure Web application.

Maps can be exported from Gismo to PDF in a variety of page sizes using the layout properties in the original GIS document.

Gismo uses ArcGIS Server
that measure the position of Earth with respect to quasars at the edge of the universe, known as very long baseline interferometry; and a French network of precise satellite tracking instruments called Doppler Orbit and Radio-positioning Integrated by Satellite, or DORIS.

Knowing the location of the center of mass, determined using measurements from sites on Earth’s surface, is important because it provides the reference frame through which scientists determine the relative motions of positions on Earth’s surface, in its atmosphere and in space.

This information is vital to the study of global sea level change, earthquakes, volcanoes and Earth’s response to the retreat of ice sheets after the last ice age. Scientists can also use the new information to more accurately determine plate motions along fault zones, improving our understanding of earthquake and volcanic processes.

Satellite helps detect Asian soybean rust
USA: Researchers in Iowa State University, have developed a way to use satellite images to find Asian soybean rust. Using remote sensing, GIS and GPS, scientists can measure the green leaf area of soybeans to detect and identify diseases down to the area of a square meter, about 1.2 square yards. "Plant pathogens and pests impact the green leaf area index of crop canopies in different ways and those changes can be detected and quantified using remote sensing," said Forrest Nutter, professor of plant pathology.

The footprints of early soybean rust infection are oval-shaped. The way it spreads over time in a field helps identify it from other diseases.

Tests conducted last year in South Africa demonstrated the importance of technology.

Nutter said the USDA and Department of Homeland Security are interested in using the technology to alert officials to a soybean rust infection during the crop season. Being able to monitor the movement of soybean rust could help reduce the impact of the devastating disease.

In response to the recent introduction of soybean rust into the US, United States Department of Agriculture (USDA) facilitated the development of a federal, state, university and industry-coordinated framework for surveillance, reporting, prediction, and management of soybean rust.

Public Security to develop crime monitoring system
China: China Public Security Technology contracting partner iASPEC has been awarded a phase I contract by Zhuhai Special Economic Zone for installing its Police-Use GIS that will enable police forces to manage their resources and guide them properly during emergency situations and crime monitoring through an emergency response system.

Under the contract China Public Security provides Zhuhai Special Economic Zone with system operations and supporting services in connection with its PGIS Platform. On PGIS platform CPST will develop the application.

The PGIS platform will help Zhuhai professionals...
with mapping services, geographic positioning services for automated police patrol area monitoring, patrol history tracking, and Crime monitoring and other services.

Indian land record management to integrate data on GIS

India: Land records management in the country is set to witness a major change with the Centre considering the National Land Resource Management Programme (NLRMP), an e-governance and system-reform initiative of the government, aimed at integrating the data on a GIS platform.

The programme aims at integrating satellite imagery, Survey of India maps and the land records on a GIS system.

Although, construction and building activities will not be covered under the programme, once implemented, it would be able to provide Records of Rights (RoRs) with maps to scale. It would also provide other land-based certificates such as caste certificates, income certificates, domicile certificates, information for eligibility for development programmes, land passbooks etc.

GIS to aid rehabilitation

India: The Delhi government is planning to carry out a survey and prepare a project report based on GIS database which will help in the rehabilitation of slums.

The surveyed data will be incorporated into a geo-database and then settlements located along river-banks, drains, railway tracks and low-lying areas will be classified. Within that the slums will be marked by their precise boundaries on maps. After complete analysis the GIS database along with satellite imageries will be utilized for rehabilitation processes.

Aerial thermal survey of North London completed

UK: An aerial thermal survey of North London to highlight heat loss from properties has been completed by BlueSky. The survey was carried using an airborne thermal infrared sensor which had the capability to measure up to 256 individual variations in temperature and was sensitive to °C.

The raw survey data was then processed by BlueSky to match Haringey Council’s Ordnance Survey MasterMap giving an average heat-loss value for each building polygon.

By matching this information to Haringey’s residential address database SeeIT has created a web page that enables visitors to search by street name or postcode and view a thermal image of their property.

UK’s flood, coastal defence database goes live

UK: The UK Environment Agency (EA) has launched National Flood and Coastal Defence Database that was developed with the help of 1Spatial and its system integration partner Scisys. The application was aimed at data re-engineering for the National Flood and Coastal Defence Database (NFCDD) system.

In January this year the latest release of the NFCDD application provided by Scisys to the EA contained new functionality to perform simplification, geometric and topological validation against EA data.

After the evaluation, a process was defined whereby the functionality and software were used outside the NFCDD system.

The data were extracted, validated then reloaded back into the database so that users could benefit from the results. This process has now been built into a workflow that automatically cleans and simplifies geometries as data updates are received.

LiDAR system improves onshore geo-modelling

UK: 3D Laser Mapping has supplied ARKeX with a second LiDAR system to improve the accuracy of their airborne geological mapping.

The Riegl LMS Q240i unit from 3D Laser Mapping tool is used for both surface and sub-surface measurements and is also used to create 3D models for additional ground exploration projects.

By using airborne LiDAR, ARKeX are mapping the terrain when they fly over and use this data to remove terrain correction.

LiDAR data is therefore found as an essential component in processing airborne gravity gradiometer data to develop 3D models for clients to plan subsequent ground based surveys.
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DVP-GS Version 6.3 photogrammetry software released

Canada: DVP-GS has announced the release of Version 6.3 of its professional photogrammetry software. Major enhancements in DVP-GS version 6.3 include: One-step batch import of stereomodels in O PKXYZ form; Optimization of mosaic polygon collection/edition; Ability to view stereo in the zone between flight lines (interline); Optimized Planimetric Dodging and Color Balancing for images; and New filters for imagery enhancement such as Auto contrast.

India to launch military satellite CARTOSAT 2A

India: India will launch its first dedicated military reconnaissance satellite CARTOSAT-2A on a Polar Satellite Launch Vehicle rocket by the Indian Space Research Organisation (ISRO) in the first week of August. CARTOSAT-2A will be an advanced remote sensing satellite with a single panchromatic camera capable of providing scene specific spot imageries for cartographic applications. The satellite will have high agility with capability to steer along and across the track up to +45 degrees. It will be placed in a sun-synchronous polar orbit at an altitude of 630 km. It will have a revisit period of 4 days, which can be improved to one day with suitable orbit manoeuvres. The panchromatic camera is designed to provide better than 1 m spatial resolution imageries with a swath of 10 km.

Spy satellite Ofek7 launched

Israel: The country’s defence establishment has launched the Ofek-7 intelligence satellite on June 11. Professor Haim Eshed, Head of the Defense Ministry’s Space Program, personally supervised the launch. Ofek-7 is currently in orbit.

The successful launch of Ofek-7 is particularly significant for Israel in providing better intelligence, particularly with regards to Iran, following the failed attempt at launching its predecessor, Ofek-6 in October 2004, which plummeted to the sea.

While refusing to divulge the performance levels of the new satellite, defense officials said that it was by far the most advanced satellite Israel has launched into space. Officials said that it was superior to the Eros B satellite - launched in April 2006 - which has the ability to spot images on the ground as small as 70 centimeters.

The new satellite is expected to circle the earth every 90 minutes, and should remain in orbit for a minimum of four years, and a maximum of six.

HP introduces new large format printers

UAE: HP Middle East has launched three new large format printers including the HP Designjet T Printer.

Recently tech sites have been showing up a new product called Microsoft Surface, which has evolved out of the concept called “Surface Computing an idea floating in the minds of researchers since the 80’s”. The Surface computing is a new way of working with computers that works without the traditional mouse-and-keyboard.

The device turns an ordinary tabletop into a vibrant, dynamic surface that provides effortless interaction with all forms of digital content through natural gestures, touch and physical objects. If you are not able to infer any thing out of this, take a look at this. Imagine a computer embedded in a table top on which you generally put your things. If you take a digital camera and place it on the Surface, instantly digital pictures will be spilled out on the tabletop.

Another important feature of surface computing is the Multi-touch feature. Imagine that after Surface displays the digital content on screen, and if you want to resize the image - hold on to the four corners of the image with fingers and stretch it, then image gets zoomed. And place a mobile on the surface, the photos are instantaneously dragged and uploaded into the phone.

And this device has been built out of the hardware that already exists in the market; a screen, a CPU made of a core 2 Duo processor, 2GB of RAM and a 256MB graphics card. Wireless communication between various devices is through WiFi and Bluetooth. And the underlying Operating System is a
series for CAD and GIS professionals and the HP Designjet Z6100 Printer series for print service providers (PSPs), and technical printing markets. The eight-ink HP Designjet Z6100 Printer series is available in 1067 and 1524 mm models. The HP Designjet Z6100 Printer series with HP Vivera pigment inks can be used for indoor and short term outdoor large-format applications. The HP Designjet Z6100 features HP DreamColor Technologies, a certified system of colour technologies, such as an embedded spectrophotometer. The HP Designjet T Printer series include the HP Designjet T610 and T1100 Printer series, with its three-black ink set, including grey ink, and HP Vivera inks. The series includes HP-GL/2 and in-printer processing architecture.

USGS Landsat data available on web

USA: The USGS has made available selected Landsat 7 slightly modified version of Windows Vista. The surface machines will cost $5000 to $10,000 at launch by Fall 2007, but as prices fall, similar devices may find their way into the home. Surface will be shipped with a portfolio of basic applications, including photos, music and virtual concierge applications that can be customized to provide their customers with unique experiences.

Similar research is being done by a company called Perceptive Pixel, which builds six-figure-plus custom multi touch drafting tables and enormous interactive wall displays for large corporations and military situation rooms. Harsha.m@gisdevelopment.net
News: PRODUCT

Image data of the United States through the Web (glovis.usgs.gov or earthexplorer.usgs.gov). The data is said to have limited cloud cover.

The Web enabled distribution of recently acquired data is taken as a pilot project for the Landsat Data Continuity Mission (LDCM), currently projected for launch in 2011. The project will allow the Landsat data user community to help refine the distribution system planned for the upcoming LDCM. Each image presented will be ortho-rectified, prior to being placed on the Web.

Landsat 7 has a panchromatic camera which is providing data at 15m spatial resolution and a thermal infrared channel with 60m spatial resolution.

23rd July 1972 - ERTS-1 or what was later re-christened as Landsat 1 was launched, and in the words of Dr. McKelvey, then director of USGS ‘The ERTS spacecraft represents the first step in merging space and remote-sensing technologies into a system for inventoring and managing the Earth’s resources’.

The Landsat program is thirty five years old and has survived the ravages of time and political ideologies. The global Landsat data users community had its say in convincing the decision makers about the need for this ‘mission’ to continue.

Veteran users of Landsat data will still have in their collection the 9” diazo positives and memories of backbreaking hours spent on mechanically registering the 70mm positives on the Addcol viewer - the then coveted instrument for generating FCC’s.

Google announces new mapping solutions

USA: Google has made new additions for Google Maps with Street View and Mapplets. Street View is a feature of Google Maps that enables users to view and navigate within 360 degree street level imagery of various cities in the US. Street View imagery will initially be available for maps of the San Francisco Bay Area, New York, Las Vegas, Denver and Miami, and will soon expand to other metropolitan areas.

Mapplets is a new tool for developers and consumers. Mapplets enables third party developers to create mini applications that can be displayed on Google Maps, much like Google Gadgets are displayed on iGoogle. These Mapplets contain information, from housing listings to crime data, and tools like distance measurement.

Users can select from a wide range of Google and third party Mapplets to display on the Map with new functionality such as local search and driving directions.

Garmin’s API library published

USA: Garmin International has introduced the Garmin Developer website that provides both free and licensed Garmin resources and a library of Application Programming Interfaces (APIs), toolkits and web services offering six products: Garmin Communicator Plugin, MotionBased Web Services, Content Toolkit, Garmin PeerPoint Messaging System, Garmin LBS Toolkit and Fleet Management Interface.

The Garmin Communicator Plugin API: It is a browser plugin and JavaScript support code that allows transfer of location data to and from a website and Garmin device.

MotionBased Web Services API: This will enable developers to access the same GPS content that MotionBased.com customers use. Garmin Content Toolkit: This lets developers compile secure POIs for GPS devices.

PeerPoint Messaging System: With this developers can look into Garmin’s location message format and send coordinates information to phones running the Garmin Mobile XT application.

Garmin LBS Toolkit: This will help developers to add location-based services to any Java-based mobile phone application. Garmin Fleet Management Interface: This will enable fleet tracking, messaging, dispatch and navigation.
Leica TITAN Network  
**USA:** Leica Geosystems Geospatial Imaging has announced the Beta release of Leica TITAN and launch of the Leica TITAN Network. With 3D virtual globe, this online solution allows to share geospatial and location based content in a single, secure environment.  
Leica TITAN is an interactive 3D gateway that provides a content forum to view, access, communicate and ultimately share geospatial data with users. Members can access the community and participate in the TITAN network through a free 3D rich client application.  
The Leica TITAN client application allows local users to publish and share geospatial data with a global network of users. Leica TITAN allows for the creation of the geospatial equivalent to ’MySpace’.
Similar to online social network concepts, users will be able to create, publish and share a geospatial ’MyWorld’ which contains geospatial content authored by a user.

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**API for Free?**

In geospatial domain, it most probably started with GoogleEarth. And today, it’s every now and then with companies releasing their APIs in public, and some even for free. The last few months too saw some similar developments - 'ESRI’s BusinessMAP 4.5 includes new data and API'; 'ESRI announces updates to the ArcWeb Services REST API'; 'Garmin publishes API Library' and 'MapQuest introduces ActionScript API'. Why all the companies have started doing this? Is it a gratis service to allow the users to develop applications around the respective core technology which can further be included in the main software, is it a pure business strategy or something else? While looking at the answers to the above, we stumbled upon Nat Torkington’s post (http://radar.oreilly.com/archives/2007/04/six_rules_for_a.html) which offers an insight to trend stating "Six Basic Truths of Free APIs". According to him, Free APIs are not a god-given right. Businesses offer them for their own self-interested reasons. If you build on top of the API but aren’t delivering the value for the business that provides the API, your use of the API will probably go away.

In case of GoogleEarth API you end up subscribing to the paid version of the API, if users/ hits to your site increases by a certain limit!! If you build your own business on top of an API, you need a contractual relationship to ensure the service doesn’t get taken away from you. These generally cost money.
If you get advertisements on your website, made using ‘free’ GoogleEarth API, you have to subscribe to the paid version.
If you find a way to get something from a site that isn’t explicitly offered as something for you to build on, your use of it will probably be fought unless you’re delivering value.

