

# SatMagazine



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*Published monthly by*  
**Satnews Publishers**  
 800 Siesta Way  
 Sonoma, CA 95476 USA  
 Phone: (707) 939-9306  
 Fax: (707) 838-9235  
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## ... Image Building ...

**L**aunching any issue of our publications is an exercise in delight — the cooperation received from industry professionals is most appreciated, and we relish the opportunity to learn something new each and every day, thanks to the informative articles, telephone calls, visits at trade shows, and press releases. The amazing factor is how well our industry remains so flexible and viable, day after day, week after week and month after month, during the economic doldrums now facing all — a true testament to the creative approaches taken to product and marketing by various SATCOM market segments.

We get as excited as you do with your new product announcements and upgrades — we enjoy hearing from you and in receiving your promotional materials and feature articles. As we all wish to put our best foot forward, here are a few recommendations that would allow us to help you with your presentations in SatMagazine, MilsatMagazine, and SatNews (daily and weekly).

For your announcements a wonderful enhancement are your product photos — if sent with a press release, this saves our editorial staff time in attempting to locate the appropriate image for the story or the news release. Unfortunately, if too much time is taken in attempting to uncover such an image, due to our daily deadlines, your company's announcement will not have a graphic to enrich your information.

This also holds true when you are forwarding information regarding personnel and/or executive team changes at your company or organization. If you could include a photograph of the individual(s) you are referencing, such would be of tremendous help. Incorrect photos or images accompanying an article or press release tend to upset those whom are being referenced... and, when so informed, the wrong photo with a product requires hasty corrections at our end of the cycle. If the issue happens to be a PRINT issue (and this is very important!) — we request 300 dpi .jpg or .pdf files...

A reminder... our upcoming December YEAR IN REVIEW issue, with an editorial deadline of November 8th, is your opportunity for your company to highlight its success over the past year. Usually under the auspices of a member of your company, or organization's executive team, the YEAR IN REVIEW features all of the important companies engaged in SATCOM, MILSATCOM, and all ancillary businesses.

And talk about being in good company! The issue features each company, in alphabetical order, and the comments are from the executive team member. Included are the author's photo, company logo, and links back to the company website and/or email addresses for further information. By taking the time to include photos, illustrations, graphs, videos and so on, you are ensuring your announcement or feature story have the added value of the imagery as well as the defining text. This allows our readers to fully appreciate your information. We heartily recommend you review 2008's December YEAR IN REVIEW issue for examples of how such is accomplished, and we are always available via phone or email to discuss with you, as well. The URL for that issue is:

[http://www.satmagazine.com/cgi-bin/display\\_edition.cgi?number=1636380431](http://www.satmagazine.com/cgi-bin/display_edition.cgi?number=1636380431)

We certainly hope you enjoy this particular issue, which offers some highly interesting expertise and insight into the launch industry. If you are heading to SATCON, our publisher Silvano Payne will be in attendance and if you have the opportunity to do so, please say hello during your visit to the show.

We would also like your comments regarding the publication... and we would certainly like to hear from you regarding articles you would like to submit for our magazines. No one person can know everything about our industry, and if not for the expertise of professionals such as yourself, the stagnation would be staggering. Thanks for visiting with us...

## The Impact of the Sea Launch Bankruptcy On The Launch Industry

by Dustin Kaiser, Futron

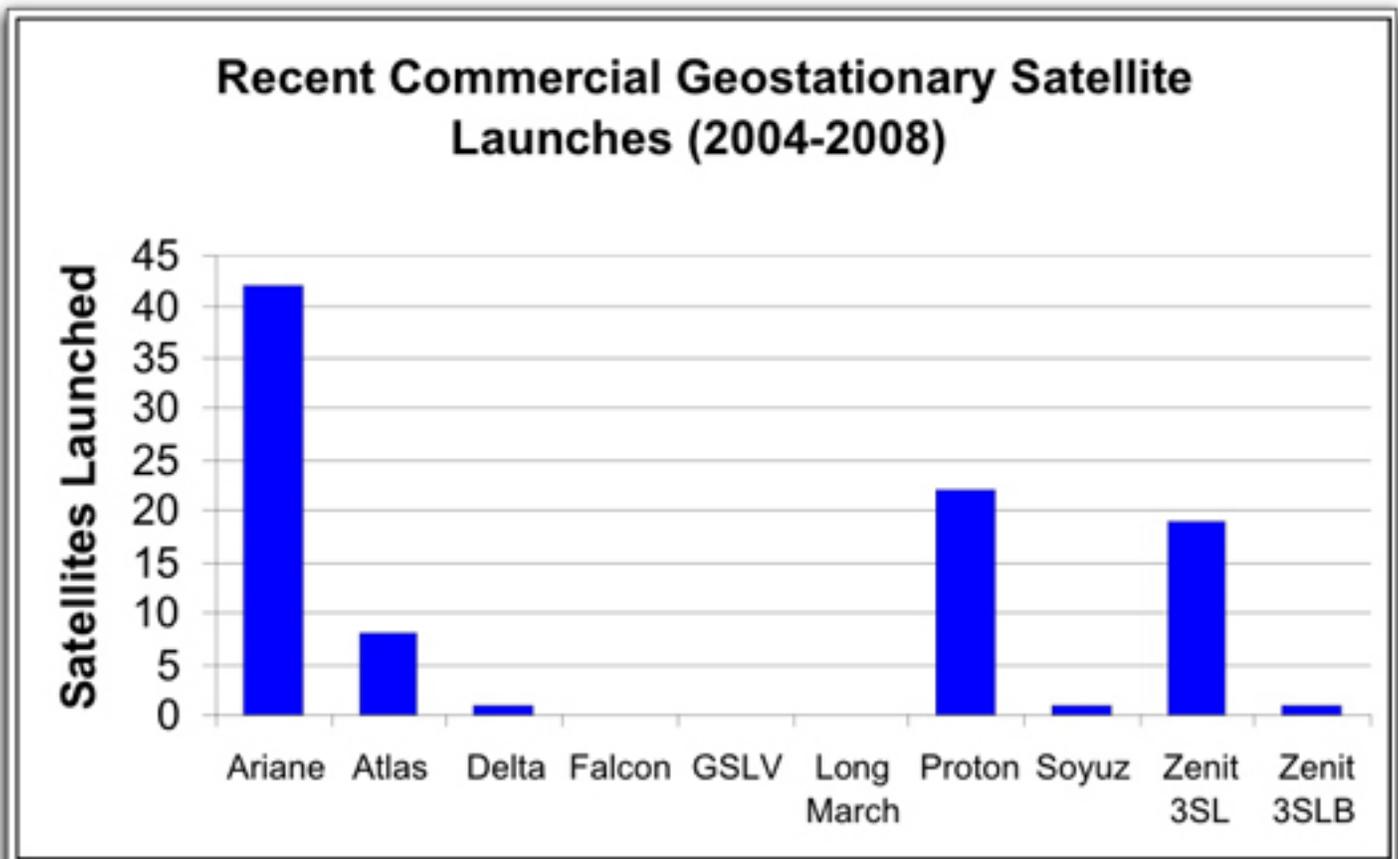
The bankruptcy filing by **Sea Launch** in June has raised considerable concern about the geostationary launch industry, which is already struggling to meet launch demand. The cyclical nature of the commercial satellite telecommunications industry — the prime driver of launches — fluctuates between conditions of over-capacity to under-capacity with the latter motivating investment in fleet replenishment and expansion. While the current situation is one of under supply, demand for launch services is expected to remain stable for the next few years, barring any further dislocation from the continuing global economic crisis.

Over the last five years, **Sea Launch** has served as one of the three pillars of the commercial geostationary launch industry, along with **Arianespace** and **ILS**. Depending on the selected

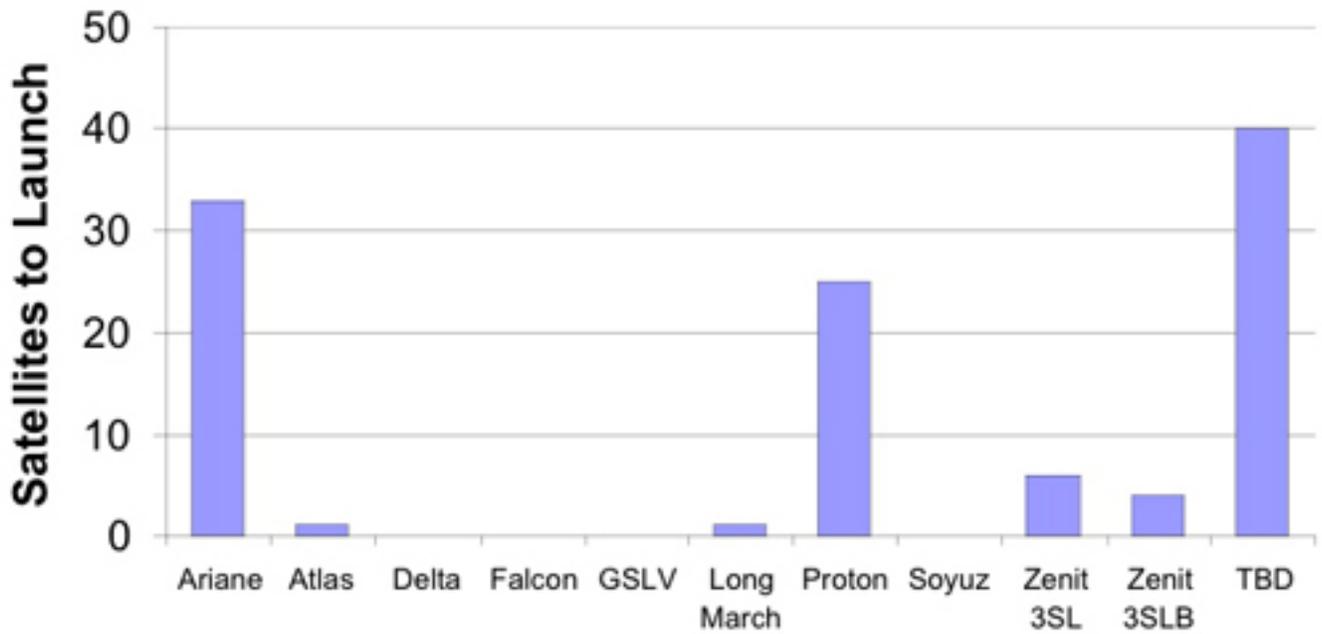
definition of commercial, roughly 94 commercial geostationary satellites launched between 2004 and 2008, or approximately 19 satellites, launched each year. Over the course of the next five years, the number of geostationary payloads launched annually is projected to increase from 19 to 22, according to **Futron** estimates as well as projections by the **2009 Commercial Space Transportation Advisory Committee (COMSTAC)** geostationary forecast.

From 2004-2008, Sea Launch captured approximately 20 percent of this launch market. Applying the 20 percent market share figure over the next five years reveals that the absence of Sea Launch could affect 22 satellites. More urgently, in the near-term, the bankruptcy process will affect between four to five satellites over the next year and create a ripple effect that will increase launch demand in the following years.

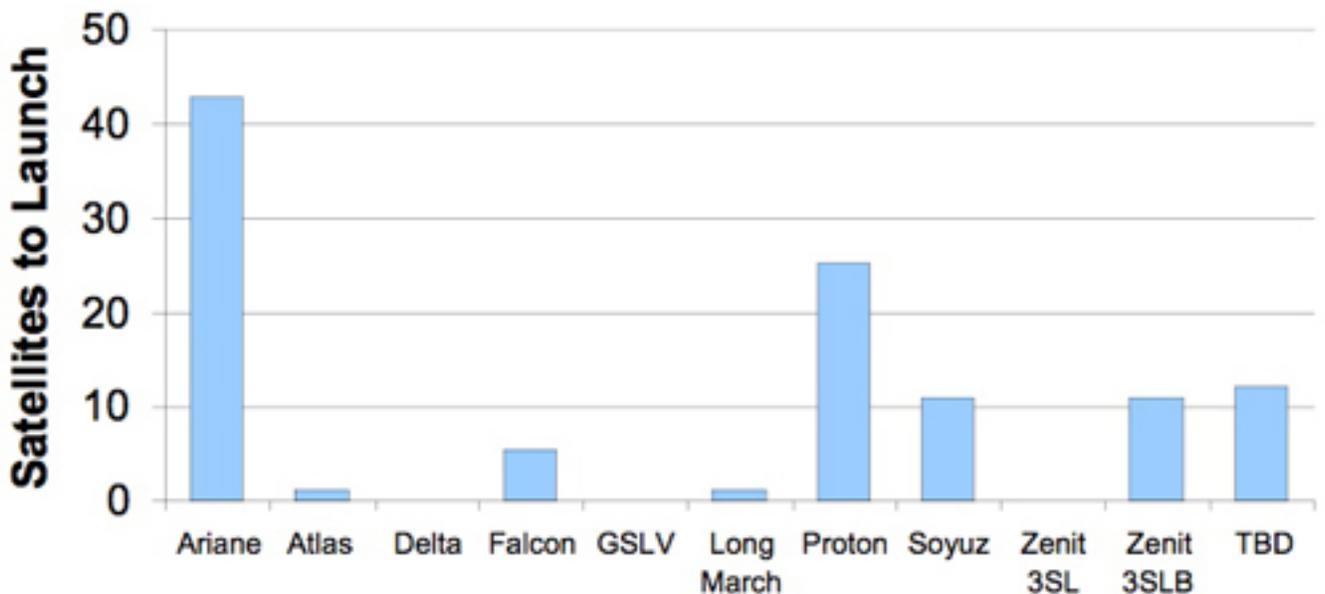
There are some potential solutions to meet the demand gap. Flexibility in schedules and healthy amounts of cash may help operators bridge the near-term gap by contracting with **Arianespace**, **ILS**, or **Land Launch**. On the positive side, Sea Launch might



### Current Commercial Geostationary Satellite/Launch Assignments (2009-2013)



### Potential Scenario Without Sea Launch (2009-2013)



emerge from bankruptcy by the end of 2010. If it does not do so, the next five years may create difficulties for those anticipated payloads still without identified launch contracts (indicated in the current satellite assignments chart as TBD) as they seek rides to orbit.

To understand how the market might adjust to the absence of Sea Launch, a scenario has been created to estimate how Sea Launch capacity could be divided among current and emerging launch systems. Smaller geostationary satellites under 4,000 kg might be able to launch on Land Launch, a commercial version of the **Zenit 3SL** operated by **Space International Services**. An Arianespace marketed **Soyuz** is estimated to come on line in 2010 with a launch capacity of 3,000 kg. The scenario assumes these vehicles can capture two geostationary launches per year.

Options for use of emerging launchers from China and India are less certain, especially in light of the recent failure of the **Long March** to place a commercial satellite into its proper orbit. On the other hand, increasing pressure to relax U.S. export controls could facilitate mid-term use of the Long March and India's **Geostationary Launch Vehicle (GSLV)**.

On the U.S. launch side, **SpaceX** has yet to demonstrate the reliability of the **Falcon 9** in order to satisfy satellite operators and, ultimately, insurers. Nonetheless, in the next

five years, a proven Falcon 9 launch vehicle could emerge as a viable commercial option. Potentially more interesting, if more difficult, would be the ability of **Boeing** and **Lockheed Martin** to offer commercial launch opportunities given that the **United Launch Alliance** and the U.S. national ranges are already straining just to satisfy U.S. government launch demand.

Overall, there are likely to be 10 to 25 satellites that will likely need to find launch capability

between 2009 and 2013, with the higher number resulting from the absence of a Sea Launch option. This potential unmet demand would indicate there is a market to spur Sea Launch's emergence from bankruptcy, or for other launch providers (existing or new) to ramp up activity to take their place. Any calculation on that opportunity must recognize the potential for a cycle back to lower demand for new satellites somewhere around 2012, especially if the general economic situation remains slow and leads to decreased demand for satellite telecommunications services.



**Arianespace Ariane 5 launch**

*In June of this year, Futron Corporation announced the completion of its second annual **Space Competitiveness Index: A Comparative Analysis of How Countries Invest in and Benefit from Space Industry.***

*Futron's 2009 **Space Competitiveness Index (SCI)** provides a structured analysis of the competitiveness of leading space-faring nations, providing further discussion of their respective strengths, weaknesses, opportunities, and threats in space activity. The SCI assesses more than 50 individual metrics across three underlying dimensions of competitiveness: government, human capital, and industry. Using this framework, Futron offers a comparative assessment of 10 leading space participant nations: Brazil, Canada, China, Europe (counted as a single entity), India, Israel, Japan, Russia, South Korea, and the United States.*

*Futron's 2009 **Space Competitiveness Index** finds that while the United States remains the leading space participant, its advantages in all three major dimensions of space competitiveness continue to narrow as other nations invest in space policy, expertise, and infrastructure. European space activity continues to cohere.*

*Russia retains its notable strengths. Asian space powers China, India, and Japan are in close competition with one another, even as they challenge established space leaders. Canada's knowledge base and cooperative approach sustain its competitive position. Finally, newer and smaller participants such as Brazil, Israel, and South Korea maintain their niche*

*roles in space — but even they face displacement by emerging space participants around the globe.*

*To better understand the complex European market, Futron's 2009 **Space Competitiveness Index** features five new mini-profiles of leading European countries and their activities. This enhanced European focus is complemented by an additional new discussion of five emerging space actors: Australia, Singapore, South Africa, and a timely examination of strategic questions surrounding the space programs of Iran and North Korea.*

*The 2009 SCI updates three separate market segments detailed in the 2008 inaugural SCI — Remote Sensing, Military, and Positioning, Navigation, and Timing (PNT) — and includes two additional segment evaluations: Space Exploration, and Technology Readiness and Capability. The Space Exploration segment focuses on global civil space exploration, including deep space missions and other scientific spacecraft. The Technology Readiness and Capability segment offers comparative snapshots of technology levels for several technical clusters considered key, from an engineering perspective, to ensuring effective space capability and functionality.*

*Futron's 2009 SCI is a tool that offers decision-makers a new benchmark to re-assess the competitive landscape of human space activity — and to contemplate its implications for their respective governments, businesses, and organizations.*

*Visit Futron's **Resource Center** to download a copy of the Executive Summary.*

## The 3DTV Experience, Courtesy Of ESA

**T**he European Space Agency is taking a practical step towards a new viewing experience — 3D television (3DTV) at home, delivered by satellite.

Through the agency's **Advanced Research in Telecommunications Systems (ARTES)** programme and the **Stereoscopic Broadcasting** project, ESA is supporting the **OpenSky** and **SkyLogic** companies in providing a 3DTV service to consumers. The 3D televisions and standard reception equipment are being deployed across Europe, at selected sites. Transmission of a continuous 3D channel was initiated on March 12th, via the **Eurobird 9A** satellite. The channel offers a range of programs and material, including sport, a short film and trailers — soon, events filmed in live 3D will be also be added to the channel.

Since the first broadcasts in the 1920s by Scottish engineer *John Logie Baird*, “the first person to produce a live, moving, television image from reflected light,” broadcasting and viewing have constantly improved. In 2008, there were more than 100 million European homes receiving TV programs transmitted by satellites, either via direct reception or through cable distribution systems.

Viewers have enjoyed the arrival of High Definition (HD), surround-sound, as well as widescreen and flatscreen televisions, all aimed at enhancing the user's experience.

Many of these developments were the result of technical advances pioneered in the cinema. This trend continues, with a recent crop of high-quality 3D

productions being released in cinemas, whetting the appetite of the viewing public.

**ESA**, recognizing the importance of assisting in the development of new technologies, is supporting OpenSky and Skylogic in the delivery of 3D television into viewers' homes. The project objectives include...

- **setting up a complete end-to-end chain for satellite 3D TV broadcasting**
- **viable consumer 3D TV products**
- **producing 3D content and delivering 3D events for the on-air pilot trial**
- **setting up reception sites to gather consumer feedback**

Two types of reception sites are being created: one mimics a home environment using longer content, while the other is a public venue with shorter content. A “home site” has been set up at **ESTEC**, ESA's research and technology centre in *Noordwijk*, the Netherlands.

*Marco Sartori*, ESA's technical officer for this project, explains, “3DTV is a step forward from HD by offering an exciting new dimension to home viewing.





**Eurobird-9A satellite**

It benefits from the ability of a satellite HD channel to carry the necessary 3DTV information. This is a first-generation system but, importantly, it is available now, can be installed easily at home and generally provokes a ‘wow!’ from viewers.”

This **ARTES** project has given partners OpenSky and SkyLogic the opportunity to explore the different aspects of running a 3DTV channel, says *Walter Munarini* from OpenSky.

“The first challenges overcome by OpenSky were a proper architecture for delivering the service and the different critical aspects, such as maintaining frame-accurate synchronisation over a long period between the left- and right-eye images,” he explains. “In addition, the project is giving evidence of the content management process that is needed behind the broadcasting in order to provide and play the 3D content properly.”

The perceived quality of 3D content is dependent on more factors than 2D, including resolution, bandwidth and the size and aspect ratio of the screen. “Now, thanks to the ESA ARTES program, we know all these aspects and we can

do it properly,” concludes Mr. *Munarini*. ESA’s **Telecommunications and Integrated Applications** directorate is supporting the development of 3DTV through several ARTES elements.

In the longer term, for example, a study is being conducted under **ARTES I** called **3D@SAT (3D Scalable Multi-View Satcom Services)**, while activities are being proposed in the **ARTES 5** work plan to maximize the data throughput for next generation satellites.

For those with the capability for viewing the 3D channel, **Eurobird-9A** is located at **9 degrees East** (transponder frequency 11 747 MHz, symbol rate 27 500, horizontal polarisation). Videos are transmitted in a modified side-by-side arrangement. To view them properly, a 3D-capable TV and glasses are required.

A collage of images related to Skylogic services. The top row shows a world map, a computer monitor displaying a test pattern, a person operating a control room, and a satellite dish. Below this is a text block describing Skylogic's services. The bottom row features three smaller images: a control room with multiple monitors, a satellite dish in a snowy mountainous landscape, and a close-up of a satellite dish pointing towards the sky.

**Skylogic supplies broadband IP (internet protocol) and TV satellite communication services for small and medium-sized businesses, great industrial conglomerates and the Public Administration.**

The company, based in Turin, is a subsidiary of Eutelsat, a leading worldwide satellite operator marketing capacity on 25 satellites, supplying coverage to over 150 countries, from the Americas to the Pacific, and reaching 90% of world population.

The **Skylogic teleport, SkyPark**, in Turin is the home of one of the largest platforms for bi-directional IP services in the world and is supported by a highly specialised team that controls the whole network, assigning band and ensuring service quality 24 hours a day.

Skylogic satellite networks are interconnected with the fibre optics of the major operators in the sector and spread over Europe, the Mediterranean basin, the Middle East, North Africa and the Americas.

## The MSS Switch to Broadband

In one of its recent newsletters, **Inmarsat** announced a higher-than-expected growth rate in subscriber numbers for its **Fleet Broadband** terminals. This confirms a trend that is already underway in the land-mobile segment and that **NSR** considers the new play in town for the MSS maritime segment: broadband is the name of the game today.

The jump from the narrowband service play to broadband speeds is a trend that is not about to die across all MSS sectors.

As solutions for ships, airplanes, and vehicles point more and more towards faster broadband services, the corollary is higher average revenue per user (ARPU) driven by a host of applications such as file transfers, Internet access, VoIP, and videoconferencing.

### **Inmarsat Leads The Way**

**Inmarsat** stated the Company reached 3,200 active units of its **Fleet Broadband** product in late summer, or a doubling of active units since the end of 2008. The operator's old **Inmarsat-B** and **Mini-M** terminal users are switching to the new IP-based service that uses the latest generation of satellites, the **I4s**. The completion of the new fleet in early 2009 is certainly partly responsible for the gains, but the primary market for Fleet, the merchant marine, has also responded favorably to the new capacity. The reasons behind the uplift are more than just the space segment, however.

Inmarsat's maritime revenues come mostly from shipping or the merchant marine such that they have a good base to work from. They continue to have a need to communicate, and Fleet broadband offers more services that in turn generate higher ARPU for the operator.

Demand for new ships is in freefall. There are no projections, yet, that indicate a sharp upturn. With no program in sight to turn old vessels in for a rebate on a new vessel, operators have to heavily focus on retrofits to entice customers to take the step to their new broadband products. This is especially true for

Inmarsat, which for large merchant marine vessels has a penetration well above 90 percent, generating 74 percent of its maritime revenues in 2008. This set of users already owns communications gear, and legacy terminals can be replaced easily with new units.

Then there are the 'lower-end' broadband customer MSS operators are trying to bring up to higher speeds, luring them away from narrowband offerings where the competition is fierce. The launch of **Fleet Broadband 150** (or **FB-150**) by Inmarsat in mid-2009 ushered in another era for them, targeting the smaller vessel segment where their presence is limited and where users are at a boundary between higher speed requirements and lower cost of equipment. Having used narrowband services for quite a while, many are well within the circle of potential upgrade customers, but not all are necessarily sure that their vessel's crew requires a \$5,000 solution when it is generally satisfied by narrowband equipment already onboard.

### **Iridium Enters the Mix**

Maritime broadband remains a potentially large market and is fostering competition that is proving to be a solid fit for users' choice. As the FB-150 went through beta-testing, Iridium launched its 128 Kbps **OpenPort** maritime products in early summer 2009. Its strongest growth in the past year having been in the maritime segment, with crews still calling home, **Iridium** made good use of its network architecture flexibility to deploy a much better solution for today's seafarer needs.

Soon after, its main dealer — **Globe Wireless** — announced a trade-in program aimed squarely at Inmarsat users by offering customers a free Iridium OpenPort terminal if they deactivated their Inmarsat **Fleet 33** terminal by the end of September 2009. The distributor started a similar deal a few weeks prior to that, squarely aimed at Inmarsat mini-M terminal users. These two trade-in programs imitate the Iridium trade-in program for the **Globalstar** satellite phones and show how operators are planting seeds in the minds of customers to switch allegiances in a strategy aimed at grabbing as many users as possible from the competition.