The provider of your API will find it easier to implement services on top of their API than you. Therefore you have to add something difficult to replicate, something beyond a simple UI tweak or a feature like “search”, so that business that provides the API doesn’t compete when you look like you’re succeeding.

For these reasons, free APIs are a very poor substitute for having the source and the data and thus owning and controlling every piece of your application. And for these reasons, there’s no such thing as a free API if you’re looking to build a business.

So, be careful when you start developing application using any of the free APIs.
German Aerospace Center (DLR) to create the new capabilities for its radar mapping software suite. IMAGINE InSAR is specifically beneficial while mapping in perennially cloud-covered areas such as equatorial, coastal and temperate mountainous regions. Radar has the ability to see through clouds, allowing the surface of the earth to be mapped while being obscured with clouds.

**Editable maps of US cities**

**USA:** Digital Vector Maps has published more than 300 new vector maps of US cities. The new vector maps cover greater metropolitan areas for over 300 major US cities.

The maps comprises of multiple layers which can be individually edited. Layers available in each of the maps include features such as: city borders, rail lines, highways, roads, county borders etc.

The digital vector maps are available in Adobe Illustrator or editable PDF formats. Since both of which use a vector based approach to display images, one can easily zoom into any portion of maps without any degradation in the quality of the text, lines and symbols of the map regardless of the magnification factor. Using Adobe Illustrator, one can then easily select area of interest in the maps and then add custom symbols and other changes to the map.

**MapQuest introduces ActionScript API**

**USA:** MapQuest had announced the beta launch of a new API for Adobe ActionScript.

The release offers ActionScript 3.0 API option within MapQuest’s Advantage API. MapQuest said that the developers can now develop applications with Adobe Flex or Adobe Flash software using native API for ActionScript.

MapQuest’s Advantage API offers location-based platform with the flexibility and efficiency of a web service. The Advantage API 5.1 version offers 16+ million POIs, premium listings that can be licensed to enrich any application, as well as following JavaScript enhancements:

- Advanced Overlays: Gives capability to create and interact with custom lines and shapes such as polygons, rectangles and ellipses. These overlays can then be used to create custom search areas and allows the user to define the geographic search area right on the map.

- Icon Declutter: For times when a map view contains map icons overlapping each other, decluttering moves those icons away from each other and allows distribution in a selected style.

**LizardTech releases Express Server 6**

**USA:** LizardTech has released the Express Server 6 for distribution of massive geospatial image datasets via the Internet. Express Server 6 advances GIS interoperability with new features such as Oracle integration, Geography Markup Language (GML), metadata for JPEG 2000 (JP2) and added sample Web applications. With the Oracle integration, Express Server 6 acts as an intermediary between Oracle and other applications. Express Server 6 distributes imagery stored in Oracle databases running Spatial Express, LizardTech’s database plug-in. In addition, Express Server preserves the security by using Oracle’s security infrastructure.

GMLJP2 has been adopted as a standard for adding GML metadata to JPEG 2000 images. Express Server 6 recognizes GML metadata stored in JPEG 2000 imagery and renders the image in the correct geospatial location and projection system. It also recognizes requests for imagery using the WMS interface where imagery is requested in coordinates from the GML metadata. By supporting GML for JP2 imagery, Express Server 6 ensures that your JPEG 2000 imagery is interoperable and geospatially correct.
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Singapore Land Authority and NTU sign MoU

Singapore: The Singapore Land Authority (SLA) and Nanyang Technological University’s (NTU) School of Civil and Environmental Engineering have signed an MoU to conduct cooperative research, development, and education in the area of spatial information science and technology.

Under the agreement SLA will use NTU’s GIS technology, array of equipment, software, training, resources and capabilities in the development of its own capabilities, whereas NTU’s researchers and students will work with SLA in areas like structure monitoring, vehicle tracking and navigation, spatial data infrastructure and map data maintained by SLA.

SLA and NTU are planning to introduce spatial data infrastructure named SiReNT which with GIS will assist in various applications related to location-based services.

GIS Development announces DigitalGlobe as its Corporate Sponsor

India: GIS Development has announced its second Corporate Sponsor for 2007 - DigitalGlobe Incorporated. Earlier this year, Leica Geosystems Geospatial Imaging also joined GIS Development as Corporate Sponsor.

The tie up between DigitalGlobe and GIS Development will result in sharing of knowledge and expertise by the global Earth imagery and geospatial information expert to educate and update readers of GIS Development’s print and e-publications.

Autodesk outlines vision for Indian market

India: Autodesk outlined its vision for the Indian Manufacturing/ Civil/ Infrastructure industries through its range of products at its ‘India Press Day.07’ on June 1st. Autodesk announced updates to its software portfolio, releasing advanced versions for industry segments that include manufacturing, infrastructure and the building industry. According to the officials from Autodesk, there is a growing need and demand for 3D products. As a part of this they have outlined a range of products from Autodesk.

Mr. Mandeep Saha, Head - Infrastructure solutions (India & SAARC region), said that the areas of Infrastructure like Transportation, Land Development etc. in India needs a leverage between the Civil/Construction and Geospatial domain. For this he has outlined the Map3D product and the Mapguide Enterprise/Studio versions.

Mr. Mandeep added, “We are working closely with Universities, Colleges to bring together GIS and Infrastructure to create awareness at base level”. He also said that Autodesk has now 22 partners across India which work closely with Autodesk on providing training on the latest or already available softwares.

Rolta, Thales joint venture to enter Indian defence market

India: The 51:49 joint venture between Rolta India and Thales will start operations in July this year.

Thales complements Rolta with its expertise in electronics. The venture targets at least 20-25 per cent of the defence market’s IT solution requirements in India.

The venture will focus on the Indian defence market with its offering of C4ISTAR technology (command, control, computers and communications systems, intelligence, surveillance, target, acquisition and reconnaissance) in India.

Hiranya Ashar, Director-Finance and Chief Financial Officer, Rolta India, said the joint venture would cater to the $1 billion (Rs 4,100 crore) domestic market in the next 3-5 years. “Even if the venture is successful in tapping 20-25 per cent of the market, it is reasonably a big share,” he added. The Indian defence spending has been growing by around 15-18 per cent, but its IT spend rate is much higher.

Dutch Ministry of Agriculture signs agreement for GIS

The Netherlands: The Netherlands Ministry of Agriculture has signed an enterprise license agreement with ESRI Nederland B.V.

The new agreement gives the ministry unlimited access to the complete platform of ESRI technology. ArcGIS Server will be used to exchange spatial data between regional offices and with people working in the field.
Comments Mark Herbold, President at ESRI Nederland, “Because the Netherlands is one of the smaller yet more densely populated countries in the world, we have unique challenges in our land use. For example, there is considerable pressure on balancing development and agriculture in our rural areas.”

Ordnance Survey to shift to OS Master Map

UK: Ordnance Survey declared 30th September 2008 to be the withdrawal date for its Land-Line family of products. Ordnance Survey is planning to move exclusively to OSMasterMap database product from Land-Line products. The decision follows a public consultation meant to explore the impact of product migration in market sectors such as local government, utilities and land and property.

Land-Line will continue to be supported and licensed until 30 Sept. 2008 and later Ordnance will help its customers to adopt OSMasterMap Topography layer.

Leica Geosystems acquires IONIC

USA: Leica Geosystems Geospatial Imaging, LLC has acquired all outstanding shares of IONIC Software, a geospatial software company headquartered in Liege, Belgium, as well as all shares of the related American company IONIC Enterprise. The acquisition was made for an undisclosed amount, with date of closing to be determined.

Vincent Dessard, CEO, IONIC Software said, “The RedSpider product line will enhance Leica Geosystems’ expertise in developing photogrammetry, remote sensing, and visualization solutions to much larger enterprise-wide markets.”

IONIC’s RedSpider product line has a comprehensive, SOA, with a highly developed open standards-based JAVA/J2EE platform and development framework.

Moving forward, the IONIC and Leica Geosystems products will be maintained and new solutions will be developed using existing technologies of both companies.

AAMHatch to use Pictometry’s imaging technology

USA: Pictometry has signed a business agreement with AAMHatch of Australia. Under the terms of agreement, AAMHatch will get the right to use Pictometry’s imaging technology to take digital aerial oblique imagery of Australia and New Zealand and to market these along with Pictometry’s images in its library and softwares.

For acquiring the images over the two countries AAMHatch will operate through an aircraft fitted with equipments including digital aerial cameras, LiDAR, video and thermal sensors. AAMHatch will carry out ground survey of the same region for orthorectification and other purposes.

GeoEye partners with SPADAC

USA: GeoEye announced a strategic partnership and investment with SPADAC, a provider of geointelligence and predictive analysis solutions.

GeoEye’s partnership is aimed at providing its customers with predictive analysis and geointelligence solutions of SPADAC in combination with M.J. Harden’s aerial imagery capabilities after the launch of their GeoEye 1 satellite which will provide images up to a spatial resolution of 0.45m. The combination of high resolution image by GeoEye 1, tools provided by SPADAC and M.J Harden is expected to form a suite for value-added offerings to commercial and government sectors.

DigitalGlobe promotes three VPs to Leadership positions

USA: DigitalGlobe has announced the promotion of its three vice presidents: Dawn Sienicki, Government relations; Mike McGill, U.S. sales, Commercial Business Unit; and, Barry Clapp, International Sales, Commercial Business Unit.

With promotion and changes in the work profile, Sienicki will lead DigitalGlobe’s Washington D.C. Operations, McGill will lead DigitalGlobe’s Commercial Sales activities in the U.S. and Clapp leads DigitalGlobe’s Commercial Sales activities Internationally.

Michael Hickey named President of PB MapInfo

USA: Pitney Bowes MapInfo announced that Michael Hickey has been named as its President with effect from May 29, 2007. Hickey, has served as Chief Operating Officer at MapInfo for five years prior to the acquisition by Pitney Bowes.
USA: In a long drawn legal battle, which Management Association for Private Photogrammetric Surveys (MAPPS) undertook for redefining “surveying and mapping” in order to bring it under the purview of Federal Acquisitions Regulations’ (FAR) Qualifications Based Selection (QBS), the association failed to get the desired result. Court for the Eastern District of Virginia has ruled against the petition filed by MAPPS against the US government that sought to strictly limit government contracting for mapping and GIS activities. The Court issued the judgment in favour of the government stating MAPPS failed to “establish that an injury in fact was suffered by the individual surveyors or their firms”. The litigation was an attempt of MAPPS and its allies to redefine the scope of definition of “surveying and mapping”. The battle began with the Brooks Act that dates back to 1972 and puts forward a framework for contracting architecture and engineering (A&E) related work for the federal government. It says that instead of selecting contractors on price, these should be based on QBS. Amendments to the Brooks Act have added surveying and mapping to the list, so that now, architecture, engineering, surveying and mapping activities are contracted using this QBS process from licensed individuals in accordance with the adopted state law in which the project is located, if applicable, in those professions. The documentation of how to implement the Brooks Act, currently details which mapping related projects fall inside and outside the scope of the Brooks Act and QBS. It says that mapping associated with research, planning, development, design, construction, or alteration of real property should be considered an A&E activity and is to be procured following the OBS route. However, document grants exemption to mapping services that are not connected to traditionally understood or accepted A&E activities. The exception is the bone of contention since its excludes many GIS activities not falling under the QBS part of the Act and allows contracts to unlicensed individuals/GIS professionals too. MAPPS wanted the exception to be struck off and the new definition of surveying and mapping to include contracts and sub-contracts for services for federal agencies for collecting, storing, retrieving, or disseminating graphical or digital data depicting natural or man-made physical features, phenomena and boundaries of the earth and any information relating to, including but not limited to surveys, maps, charts, remote sensing; data and images and aerial photographic services”. Removal of the exception would mean that all federal contract mapping would fall under the QBS provision and need to be procured through licensed architects, engineers, surveyors and mappers, pursuant to applicable state law. On the other side, an Amicus (friend of the court) brief was submitted by the AAG, the GIS Certification Institute, GITA, the University Consortium for GISc and the Urban and Regional Information Systems Association. They disputed the MAPPS claim and said that there is an attempt to prevent the government from awarding contract for “mapping” to anyone but a licensed architect, engineer or surveyor. This will affect not only those individuals and companies involved in GIS but also those involved in many other types of mapping activities, with further implications on industries and applications ranging from electric utilities to city planning, from agriculture to homeland security. The issue doesn’t seem to douse down here with the MAPPS stating that the court did not address the legal merits and policies and the question of QBS applicability to mapping is unresolved and leaves the door open to further litigation. The issue may be seen as an attempt to keep off the budding GIS to enter the traditional surveying domain. The GIS has grown to an extent that it is now gradually being recognised as IT service domain with innovations and value additions as new building blocks of the industry. It seems tough to have such legislations in place that restrict the growth scenario all over the world. MAPPS still looks hopeful... Let’s see!
ITC offers PG course in Applications of Earth Observation, GIS in IWRM

Kenya: The International Institute for Geo-Information Science and Earth Observation (ITC) is offering a postgraduate course in Applications of Earth Observation and GIS in Integrated Water Resources Management (IWRM) in Nairobi for a period of 16 weeks from 7 January to 25 April 2008.

The ITC officials have informed that postgraduate course will provide professionals in the field of IWRM with practical tools and methods which are in-line with the recent advances in research and development and are directly applicable.

Google Earth urged to blur images of potential terror targets

UK: New York state lawmaker Michael Gianaris has urged Google Earth to blur views of potential terror targets on its maps. At a press conference on June 10, the Queens assemblyman said that the federal authorities need to work with Google to blur maps that detail sensitive areas such as airports, chemical storage plants and military bases.

The call comes after reports that the terrorists who were plotting to blow up a pipeline feeding JFK airport, used the site to plan their attack. Google takes security concerns very seriously, and is always willing to discuss them with public agencies and officials.

USGS to celebrate 25 years of Landsat5 mission

USA: USGS has obtained a waiver that will allow them to maintain the orbits of both Landsat-5 and Landsat-7 until 2012. This was announced in Landsat Technical Working Group meeting held recently. The USGS is planning a celebration to mark Landsat-5, which is entering 25th year of its operation next year. Also, USGS is optimistic that the satellite will continue to provide high-quality data past its 25th anniversary. The Landsat Data Continuity Mission (LDCM) is issuing tenders for most of the major systems. The expected launch date for next generation Landsat series satellite Landsat - 8 is July 2011 which will enable on-orbit cross calibration with Landsat-5 and 7. Landsat -8 is designed for a five year life, but will carry ten years of consumables.