But these types of subsidies to help users switch from one brand to another, or to move up in terms of

product class, are part of the play that MSS operators have to consider when capital outlay is a big question mark for customers. For example, **Stratos Global** went in this direction with Inmarsat when in June 2009 it announced its program for BGAN and Fleet Broadband. The promotion for first-time users offered them multi-year service contracts in exchange for a FleetBroadband terminal at the end of the period. Customers had the onus to switch or adopt broadband connectivity with little or no capital outlay, and it proved to be a solid contributor to the high Fleet Broadband terminal growth. The trend to higher speeds is also behind Globalstar's recent moves, which has started implementing network upgrades to enhance messaging capacity by a factor of 10 for its data service, even if the service remains in the low Kbps.

### **Bottom Line**

However, with all these changes on the horizon, there looms the real menace: a deepening or longer recession that could put a cold stop to the communications revenues from these new products. Various reports peg a threatening 10 to 15 percent of the world's container shipping fleet sitting idle at a time when goods that are sent for the upcoming holiday season should be loaded onto the high seas. MSS operators are also seeing stiff competition from VSAT providers, which are encroaching on the maritime market by offering customers high-speed data services, broadband IP services with lower equipment prices, and flat monthly fees.

In the maritime space, it definitely helps to get new broadband equipment on the upper deck as quickly as possible for the bottom line and sign up customers as they seek higher bits per second rates. The jump in associated revenues is, then, a natural consequence of users' growing traffic patterns as they go from narrowband to broadband.



# Southern Atlantic Opened Up To Broadband

by Nick Fulford

**T**he Southern Atlantic area has, for too long, been the poor relation when it comes to fast, reliable, and cost effective broadband communications. But that's now changing, thanks to a new service provider in the region offering much faster communication.

Satellite based communication is the obvious solution when it comes to communicating at sea. And the Southern Atlantic ocean is one of those areas in the world where the sheer size of the sea makes satellite communications certainly an attractive option as well as, often, the only option. The vast distances involved means radio based contact is often impractical and the distance from land renders cell based communication useless.

However, crews, owners, and passengers on cruise liners, yachts, tankers, ships, and aboard oil and gas platforms, have struggled with the poor rate of available broadband speed. Commercial communication between companies and their vessels is extremely restricted with all the problems this presents. Plus, slow speeds have also created headaches for maritime employers. Crew calling is very restricted when it comes to the use of video and other multi-media methods, being constrained due to the costs and speed of such transmissions. This has led to higher crew rotation rates as sailors have a real problem with a lack of family and friend contact. They, instead, opt to work those routes where keeping in touch isn't as difficult or expensive to enjoy.

Volume crew calling, downloading and uploading large files, using multimedia or even video conferencing has been the exception rather than the rule. Some experts believe the communications gap between the rest of the world and Southern Atlantic has led to this region's development as an increasingly significant maritime route, but with highly restrictive SATCOM capabilities.

Until now, SATCOM providers in the area had been unable to deliver connection speeds with a cost that makes commercial sense. Those high speed connections that have existed have been specialist, top dollar connections for bespoke users. Most users have had to struggle along with a paltry .5 MB connection speed (similar to the speed that most home users suffered with more than ten years ago.) Catching up with an increasingly connected world has to be a top priority for those with a vested interest in the maritime industry.

Sea farers should welcome the announcement by satellite communication provider **NSSL Ltd.** and **Telemar Scandinavia** that — thanks to the launch of the new **TII** satellite — a new and substantially quicker 4 MB connection is now available across the Southern Atlantic (and into Southern African territories, as well.)

Product Perspective

NSSL is known for its work in providing advice, equipment, and service contracts to a wide variety of mining, oil, media, military, maritime and governmental organizations. They recently made headlines when the Company was elevated to the status of being a *Tier 1 Distribution Partner* of **Inmarsat** which, in addition to their Tier 1 relationship with **Thuraya** and the operation of their own DVB-S2 network, means NSSL offers a wide range of mobile and fixed communications services. NSSL is one of the few satellite companies that can claim a long history, having launched in the 1960s. In fact, 2009 marks the Company's 40th anniversary.

*Danielle Edwards*, Product Manager at NSSL, said: "Increasingly, people crossing the Southern Atlantic need instant communications wherever they find themselves. But, previously, the slow rate of connection and limited choice of bandwidth has made fast and reliable communication a scarce resource.

"NSSL, as a new provider in the region, is now offering organizations that operate across the Southern Atlantic a fast 4 MB connection that will help them to keep in touch. We have plans to keep increasing this speed as, and when, its technically possible. We note that while a lot of competitors advertise that they are going to increase their connection speed in the 'future,' NSSL is the only broadband provider that already has the service up and running already.

"And, we are not only offering the market greater speed, but also greater choice. We act as a convenient one-stop-shop for all SATCOM needs. Organizations can now use NSSL for all their voice, data and broadband communication requirements. NSSL provides upfront consultancy on the most suitable equipment, and can then provide that equipment from a broad selection of different types and models. NSSL then manages the service contract and provides ongoing maintenance support. We will be offering a wide range of communication services to this exciting market. We believe the opportunity is huge. In just the first month of trial operations we had dozens of enquiries from vessels keen to get connected."

The new service is already up and running and is starting to attract positive feedback. *Robert Bell*, First Officer of the world's leading super sailing yacht 'The Maltese Falcon,' outlined the benefits, "The guests were exceptionally happy when we were able to provide

them with a fast internet connection in the Atlantic. Real time email is very important for our owner and guests; the crew were also over the moon when skype worked in the Atlantic!"

The new NSSL coverage area extends across the Southern Atlantic Ocean and Southern Africa. The extension of this coverage zone is due to NSSL's support for the DVBS2 network and its ongoing partnership with Telemar Scandinavia. As part of the previous *Nera Regional Support Network*, the two companies provided mutual support for maritime customers in different ports. Both firms also have a long history of developing and supporting DVB-RCS services into their respective land and maritime markets.

The partnership for DVBS2-RCS started in early 2008 when Telemar was searching for a global maritime commercial Ku-band solution and approached NSSL, who was already covering the Caribbean, U.S., Mediterranean and Pacific regions.

NSSL and Telemar begin working together with the goal of quickly launching a global maritime solution that could be realized far faster than if both parties developed such services separately. Initially DVBS2-RCS services covered the Middle East and Northern Europe — that was in August of 2008. Both parties also agreed Telemar would install a new Land Earth Station to service the Indian Ocean Region, and NSSL would support coverage in the Atlantic, South Africa, and South America, from its US .HUB.

*Sally-Anne Ray*, Sales Director, NSSL, says: "We are committed to extending the reach of our service for the simple reason that it is what our customers demand. We are constantly investing in new service enhancements and coverage areas. We believe that the new DVBS2-RCS standard is the future 'best of breed' for broadband services."

For the maritime industry, maintaining communications while at sea is important for commercial, personal, and often safety reasons. Fast communications with cost similar to those when crossing other oceans is essential to creating a more level playing field upon which the maritime industry can compete and communicate in the interconnected global economy.



# Anatomy Of A Mission: LRO/LCROSS

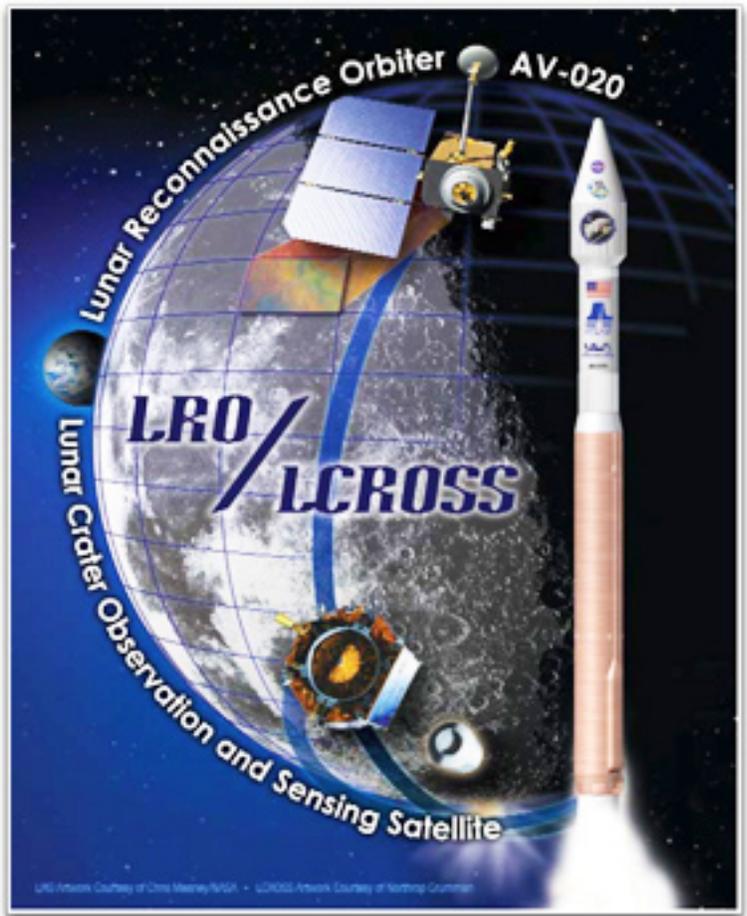
## Insight

**A**t 5:32 p.m. EDT, on June 18, 2009, an United Launch Alliance Atlas V rocket roared off the launch pad at Launch Complex 41 to begin the Lunar Reconnaissance Orbiter and Lunar Crater Observation and Sensing Satellite missions to the moon. The LRO and LCROSS spacecraft were tucked inside the payload fairing at the top of the rocket to protect them from atmospheric heating as the rocket climbed through the atmosphere toward space. The fairing separated as planned, and the LRO pushed away from LCROSS and the Centaur stage was on its way to its orbit around the moon. The LRO/LCROSS mission marks the 16th Atlas V launch and the seventh flight of an Atlas V 401 configuration.

**LRO/LCROSS** is a dual-spacecraft (SC) launch. **LRO** is a lunar orbiter that will investigate resources, landing sites, and the lunar radiation environment in preparation for future human missions to the Moon. **LCROSS** will search for the presence of water ice that may exist on the permanently shadowed floors of lunar polar craters. The LCROSS mission will use two **Lunar Kinetic Impactors**, the inert **Centaur** upper stage and the LCROSS SC itself, to produce debris plumes that may reveal the presence of water ice under spectroscopic analysis.

### LRO Overview

LRO is the first mission in NASA's planned return to the Moon (now somewhat delayed, thanks to government funding issues). LRO's objectives include finding safe landing sites, locating potential resources, characterizing the lunar radiation environment, and testing new technologies. LRO's mission to the Moon will enable scientific activities that address fundamental questions about the history of Earth, the solar system, and the universe at large. The LRO mission will allow NASA to test technologies, systems, and flight operation and exploration techniques. These new flight operation and exploration techniques are designed to reduce risk and increase the productivity of future missions to the Moon, Mars, and beyond. LRO will also help to expand





## Atlas V Launch History



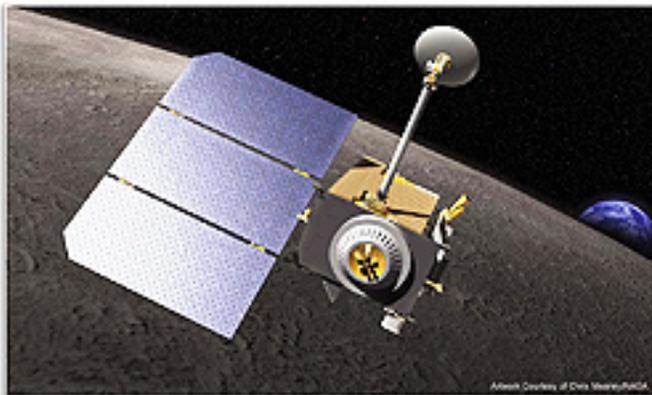
Flight	Config.	Mission	Mission Date
AV-001	401	Eutelsat Hotbird 6	21 Aug 2002
AV-002	401	HellasSat	13 May 2003
AV-003	521	Rainbow 1	17 Jul 2003
AV-005	521	AMC-16	17 Dec 2004
AV-004	431	Inmarsat 4-F1	11 Mar 2005
AV-007	401	Mars Reconnaissance Orbiter	12 Aug 2005
AV-010	551	Pluto New Horizons	19 Jan 2006
AV-008	411	Astra 1KR	20 Apr 2006
AV-013	401	STP-1	08 Mar 2007
AV-009	401	NROL-30	15 Jun 2007
AV-011	421	WGS SV-1	10 Oct 2007
AV-015	401	NROL-24	10 Dec 2007
AV-006	411	NROL-28	13 Mar 2008
AV-014	421	ICO G1	14 Apr 2008
AV-016	421	WGS-2	03 Apr 2009



Earth's economic sphere, enabling NASA to conduct lunar activities with benefits to life on Earth.