Researchers to improve robots’ navigation & mapping

USA: A research group at Purdue University, USA is working on improving the navigational abilities of mobile robots in new environments. They are trying to make robots visualise “what lies a head” in advance as they move in unfamiliar surroundings. Consequently this will help robots in reducing the amount of time they take in navigating new territories. Navigation is one of the main challenges faced by mobile robots.

The new methods developed by Prof. C.S. George Lee and his student H.Jacky Chang use new software algorithms that enable a robot to create partial maps as they traverse through an environment for the first time. The algorithms developed is a modification to the already existing concept called SLAM or Simultaneous Localization And Mapping. The new methodology named as P-SLAM or prediction based SLAM’s prediction process is based on the observation of surroundings of an unexplored region and comparing it with the built map of explored regions. If a similar environment or structure is matched in the map of explored regions, a hypothesis is generated to indicate that a similar structure has been explored before. If the environment has repeated structures, the mobile robot can decide whether or not to explore the unexplored region to save exploration time. Further this research will be extended to four robots working as a team, to explore an unknown environment by sharing the mapped information through a wireless network.

Donald Cooke from Tele Atlas receives ESRI Lifetime Achievement Award

USA: Donald Cooke, Tele Atlas’ Chief Scientist and founder of Geographic Data Technology, Inc. (GDT), has been awarded the ESRI Lifetime Achievement Award. The award was bestowed by ESRI president Jack Dangermond at the ESRI International User Conference.

“It is with great pleasure that we recognize Don with this award, as he is an industry leader and pioneer who remains dedicated to exploring the future of digital mapping and continues to demonstrate a commitment to GIS education with incredible passion,” said Dangermond.

News Compiled by: Neha Arora neha.arora@GISdevelopment.net
The availability of sub-metre resolution colour imagery from satellites coupled with Internet based services like Google Earth and Microsoft Virtual Earth have resulted in an enormous interest in remote sensing among the general public. This interest is more in the nature of a ‘wow’ factor. The ability to see one’s home or familiar landmarks in an image taken from hundreds of kilometres above the earth elicits wonder and awe. I remember exactly the same reaction when ISRO sent up its first remote sensing satellite, Bhaskara way back in 1980s. We could see the Bhakra Nangal reservoir and the vast expanse of the Indus even at the low resolution of one kilometre. Soon, however, wonder gave way to the question ‘so what?’ Clearly, there had to be a more productive use of the satellite images. As we set to work interpreting the imagery we soon realised that we were only confirming our knowledge of geography captured by the images. Finding something new was proving to be difficult. So whether it is going beyond seeing the Bhakra Nangal reservoir at one kilometre or the roof of my house at 0.6 metre the problem of value derivation remains the same.

To be able to add or derive value from a remotely sensed image we need to consider several factors such as resolution, swath, signal to noise ratio, etc. Resolution itself has three components: spectral, spatial and temporal. We also need to consider the coverage or swath and the signal to noise ratio of the data which indicates its ability to detect minor variations in the image intensity. The accuracy of orbit and attitude determination impacts the absolute and relative positional accuracies of the image. These characteristics of a remotely sensed image are a result of several compromises dictated by technological factors. As technology improves these compromises are reduced. However, at some point natural factors will put a cap on the technological capabilities.

Ideally, a remote sensor should be able to deliver images of chosen areas at chosen times with the desired spatial and spectral resolutions and quality and accuracy. This requires a stationary platform which can image on demand. Orbital mechanics dictate that a platform will be stationary above the earth only when its angular velocity matches that of the earth and this happens at an orbital height of 36,000 Km. At this height we need a very powerful telescope to provide the desired spatial resolution, very sensitive detectors and excellent attitude control and station keeping of the platform. The state of the art is imagery at one Km spatial resolution every half an hour from a geostationary satellite. This may be improved to hundreds of metres but ultimately the scintillation due to atmospheric turbulence, orbital and attitude perturbations will limit the achievable spatial resolution to several tens of metres at best. Today, metre and sub metre resolution imagery is available only from low earth orbiting satel-
lites which are highly agile and use techniques like ‘step and stare’ to image designated targets. In the process they compromise on the time of imaging and the total coverage area.

Do we always need high resolution imagery? In the early days of satellite remote sensing geologists using low resolution imagery could trace long faults and fractures which they missed in smaller high resolution photographs from aerial surveys. This property of imaging large areas at a time, called a ‘synoptic’ view was extolled as one of the advantages of remote sensing from space. Applications scientists appreciated the synoptic view from satellite borne sensors and found that applications like flood mapping, crop inventory, drought monitoring could be implemented much better with imagery at resolutions of 70 to 20 metre.

One of the interesting observations relates to the use of statistical spectral classifiers. Low resolution imagery averages out local variations hence spectral based statistical segmentation techniques like Maximum Likelihood Classifier can be used with a limited number of training sets. At medium resolutions the variability in the data increases requiring more and more number of training sets. At sub metre resolution where individual objects become detectable such classifiers will be difficult to use. Such high resolution imagery interpretation requires the application of techniques of image understanding rather than statistical pattern recognition. A human interpreter who can, by looking at an image, differentiate between a canal and a river is actually using shape and context information. Image understanding software may be based on neural networks and on artificial intelligence techniques which can also take into account such features. The ‘step and stare’ technique of imaging results in imagery with oblique viewing angles. In urban environments tall structures appear with their apexes displaced away from the viewing direction and features on the side opposite the viewing side are occluded. Any mapping in such situations will require stereo pairs to be able to generate urban Digital Elevation Models and fill in the occluded areas. These will double the cost but the urban DEM is a product very much in demand by the communications industry among others and will offset the increased cost of mapping.

High resolution imagery has brought in a number of new applications in the area of Location Based Services. Such imagery used as a map on a GPS enabled 3G mobile phone can become a significant LBS application. To be able to exploit these features the way imagery is delivered to the end user will also need to change. Google Maps and its clones have opened up a new approach where the end user accesses imagery freely or at a very nominal cost without having to own the imagery. Most users overlook the fact that the volume of data increases as the square of the resolution. Data storage and preservation problems will become significant as data assets increase. By trading assets for access users can be freed of this burden. This is what Spatial Data Infrastructure is all about. SDI can be expanded to include imagery access in the same manner as map and other data access.

High resolution satellite imagery is one of five major technologies which will significantly contribute to SDI. The others are Web 2.0, Photogrammetry, GIS and GPS. However, low and medium resolution satellite imagery will continue to play a significant role in applications like weather forecasting, crop estimation, disaster management and environmental monitoring where a synoptic view is necessary.

Two other imaging technologies are also capable of high resolution imaging. SAR is able to give metre level spatial resolution but the imagery interpretation requires special expertise. The other is Hyper-spectral imaging which provides very high spectral resolution. Both these technologies have been overshadowed by the explosion of sub metre optical imaging. Will there be an application like Google Earth which uses these technologies and make them accessible to an average, non-technical user?
Observing and understanding the Earth system more completely and comprehensively will expand worldwide capacity and means to achieve sustainable development and will yield advances in many specific areas of socio-economic benefit, including:

- Reducing loss of life and property from natural and human-induced disasters;
- Understanding environmental factors affecting human health and well being;
- Improving management of energy resources;
- Understanding, assessing, predicting, mitigating, and adapting to climate variability and change;
- Improving water resource management through better understanding of the water cycle;
- Improving weather information, forecasting, and warning;
- Improving the management and protection of terrestrial, coastal, and marine ecosystems;
- Supporting sustainable agriculture and combating desertification;
- Understanding, monitoring, and conserving biodiversity.

With the availability of a variety of launch vehicles suitable for lifting micro to macro satellites into LEO or GEO orbits, satellite sensors were designed to perform various kinds of earth observations. Depending on the application requirements, sensors with greater spatial, spectral, radiometric and temporal resolutions were developed. Also different kinds of non-conventional imaging techniques like synthetic aperture radar (SAR), synthetic aperture imaging lidar (SAIL), Interferometric Imaging Systems, etc were also developed. The optical and infrared sensors currently used for earth remote sensing applications include sub-meter resolution imagers, hyper-spectral sensors, wide-swath sensors with high temporal resolution.
With these sensors it is possible to observe any given region of the earth with greater spatial, spectral and temporal resolution. These observations have enabled a wide range of applications covering.

**Cartography at every scales in 2D and 3D:** The demand for good maps arises from many different needs, e.g., the regional development, the town and country planning with roads and rail tracks, parks and forests, water supply and other installations.

**Land cover inventories:** For agriculture, forest management, buildings, observation via satellites offers unique possibilities.

**Closed waters, open seas, humid zones surveillance:** This area offers certainly one of the biggest challenge of the century, as keeping the waters healthy could well become one of our priorities.

**Installation of communication equipment:** For instance, the installation of new telecommunication and television relays requires extensive study of topography, terrain occupation and population density.

**Agriculture aids and management:** Images of cultures could give information on expected yields (crop evaluation) or for the farmer it can give information on demands for fertilizers, for watering or for chemical treatments.

**Disaster management, Analysis of changes, etc.**

**SCENARIO TILL NOW**

NOAA-A/Landsat-1 satellite, which was launched in orbit in 1972, was the first one to target systematic coverage of earth surface from space. It has paved the way for much better satellite sensors with greater spatial and spectral resolution. SPOT family of five satellites with the latest one launched in April 2002 has helped in developing the commercial market for space imagery of the Earth. IRS family of ten satellites which started with IRS-1A in 1988 with a spatial resolution of 72 meters, improved the spatial resolution to 5 meters with IRS-1C in 1995 (Between 1995 and 1999 till the launch of IKONOS this was the highest spatial resolution data available in civilian domain) and further improved the resolutions to 1 meter with Technology Experiments Satellite (TES) in 2001. This was followed with first dedicated high-resolution stereo mission in Cartosat-1 with 2.5-meter resolution. The latest addition to this - Cartosat-2 with a spatial resolution of better than one meter - was launched into orbit in January this year.

As can be seen, the geometrical resolution has continuously improved, for instance, from 100 m for the first NOAA-A satellite to 10 m for NOAA-K or from 10 m for SPOT 1 launched in 1986 to 2.5 m for the recently launched SPOT 5, or 72 meters from IRS 1A launched in 1988 to <1 meter of Carto-2 launched in January 2007.

Other satellites also have been launched over the past 7 or 8 years with performances down to 0.6m resolution but with less wide field of view than SPOT or Landsat.

Some of the missions like IKONOS and QuikBird with imaging resolutions of 1m and 0.6m respectively were entirely private funded. A significant event happened during this period is the development of low cost micro satellite with advanced payloads for variety of remote sensing applications. The low cost of micro satellite system allows the launch of multiple satellites (either identical or different) forming a constellation, which greatly enhance the capabilities of the system. Surrey Satellite Technology Ltd (SSTL) at the University of Surrey (UK) has developed and launched a series of micro satellites with advanced Earth observation payloads. The RapidEye satellite system to be launched in near future will have five identical earth observation satellites flying in a formation. The orbital formation of satellites ensures total coverage of the earth in a day.

The observations in visible and near infrared region of the Electromagnetic spectrum is affected by weather and it is not possible to carry out imaging over cloud covered regions. This limitation is overcome by use of Microwave region of Electromagnetic spectrum and this provides all weather observation capability.

This however requires Active Sensors, which carries its own source of EM energy for scene illumination. Over the last few decades this technology has developed to provide data with spatial resolutions close to few meters. There have been Satellites launched with Synthetic Aperture Imaging Radars operating in X band capable of providing High resolution data. SeSat mission launched in 1978 was the first SAR mission with a spatial resolution of 25m. SAR payloads of ERS mis-
GIS DEVELOPMENT

**TRENDS IN HIGH RESOLUTION OBSERVATIONS FROM SPACE**

**Geometric resolution:** In 1986 the resolution improved to 10 meters (SPOT-1) from 100 meters that of NOAA in 1972. In 1995 the resolution improved to 5.6 meters (IRS 1C).

In 1999, the resolution improved to 1 meter (IKONOS). It saw a further improvement to 0.61 meters through Digital Globe’s QuickBird. While a number of satellite missions are being planned for resolutions between 0.2 to 0.5 meters nobody has announced a programme for 0.1 meter resolution electronic imaging system.

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<th>Table 1: Satellite</th>
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<tr>
<td><strong>OPTICAL</strong></td>
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<tr>
<td>IKONOS-2</td>
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<td>QuickBird-2</td>
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<tr>
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<td>EROS-B4</td>
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<td>&lt;1</td>
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<td>France</td>
<td>&lt;1</td>
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<tr>
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<tr>
<td>IGS-02</td>
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</tr>
<tr>
<td>Resurs DK-1</td>
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<td>Resurs DK-2</td>
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<tr>
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<tr>
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<td>1.0</td>
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<tr>
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</tr>
<tr>
<td>COSMO-Skymed-3</td>
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<td>Japan</td>
<td>1 to 3</td>
</tr>
<tr>
<td>US</td>
<td>US</td>
<td>1 to 3</td>
</tr>
<tr>
<td>Resurs DK-2</td>
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<td>Resurs DK-3</td>
<td>Russia</td>
<td>1.0</td>
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<tr>
<td>RISAT</td>
<td>India</td>
<td>3.0</td>
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</table>

**Data rate and compression:** As the spatial resolution increases the data rate becomes very high and in view of the limited bandwidth available in X band, which is currently the most used band, it becomes necessary to adopt compression and other methods of data reduction.

As the area of image covered at very high resolutions is very small the satellite is equipped with a high degree of maneuverability so that spot images are taken which lie within a certain field of regard of the satellite. This also implies that continuous imaging is no longer adopted and the time required for maneuvering can be effectively used for reducing the transmitted data rate by adopting compression and deferred transmission.

In addition the deferred transmission could also provide opportunity to carry out compression of data based on the analysis of the entire frame and enable...
significant reduction in data rate. With the increase in processing capability available onboard one could consider extraction of specific information instead of the entire data being transmitted. One could consider transmitting only the processed results for near real time transmission while sending the entire collected data at a later point in time for detailed studies.

**Satellite Size**

The first observation satellites, NOAA was in the 2 ton range. As the resolutions improved swaths became smaller there was a need for agile satellite to facilitate spot image acquisitions. Such agility demanded that the satellite size be reduced. IKONOS, QuickBird, EROS, Cartosat-2 are examples. However there is a conflict in this approach as one seeks to improve the resolution further. Higher resolution demands larger optics diameter hence the size and weight of payload and thereby the satellite to increase its size substantially making it difficult to achieve higher agility.

A number of mini satellites and micro satellites (in the 100-120 kg range) with interesting performances have been launched. Micro satellites have been in existence for 10 or more years providing some images of the Earth but their performances in terms of image quality or image production capacity have been rather limited. The new generation is expected to be far better and must be able to produce images suitable for science and applications. The concept of using micro satellites for high-resolution imaging could see a significant boost when the cost comes down significantly. It would be possible to put micro satellites to provide very high resolutions of the order of 0.1 to 0.2 meters by operating them at very low altitudes of about 100 kilometers. Short life of very low orbits could be more than offset by lower costs.

**Image or Information?**

The final user is generally not interested in getting an image of the Earth taken by the satellite but in the information it contains. The future should see development of more sophisticated means of extraction of the information from the image, taking into account the needs of various users and making use of data banks allowing comparison between two images for instance to detect changes between two periods.

The increase in the number of LEO satellites would lead to time saving, i.e., to shortening the time to get the image. With the decrease in size, and consequently in cost of satellites, this can be expected to be economical also.

**GEO Platform**

Earth observation satellites in geostationary orbit from where they are able to observe/monitor a large part of the globe continuously. Such systems apart from providing useful data would also enable deciding which portion of ground needs to be monitored at a very high resolution at given point of time.

In the future, any Earth observation satellite will have to work in close link with meteorological satellite data to optimize the image capture to reduce effect of the clouds in the image.

**Active or passive**

One could see the adoption of microwave imaging techniques to optical domain for improving the resolutions to less than 0.1 meters. The active imaging techniques would receive a big boost with the availability of low cost micro satellites.

**CONCLUSION**

High resolution imaging from space has seen a steady growth with an improvement of one order resolution once in 13 years over the last three decades. Advances in electronics, and cost small satellite technology could result in a significant change in earth observation scenario, as one would see satellites operating at very low altitudes for realizing high resolutions. A constellation of satellites working for a single mission could enable active imaging systems providing very high resolutions.

It is expected that a constellation of satellites working as a single system will orbit earth. The increased data streams and delivered information will allow decision makers to be virtually present through their remote vision in any region of the world at almost any time.

The most advanced countries will have daily access to high resolution all weather data in most places on the globe. In addition, possibility of observing the Earth in many more wavelength bands, e.g. infrared, visible light, microwave, different polarizations and in various narrow bands in visible light (super-spectral or hyper-spectral) could see significant growth.
Earth Observation (EO) is broadly the acquisition and exploitation of data acquired from remote (aircraft- or satellite-based) observations of the Earth. It covers a diverse range of remote sensing applications, including weather forecasting, environmental monitoring, surveillance and numerous scientific applications in the atmospheric, land and ocean domains.

With increasing demand from various walks of life, which includes individuals, groups and commercial enterprises, new EO applications are being developed. Insurance sector (helping assess risk) and planning emergency response services (in case of natural or man-induced disasters) are few of the examples of areas offering newer markets to the remote sensing data products. The EO Value Adding (VA) sector is the group of companies that processes the raw or semi-processed data from the remote sensing instruments, and converts the data into information that is commercially useful end users.

The multiple ways in which value to the source data added are -
• Integration of multiple data sources
• Data process to obtain ‘GIS ready’ information products
• Interpretation and reporting
• Customisation
• User support services

EMERGENCE OF EOVA

Certain essentialities put up by the growth trends in demand have led to the building up of the VA industry. Remote sensing continued to show movement toward market education and geospatial information adoption and becoming a part of emerging broader geospatial market (and even broader IT market trends). Web-based mapping providers (Google) have made more people aware of remote sensing technology and aided further insights to its commercial applications. The affect is evident from the remarkable growth of “aftermarket” of VA companies. Key trends witnessed nowadays as part of merger (with IT) are -
• Marketplace moving from geospatial technologies to information services with implications on business models (Table 1)

• Geospatial technologies are being integrated more and more for user applications
• Users want seamless applications
• Distributed yet integrated applications are emerging through Internet.

These trends are likely to continue and could substantially influence how the remote sensing industry develops. Llyod E Stallkamp, in his paper “RS data as a Public Good” suggests that ‘public good’ is best served by having value added products provided by private business. With the industry taking...
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turn to value-additions, speculations are being made towards the developments of applications to potential areas (niche markets) as agriculture, communications, travel, tourism, etc. (Table 2). This being the scenario, the companies seem to have followed what Donald B. Segal, president, Spatial Insights, recommended to the data providers. According to him data providers must

Reconsider packaging of the data to be more inline with the geographies of the business user
“Scenes”, “sensor footprints”, and “flight paths” are meaningless to the business user. They simply want their area of interest (site, county, market, etc.), and they want it yesterday.

Provide data in a GIS-ready format, rectified to a common projection
Charging extra to geometrically corrected data or to mosaic the data to form seamless coverage of a study area is nuts. Build this into the price if need be, but don’t burden the buyer with these details. Most businesspersons are blissfully ignorant about map projections and are quite happy to remain that way.

"Web-based mapping providers (Google) have made more people aware of remote sensing technology and aided further insights to its commercial applications."

Make it easy to order and deliver it quickly.
Finding out the cost and availability of coverage online is cumbersome - if not impossible - in most cases. For “archived” imagery, shipment should be faster than the “5-business day” estimate given by most providers. Delivery of compressed data via email or FTP could/should be accomplished within hours. For most clients, the projects are short-fused and are over within a day or so. Waiting 5-7 days to receive data just doesn’t work.

Revisit pricing strategies
While the price of imagery has come down over the years, it is still relatively expensive, particularly for the small to mid-sized companies that aren’t yet convinced of its value. Basic economics would suggest that lower prices will spark interest in a much larger portion of the potential market.

FEATURES OF VA INDUSTRY
The EOVA industry is a highly diverse sector that develops products and services addressing a wide range of thematic domains. The industry comes out with a variety of products that differ in terms of the way they are produced and delivered. With the products and applications so diverse, the natural staggered-ness with ‘no company producing all’ is the situation. Certain broad features of the industry are -

• The typical profile of a VA company is a small, specialised organisation that focuses on one or two thematic and geographic areas. The industry is characterised by isolated expert groups offering niche services (Table 3).
• An EO product (sales transaction) is typically a one-off project delivery or a customised core product.
• The institutional market accounts for more than 75% of the customer base. (Markets- Figure. 1)
• Development of innovative EO based services such as location based services (LBS), Geo-marketing, on-line micro-payments and web services all continue to open up new business models for the industry.
• Data from multiple satellite sources are used to develop products. Integration with non EO data sources (ground sensors, socio-economic data) is also important for successful value adding, and so are data integration, assimilation and modelling. This is why the sector has a high level of technical sophistication and complexity.
• The industry is highly dependent upon the quality of its data supply (in terms of revisit, resolution, fitness for purpose, timeliness and access to data).

Opportunities for the industry lies in
• Significant growth in the geospatial information, that doesn’t come without competition from traditional information sources)
• Public sector’s environmental monitoring projects that long-term view ensuring at least medium term security in contract acquisition.
• New satellite programmes such as Radarsat-2, TerraSAR-X, Cosmo-Skymed, Pleiades etc. will offer more sophisticated data products than those available currently, and access to data from these national missions is expected to become easier.
INDUSTRY OUTLOOK

The industry outlook as is stated by eoVOX’s (http://www.eovox.org/) industry position paper says that Eova is still very much an emerging sector with a fragmented industry structure and highly diverse and varied product and service supply mechanisms.

The keyword, which best summarises the future structure expected to be seen for the EO Industry is ‘consolidation’. It is expected that the main large companies will grow bigger through absorption and expansion. Their prevailing strategy will be to provide end-to-end systems and to deliver standardised GIS ready products directly to the end-user. It is believed that smaller VA companies will be absorbed or bought up either by the big EO players or by complementary players or end user organisations (in-sourcing), disappear, grow bigger by networking or sustain as niche players. At the same time small new players, mainly spin-offs from universities, will keep emerging as there are low entrance barriers into the industry.

The sector is expected to become very large, and even more so considering the numerous new observation systems that will be set up across the world in the coming years, in particular within the GEOSS and other initiatives, and also as national or private initiatives.

CONCLUSION

With the advent of commercial remote sensing enterprises the technology has become a part of information technology and thereby of an emerging form of electronic commerce (e-commerce) and not just an aerospace technology or scientific technique.

Titles of studies like “Making Remote sensing a media event” and “Remote Sensing as electronic commerce” may well serve well to indicate where the industry plans (or visions) to head catering mass customers with standard products (single time delivery) rather than customisations. To accommodate new level of demands, satellite imagery vendors will need to address capacity concerns related to imagery collections and updates.

“Once we rise to that challenge, satellite imagery will become as ubiquitous as search engine and Internet technologies, moving far beyond the realm of traditional GIS professionals and into the hands of everyday users.”

The industry’s ability to clearly communicate the utility of satellite imaging for a multitude of commercial market applications will be key to greater adoption of remote sensing as decision-making tool.

Still, a “killer application” for the remote sensing marketplace that causes dramatic market growth has yet to be identified.

Saurabh Mishra saurabh.mishra@GISdevelopment.net

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**Table 2: Niche market sectors for remote sensing:**

<table>
<thead>
<tr>
<th>Markets demonstrated for remote sensing</th>
<th>Potential markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forestry</td>
<td>Agriculture (Precision agriculture)</td>
</tr>
<tr>
<td>Environmental/Natural resources mgmt</td>
<td>Disaster response and emergency services</td>
</tr>
<tr>
<td>Extraction industries</td>
<td>News, media and entertainment</td>
</tr>
<tr>
<td>Mapping</td>
<td>Real estate, insurance, and property finance</td>
</tr>
<tr>
<td>National security</td>
<td>Travel and tourism</td>
</tr>
<tr>
<td>Transportation</td>
<td>Outdoor recreation and sports</td>
</tr>
<tr>
<td>Utilities</td>
<td>Communications</td>
</tr>
</tbody>
</table>

**Table 3: Services types offered by the VA companies of Europe and Canada**

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardised Products and Services</td>
<td>Standardised off-the-shelf geo-information solutions with routine/standard delivery. Typically corresponds to repeat sales offerings for many customers, in general high volume.</td>
</tr>
<tr>
<td>Customised Products and Services</td>
<td>Customised geo-information solutions based on EO interpretation and tailored to specific users. Typically corresponds to one-off offerings for individual customers, generally project-oriented.</td>
</tr>
<tr>
<td>Integrated / Turnkey Solutions</td>
<td>Offerings combining EO products and services plus other elements such as hardware, systems maintenance, etc.</td>
</tr>
<tr>
<td>Data Products and Services</td>
<td>Reselling EO images/data (with little if any added value)</td>
</tr>
<tr>
<td>Software Products and Services</td>
<td>Packages sold under license to support use of EO images or data, including maintenance.</td>
</tr>
<tr>
<td>Training</td>
<td>Standalone training courses available on a commercial basis including e-learning.</td>
</tr>
</tbody>
</table>
The new era of earth observation started with the launch of Landsat-1 (earlier named as Earth Resources Technology Satellite or ERTS) in 1972. According to the latest data available (updated on 9th April, 2007) from the Union of Concerned Scientists (UCS, a science-based nonprofit organisation working for a healthy environment and a safer world) at http://www.ucsusa.org/global_security/space_weapons/satellite_database.html, at present there are 847 active satellites in the space being used for different purposes (Fig-1). As per the classification done by UCS, only 4% are being used for remote sensing purposes and 8% for the earth observation/earth sciences. Upon studying the purposes and the sensors being used in the satellites, there are 50 satellites (6%), exclusively being used in the geospatial domain. For the satellites under the geospatial domain, further, it was found that there are only 9 satellites being operated by the private organisations while the rest were being operated by the government.

The country wise distribution of the already launched remote sensing satellites (till Dec 2006) are given in Fig-2a. This was compared with the remote sensing satellites, proposed to be launched (data available at www.space-risks.com) in the years to come (Jan 2007 onwards), and is shown in Fig-2b. At present there are 19 countries who own remote sensing satellites while, Argentina, Brazil and Thailand are the three new countries, who will have their own satellites in the years to come.

The present users of the satellite data are mainly government (Fig-3) while the rest 50% are split between civil, military and commercial users. Among these 4% of the military data is also used by the commercial users whereas...
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8% of the government data is also used for the commercial purposes. Since 1984, till 2006, the number of satellites launched every year increased which saw a steep rise after 1999 (Fig-4a).

There is a significant increase in the proposed launches in 2007, which will reach to 14 and the subsequent years having significant launches planned (Fig-4b). This year, till June 2007, satellites proposed to be launched (www.space-risks.com),

- **COSMO-Skymed (4X)**: 8th June, 2007
- **GeoEye-1**: 30th June, 2007
- **CARTOSAT-2**: 10th Jan, 2007
- **ORBVIEW-5**: 1st Jan, 2007
- **RADARSAT-2**: 31st March, 2007
- **RAPIDEYE (5X)**: 30th June, 2007
- **TERRASAR-X**: 1st June, 2007
- **THEOS**: 30th June, 2007
- **WORLDVIEW-1**: 30th June, 2007

However, only three of them (Cartosat-2, COSMO-Skymed & TereaSAR-X) have been launched. The remote sensing satellite launches, in the coming years, with their other details are given in Table-1 and these satellites with their operating life are shown in Fig-5.
With the advancement and development in the sensor technology, remote sensing has reached a resolution of 0.7m (PIC-2 sensor in the Israeli satellite EROS-B1, launched in April, 2006). Although IKONOS was the first satellite with MSS and PAN sensor, to reach 1m resolution in PAN, more and more satellites are being launched and scheduled to be launched in the near future with better resolution. Worldview1 and 2 will have 0.45m and 0.46m as its spatial resolution, scheduled for launch in 2007 and 2008. Although more satellites will be launched in the coming years, but according to the published data, no satellite will have spatial resolution better than the Worldview satellites. There were only three satellites with RADAR capability, till 2005, which will increase to 9, by this decade. RADAR satellites are mainly being launched by European countries with Argentina and India also venturing. Surprisingly, USA does not have any RADAR satellite, nor they have planned for any!

In the high resolution category (1m or better), there will be 9 satellites by the end of this decade and except 2 from...
USA, one from India and Israel each, all five are planned by Europe (Germany, France and Italy). The coming years will see a lot of public-private partnerships, where the commercial operators will build, launch and manage the satellites and the data, and the government will be the major buyer of the data. The launch of TERRASAR-X on 15th of June started this trend which will soon be followed by other countries.