A variety of scientific instruments will be used to accomplish these objectives. The **Cosmic Ray Telescope for the Effects of Radiation (CRATER)** will acquire data allowing NASA

to characterize the lunar radiation environment, determine the scope of potential impacts to astronauts and other forms of life, test models of the effects of radiation, and measure radiation absorption by a plastic material similar to human tissue. The results will aid in the development of protective equipment for future lunar explorers.



**LRO satellite - artwork courtesy of Chris Meaney, NASA**



**LCROSS + Centaur stage. Artwork courtesy of Northrop Grumman**

The **Diviner Lunar Radiometer Experiment (DLRE)** will measure surface and subsurface temperatures from orbit and identify cold traps, potential ice deposits, rough terrain, and other landing hazards.

The **Lyman-Alpha Mapping Project (LAMP)** will map the entire lunar surface in the far-ultraviolet spectrum and provide images of permanently shadowed regions illuminated only by starlight. This far-ultraviolet map will aid in the search for surface ice and frost in the polar regions.

The **Lunar Exploration Neutron Detector (LEND)** will create high-resolution maps of hydrogen distribution and gather information about the neutron component of lunar radiation. Its data will be analyzed for evidence of water ice near the Moon's surface.

The **Lunar Orbiter Laser Altimeter (LOLA)** will measure landing site slopes and lunar surface roughness and generate high-resolution, 3D maps of the Moon. The instrument also will measure and analyze the lunar topography to identify both permanently illuminated and shadowed areas.

The **Lunar Reconnaissance Orbiter Camera (LROC)** will take high-resolution, black-and-white, color, and ultraviolet images of the lunar surface, capturing images of the lunar poles with resolutions down to one meter. These images will provide knowledge of polar illumination conditions, identify potential resources and hazards, and enable safe landing site selection.

The **Mini-Radio Frequency (RF)** technology demo's primary goal is to search for subsurface water ice deposits and take high-resolution images of permanently shadowed regions.

## LCROSS Overview

In 1999, NASA's Lunar Prospector detected concentrated hydrogen signatures in permanently shadowed craters at the lunar poles. These readings may indicate lunar water, which has far-reaching implications for human exploration beyond low-Earth orbit. The LCROSS mission seeks a definitive answer.

LCROSS is a low-cost, fast-track companion mission to the LRO mission. Its main objective is to confirm

the presence or absence of water ice in a permanently shadowed crater near a lunar polar region.

After the launch, the LCROSS shepherded SC and the Atlas V's Centaur upper stage executed a fly-by of the Moon and entered an elongated Earth orbit to position LCROSS for impact on a lunar pole. On final approach, the shepherding SC and Centaur will separate. The Centaur will act as a heavy impactor to create a debris plume that will rise above the lunar surface. Following four minutes behind, the shepherding LCROSS SC will fly through the debris plume, collecting and relaying data back to Earth before itself impacting the lunar surface and creating a second debris plume. Both debris plumes should be visible to the LRO and to Earth- and space-based telescopes with 10- to 12-inch apertures and larger.

LCROSS's science payload consists of two near-infrared spectrometers; a visible-light spectrometer; two mid- and two near-infrared cameras; a visible-light camera; and a visible-light radiometer. These instruments will provide mission scientists with multiple measurements and analyses of the debris plume created by the Centaur impact.

As ejecta rises above the target crater's rim and is exposed to sunlight, any water ice, hydrocarbons, or organic material will vaporize and break down into its basic components. These components will be monitored primarily by the visible and infrared spectrometers. The near- and mid-infrared cameras will determine the total amount and distribution of water in the debris plume. The SC's visible-light camera will track the impact location and the behavior of the debris plume, while the visible radiometer will measure the flash created by the Centaur impact.

The **Atlas V 401** configuration consists of a single Atlas V booster stage and the Centaur upper stage. The Atlas V booster and Centaur are connected by the conical and short *interstage adapters (ISAs)*. The Atlas V booster is 12.5 ft in diameter and 106.5 ft long. The booster's tanks are structurally rigid and constructed of isogrid aluminum barrels, spun-formed aluminum domes, and intertank skirts. Atlas booster propulsion is provided by the RD-180 engine system (a single engine with two thrust chambers). The RD-180 burns RP-1 (Rocket Propellant-1 —

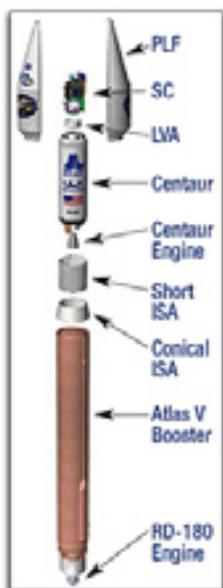
highly purified kerosene) and liquid oxygen; and delivers 860,200 lb of thrust at sea level. The Atlas V booster is controlled by the Centaur avionic's system which provides guidance, flight control, and vehicle sequencing functions during the booster and Centaur phases of flight. The boost phase of flight ends 6 seconds after propellant-depletion-commanded booster engine cutoff (BECO), when the separation charge attached to the forward ISA is fired and eight retrorockets push the spent Atlas booster stage away from the Centaur upper stage.

The Centaur upper stage is 10 ft in diameter and 41.5 ft long. Its propellant tanks are constructed of pressure-stabilized, corrosion-resistant stainless steel. Centaur is a liquid hydrogen/liquid oxygen-(cryogenic) fueled vehicle. It uses a single RL10A-4-2 engine that produces 22,300 lb of thrust. The cryogenic tanks are insulated with a combination of helium-purged insulation blankets, radiation shields, and closed-cell polyvinyl chloride (PVC) insulation.

The *Centaur forward adapter (CFA)* provides the structural mountings for vehicle electronics and the structural and electronic interfaces with the SC. The LRO LCROSS mission uses the 4 m- (14 ft-) diameter large payload fairing (PLF). The PLF is a bisector (two-piece shell) fairing consisting of aluminum skin/stringer construction with vertical split-line longerons. The vehicle's height with the PLF is approximately 189 ft.

### **Mission Overview**

The LRO/LCROSS mission flew from **Space Launch Complex-41** at **Cape Canaveral Air Force Station** on an Atlas V401 configuration vehicle (tail number AV-020) with a single-engine Centaur. The payload was encapsulated in a 4-m diameter large PLF and integrated to the Centaur upper stage using two modified C22 payload adapters (PLAs) and a ULA-provided spacecraft launch vehicle adapter (SCLVA), separation system, and electrical harness.



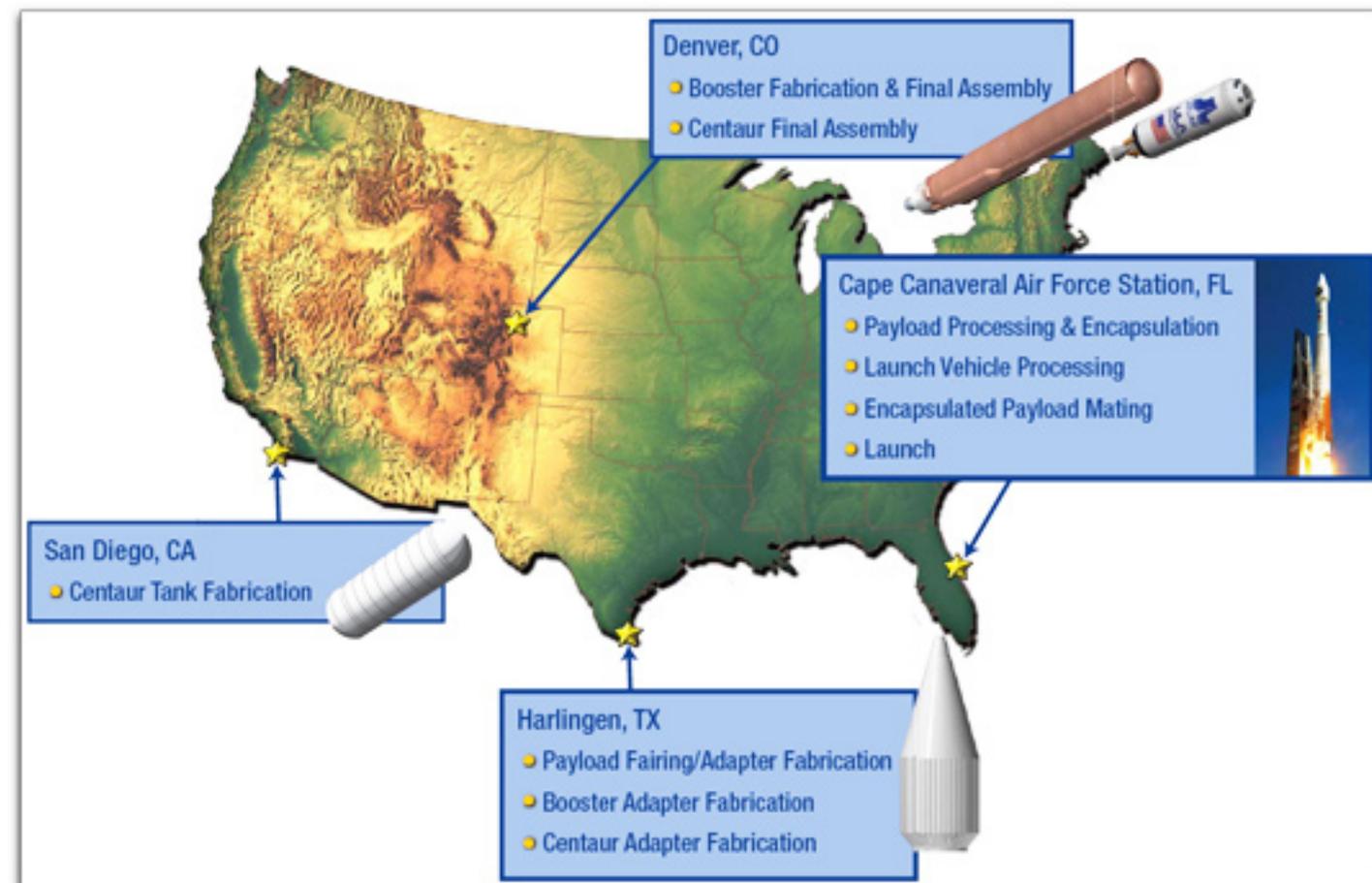
AV-20 configuration diagram

The LRO/LCROSS payload consists of two lunar exploration satellites. The mission will fly an easterly trajectory from SLC-41. The first SC separation event released the LRO spacecraft into a lunar direct-insertion trajectory, which reached the Moon approximately four days after launch. At the Moon, LRO's on-board propulsion will first insert LRO into an elliptical "commissioning" orbit from which it will move into its final orbit, a circular polar orbit approximately 50 km (a little over 30 miles) above the Moon's surface.

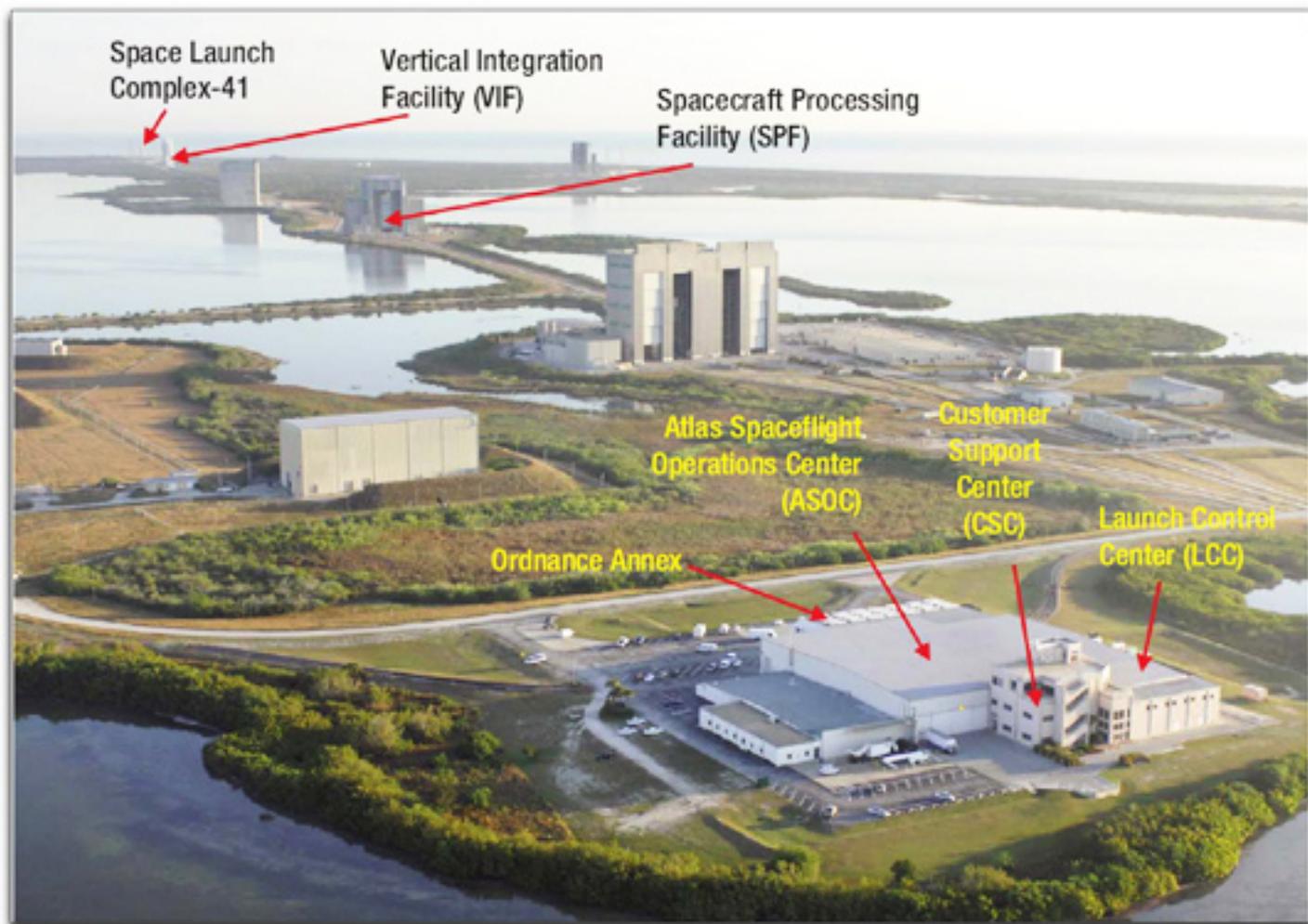
LCROSS will remain attached to the inert Centaur and shepherd it to the Moon using its own on-orbit resources. Passing the Moon, LCROSS/Centaur's orbit will change to an approximately 38-day geocentric elliptical polar configuration (36 to 40 days, depending on mission-specific guidance). LCROSS will guide Centaur through two to four Earth orbits (depending on the choice of a north- or south-polar impact site), direct Centaur to impact, and separate from Centaur. LCROSS and Centaur will then impact in permanently shadowed craters at approximately 2.5 km/s, with LCROSS passing through Centaur's debris cloud before impact.