Another trend of collaborations between countries to build and launch satellites might change in the years to come. As the sensor technologies, hardware and other necessary equipments have become easily available, countries

<table>
<thead>
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<th>Name of Satellite, Alternate Names</th>
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Fig 5
have started assembling the satellites and soon there will be a proliferation of satellites and availability of data, which should result cheaper satellite data and value added services and products for the end-users.

Every country and organisation responsible for the launch of the satellites, archive their data, but still there is a lack of a global metadata, availability of which could help the users in locating the desired data and procuring them.

The above observations might be achieved in some or the other form, in the years to come.

Dr. Satyaprakash
satya@GISdevelopment.net

Table 1

Please Note: The graphs in the article have been prepared using the data from UCS and EOSS websites.
Since the time when Sir Isaac Newton published the concept of dispersion of light, the scientific terminology and definitions of the term "spectroscopy" has evolved over time. Today, imaging spectroscopy or "hyperspectral imaging" is defined by a contiguous statement of spectral bands.

It is the science of acquiring digital imagery of earth materials in many spectrally narrow contiguous bands and produce complete spectral signatures with no wavelength omissions. The image produced is similar to an image produced by a multispectral sensors, except that each pixel has many bands of light intensity data instead of just three bands: red, green and blue. Hyperspectral imaging collects data to generate a "data cube" or "image cube" that can reveal objects and information which conventional multispectral scanners cannot pick up.

Each element leaves a unique spectral signature, also called spectral reflectance curve, in various bands of the spectrum, based on their spectral reflectance. The overall shape of the spectral curve and the position and strength of absorption bands is used to identify different materials. The reflectance spectra of various materials of known composition can be measured in the field or laboratory and can be collected as spectral libraries to facilitate analysis of hyperspectral imagery. Several high quality spectral libraries of reflectance spectra of natural and man-made materials are available for public use. These libraries provide a source of reference spectra that can aid the interpretation of hyperspectral and multispectral images. Various type of spectra can be browsed, viewed and downloaded from USGS (http://speclab.cr.usgs.gov/spectral.lib04/spectral-lib04.html) and ASTER (http://speclib.jpl.nasa.gov) website.

Multispectral RS deals with several images at "discrete and narrow band", from the visible to the Infrared wavelength, whereas hyperspectral RS deals with imaging narrow spectral bands over a contiguous spectral range, and produce the spectra of all pixels in the scene. It is not the number of measured wavelengths that defines a sensor as hyperspectral, rather it is the narrowness and contiguous nature of the measurements.

Thus, a sensor with only 20 bands can be hyperspectral when it covers the range from 500-700 nm with 20 10-nm wide bands, while a sensor with 20 discrete bands covering the VIS, NIR, SWIR, MWIR, and LWIR would be considered multispectral.
APPLICATION AREAS
Data from hyperspectral remote sensing provides more details of the Earth’s surface than is currently available from multispectral instruments.

The detailed classification of complex land ecosystems with hyperspectral imagery is expected to increase the accuracy of remote sensing data in applications including mining, geology, forestry, agriculture and environmental management.

Projects utilizing hyperspectral imagery usually have one of the following objectives:

• **Target detection**: Involves distinguishing targets from similar backgrounds, or locating examples of targets that are smaller than the nominal pixel size.

• **Material identification**: The analysis is designed to use hyperspectral imagery for identifying the unknown materials. This analysis may also be accompanied with material mapping in which the identified materials are geographically located throughout the image.

• **Material differentiation**: It is carried out to distinguish between spectrally similar materials.

• Hyperspectral imagery has also been used for mapping surface properties that are undetectable using other types of imagery.

Challenges with hyperspectral imagery
Hyperspectral images contain wealth of data, but interpreting them is a very big challenge. It requires an understanding of exactly what properties of ground materials are being measured and how they are related to the measurements actually made by the hyperspectral sensor. Although the potential of hyperspectral remote sensing is exciting, the following issues needs to be considered while analysis/processing of this unique type of imagery,

- Accurate atmospheric corrections

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<td>HyMap</td>
<td>Integrated Spectronics</td>
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<td>EPS-H (Environmental Protection System)</td>
<td>GER Corporation</td>
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</tbody>
</table>
Hyperspectral Missions: List of space/ aircraft based sensors

Hyperspectral imagery is often not as readily available as other types of remotely sensed data. In particular, there are few space borne hyperspectral sensors, including the Hyperion sensor on NASA’s EO-1 satellite, the CHRIS sensor on the European Space Agency’s PROBA satellite and the FTHSI sensor on the U.S. Air Force Research Lab’s MightySat II satellite.

Future Hyperspectral Missions

Hyperspectral instruments will play an important role. The success of applying such techniques often relies on the detection of subtle variations in the spectral properties of one or more of the components being imaged and on the integrity of remotely sensed data, available today. Extracting the reflection spectra information from myriad of bands from the earth’s surface give scientists, a broad basis for detailed analyses. For the next generation of optical satellite sensors hyperspectral instruments will play an important role.

CONCLUSION

For almost two decades now, there has been worldwide research and development into the application of high spectral resolution remote sensing to various earth resource and environmental mapping and monitoring tasks. Hyperspectral image analysis has matured into one of the most powerful and fastest growing technologies in the field of remote sensing. This has the potential for more accurate and detailed information extraction than possible with any other type of remote-sensing data, available today. Extracting the reflection spectra information from myriad of bands from the earth’s surface give scientists, a broad basis for detailed analyses. For the next generation of optical satellite sensors hyperspectral instruments will play an important role.

The success of applying such techniques often relies on the detection of subtle variations in the spectral properties of one or more of the components being imaged and on the integrity of...
GIS DEVELOPMENT

the sensor’s calibration. Such requirements have driven sensor technology to achieve higher signal to noise ratios, improved operational stability and improved levels of traceable spectral and radiometric calibration. As new sensors provide more hyperspectral imagery and new image processing algorithms continue to be developed, hyperspectral imagery will become a powerful tool for research, exploration of minerals and monitoring of natural resources and their sustainability.

### SAND
- **Wavelength:** 430 nm - 520 nm, 520 nm - 765 nm, 765 nm - 1050 nm, 1050 nm - 1300 nm, 1480 nm - 1750 nm, 1950 nm - 2000 nm, 2000 nm - 2400 nm
- **Spectral sampling interval:** 9 nm, 9 nm, 12 nm, 13 nm, 12 nm, 10 nm, 10 nm
- **Number of bands:** 10, 27, 23, 19, 22, 5, 40

### EnMAP
- **Wavelength:** 420 nm - 1030 nm, 950 nm - 2450 nm
- **Spectral sampling interval:** 5-10 nm, 10-20 nm
- **Number of bands:** 92, 108

### Chandrayaan - 1
- **Resolution:** 5 m, 80 m, 75 m
- **Number of bands:** -
- **Wavelength:** 430 nm - 520 nm, 520 nm - 765 nm, 765 nm - 1050 nm, 1050 nm - 1300 nm, 1480 nm - 1750 nm, 1950 nm - 2000 nm, 2000 nm - 2400 nm
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**Sensor Characteristics of SAND**

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- **Wavelength:** 420 nm - 1030 nm, 950 nm - 2450 nm
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**Environmental Risk Assessment**
- To assess land degradation via the use of a globally applicable index of Land Degradation Status.
- To monitor land degradation processes through erosion and dyland degradation models using bio-geochemical/bio-geophysical parameters.
- To gain indicators for characterizing specific surface properties related to water cycles, erosion processes and plant productivity in drylands.
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TerraSAR-X is the first German satellite out of a public-private partnership (PPP) between German Aerospace Center (DLR) and Astrium GmbH. These two share the costs of the development, construction and deployment of the satellite.

TerraSAR-X’s greatest and most obvious benefits are its weather independent radar sensor, which is an advantage over the high-resolution optical satellites available today; and the high resolution acquisition capability of up to 1m - which none of today’s commercial radar satellites are capable. Further, its flexible antenna enables a near-real-time data acquisition in time critical situations. Its three different operational modes allow targeted data acquisition tailored to individual application needs; e.g. large-area assessment at 16m resolution for cartography applications, and dedicated imagery of at 1m resolution for the detailed assessment of infrastructure settings.

**The Launch**

**Initially delayed; finally the launch was a success**

The German radar satellite TerraSAR-X was successfully launched on June 15th from the Russian Cosmodrome in Baikonur, Kazakhstan. Launch of TerraSAR was initially announced to be during the second quarter of 2006, but there has been a shift of a few months due to some technical reasons. The main delay was caused by the Russian Dnepr launch failure in July 2006, which entailed an in-depth investigation of the failure cause and a careful implementation of corrective measures.

This waiting period was used to perform additional testing, especially in combination of the satellite with Ground Control and SAR Processing elements of the mission.

**First Images**

The first satellite images from TerraSAR-X have been received just five days after its launch.

The first TerraSAR-X image acquired on June 19, were delivered by DLR’s processing system for a region in Southern Russia; about 500 km northeast of the Black Sea and 50 km west of Volgograd. Only 30 minutes after the data had been received by the ground station in Neustrelitz - the first images appeared on the monitors at the German Aerospace Centre (DLR) space centre in Oberpfaffenhofen.
Data & Pricing
The price depends on various specifications.

The pricing of a TerraSAR-X scene depends on its individual specifications, e.g. image resolution, requested processing and treatments, or the time frame set for the acquisition.

An image of 100 x 150 sqm in size with a 16m resolution, ordered in a non-time-critical frame, can be purchased for €2,750.

If the desired area of interest has already been captured and is available in the archive, this price is further reduced by up to 50%.

However, if a near-real-time, high resolution image acquisition must be performed within a few hours time, and a rapid evaluation through experts is demanded, such an acquisition may cost up to €13,500.

Infoterra is inviting interested users to apply for the delivery of a free TerraSAR-X scenes. At this point in time, the application can be accessed at www.terrasar.de/promotional

Partner Networks
First TerraSAR-X Direct Access Partner: PASCO, Japan

In order to ensure a secure and reliable marketing of the TerraSAR-X data, Infoterra is establishing a global network of distribution partners. TerraSAR-X users may either place their data orders directly with Infoterra, or order through a partner located in their respective country or region.

At this point, more than 30 partners worldwide have joined the network.

Processing
Leica announced TerraSAR-X processing capabilities in ERDAS.

On 25 June, Leica Geosystems Geospatial Imaging announced the development of a TerraSAR-X processing capabilities in ERDAS IMAGINE Radar Mapping Suite 9.1. The Radar mapping suite will allow users to display and manipulate images captured by the TerraSAR-X satellite.

The Remote Sensing Technology Institute of the DLR has assisted Leica Geosystems in developing the new suite for processing radar images.

According to Infoterra they are taking a great interest that all relevant geospatial software handles TerraSAR-X data optimally. Also they are supporting the software providers with detailed information on format and sensor parameters and free sample data sets to use for their development purposes.

Future
The future has already started with TerraSAR-X2 and TanDEM-X

The course has already been set for the successor TerraSAR-X2, which is scheduled for launch in 2012.

Astrium is preparing to implement the TanDEM-X project (TerraSAR- add-on for Digital Elevation Measurement) on behalf of DLR.

This consists of an additional satellite, similar in construction to TerraSAR-X, that will fly alongside TerraSAR-X at a distance of between 500 metres and two kilometres. TanDEM-X will also be financed under the PPP model, and could be launched in March 2009.
Huge landmass of the Russian territories and lack of up-to-date technologies and information demand for rapid development of GIS solutions for the booming Russian economy. Looking back to the history of the Russian remote sensing it is true to say that the Russians have always had a very active and prolific remote sensing program.

Russian satellite imagery is provided for the Ministry of Natural Resources of the Russian Federation, state and private national companies, cartography, environmental and other needs. Russian satellite imagery is distributed to the international market as well. The major civilian remote sensing spacecraft in Russia is the Resurs series, which will play a significant role in the Russian contribution to Mission to Planet Earth. Resurs-DK1 is a commercial earth observation satellite able of transmitting high-resolution imagery (1 m).

Resurs-DK1 is operated by Research Center for Earth Operative Monitoring (NTs OMZ) - an affiliated branch of the Space Observation Center which is a directing agency of Roskosmos engaged in exploitation of Earth remote sensing systems.

The lines of the NTs OMZ’s activity with regard to Resurs-DK1 satellite include operation, maintenance, imagery collecting, as well as archive creating and updating.

The Russian Federal Space Agency was formed after the breakup of the former Soviet Union and the dissolution of the Soviet space program. It is commonly known as “Roskosmos” or RKA, being the government agency responsible for Russia’s space science programme and general aerospace research. Roskosmos plays the leading role in commercial satellite launches and space tourism.

Resurs-DK1 was launched from Baykonur launch area on June 15, 2006 with Soyuz carrier vehicle. It was built by the Russian space company TsSKB Progress in Samara, Russia. The design lifetime is up to 5 years.

The satellite of 6570 kg weight was placed into elliptical orbit with the altitude of 360-604 km. With 6-day revisiting frequency, 100 m position accuracy and 1 min. sq. km per day of maximum technical capacity Resurs-DK1 is able of collecting unique 1 m resolution imagery in panchromatic mode.

Resurs-DK1 Major Current Tasks are as follows:

- Data supply for resource management and economical activity (inventory of natural resources, topographic and thematic mapping).
- Monitoring of pollution sources of the atmosphere, water and soil with the view of providing Federal and regional environmental authorities with the relevant information to make management decisions.
- On-line monitoring of man-caused and natural emergencies for the purpose of effective planning and timely performing of measures to eliminate damages.
- Supplying home and foreign consumers on a commercial basis.
- Research activities (PAMELA and Arina experiments).
SuperObjects 2

Customize your own GIS Applications

What’s SuperObjects

SuperObjects is designed to develop customized GIS applications. It contains more than 50 programmable ActiveX automation objects and controls, which are compatible to run on standard Windows development platforms, such as Visual Basic, Visual Basic for Applications (VBA), Visual C++, Visual Studio.NET (VB.NET and C#), Delphi, Borland C++ Builder, Visual FoxPro, PowerBuilder, and so on.

With SuperObjects, you can:

- Add mapping components to existing applications.
- Support vector and raster images display.
- Provide abundant coordinate transformation methods.
- Support many spatial analyst functions, including buffer, union, intersect, clip, merge, etc.
- Provide legend and scale bar control to make it easily developing the target applications.

Desktop GIS

SuperGIS Desktop

Extensions
- Spatial Analyst
- Spatial Statistical Analyst
- 3D Analyst
- Biodiversity Analyst
- Network Analyst
- 67-97 GTS Analyst (TW only)
- Tracking Analyst
- Topology Analyst

Add-ons
- OGC Add-on
- GIS Add-on
- GDB Client

Developer GIS

SuperGIS Engine

Extensions
- Network Objects (SuperNetObjects)
- Spatial Objects
- Spatial Statistical Objects
- Biodiversity Objects
- 3D Objects
- Chart Objects

Mobile GIS

SuperGIS Mobile Engine

SuperPad Suite
- SuperPad
- SuperPad Builder

GIS Thin Client

SuperGIS Explorer

Database Gateway

SuperGIS GDF

D3

Server GIS

SuperWebGIS

Extensions
- Cache Extension
- Online Edit Extension
- Chart Extension

SuperGIS Server

SuperGIS Image Server

SuperGIS Network Server

SuperGIS Tracking Server

GIS Service

SuperGIS Web Services

Data Services

Function Services

Please contact us if you are interested in becoming one of our distributors.
Space-based observation provides repeated, unrestricted access to every corner of the globe, in full compliance with international law. This capability provides early warning of situation even before any action has to be taken to deal with them.

Risks can be assessed before they turn into threats. Image fusion has been the focus of considerable research attention in recent years with a plethora of algorithms (proposed), using numerous image processing and information fusion techniques. Yet what is an optimal information fusion strategy or spectral decomposition that should precede it for any multi-sensor data cannot be defined. The human brain routinely carries out information processing and fusion. The bio-target is to garner observations from various similar or dissimilar sources and sensors, extract the required information (inferences, illations) and combines or fuse these with an aim to obtain an enhanced status and identity of a perceived object.

This paper reports on the experiences gained using orthorectified images to integrate multi-sensor images for data fusion in order to benefit from increased spatial, spectral and temporal resolution in addition to increased reliability and reduced ambiguity.

**ORTHORECTIFICATION AS CONCEPT**

A digital orthophoto is simply a photographic map that can be used to measure true distances. It is an accurate representation of the earth’s surface. "Digital orthophoto: A raster photographic image that is combined with differential rectification to remove image displacements caused by camera tilt and terrain relief." Orthoimagery serves as a seamless base map layer to which many other layers are registered and can be combined with digital elevation data for 3-D modeling and slope and terrain analyses which can be easily mosaicked to create seamless images of larger areas.

**Orthorectification Work Process**

Orthorectification and stereo intersection are two most important methods for preparing fundamental data for multi-sensor integration applications. Orthorectification transforms the central projection of the image into an...
orthogonal view of the ground with uniform scale, thereby removing the distorting affects of tilt optical projection and terrain relief. To create a digital orthophoto, several fundamental inputs are necessary:

- Aerial photos / satellite imagery with a high-percentage overlap, which can be obtained from scanning aerial photo diapositives or negatives on an image-quality scanner or by satellite sensor.
- Aerotriangulation (A.T.) results / ephemeris. Ground Control Points (GCP) are determined either conventional ground surveys, from published maps, by Global Positioning System (GPS) surveys, or by aerotriangulation. These points are taken at visible physical features on the landscape. Depending on the type of algorithmic correction to be used, a minimum of 3 to 5 good GCP must be established. The relationship of the x, y photo coordinates to the real world GCP is then used to determine the algorithm for resampling the image. By using GCPs, the mathematical relationship between the real world coordinates and the scanned aerial photograph is determined and the digital image is resampled to create the rectified image.

- A digital elevation model (DEM) or a regularly spaced grid of masspoints, each containing an x, y, and z value. These elevations are collected from stereoscopic models by photogrammetric methods to form a digital elevation model (DEM). A more robust digital terrain model (DTM) can also be used because it includes strategically placed masspoints, dense break lines, and ridgelines.

For orthorectification, the resampling of the digital image involves warping the image so that distance and area are uniform in relationship to real world measurements. Depending on the needs of the aerial imagery in the GIS system, there are advantages and disadvantages to using either method. GCP orthorectification is a faster process while using DEMs for orthorectification is a more accurate process.

Usage Of ortho-imagery

Digital ortho-imagery provides visual information for the following partial list of applications:

- Internal Security
- Surveying & Mapping
- Emergency Management
- In disaster management & Public Safety Planning, Response, & Mitigation
- Environmental Management
- Tax Mapping
- Transportation Management
- Operations & Planning
- Utilities Management
- Land Planning and Zoning
- Drainage Planning & Management
- Agriculture
- Insurance
- Planning & Regulation
- Natural Resource Inventories and Assessments

Limitations of Digital Ortho-photos

Though the orthoimagery / photo looks after plethora of issues in multi-sensor integration but limits itself in:

- Expansion features, such as bridges, create problems in ordinary digital orthophotos. DTM data is captured at ground level, so bridges that are rectified with this data are “pulled down to the ground,” giving them a distorted appearance.
- Elevated features (e.g., buildings,
trees, power lines) also create a problem due to radial displacement. Distortion increases with the distance from the center of the aerial photograph-features, such as buildings, lean noticeably. The amount a feature leans depends on the percentage of overlap in the aerial photography and the height of that feature. The higher percentage of overlap in the aerial photography used, the less features will lean because the amount of photography used from the outer edge is reduced.

- In an urban landscape there are unavoidably hidden areas for which no information on the original aerial image exists. The presence of hidden areas results in double mapping effects on resulting traditional orthophoto images

This distortion can have an impact on the functional and aesthetic features of a digital orthophoto. However, these problems are limited in satellite imagery.

**Traditional “True Ortho” is the solution for double mapping**

In recent years several orthographic rectification schemes compensating for double mapping effects were proposed for generating large-scale true orthophotos. These schemes use image based hidden area detection algorithms.

**CO REGISTRATION IN MULTI SENSOR IMAGERY AND ORTHORECTIFICATION**

The remote sensing community has been more concerned with co-registration of images than the comprehensive image rectification concerns of the photogrammetry community. Terrain effects have been considered of minor impact by the remote sensing community until recently, when
- Higher resolution systems became available,
- A greater emphasis on satellite data integration with GIS for business applications occurred, and
- Change detection and data fusion studies became more prevalent.

The emerging standard for remotely sensed imagery data transfer has identified the basic requirement for orthorectification processing as well as adherence to map projection and datum accuracy standards and annotation. Many sensor systems (e.g. AVHRR, MODIS, GOES, and Landsat) employ line scan designs that view off-nadir as much as 55 degrees, while other sensor systems with push-broom imaging designs (e.g. ASTER and Hyperion) regularly acquire off-nadir views of as much as 25 degrees.

The development of automatic orthorectification and mosaicking system of procedures has relied on two key recent developments. The first is the general availability of DEMs with 1 arc second posting (nominally 30 m) for much of the world DEMs for the world’s landmass from the Shuttle Radar Topography Mission (SRTM). This permits the preparation of orthorectified satellite imagery using similar techniques to those developed by the photogrammetry community for aerial photographs. These two developments provide the key datasets necessary to prepare a baseline image dataset to which all satellite imagery datasets having a pixel resolution of 10m or greater can be automatically orthorectified to sub-pixel accuracy.

**MULTI SENSOR DATA FUSION**

Image fusion aims at the integration of complementary data to enhance the information content of the imagery, i.e. make the imagery more useful to a particular application. The definition of image combinations and techniques depends on the characteristics a dataset
You will meet Sunita Williams here...
You will also meet the who's who of GIS Industry

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should have in order to serve the user. However, it is possible to summarize a general approach, which describes the overall processing chain needed in order to achieve image fusion. In the case of multi-sensor image data, the images have to be geometrically (ortho- metrically) and radiometrically corrected, before being suitable for the fusion process, using collateral data such as atmospheric conditions, sensor viewing geometry, ground control points (GCPs), etc.

An elementary pre-processing step is the accurate co-registration of the dataset, so that corresponding features coincide. Depending on the processing stage at which data fusion takes place, it is distinguished between three different fusion levels:

- **Pixel, Feature, and Decision level**

Image fusion mostly refers to pixel-based data fusion, where the input data is merged applying a mathematical algorithm to the coinciding pixel values of the various input channels to form a new output image. Once the alignment of the dataset is established, it is possible to apply certain fusion techniques. The manifold fusion techniques can be grouped into

**Colour related techniques:** This group comprises methods that refer to the different possibilities of representing pixel values in colour spaces. An example is the Intensity (I) - Hue (H) - Saturation (S) colour transformation. If a multispectral image is transformed from the RGB space into HIS, it is possible to integrate a fourth channel exchanging it with one of the elements obtained (I, H or S). There are many other techniques that follow the substitution principle. Of course, there are other colour transformations which suit the fusion concept (e.g. RGB or Luminance/Chrominance - YIQ).

**Statistical / numerical approaches (Pohl, 1996):** The second group of fusion techniques deals amongst others with arithmetic combinations of image channels, Principal Component Analysis (PCA) and Regression Variable Substitution (RVS). Fusion by band combinations using arithmetic operators opens a wide range of possibilities to the remote sensing data user. Image addition or multiplication contributes to the enhancement of features, whilst channel subtraction and ratios allow the identification of changes. The Brovey transformation forms a particular method of ratioing, preserving spectral values, while increasing the spatial resolution. The PCA and similar methods serves the reduction of data volume, change detection or image enhancement. RVS is used to replace bands by linearly combining additional image channels with the dataset.

**RATIOCINATION**

The experiences gained show very clearly that a major element of the operational implementation of image fusion with respect to visual image interpretation is the interactive component. The fine tuning of the image enhancement parameters, i.e. histogram value distribution, filter, assignment of colours etc., influences the success of the fusion itself. Similar types of areas and datasets require similar values for a successful merge. Crucial in the overall achievement of image fusion is the adjustment of the colours in the final product. The use of filters for noise reduction or edge enhancement is a sensitive matter in visual image interpretation. Depending on the scale and type of feature to be looked at, filters can help understand the image. In some cases however, it leads to a loss of detail which might be relevant for the application performed. It has to be decided on a case by case basis, if and when to apply filtering to VIR or SAR data. Change detection is vastly simplified, and SAR and multispectral imagery can be more easily and accurately interpreted.

The perspective and terrain distortion that presents a significant obstacle both to human and machine correlation can be overcome by orthorectification which provides a common perspective and thus both reduces mental labor and provides a practical first step for follow-on correlation algorithms.

*This work is a collection of works done in the field of orthorectification and data fusion by various individuals and institutes. Author takes no claim in either designing the concept or its methodologies, however, direct integration of isolated works in the field of orthorectification and data fusion is been done in this article.*
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Todat, with the changing global and regional dynamics, coupled with strategic and military environments, the world is witnessing a growing appetite for geospatial information and high-resolution remote sensing data. But, clearly defined policies on remote sensing data acquisition and distribution are hard to come by.

This gives rise to a question as to why have most of the states (that have satellite programmes in place and consequently generate large volumes of data) shrouded their satellite remote sensing policy on data issues under a veil? The reasons may range from an absence of a well-defined policy to deliberate secrecy.

In this article, some general observations on remote sensing data policies of different countries have been outlined, especially those pertaining to availability of data in the public domain.

OVERVIEW
The countries engaged in remote sensing data collection and distribution are many. USA, Canada, China, India, Israel, Japan, Russia, and the European Union (especially France, Germany and Italy) are the major players in the remote sensing industry. Other nations which are gaining a foothold in the industry are Argentina, Australia, Brazil, Malaysia, South Korea, Nigeria, Thailand and South Africa. All of these countries express agreement and compliance with UN resolutions on remote sensing of the earth from outer space, which are discussed in the following paragraph.

UN PRINCIPLES ON REMOTE SENSING
The United Nations General Assembly adopted Resolution 41/65 in December, 1986, which contained general principles related to remote sensing of Earth by satellite.

The Principles (specific to data related issues) adopted in the 1986 resolution are as follows:

• In order to maximize the availability of benefits from remote sensing activities, States are encouraged, through agreements, to provide for the establishment and operation of data collection, storage, processing and interpretation facilities, in particular within the framework of arrangements wherever feasible.

• As soon as the primary data and the processed data concerning the territory under its jurisdiction are produced, the sensed State shall have access to them on a non-discriminatory basis and on reasonable cost terms. The sensed State shall also have access to the available analysed information concerning the territory under its jurisdiction in the possession of any State participating in remote sensing activities on the same basis and terms, taking particularly into account the needs and interests of the developing countries.

• Remote sensing shall promote the protection of mankind from natural disasters. To this end, States participating in remote sensing activities that have identified processed data and analysed information in their possession that may be useful to States affected by natural disasters, or likely to be affected by impending natural disasters, shall transmit such data and information to States concerned as promptly as possible.

GENERAL OBSERVATIONS
Most of the countries (stated earlier) have space laws, which relate to launch and safety of satellites in orbit. These laws have been framed on the basis of respect for the principle of full and permanent sovereignty of the State and its people over their own wealth and natural resources, in accordance with international law. But, only a handful of countries address remote sensing data issues through laws or policies. According to Gabrynowicz (2003), countries which have no legislation on remote sensing in place, follow international treaties. More often than not, U.S. law is considered a benchmark and is therefore, given due consideration while framing policy directives. One such example is the U.S. Land Remote Sensing Policy Act of 1992.

The Act confirmed U.S. supremacy in land remote sensing technology through the Federal Government’s Landsat programme. It states that “to maximize the value of the Landsat program to the American public, unenhanced Landsat 4 through 6 data should be made available, at a minimum, to United States Government agencies, to global environmental change researchers, and to other researchers who are financially supported by the United States Government, at the cost of fulfilling user requests, and unenhanced Landsat 7 data should be made available to all...
users at the cost of fulfilling user requests”. The Land Remote Sensing Policy Act also states that “to stimulate development of the commercial market for unenhanced data and value-added services, the United States Government should adopt a data policy for Landsat 7 which allows competition within the private sector for distribution of unenhanced data and value-added services.” The Landsat 7 data, therefore, is available to all the countries that have entered into an agreement with U.S. thereby, becoming non-US ground receiving stations. It is to be noted that USA retains ownership of all unenhanced data generated by Landsat 7.

An important policy that engages attention is the U.S Commercial Remote Sensing Policy, released in April, 2003. Among other things, it states that “United States Government civil agencies acting individually, or when beneficial, together shall acquire and operate U.S Government systems that collect data only when such data are not offered and will not be made available by U.S. Commercial remote sensing space systems.” This suggests an increased reliance on commercial remote sensing satellites for data purposes, signifying a major shift from the dependence on data provided by government controlled satellites.