Launch began with **RD-180** engine ignition, approximately 2.7 seconds before liftoff (T-2.7 seconds). Liftoff occurred at T+1.1 second, after telemetry indication of healthy RD-180 startup. Shortly after the vehicle cleared the pad, it performed its pitch/yaw/roll program. Maximum dynamic pressure occurred at approximately 91 seconds. BECO occurred at approximately 243 seconds, based on booster fuel or LO2 depletion detection.

Telemetry data is gathered by **TEL-4** (Merritt Island, FL), **Jonathan Dickinson Missile Tracking Annex** (JDMTA-Jupiter, FL), Antigua, and Guam tracking stations. The **TDRSS** constellation also participated in gathering telemetry during the LRO/LCROSS mission.



Atlas Processing Overview, diagram courtesy of ULA



*Launch site overview, photo courtesy of ULA*

Centaur separation was 6 seconds after BECO. The first Centaur main engine start (**MESI**) occurred 10 seconds after the separation event. Payload fairing jettison took place at 8 seconds after MESI. At approximately 14 minutes into the mission, main engine cutoff 1 (MECO1) occurred and Centaur achieved its parking orbit.

After reaching the guidance-determined optimum position for injection, Centaur reoriented itself for MES2. The second Centaur engine burn lasts a little less than 5 minutes, at which point the second Centaur main engine cutoff number two (**MECO2**) occurs. After MECO2, Centaur reorients its attitude for the LRO separation event.

The LRO SC separated about 2.8 minutes after MECO2. Following LRO separation, Centaur maneuvered into the LCROSS transit orbit. This maneuver uses directed impulse from blowdown of the main propellant system, followed by a guidance

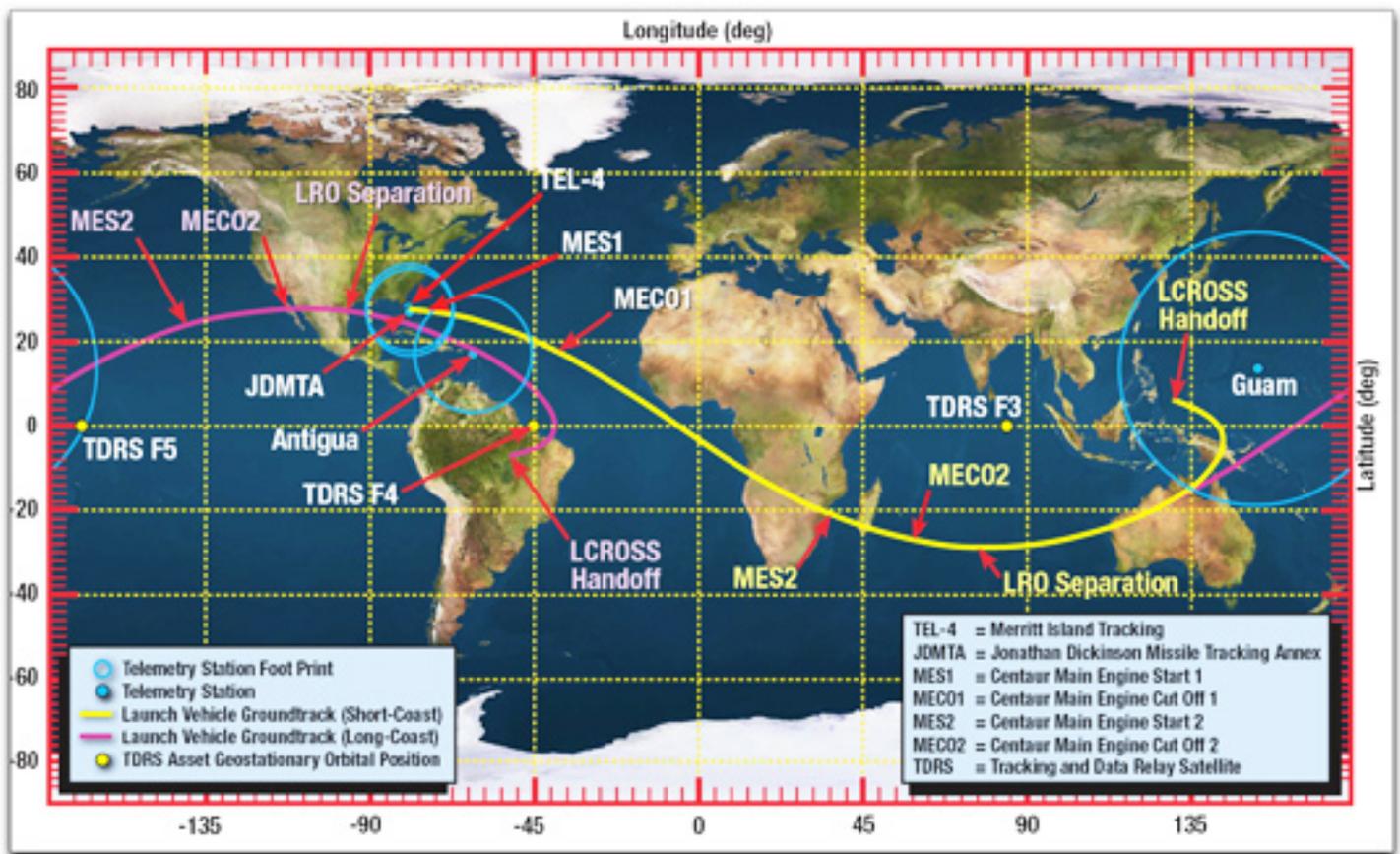
determined maneuver using the *Reaction Control System's* hydrazine-powered settling motors.

Following the transitorbit- injection maneuver, remaining propellants were blowdown before handing off guidance to the LCROSS SC.

### **LRO Update**

As of September 17th, LRO had successfully completed its testing and calibration phase and had entered its mapping orbit of the moon. The spacecraft already has made significant progress toward creating the most detailed atlas of the moon's south pole to date.

During the next year, LRO will produce a complete map of the lunar surface in unprecedented detail, search for resources and safe landing sites for human explorers, and measure lunar temperatures and radiation levels. The south pole of the moon



**Mission ground trace, diagram courtesy of ULA**

is of great interest to explorers because potential resources such as water ice or hydrogen may exist there. Permanently shadowed polar craters that are bitterly cold at their bottoms may hold deposits of water ice or hydrogen from comet impacts or the solar wind. The deposits may have accumulated in these “cold-trap” regions over billions of years. If enough of these resources exist to make mining practical, future long-term human missions to the moon potentially could save the considerable expense of hauling water from Earth.

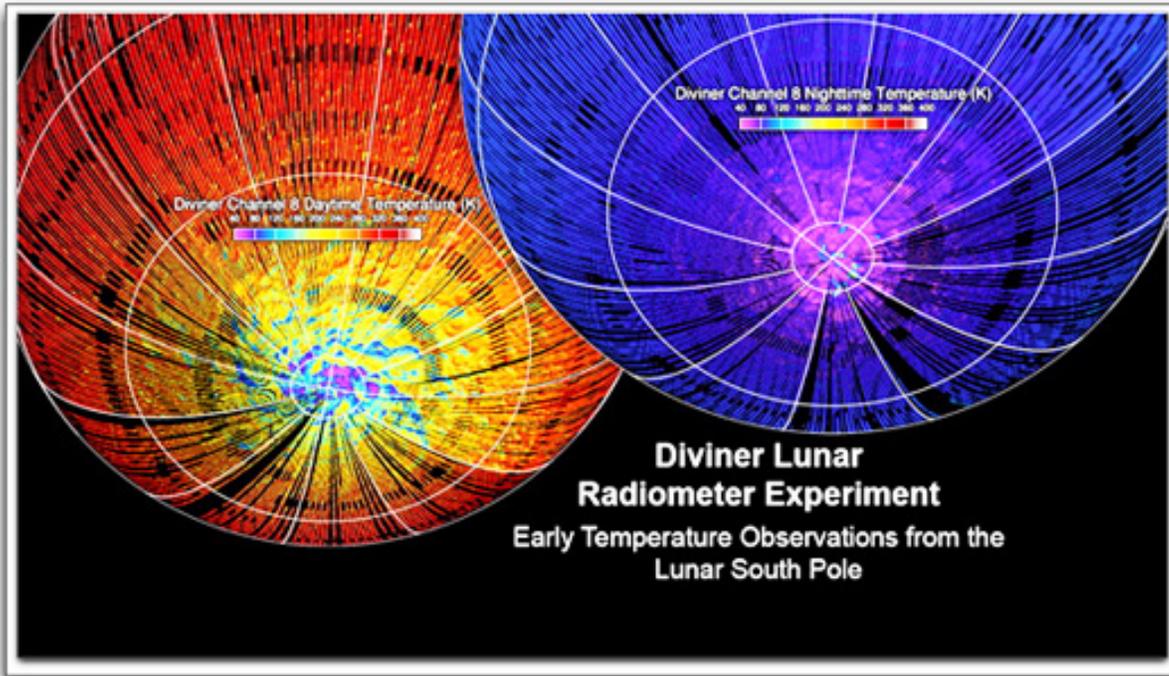
### **LRO NASA Diviner Experiment**

First results from LRO’s **Lunar Exploration Neutron Detector**, or **LEND**, indicate that permanently shadowed and nearby regions may harbor water and hydrogen. Additional observations will be needed to confirm this. LEND relies on a decrease in neutron radiation from the lunar surface to indicate the presence of water or hydrogen.

Data from LRO’s **Lunar Orbiter Laser Altimeter**, or **LOLA**, however, indicates that exploring these areas will be challenging, as the terrain is quite rough. The roughness is probably a result of the lack of atmosphere and absence of erosion from wind or water, according to *David Smith*, LOLA principal investigator at **Goddard**. LRO’s other instruments also are providing data to help map the moon’s terrain and resources. According to the first measurements from the Diviner instrument (image above), large areas in the permanently shadowed craters are about minus 400 degrees Fahrenheit (33 Kelvin), more than cold enough to store water ice or hydrogen for billions of years. The Lunar Reconnaissance Orbiter Camera is providing high resolution images of permanently shadowed regions while lighting conditions change as the moon’s south pole enters lunar summer.

### **LRO NASA LAMP Experiment**

LRO’s **Lyman Alpha Mapping Project**, or **LAMP**, also is preparing to search for surface ice and frost in the polar regions. The instrument provides images of permanently shadowed regions illuminated only by



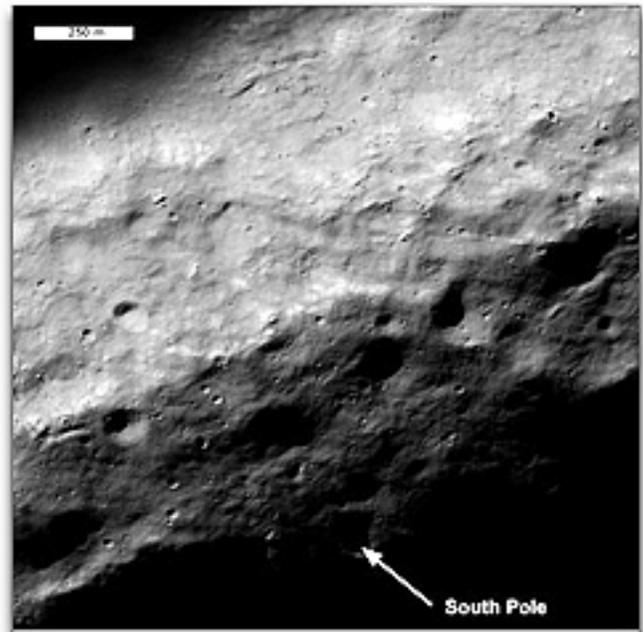
starlight and the glow of interplanetary hydrogen emission. LAMP has provided information to confirm the instrument is working well on the lunar night and day sides.