**COUNTRY-SPECIFIC POLICIES**

Remote sensing policies vary from one country to another. Most of the countries have data distribution policies for medium resolution imagery as they are useful for determining the general layout of large-scale facilities and also for finding out the approximate locations of illegal facilities. Some of the satellite systems that provide medium resolution global data ranging from 5 to 15 meters are SPOT, LANDSAT and IRS-1C/D. The following paragraphs provide a brief overview of remote sensing policies in some of the other nation states.

**Australia**

The Australian Centre for Remote Sensing (ACRES) promotes the use of Advanced Land Observing Satellite (ALOS) data within national and regional government agencies, institutes, educational establishments and non-profit organisations for non-commercial purposes only. The Australian policy requires the customers to sign a legal agreement (at the time of ordering the data) stating that they are permitted to use the data only for non-commercial purposes and that they will prevent commercial use of that data by other parties and also follow restrictions related to data sharing and redistribution. The distribution of simply converted imagery or unprocessed data to third parties is not permitted, or in other words, permission is not granted for transferring data if it retains its original pixel structure and can be converted back to primary data. Also, duplication of data is not permitted, except for keeping backups. The ACRES policy (as outlined on their website) also states that “should non-commercial use extend over time to be a commercial use, a commercial use licence must be obtained from a commercial distributor. If an organisation requires data for both non-commercial and commercial purposes, it is recommended that only a commercial licence be purchased.”

**Brazil**

Brazil is also a major player in the Earth Resources Satellite arena, especially in South America. The Earth Resources Satellite Programme was developed in collaboration with China and is better known as CBERS, that is, China-Brazil Earth Resources Satellite. The objective of CBERS was to build a family of remote sensing satellites to fulfil the needs of users working on earth resources applications. The free CBERS data distribution strategy is the highlight of Brazilian-Chinese partnership. CBERS images received in Brazil are freely available on the internet for Brazilian and Latin American users. Similarly, CBERS images received in China are freely available on the internet for Chinese users. The CBERS data policy has been appreciated by the Government as well as the user community in Brazil as internet has reduced the cost of data distribution to almost zero.

**Europe**

European Space Agency (ESA) is the nodal agency for space-faring countries of the European Union (EU). One of the main problems debated by ESA was that European legislation did not cover remote sensing data. Most of the satellite operators in Europe earlier protected their data under copyright which was risky because the implementation could differ between ESA Member States depending upon the national copyright laws. Therefore, the EU Directive on databases was adopted in 1996 with ESA’s full participation, and was subsequently incorporated into domestic laws by the EU Member States. This means that the remote sensing data which is not protected under copyright are secured under the protection granted by the EU Directive. Although, a well-defined policy on remote sensing data is not available, the Resolution on the European Space
Policy adopted recently in May, 2007, discusses the ‘key issues to be considered in the implementation of instruments and funding schemes for Community actions’. One of the main issues is the development of a comprehensive data policy, comprising data access and pricing, which will aid the rapid development of the space services sector. Therefore, we can hope for a comprehensive European policy, specially formulated for data acquisition and distribution.

**France**

France boasts of the SPOT satellite earth observation system, which was designed by CNES, the French Space Agency, and developed in collaboration with Sweden and Belgium. Direct reception of real-time SPOT data is available through a SPOT data reception licence that allows direct reception of data acquired from SPOT 2, SPOT 4 and SPOT 5. The licence includes a data distribution licence for imagery acquired within the station’s territory or for a given market on request. SPOT data or any value-addition to it can be used by the clients for internal purposes only. The policy also states that any scene (maximum size of 1024x1024 pixels) from the images or value-added products, can be printed and distributed only if the full credits (to CNES) are clearly displayed.

**India**

In India, there exists a comprehensive Remote Sensing Data Policy which contains “modalities for managing, permitting the acquisition or dissemination of remote sensing data in support of developmental activities.” It is necessary to obtain license and/or permission from the nodal agency (Department of Space) in order to operate a remote sensing satellite from India as well as to acquire/distribute remote sensing data within the country. The policy further states that “for acquisition/distribution of IRS data for use in countries other than India, the Government of India, through the nodal agency, would grant license to such bodies/agencies of those countries as are interested in the acquisition/distribution of IRS data, as per specific procedures.”

The Indian remote sensing policy also provides clear guidelines that need to be adopted for distribution of satellite remote sensing data within India. These are:

- All data of resolutions up to 5.8 m shall be distributed on a non-discriminatory basis and on “as requested basis”.
- With a view to protect national security interests, all data of 5.8 m and better than 5.8 m resolution images will be screened by the appropriate agency before distribution so that images of sensitive areas are excluded.
- The Government of India does allow sale of 1m resolution commercial imagery also but its distribution is kept under check through specific sale/non-disclosure agreements that need to be concluded between National Remote Sensing Agency and users of the data.

**Malaysia**

Malaysian Centre for Remote Sensing (MACRES), the centralised national remote sensing data provider of Malaysia, hosts a Data Quicklook System, which is a web-based system that provides online remote sensing satellite data catalogue browsing to the public users. MACRES Ground Receiving Station directly acquires data from Radarsat-1, and Spot 2, 4 and 5, Landsat, NOAA, Terra/Aqua (MODIS) and IRS (OCM) satellites which are subsequently used for generating value-added products. IKONOS and QuickBird high-resolution data are also acquired by the agency from foreign sources. MACRES is also striving hard to acquire MS ISO 17799 certification for Information Security Management System (ISMS 17799) for its data services.

**Nigeria**

There exists a proposed pricing policy for the NigeriaSat-1 data, the first satellite launched by Nigeria in 2003. It calls for acquiring all images over Nigeria which would be available for sale at National Space Research and Development Agency (NASRDA). It is proposed that the disaster response images would be free, while the images of scenes covering an area of 600x300 km will be available on request. Short term plans of NASRDA also include the development of a permanent site of the National Centre for Remote Sensing (NCRS) in Jos, Nigeria. NASRDA also plans to build a national earth observation ground receiving station with foreign partnerships.

**Russia**

Russia entered into a new phase of commercial image marketing in 1992 by permitting the distribution of high-resolution images acquired by KVR-1000 panchromatic camera, which was initially designed for intelligence applications. But, it should be noted that the Russian policy regarding sale and distribution of pre-1992 high-resolution imagery is not clearly defined, probably due to intelligence and military compulsions. Although the available commercial images from KVR-1000 have a resolution of two meters, in June 2000, Sovinformsputnik (the Russian Space Agency) announced the commercial distribution of one-meter spatial resolution space images taken by Russian satellite system KOMETA. The KOMETA images were ultimately used to
produce 1:50,000 scale topographic maps. The use of these images are currently prohibited for civil commercial purposes.

CONCLUSION
Satellite-based services for communication, broadcasting, navigation and earth observation have become the mainstay of our modern world. Space, therefore, is not confined to being just a technological frontier but has also become a geopolitical issue today, which transcends all international borders. As pointed out by Gupta (1994) in a paper titled ‘New Satellite Images For Sale: The Opportunities and Risks Ahead’, “there are numerous potential hazards associated with the horizontal proliferation of high-resolution imagery and many high-resolution satellite images are a function of the specific circumstances that surround the application. In general, the risks depend on how the new remote sensing services will be distributed throughout the political landscape, how belligerent states will use high-resolution images, and how observed states will respond to routine overhead imaging by their neighbours”. Many countries prohibit the reproduction of multiple copies of data for distribution for commercial purposes to prevent misuse of data for non-peaceful purposes. But, these restrictive measures have given birth to applications like Google Earth, which provide free high-resolution imagery to users around the world. This, therefore, highlights the need for an internationally coordinated strategy to curtail the threat posed by free-for-all high resolution images. Hence, it would be in the common interest of all the nations if a common international policy framework is formulated to help streamline the processes of data acquisition and data distribution around the world, without jeopardising or comprising national security.

References
http://ceos.cnes.fr:8100/cdrom-00b/ceos1/policy/policy1.htm
www.esa.int/SPECIALS/Intellectual_Property_Rights/SEM1101A90E_O.html
http://geo.arc.nasa.gov/sge/landsat/coverage.html
Vipin Gupta, ‘New Satellite Images For Sale: The Opportunities and Risks Ahead’, 1994,
www.llnl.gov/csts/publications/gupta/contents.html
http://www.spotimage.fr/html/_167_.php
Later this year GeoEye will launch GeoEye-1, a commercial Earth-imaging satellite which will provide the high resolution and advanced collection capabilities in commercial remote sensing domain.

Offering 41-centimeter panchromatic and 1.64-meter multispectral in the blue, green, red and near-infrared bands, the satellite will enable clients to identify and differentiate small objects and features at high level of detail. Geospatial data users in the urban planning, utility, and cartographic disciplines - all of which traditionally map small features - are expected to expand their use of satellite imagery as a result.

GeoEye-1 will offer three-meter geolocation accuracy, which means end users can map natural and man-made features in stereo to within three meters of their actual locations without ground control points.

This level of geolocation accuracy will be achieved with the help of three onboard systems: a Global Positioning System (GPS) receiver, gyroscope and star tracker, which will enable the satellite to determine its precise attitude, position and location at all times. Another technological advancement found in the GeoEye-1 satellite will be its ability to collect a large amount of imagery.

In the panchromatic mode the satellite will be capable of collecting up to 700,000 square kilometers in a single day, and in multispectral mode 350,000 square kilometers per day.

The standard image swath width will be 15.2 kilometers, but GeoEye-1 will be able to swivel and collect multiple adjoining swaths on a single pass, meaning that very large continuous areas can be imaged at one time. This is ideal for large-scale mapping requirements, especially in terms of monitoring climate change, emergency response and disaster relief.

The satellite will swivel up to 40 degrees off nadir, giving it an effective revisit rate of less than three days.

Once in orbit the satellite will undergo approximately 45-60 days of calibration and checkout. The satellite will then commence a three-month imaging operation dedicated almost exclusively to meeting the needs of the U.S. Government’s National Geospatial-Intelligence Agency (NGA).

While GeoEye-1 will be able to collect imagery with a resolution of 41 centimeters, under the company’s current operating license from the National Oceanographic and Atmospheric Agency (NOAA), the imagery will be re-sampled to 50 centimeters or half a meter for commercial customers. However, modification to this licensing constraint is being worked upon, to offer customers best available product and more effectively compete with providers outside the United States.

Mark Brender
VP Corporate Communications & Marketing, GeoEye
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Q: How has been the experience, being part of industry after a long stint as academician?

Here at Microsoft the environment is different than the organisation I previously lead and managed (GeoTango, a 3D mapping and visualization company). The issues we are tackling are of a larger scale than the ones I used to handle before. But one thing I find in common, between academic research and industry, is that we are all focused on innovation. If researchers have opportunities I would definitely encourage them to work in the industry for some time period so as to understand the major drivers behind the industry evolution. However, this is really a personal choice as academia also has many exciting research issues to address.

Q: How has the growth of Microsoft Virtual Earth been since its inception?

It started in 1995 with Encarta, where people get the view of 3D globe with detailed map of different regions. Then came MapPoint in 2001, which provided online maps and directions, with a set of APIs allowing third parties to integrate a mapping component directly into their websites. So, Microsoft has had a long experience with providing consumer-based map products online. Microsoft started building the Virtual Earth (VE) platform in early 2005 to help consumers gain more immersive mapping and search experiences. The entry point to Virtual Earth is through the Live Search Maps consumer portal at http://maps.live.com, which is built on the Virtual Earth platform.

Virtual Earth is a technology platform with a set of services and API’s allowing developers to integrate Virtual Earth into their own applications or their own entry points (websites). Microsoft Virtual Earth, in both 2D and 3D versions, is offered as part of the Microsoft Developer Network. For consumers, Virtual Earth powers online mapping services through Microsoft’s www.Live.com and MSN, the later is available in 21 languages in some 42 markets, and we are able to reach a huge audience through these entry points.

Q: How do you analyse the growth of VE?

The growth is of two sides. On the consumer side, the analysis is based on of course, the statistics about usage of users such as unique visitors per month and page views. There is a daily tracking system to analyse how the numbers (traffic) are growing. We have not released any figures yet; we only have internal numbers that help our analysis, but there are third party companies who track these numbers using a certain approach. However, there are other factors also affecting growth for VE, Microsoft as a whole and for many other businesses. There is a lot of room for us to grow in this sector. On the business side, this is based on transactions. We do count how many mapping tiles are being accessed by users, by third party websites and also by fees when people pay to license our platform. We are very pleased with our growth so far.

Q: How do you differentiate MapPoint from VE?

VE goes far beyond the general mapping features like finding maps and directions. It extends online-mapping to the next stage. The next stage is what we define as local search, online infotainment and social networking. So, it is beyond the scope of MapPoint, which was merely a mapping software. VE’s vision is to enable the connection between people to local content, people...
to local business and people to people locally. This allows users to access not just maps and directions; but much more rich information about the community they live in, about the places they want to visit and about the events they want to join. We have invested significantly in technology innovation, from oblique images to 3D textured models, from streetside images to Photosynth. The later two features have not been released yet. Map is being evolved as social media where communication and collaboration among users will become one of the major drivers for people to use maps to share their knowledge, information, and experiences.

Q: If a city wants to integrate local information say, traffic information to VE, do standards play role?

For the Virtual Earth platform, we deliver a very rich set of APIs that supports both 2D and 3D functions, which is VE 2D and 3D respectively. In our own portal, you can see 2D and 3D are fully integrated into the web browser environment. For example, without downloading a separate client application, you can either look at a 2D map for traffic information or you can drive through in 3D to have a feel of it. These capabilities are provided to developers and the third parties so they can integrate into their own software applications. For example the Microsoft Virtual Earth Plug-in for Outlook is available for free downloading. Once you download and install it, it is part of Outlook scheduling. When you schedule a meeting for example with someone in Downtown, and it will take 30 minutes to get there, the programme will alert you 30 minutes before the meeting and provide driving directions as well. This is how you can integrate the 2D and 3D features of Virtual Earth into your own client and desktop applications.

Q: Is there any current support in VE for the industry standard Vector or Imagery formats to be overlaid for analysis?

As I have said earlier, we provide APIs and the developers can have their own ways for integrating their content. There are many data conversion utilities available that can help to convert data and use our APIs to overlay over VE. So at the API level we support image overlay, different formats, and many of the GIS functions and operations. At the data format level, we currently support GeoRSS for the web portal, and VE is one of the first to support GeoRSS, an open standard that will help in import/export of data collections. There is a big question for us, i.e should we offer a new format for data exchange?. Personally, I am very careful about that. I am coming from a geospatial background and we all understand the issue with the proprietary formats and their implications with regard to interoperability. However, there is no OpenGIS format currently available that supports the capabilities that we need for VE.

Q: If after using Google API user wants to migrate for some reasons to VE and vice-versa, how do you see such situations?

It should be straight forward. At the API level, it is interesting that many users have experienced different API’s (provided by different vendors). Unfortunately you will observe that there are no API standards as vendors try to provide innovative features through their own API’s. But the good news is, at the web service level all those API’s are similar, i.e. XML based and it is not too difficult for developers to switch, to use one API or the other. In fact, they can even combine different API’s in their own software. I do not see the possibility of standardising all the APIs in future. At the data format level, however, I believe that there is room for standardisation.

Q: Would you like to describe licensing options available on VE?

For developers it is free for use on websites that have less than 1 million unique visitors per month, which is a lot. You have limitations in terms of transactions of mapping tiles up to 3 million per month. If it is more than that, meaning your business is substantial, Microsoft would like to have a share from it by way of fee based licensing. This policy allows as many developers as possible to do the integration for free either for research or for business purposes.

“ If researchers have opportunities I would definitely encourage them to work in the industry for some time period so as to understand the major drivers behind the industry evolution. ”
The term, “remote sensing,” was first introduced in 1960 by Evelyn L. Pruitt of the U.S. Office of Naval Research.

Over the past decade, a renewed and expanding interest in practical applications of Earth observations from space and airborne platforms has coincided with and been fueled by changes in the data, in how they can be used, and in who produces them. There have been significant improvements in the availability of remote sensing data from India, US and France in the spectral and spatial resolution. In addition, the data can be adapted for more varied uses because of the extension and advancement of complementary spatial data technologies, such as GIS and the GPS, which can be used in conjunction with remote sensing data.

**HIGH RESOLUTION OPTICAL REMOTE SENSING**

Optical remote sensing makes use of visible, near infrared and short-wave infrared sensors to form images of the earth’s surface by detecting the solar radiation reflected from targets on the ground. Different materials reflect and absorb differently at different wavelengths.

Thus, the targets can be differentiated by their spectral reflectance signatures in the remotely sensed images. Optical remote sensing systems are mainly classified Panchromatic, Multispectral, and Hyper spectral depending on their spectral resolution.

**NASA - LANDSAT**

Landsat satellites have been collecting images of the Earth’s surface for more than thirty years. NASA launched the first Landsat satellite in 1972, and the most recent one, Landsat 7, in 1999. Instruments onboard the satellites have acquired millions of images of the Earth. These images provide a resource for global research. It has the following the sensors.

**The Multispectral Scanner (MSS)**

It was a sensor onboard Landsats 1 through 5 and acquired images of the Earth nearly continuously from July 1972 to October 1992, with an 18-day repeat cycle for Landsats 1 through 3 and a 16-day repeat cycle for Landsats 4 and 5. Landsat MSS image data consisted four spectral bands, although the specific band designations changed between Landsats 1-3 and Landsats 4-5. The resolution for all bands of 79 m, and approximate scene size is 170 km north-south by 185 km east-west (106 mi by 115 miles).

**The Thematic Mapper (TM)**

It is a sensor carried onboard Landsats 4 and 5 and has acquired images of the Earth from July 1982 to the present, with a 16-day repeat cycle. Landsat TM image data consists of seven spectral bands with a spatial resolution of 30 meters for bands 1 to 5 and band 7. Spatial resolution for band 6 (thermal infrared) is 120 meters, but band 6 data are oversampled to 30 meter pixel size.

**Enhanced Thematic Mapper Plus (ETM+)**

It consists of eight spectral bands, with a spatial resolution of 30 meters for bands 1 to 5 and band 7. Resolution for band 6 (thermal infrared) is 60 meters and resolution for band 8 (panchromatic) is 15 meters. Approximate scene size is 170 km north-south by 183 km east-west (106 mi by 114 mi).
INDIAN REMOTE SENSING SATELLITES

The launch of India’s first civilian remote sensing satellite IRS-1A in March 1988 marked the beginning of a successful journey in the course of the Indian Space Programme.

IRS 1C &1D

The fourth in the IRS series, IRS1C and IRS1D were launched on 1995 and 1996. The satellite payload consists of three sensors, namely panchromatic camera (PAN), Linear Imaging and Self-Scan ning Sensor (LISS - III) and Wide Field Sensor (WiFS). The PAN camera provides data with a spatial resolution of 5.8m. LISS - III camera provides multispectral data in 4 bands.

The spatial resolution for visible (two bands) and near infrared (one band) is 23.5m. WiFS camera collects data in two spectral bands with a spatial resolution of 188m and a ground swath of 810 km. The scale of mapping for IRS 1C & D ranges from 1:100,000 - 1:25,000.

IRS RESOURCESAT

The RESOURCESAT-1 (IRS-P6) is envisaged as the continuity mission to IRS-1C/1D, with enhanced capabilities both in the payload and the platform, to meet the increasing demands of the user community. The resolution of the sensor is 55, 23 & 5 m Multispectral as well as 5 m Panchromatic. The scale of mapping for Resource sat ranges from 1:100,000 - 1:25,000.

IRS Cartosat-1 & Cartosat-2

Cartosat-1 is the first in-track stereo viewing satellite in the IRS series of satellites. Cartosat 1 with a capability for global coverage, revisit period 5 days and 2.5 m nadir resolution and 27 km swath.

Cartosat -1 images can be utilized to generate data products resulting in topographic map generation in 1:10,000 scales

Cartosat-2 carries a panchromatic camera (PAN) to provide imageries with a spatial resolution of better than one meter and a swath of 9.6 km. The satellite can be steered up to 45 deg along as well as across the track.

DIGITAL GLOBE - QUICK BIRD

Launched in October 18, and 2001 fueled for 7 years orbiting the earth at an Altitude: 450 km - 98 degree, sun-synchronous inclination, the Quick Bird satellite is the first in a constellation of spacecraft that Digital Globe has developed that offers commercial high-resolution imagery of Earth.

Quick Bird’s panchromatic and multispectral imagery is designed to support a range of applications. Quick Bird collects image data at 0.61m pixel resolution and can fit for the application that needs upto 1:3000 scale.

GEOEYE - IKONOS

The IKONOS Satellite is a high-resolution satellite operated by GeoEye. Its capabilities include capturing at 4 m multispectral, Near-Infrared (NIR)/0.82m panchromatic resolution at nadir. Its high resolution data makes an integral contribution to homeland security, coastal monitoring and facilitates 3D Terrain analysis.

SPOT

SPOT is a high-resolution, optical imaging earth observation satellite system. SPOT 1 was launched in 1986 with 1m panchromatic and 20m multispectral capability. SPOT 2 was launched in 1990 and is still operational. SPOT 3 was launched in 1993 and stopped functioning in 1997. SPOT 4 was launched in 1998. SPOT 5 was launched in 2002 with 2.5m, 5m and 10m capability. Spot satellite imageries are widely used for the mapping scale of 1 : 50,000 - 1:10,000.

CSA - RADARSAT

It is equipped with a Synthetic Aperture Radar (SAR), which can transmit and receive signals to “see” through clouds, haze, smoke, and darkness, and obtain high quality images of the Earth in all weather at any time.

This provides significant advantages in viewing under conditions that preclude observation by aircraft and optical satellites. Using a single frequency, C-Band, the RADARSAT SAR has the unique ability to shape and steer its radar beam over a 500 kilometre range. It can image a swath from 35 kilometres to 500 kilometres with resolutions from 10 metres to 100 metres respectively. Incidence angles range from less than 20 degrees to more than 50 degrees. The satellite’s orbit is repeated every 24 days. The RADARSAT-2 Synthetic Aperture Radar (SAR) will acquire data at horizontal (HH), vertical (VV) and cross (HV & VH) polarizations over a range of resolutions from 100 to three metres.

Mohamed Elias
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Q. How has DigitalGlobe evolved as a company in the past few years? Where is it headed to in the near future?

DigitalGlobe was earlier a traditional satellite company. In other words, we had an asset up in space and people would approach us with requests to take pictures of their area of interest using our satellite. This was the model for many years for the satellite industry. What has changed for DigitalGlobe in the past few years is that we have tried to become a content company by focussing more on making strategic decisions regarding which areas to capture and thereafter trying to sell them multiple times. We will be expanding our capacity to systematically image different parts of the earth significantly, later this year, with the launch of WorldView I satellite. This will be a fundamental change for us. The model entails working with our partners in various countries of the world, understanding which areas of the earth they care about the most, doing our best to image them and finally selling the images to multiple customers.

Q. Every industry changes with the change in demand pattern. Has there been a change in the demand pattern for satellite products too?

Spurred by Google Earth, there has been an increase in the demand for satellite imagery in the past few years.

The range of people who use the imagery has also undergone a change. Historically, it was the domain of GIS and Remote Sensing specialists. Also, only a few people in an organisation could access this information. Increasingly, what we have seen is that in the last few years is an increase in awareness for and expansion of use of imageries within an organisation. Today, there are more tools available that make it easier to view this data (Google Earth, Virtual Earth, GIS packages etc.). Hence, more people are using this information than ever before.

Q. Do you foresee a shift in the model of image delivery?

There will be a shift in the image delivery model definitely. The web is going to play an increasingly larger role in how people consume the content. DigitalGlobe has an online store. It is different than the typical delivery model where someone can order for the imagery in a JPEG format, which does not contain geo-referenced information. So, we see a need to have products that are useful to different types of customers, that is, people whom we are selling these imageries to. In case of the DigitalGlobe online store, we have tasted major success in commercial real estate industry. Other distribution mechanisms through which you can get a lot of detailed information is through direct desktop plug-ins and software solutions.

Q. Keeping in view the scheduled launch of WorldView-I in September 2007, what according to you has fuelled the growth of satellite industry?

The fundamental difference is in the capacity to acquire imagery which is of high resolution and accurate. The launch of WorldView I, would in certain regards, mean better imagery than what we have today. The satellite is also more agile. It can capture five times the imagery that QuickBird can capture today. If you couple the launch of WorldView I with that of WorldView II, scheduled for launch in late 2008, there will be a ten times increase in our capacity. This means that it would become much more easier to execute the content strategy as the required frequency of capturing more areas will become quite feasible. It would signify a big shift in the model where one had to wait for six to eight months to get a relatively smaller imagery to pro-actively going out and refreshing key parts of the earth at regular intervals.

Q. Aerial imaging is emerging as an industry very strongly. Do you consider that as a competition to the satellite imagery market?

I view it as very complementary indeed. It certainly becomes competitive if you do not have access to aerial photographs. This is the reason why we acquired GlobeXplorer earlier this year.
GlobeXplorer has a subsidiary called AirPhotoUSA. This company has a very interesting model. They fly all over the U.S to acquire and maintain current, nationwide aerial imagery at one-foot pixel resolution. Plans are afoot to extend into Europe as well. All the processing would then be centralised.

We at DigitalGlobe think that aerial imagery and satellite imagery are quite complimentary because aerial imagery is useful for imaging downtown metropolitan areas, giving a wider coverage at higher resolution which is not possible in commercial satellite images due to restrictions. Satellite images, on the other hand, are great for markets all over the world where it is not possible to fly.

**Q. Many nations worldwide are building their own satellite programmes. What is your reaction (being a commercial satellite company) to such developments?**

It is good for the industry that there are going to be more satellites. There is a growing demand for satellite data. According to me, the key to success in the future will be our ability to execute ourselves as a content company. Having the content that people need today in our image library is not everything. It is important that we make it possible for them to consume it the way they wish to. So, I think our data archive, available over the web, will give us an advantage. Other new emerging companies will probably not be systematic in giving out their content. A lot of them are probably going to be project-based. Hence, they are going to satisfy individual project demands probably within the market. But, our advantage is that we can go to people with the imagery they need, customised to their requirements.

**Q. What are your views on the Asian market with regards to its potential?**

Historically, Asia has been the fastest growing region for us for a number of years. It is the market that we are most excited about. The Asian market is growing very rapidly. There is an unbelievable amount of infrastructure being built as cities are growing and expanding rapidly. Whenever there is a lot of change and investment in infrastructure, it suits our industry very well. I think there is a lot of opportunity there and as we increase our capacity, we will be in a much better position to serve this growing market.

**Q. How do you view the relationship between DigitalGlobe and Google Earth?**

It is a fantastic relationship. We view one another as strategic partners. The relationship has worked out very well owing to the synergy. Google Earth has contributed immensely in increasing awareness about our industry and in contributing to DigitalGlobe’s success. It makes me happy to say that we have played a small part in making what Google Earth is today.

**Q. What is DigitalGlobe’s strategy for making available satellite imageries for commercial consumer level applications?**

I think the consumer is more demanding than the professional user. A consumer expects the imagery to be current. So, the bar is quite high. Therefore, the key to being successful is to have consistent coverage which is of a good quality and is current. If these three elements are achieved, then the imagery can be deployed in a number of consumer-based applications. That really has driven the success of Google Earth in many regards because they were the first to invest in seamless coverage of the earth.

This, I feel, was the turning point for the industry. Until then, nobody had the resources to really go out and do that kind of work. We like to think our-
selves as the first company that is emerging as a content company by building the largest constellation of commercial satellites and complimenting that with an aerial programme.

Q. As one of the leaders of the satellite industry, where do you see this industry heading to in the next few years?

There will be two major developments. One is the growth in the number of people who will be using this information. I think, presently we have only scratched the surface. So, instead of being a very specialised industry for a select few scientists or defence analysts, you are going to witness a continued expansion in the use of satellite imagery.

Also, given that we are about to experience an explosion in capacity, we will see new applications for the imagery emerge, which were not feasible in the past. If an area is visited frequently, it opens up a lot of new application possibilities which we had not considered before.

Q. There is a lot of competition in the satellite imaging market especially in sub-metre resolution data. How is DigitalGlobe trying to consolidate its position?

Competition will always be there. DigitalGlobe will much rather be in an industry where there is competition because it means that there are opportunities available. If there are no competitors, it means that most people do not consider it a valuable industry to be in. So, competition is beneficial.

We are very confident that we are in a good position to continue to maintain our leadership in the market. Two satellites (WorldView I and WorldView II) are being developed by DigitalGlobe. Worldview II is going to be a purely commercial satellite. From a constellation standpoint, we are in a really good position.

As I mentioned earlier, marrying the aerial imaging with the satellite is really going to benefit us in the long term. There is a big difference in having satellites and partnering with an aerial imaging company than actually controlling where the sensors go. Hence, we can be more efficient in avoiding overlaps.

If we know that we are going to capture a certain market aerially, we are not going to waste precious satellite capacity on that market. We will redirect it to aerial which will prove to be more useful.
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