The **Mini RF Technology Demonstration** on LRO has confirmed communications capability and produced detailed radar images of potential targets for LRO's companion mission, the **Lunar Crater Observation and Sensing Satellite**, which will impact the moon's south pole on **October 9th**. Meanwhile, LRO's **Cosmic Ray Telescope** for the *Effects of Radiation* instrument is exploring the lunar radiation environment and its potential effects on humans during record high, "worst-case" cosmic ray intensities accompanying the extreme solar minimum conditions of this solar cycle.

Goddard built and manages LRO, a NASA mission with international participation from the Institute for Space Research in Moscow. Russia provides the neutron detector aboard the spacecraft. 

*Editor's Note:*

*Our thanks to United Launch Alliance for the content of this informative article, as well as to NASA for the latest information regarding LRO/LCROSS.*



***During the LRO Commissioning Phase, the high-resolution Lunar Reconnaissance Orbiter Camera (LROC) captured this 1-m pixel scale (angular resolution) two-image mosaic of the lunar south pole, which is located on the rim of the 19-km diameter Shackleton crater. The Lunar Reconnaissance Orbiter Camera was built by Malin Space Science Systems in San Diego, California, and is operated from the LROC Science Operations Center, part of the School of Earth and Space Exploration at Arizona State University in Tempe, Arizona.***

## Chronicles Of SATCOM: World Traveler

**D**uring my early years in SATCOM, I often became restless being another cow in the herd of night-shift bench techs spending my nights following mundane tuning procedures or scanning countless PCBs for solder-bridges and incorrectly oriented components, all the while wishing I was out partying with the rest of my generation. To call it a “structured environment” would be an understatement, as everyone on the production floor was expected to function in unison — like a mass of symbiotic organisms sharing the same vital organs and controlled by a loud, screeching buzzer that paved the only sanctioned exit from my assigned duty station.

Hearing that irritating screech announcing the beginning of my ritual 10 minute reprieve from the night’s mind-numbing duties, I would head for the break room and congregate with the other techs around powdered donuts and sticky-buns (way back when my metabolic-rate allowed such luxury), where we would collectively plan our escape from this insidious existence. I can still remember gazing starry-eyed over the proverbial fence — the greener grass beckoning me to leave the shackles of SATCOM and join the quest for the golden ring — a new existence laden with a clear path to fame and fortune, or at least an office with a window.

Then one night it happened — there it was on our internal job-post bulletin board, displayed seductively over the drinking fountain. “Field Engineer needed for International SATCOM Division – *requires extensive world travel.*” My juices immediately began to flow as my brain constructed a fantasy comprised of exotic ports-of-call and a whole new set of experiences that were hardly visible from the confines of my tiny cubicle and hamster-wheel ruled life.

Fortunately for me, my technical experience was supplemented with years of service in various blue-collar trades, the combination of which positioned me well to become an Earth station installer, a global mercenary — a rookie member of an elite society of field-hardened nomads with the elemental resilience of *Rambo* and ingenuity of *MacGyver*. So I tossed my tweaker and embarked on an adventure into a new world.

Unlike today, international travel in the 80’s was much easier and a bit more respectful. Though carrying weapons and incendiary devices onto a plane was certainly frowned upon, it was unlikely you would be groped or tackled for possessing such sinister items as toothpaste or bottled water. Come to think of it, back then, I don’t think they put water in bottles.

As I hadn’t traveled much outside of the southeastern U.S., it’s fair to say that my knowledge of international culture and protocol was slightly less than mature. But here I was — heading out to make my mark on the world, armed with a new mission, an impassioned spirit, a sense of adventure and that all important corporate credit card — ready to tackle whatever trials and tribulations were tossed my way.

The years that followed led me to countless locations abroad — Asia, Latin America, Middle East, Europe, Africa and the untamed wilderness of Alaska. Due to the nature of SATCOM and



**Author Tony Radford planning another trip**

its irresistible appeal to under-developed geographic regions, many of my destinations were of the sort that failed to make travel magazines' list of top vacation spots.

Though ripe with adventuresome appeal, there were, of course, the pitfalls that shadow trips to locations far from the reaches of five-star hotels and void of tourist glamour — those remote locations where ingestion of the local cuisine should only commence after close scrutiny and the following of a few simple, though unwritten, rules.

On the other hand, *Jenny Craig* couldn't touch Montezuma's revenge when it comes to rapid weight loss. Of course, you can send Jenny away when you've had enough, but giving Montezuma the boot requires nothing short of a gastronomical exorcism. And "Lord help me" if someone occupies the isle seat between me and the plastic throne of relief.

Ah, but every foreign excursion ends with an eventual homecoming and one last hurdle — to traverse U.S. Immigration.

My local airport is home to a pair of beagles, four-legged members of the *Homeland Security Team* that includes *Linus* — trained to detect illegally imported food items, and *Remi*, who searches for large amounts of undeclared currency. Both of these intrepid, four-legged sniffers could be seen regularly in the international baggage claim area, dragging their human assistants around

the carousels, winding and weaving through the bags of returning travelers in search of contraband.

On one of my trips abroad, I became addicted to delicious praline-covered peanuts I purchased from a foreign market. I mean, really addicted! My desire was to continue to support my addiction, or at least to delay a cold turkey withdrawal until such was unavoidable,

I packed a couple of pounds in my carry-on bag. After sailing through passport control, I proceeded



to baggage claim and waited for my checked bag to appear. Through the corner of my eye, I could see a tail wagging above the sea of suitcases piled about the floor. Oh no! *Linus*! My heart raced as I watched each bag on the carousel pass before me, praying that mine would appear and allow me to exit before being discovered carrying illegal booty and herded down the dreaded “red line.” The passing minutes seemed like hours as *Linus* headed my way. In my brain I could hear *Glen Fry* singing lyrics from “Smuggler’s Blues”.



**The Great Wall of China — sans tourists or the well-meaning Radford...**



**How can this be the Lost City of Petra if Tony found it??**

Fortunately, and as luck would have it, a curious aroma seeping from the bag of a Colombian tourist sent *Linus* into a drooling frenzy, causing the distraction I needed to escape the scene.

On a serious note (and I’ll try to keep such to a minimum), many of the places I visited could claim some intrinsic beauty. Whether it be cultural, geographic, or historic, something worth seeing or doing was typically within reach of the visiting traveler once the mission was completed. From the **Great Wall of China** to Jordan’s **Lost City of Petra**, spectacular experiences provided contrast to Montezuma’s intestinal wrath.

Other locations, seemingly unable to support human life, also dot our vast planet — and most have an earth station standing like a shrine to the testament of past sacrifices made by one or more of my fellow travelers.

In closing, some words of wisdom from the world traveler taken directly from the *Chronicles* — always ask the price, never leave your drink unattended and you can gargle with the tap water, but **DON’T SWALLOW IT!**

More Radford ruminations [at this link](#).



## A Potent Pacific Presence

It's no longer just about connecting to the rest of the world it's also about how fast, where and at what cost you can do it. One company that wants to keep you competitive and up to speed anywhere and at any time is Pactel International.

**Pactel International** is the premier satellite Internet and voice provider in the Pacific region. The Company provides satellite Internet trunks, VSAT solutions; TOIP services and other associated value add products to telecommunication carriers, governments, NGOs, and corporates across the Pacific region.

In a time when many companies have been forced to cut back on investment, Pactel International is moving from strength to strength. They remain focussed on their long term strategy to advance their global presence while continuing to maintain a strong focus on the Pacific islands.

Pactel International (formerly *Pacific Teleports*) was founded in July 2003 by *Andrew Taylor* and *Steffen Holz*. Between them, they have more than 40 years experience in the satellite and telecommunications industry. *Andrew's* career experience includes tenure in senior commercial and engineering roles at **PanAmSat**, **Comsyst**, **Optus** and **Telstra**. *Steffen* embarked on his career in satellite communications with **AntenneCal** based in Noumea. In 2000, he became the founder and director of **Pacific IP Services** in New Caledonia, which in turn was merged into Pacific Teleports.

The company's' original objective was to provide satellite Internet services to the Pacific Islands, which were initiated with the Company's first link, a 4/2Mbps trunk on the **Intelsat 701** satellite. The business grew steadily from that point on, as companies and carriers started contracting with Pactel International's IP services. In June of 2004, *Telephony over IP (TOIP)* was delivered as a service. From the first voice connection, the network rapidly grew to its current membership of more than 20 carrier interconnects.

In 2007 Pacific Teleports merged operations with the New Caledonia-based Pacific IP Services, Pactel International continues to deliver innovative, forward thinking, and flexible telecommunication solutions. Working closely with clients, the Company applies a very hands-on approach during all design, implementation, and delivery of all projects to clients.

In addition, Pactel prides itself on its ability to understand customers' unique connectivity requirements, providing bespoke solutions guaranteed to meet individual needs and budgets.

Product Perspective



From point to point links to fully managed networks, the firm ensures high quality solutions and service at highly competitive rates. What sets Pactel apart is its expertise in using satellite based technologies to provide telecommunications solutions at these appealing rates. With the corporate office in Sydney, Australia, and a regional office in Noumea, New Caledonia, Pactel International offers support to customers within similar time zones.

### **Coming Up...**

As the market moves into 2010, mobile telephony is expected to continue to outpace fixed-line connections growth. **Pactel Mobile** (Part of Pactel International) intends to take full advantage of this market by continuing the roll out of its mobile system throughout the South Pacific.

Recently, Pactel Mobile was appointed by **Tuvalu Telecom Corporation** to install a replacement mobile phone network to operate on the main Island of Funafuti. The existing network was damaged by a storm, leaving the Island's customers without mobile phone coverage. Pactel will install a 2.5G mobile network system, which will allow prepaid customers to access normal mobile services at extremely reasonable rates.

## **Pactel International Partners**



*In 1964, Intelsat established the first commercial global SATCOM system, enabling people, businesses and governments to communicate instantly, reliably, and simultaneously from all corners of the globe.*



*SES-Newskies has designed and implemented one of the world's most advanced and far-reaching commercial SATCOM global networks, broadcasting TV programming, Internet content and critical data.*



*Shiron's 2-way broadband SATCOM system, InterSKY, provides fast and efficient Internet, Interactive Multimedia and IP applications. Innovative and cost-effective, InterSKY brings high-quality broadband IP access to even the remotest of locations.*



*APT SATELLITE HOLDINGS LIMITED ("APT Group") is a listed company on The Stock Exchange of Hong Kong Limited and NYSE. Starting in 1992, APT Group has been providing high quality transponder, SATCOM and satTV broadcasting service to operators in Asia-Pacific, Europe, and the United States.*



*SAT-GE, a subsidiary of GE, provides satellite capacity on GE-23 (former name AMC-23) across the Pacific basin, encompassing 6 individual beams, 5 Ku-band and 1 C-band, offering almost total coverage of land mass and ocean in the Pacific region; from Perth in Australia to Los Angeles in the U.S. and from Alaska to South New Zealand.*



*ConceroTel has been created by Pacific Teleports to expand our satellite and ToIP services and support to the local telecommunications providers in the African / Indian Ocean region.*

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The Pactel Mobile system is an effective gap filler that allows a low cost network to be rolled out in markets such as Tuvalu where the total population is about 12,000 in number. Current technologies do not make commercial sense in markets of this size — this gives Pactel the edge. In the past, the costs of mobile equipment would have prevented such a service rollout.

Less than half of all Pacific Islanders have a phone, and generally only one supplier for any particular fixed, mobile, or Internet service. Pactel can provide a system to equip existing carriers in the Islands to be better prepared for the onset of competition without putting a strain on capital expenditure budgets.

Pactel intends to continue to partner with like minded companies, (e.g., **Shiron, SES New Skies, Intelsat**) delivering high speed bandwidth throughout the Pacific region, including vessels at sea.

For the Company's satellite IP solution, their services are available on several satellites including, **Intelsat 602, NSS-9, Intelsat 701, IS-8, IS-2, Apstar-6** and **GE-23**. With this diversity of satellites, coverage and frequency bands, a solution for most Pacific ops can be customized for any need.

Pactel and partner systems will ensure additional competitive solutions for rural, remote, and maritime markets, where prices are increasing due to the scarcity of satellite capacity. Pactel's plans are quite simple — to grow from being the premiere satellite Internet provider in the Pacific to a true, global presence.



# Forrester's Focus—Showtime + Orbit: Will It Work?

by Chris Forrester

**R**egular readers will know we've kept a close eye on the fascinating Middle East market for years. We've watched the region explode in terms of the number of FTA channels being offered topping 500, and perhaps more importantly, the top dozen or so channels have significantly raised their broadcasting game. Content quality is now high, and this proves that competition raises everyone's game.

The region's three main pay-TV platforms have suffered at the strength of these FTA viewing options. If there are free sports channels, free movie channels, free documentary and kids channels, then one might validly ask why viewers need to pay for programming? And this seems to be the case. **Orbit** has long since dropped claiming its notorious "400,000 viewing points" nonsense, although the generally accepted position is that Orbit and **Showtime's** subscriber numbers (including wholesale connections via suppliers like **Du** and **E-Vision**) are no more than 200,000 for each operator — and perhaps much fewer.

The market leader in Mid-East pay TV is **Arab Radio & Television (ART)**, the company founded by Sheikh *Salah Kamel* in the mid-1990's. ART might well have the top position in terms of subs numbers, but this is no guarantee that it is making meaningful profits. Not that profits need matter. Well-heeled investors, who seem staggeringly relaxed about losses that must, by now, be measured in the billions, fund all three operations. Everyone, including the pay-TV operators themselves, have each, at one time or another, agreed that consolidation would be the sensible route to follow — but until now, they have ignored their own advice.

The July 12th announced merger between Showtime and Orbit is undoubtedly good news for the operators themselves and viewers. The combined business will offer around 70 exclusive channels, and will, no doubt, start achieving the economies of scale that will help drive profitability. *Marc-Antoine d'Halluin*, currently running Showtime, is the new company's CEO. The announcement is of an "equal partnership"



*Cairo dish heaven*

between Orbit, until now a wholly-owned subsidiary of the Saudi Arabia-based **Mawarid Group**, and **Showtime Arabia/Gulf-DTH**, which was owned by Kuwait's **KIPCO** and **Viacom**.

The merger of these two competing pay-TV platforms is partly aimed at addressing the fragmentation of the region's pay-TV sector, which has "not helped the consumer to make his mind up," according to *Samir Abdulhadi*, president and CEO of Orbit Group. A by-product is that the platforms are also likely to see "tens of millions of dollars" in synergies.

Orbit started transmitting in 1994 and was the first company in the world to use an MPEG-compliant digital system. Showtime went live in 1995. The new business will offer new packages to viewers on August 1 and will include HDTV in their offering. Formally, the deal will also close on or about August 1, according to the company's lawyers. *Inside Satellite TV* understands that Showtime Arabia and KIPCO bought out the small Viacom share in the business before the merger.

Commenting on the merger, *Mr. Faisal Al Ayyar*, KIPCO's Vice Chairman, said the merger was good news for customers, staff, and the industry: "This deal brings together two great brands into one company to offer customers the very best in Western and Arabic entertainment. "Showtime and Orbit were pioneers of the region's pay-TV market and we've both been calling for consolidation of the market for some time. Joining forces in this way

is good news for customers, staff and the regional television industry."

*Mr. Abdulhadi* added: "This unprecedented merger is great news for the industry and customers alike, because it consolidates two leading pay-TV platforms, brings together the best channel line-up under one operator and combines all customer service and distribution networks into a single point of call."



Abdulhadi said that with so many platforms competing for the same content, the platforms had pushed up the price of content without being able to offer consumers a total package. Mr. d'Halluin said he is "utterly convinced" the market for pay-TV in the Middle East is as potentially big as elsewhere, despite the region historically being slow to sign up, and despite the plethora of free-to-air channels available.

As in other markets where there are two or three competing platforms, there will be a sector that is unwilling to subscribe to platforms that don't offer all content, said d'Halluin. But the rationale behind the merger is to create a pay-TV "one-stop shop". "All Hollywood movies are on our platform. All without ads. All in wide screen. And we started in HD last week. All these things will unlock the potential of the pay-TV market in the region," d'Halluin asserted.

Logistically, however, merging the two platforms will be a hard and perhaps lengthy task, as is usually the case with DTH mergers. "If we have to migrate [one set of subscribers], which we will need to do, that takes time and a lot of logistics and know-how... It will take the time it needs. Eventually we will come to the right technology, the right HD-compatible box, the right DVR."

Orbit's long-term losses are legendary, and Showtime pulled a long-planned IPO some two years ago, citing market conditions. However, both companies were well-backed financially by wealthy patrons.

d'Halluin said, "This merger creates MENA's largest pay-TV operator offering the very best premium channels in the region as well as truly innovative services to our customers including HD channels, Video on Demand and other interactive services.

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*A local expert's comment:*

Gabriel Chahine, partner and head of consumer and media at management consultancy *Booz & Co*, and which took a very close look at Showtime ahead of Showtime's planned — and pulled — IPO, says that neither pay-TV company was generating solid revenues as separate operations. "We don't have the economics of the paid-TV networks but it would be very difficult to imagine they are making money, especially with the amount they pay for sports rights," he said.

"The packages they put in the market place (for consumers) are very low, especially Orbit which has a \$5 one in Egypt. With these packages and the content they are buying, it would be very difficult for them to make money," he said, adding that with Showtime and Orbit struggling to make money, a long "overdue" merger was the best outcome for both companies. "From an economic standpoint, three [pay] TV networks (in the Middle East) was way too much and it's very difficult for them to differentiate their content from free-to-air."

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"The new company will continue to run its core operations and corporate functions from Bahrain and Dubai, bringing together experienced and talented employees who are tasked with extracting significant synergies and delivering the best value from this merger for all our stakeholders and customers. We look forward to updating the market on this exciting merger and future plans."

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*A subscriber writes to ArabianBusiness.com:*

"For those familiar with pay TV, the customer base the mideast offers is so small that I was always surprised Showtime was able to offer the great content it does, latest series, films etc. It takes much larger markets to make it viable to purchase rights for content that is priced for million plus subscribers. Showtime did, after all, pay \$120m for the English Premier League... what the merger will beget is yet to see, will we get the best of both worlds? i sure hope so." From ' Hopeful, Dubai'

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**Noorsat**, a virtual satellite operation using surplus capacity from **Eutelsat**, and owned by **Mawarid**, is not part of the new merger — neither is Orbit-owned **Media Gates** or **Orbit Data Systems**. These businesses will continue to be managed by their respective management teams independent of the new company. Media Gates, Orbit's Arabic production company, will continue to distribute the Arabic channel line up exclusively through the newly created platform.

There are many questions still unanswered, not the least of which is whether the companies will continue dual-illuminating their signals onto two transmission platforms — and for how long. Part of the consolidation has been underway for some months, given that Orbit selected **Irdeto's Conditional Access** some months ago. There is as yet no word on operational job losses and the other obvious ramifications of the merger, closing of call centres, etc.

Showtime broadcasts on **Nilesat**, which given that Orbit uses its own Noorsat virtual satellite (which in fact leases Eutelsat capacity) seems to suggest that the final consolidated platform will end up on Noorsat.

Mr. *d'Halluin* insists the merged platform will “have everything one can dream of”. It is, he says, looking at a bright future. But *d'Halluin* also does not discount potential conversations with ART.

“We will be focusing on integrating the two platforms. If there are potentials for other combinations, we will consider them,” he said. Mr. *d'Halluin* insisted that both parties to the merger had hundreds of thousands of subscribers and the combination of the two will essentially multiply by two the size of each one of the entity. “By that I mean the subscriber bases were not far apart, so at the very least it is a multiplication by two and in fact it's more than that for revenues. It is a very strong leading media player that we are building together, which will immediately be at the top

of the ranking in terms of size and revenues in the Middle East and MENA region.”

Which takes us right back to the old saying, “lies, damned lies and subscription numbers!”.

Perhaps Mr. *d'Halluin* thinks he is merging his numbers with Orbit's 400,000 “viewing points” and thus magically giving the merged business 800,000 “viewing points”.

The reality is significantly less. An *Inside Satellite*

TV senior source, extremely familiar with the actual numbers, suggests the merged players will have an uphill battle to reach 400,000 actual subscribers. By any measure this is a miniscule viewing base (after 15 years of transmission in Orbit's case).

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*A non-subscriber writes to ArabianBusiness.com:*

*“I do not subscribe either to Orbit or to Showtime primarily due to the expensive packages they offer, but also due to the fact that most programmes are re-runs as are the movies. Except for sport, these two have nothing to offer, and even the sport they carry is the unpopular content like golf, rugby, etc. which caters most to the western expatriate population (though I have no gripe against that). Well I for one wouldn't have been sorry to see the two go under cause they have fleeced the populace for as long as they could. Well done Abu Dhabi Media for getting the EPL rights, I hope you can price it within reach of the population at large. Sorry to you guys at Showtime/Orbit, but it seems the good times for me and like minded people may just be beginning.”*  
From 'Joe, Dubai'

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### **ANT Galio Suite modular architecture**

Added to this tale of woe is the fact that Showtime has just lost its Crown Jewel coverage of the **English Premier League**, that cost it more than \$100m for three years' coverage. Its exclusivity ends in the Spring of 2010, when the contract switches to **Abu Dhabi Media**. Showtime is angling for a sub-licence for the games.

ART hasn't made an unequivocal statement, but senior insiders suggest that Sheikh *Saleh's* team will stay focused on its own challenges — and remain independent. Meanwhile, ART is quietly readying its own plans to consolidate and grow its own rival pay-TV business — and this includes MPEG-4 based HDTV and an IPTV-enabled set-top box (STB).

ART started broadcasting in the mid-1990's but has been somewhat hamstrung by the lack of enthusiasm for pay-TV in the region. ART has spent the past few years concentrating on sport as well as Arabic content. The broadcaster is now abandoning its previous dependence on non-proprietary (and so called 'zap' boxes) in favour of a purpose-designed and unique STB which contains ART-owned software and

IP. It is also switching from Irdeto conditional access (which Orbit has recently adopted) and has selected **Viaaccess** encryption from **France Telecom**. However, key to its strategy is its use of **ANT's Galio** browser and ANT Galio Core Applications for its new service.

The new ART service will have an entirely new look and feel designed by Arab Media Corp. (ART's parent company). The ANT architecture also enables the re-design and re-skinning of services on deployed STBs as and when desired after the initial launch of the service, an important capability in this programme.

"Not only is it important for us to build a compelling new service but also to have a solution that can continue to grow. ANT, with its standards based software architecture, is at the forefront of delivering next generation services and applications," said Alan Constant, CTO at Arab Media Corporation. "We are looking beyond what the market is currently demanding to the types of services that consumers will want next year and in future years."

However, long-established as these three pay-TV players are, there's shortly going to be a new kid on the block in the shape of Mr. Charlie Ergen and his **Echostar/Dish** operation. Ergen is not wholly 'new' as far as the Mid-East is concerned. Echostar-branded boxes have been sold in the region for 15 or more years. Echostar 'imports' some ART and other Middle East channels as part of its speciality linguistic packages on **Dish Network**. Now it thinks it can be a consolidator in the region. Not, they stress, among any of the existing pay-TV operators, but among the well-established and highly-professional free-to-air players.

And Echostar wants to use HDTV as the catalyst for change. ART and Showtime/Orbit are starting to embrace HDTV, and the FTA broadcasters want to start tinkering with HD. They recognise it represents the future for TV, but as yet, HD's impact in the Mid-East has been miniscule.

Which brings us back to the satellite conundrum — think about these statements...

- **Arabsat wants to win the Echostar bouquet.**
- **Nilesat might well lose Showtime's support once contracts expire.**
- **Noorsat is the profitable arm of Orbit**
- **SES has done a marketing deal with Abu Dhabi based YahSat**
- **YahSat 1 will launch next year**
- **Echostar & SES frequently work together**

#### About the author

London-based Chris Forrester is a well-known entertainment and broadcasting journalist. He reports on all aspects of the TV industry with special emphasis on content, the business of film, television and emerging technologies. This includes interactive multi-media and the growing importance of web-streamed and digitized content over all delivery platforms including cable, satellite and digital terrestrial TV as well as cellular and 3G mobile. Chris has been investigating, researching and reporting on the so-called 'broadband explosion' for 25 years.



## A New Age In Digital Satellite Imagery

by K.C. Higgins, DigitalGlobe

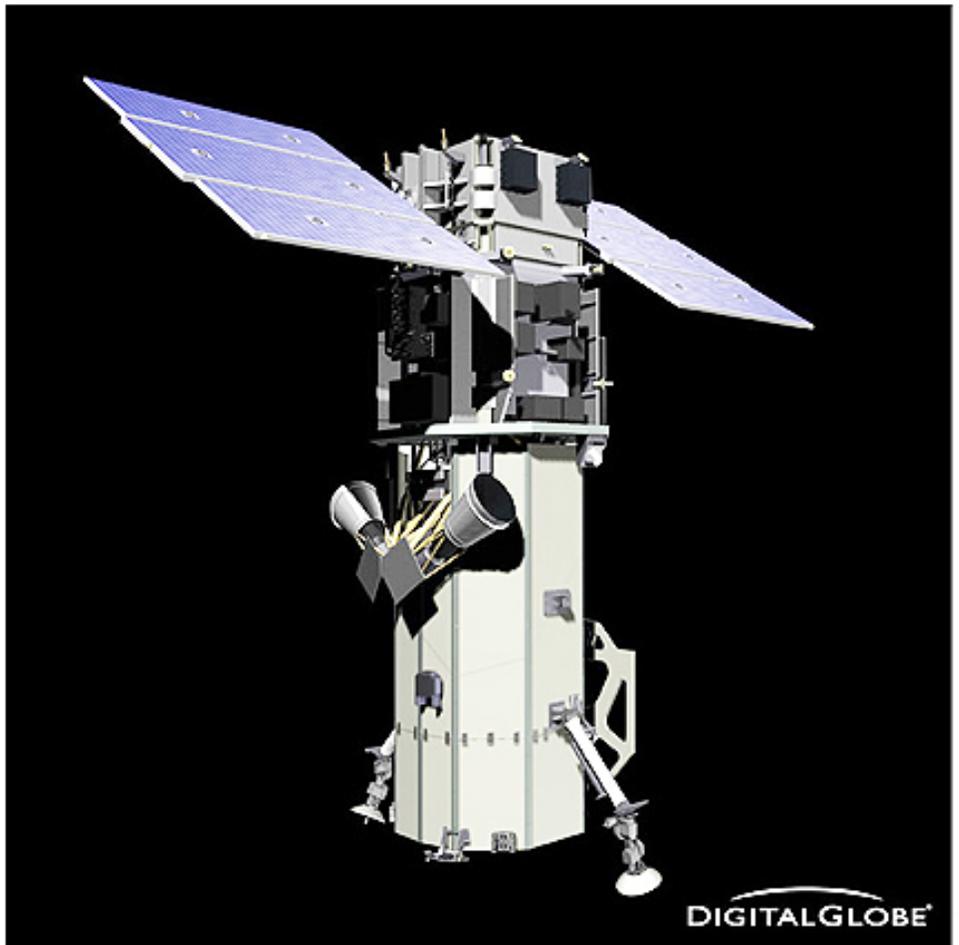
**A**fter massive flooding in an Eurasian country, relief workers seek open roads, allowing them to bring necessary supplies to stranded residents. Amid the chaos of war, a military general redirects a planned convoy to safety. Scientists measure the true levels of coastal erosion, an oilfield worker finds new potential for digging, and a tourist successfully navigates to a hotel in an unfamiliar city. Every day, satellite imagery plays a significant role in the decisions — both small and large — that make a difference in our lives.

This year marked some of the most significant advances in the satellite industry, bringing technology to life in new ways and to a broader audience. Japan's **SELENE** satellite gave us stunning images of the lunar landscape as it concluded its mission this June, and South Korea attempted its first satellite launch from its own territory. In the commercial segment of the market, **DigitalGlobe** is also set to make history this year with the October launch of its second next-generation class satellite, **WorldView-2**, the first with combined high resolution and eight-band multispectral capabilities.

### **WorldView-2: Fueling the Demand for World Imagery**

Demand for accurate, up-to-date, high-resolution imagery continues to increase as new and varied industries learn how the information can provide game-changing opportunities for growth. Constituencies as diverse as defense and intelligence, civil agencies, mapping and analysis, environmental monitoring, oil and gas exploration, companies, infrastructure initiatives, Internet portals, and navigation technology concerns are seeking more detailed and improved currency of imagery to help solve everyday business issues.

The DigitalGlobe WorldView-2 satellite introduces the next generation of geospatial information, adding to what is already the world's most complete and current resource of high-quality world imagery. The satellite will be the third component in DigitalGlobe's



constellation of high-resolution digital imaging satellites, and it represents a significant step forward for the industry. WorldView-2 features advanced agility and accuracy, state-of-the-art collection capacity, and eight-band multispectral capability. In addition, the company's sophisticated constellation will offer an unprecedented stream of new images every day, enhancing DigitalGlobe's ability to rapidly collect and disseminate up-to-date imagery through its world imagery solutions.

***Improved  
Intelligence +  
Smarter  
Business  
Decisions***

We live in a society that expects access to timely and accurate information. Viewing up-to-date imagery alongside historical benchmarks has a discernable impact on real-time decision making. On a battlefield for example, it is imperative to understand the whereabouts of supply routes, bridges, and safe-harbor locations — such as schools, churches, and hospitals — but taking the necessary time to confirm the true ground status can delay field decisions or require more dangerous and costly verification of the location of potential weapon caches or enemy forces. Today's satellite imagery advancements ensure that troops have the intelligence they need to make the best decisions possible in real time, as events on the ground unfold. For relief workers in the aftermath of natural or

man-made disasters, access to detailed imagery in the days surrounding the event can mean life or death for those awaiting evacuation, relief supplies, or rescue. The smallest delay can have a tremendous impact on human life and recovery efforts. The accessibility and delivery of current and historical imagery can accelerate relief efforts by determining the safest and fastest routes for supplies and rescue, pinpointing safe harbor locations, and identifying potential roadblocks that could cause life-threatening delays.

DigitalGlobe Satellites	QuickBird	WorldView - 1	WorldView-2 (Q3-09)
Resolution	60 cm	50 cm	50 cm
Swath Width	16.5 km	17.6 km	16.4 km
Avg. Revisit	2.4 days	1.7 days	1.1 days
Slew Time	62 seconds	9 seconds	9 seconds
Spectral Bands	Pan + 4 MS	Pan	Pan + 8 MS
*Accuracy Spec.	24M CE90	6.5M CE90	6.5M CE90
Collection	210,000 km <sup>2</sup> per day	750,000 km <sup>2</sup> per day	975,000 km <sup>2</sup> per day

\*At nadir on flat terrain



**Note: Slew time based on 300 km slew**

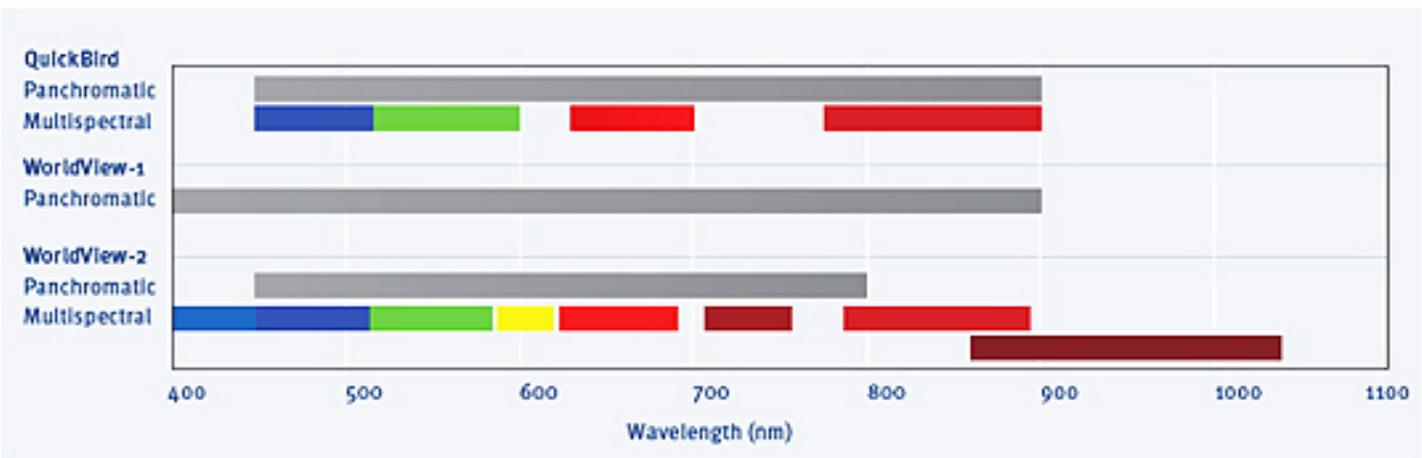
In the business world, imagery may not always save lives, but it does aid organizations and individuals in corporate decision-making support, asset management, and GPS navigation. In fact, major consumer mapping sites have already realized the benefits that satellite imagery providers like DigitalGlobe have to offer, leveraging the technology to share and deliver image-based maps and applications to millions of users with a single click.

DigitalGlobe has been a pioneer in the commercial satellite imaging market. It was the first company to receive a license by the U.S. government to operate a high-resolution satellite for commercial use, and it

has facilitated the adoption of satellite imagery into new markets by partnering with providers of personal navigation, social networking, and location-based services to integrate high-resolution satellite imagery with a variety of consumer applications.

With the launch of WorldView-2, DigitalGlobe will continue its leadership by bringing the world's first commercial high-resolution eight-band multispectral products to market and by making an unprecedented amount of new imagery available to expert and lay users. The combination of large, seamlessly collected countries, states, and counties imaged in higher level of detail than traditional four-band satellites, combined

## THE 8 SPECTRAL BANDS OF WORLDVIEW-2



with the sheer amount of daily new image collections, make for a formidable new offering from DigitalGlobe. A powerful constellation of agile, high-resolution satellites provides three options to collect points on the globe on a given day, or multiple points of interest within a defined area, such as the disparate Olympic arenas in Beijing. The additional band capabilities of WorldView-2 will also provide end users with the enhanced ability to track landscape changes down to the species levels of trees and plants, map the ocean floor, and identify and extract more features from the earth's surface with much higher degrees of confidence than were previously possible.

### **Better Accuracy**

WorldView-2's advanced geospatial technology allows for significant improvements in accuracy. The current accuracy specifications for an image acquired at nadir have been tightened to 6.5m CE90 without ground control. WorldView-class satellites record measured accuracy for a nadir image at a remarkable 4.1m CE90 without ground control and achieve sub-meter CE90 with ground control. These levels of accuracy provide detailed imagery for precise map creation, change detection, and in-depth imagery analysis without additional processing required by the user. Removing the need for further processing can mean the difference between immediate or delayed access to high-resolution imagery for end-users—a critical difference for professionals making real-time, location-based decisions as events occur.

### **New Spectral Bands Mean Deeper Analysis, Faster Insight**

WorldView-2 will be the only commercial high-resolution imagery satellite with eight-band multispectral capability. The new bands support greater levels of feature identification and extraction, more accurate change detection, and a truer reflection of the world's natural colors.

The benefits of the new multispectral bands are particularly useful for those monitoring land and aquatic environmental change. For instance, scientists studying coastline erosion will have a

clearer picture of the areas they are monitoring than with four bands, allowing them to notice subtle differences and changes in greater detail: The four new spectral bands (coastal blue, yellow edge, red edge, and near infrared 2) enable broader ranges of classifications, enhanced vegetation and coastal analysis, the extraction of more features, and the identification and tracking of coastal changes and infractions. Additionally, the new red edge (the first in the commercial industry) and yellow edge spectral bands deliver more granular field classifications, improve the understanding of vegetation analysis, and provide early warning capabilities to industries that interact with the environment. The new coastal blue spectral band will enhance bathymetry studies for sea floors, coastal plains and waterways, discriminate features of the shallow ocean floor more accurately, and increase the scope of coastal remote-sensing applications, improving the safety of marine navigation and providing important insight into the ever-changing marine environment.

Further, mapping experts can use the additional bands to pinpoint more points of interest and create more diverse and interesting navigation applications.

### **Supporting Emerging Market Demands**

As the number of industries leveraging satellite imagery continues to grow, so do estimates about geospatial imagery industry growth. **Frost & Sullivan** has reported estimates of \$8.34 billion in revenue by 2010 for the global market that includes commercial remote sensing imagery, GIS software, data, and value-added services. **The American Society for Photogrammetry and Remote Sensing (ASPRS)** has published similar high-growth projections, citing the call for higher resolution and improved geolocational accuracy as key industry drivers.

WorldView-2 is among the first commercial satellites to have control moment gyroscopes (CMGs), a high-performance technology that provides acceleration up to 10 times that of other attitude-control actuators and improves both maneuvering and targeting capability.

With the CMGs, slew time is reduced from more than 60 seconds to just nine seconds to cover 300km,



allowing WorldView-2 to swing rapidly and precisely from one target to another in a single pass. Its sister satellite, **WorldView-1**, demonstrated WorldView-class agility by collecting eleven separate images of the Beijing 2008 Olympic stadiums in one pass.

When a more up-to-date source of world images is available, the potential uses increase, as more knowledge and insight can be extracted and imported into the daily location decisions and plans of organizations. Additionally, more predictability and more proof that images reflect the most accurate ground truth, discern more features, and track more changes increase an end-user's ability to make location-based decisions. Automating world imagery changes and extruding relevant sets of information are the next steps toward increasing the ubiquity of world imagery in business and social applications.

### **What's Next?**

As the satellite imaging market continues to grow, new applications will emerge and companies will continue to offer more sophisticated collection and monitoring capabilities. As a pioneer in the industry and a leading provider of commercial high-resolution imagery, DigitalGlobe will continue to innovate and excel in its development of highly accurate, easily accessible, and comprehensive world imagery. With the support of WorldView-2, users will be able to tap satellite imagery to address all of their location-based concerns—whether ensuring the safety of flood victims or just finding their way to the nearest Starbucks.

# A Costing + Pricing Challenge

by Jos Heyman CPA, Tirus Space Information

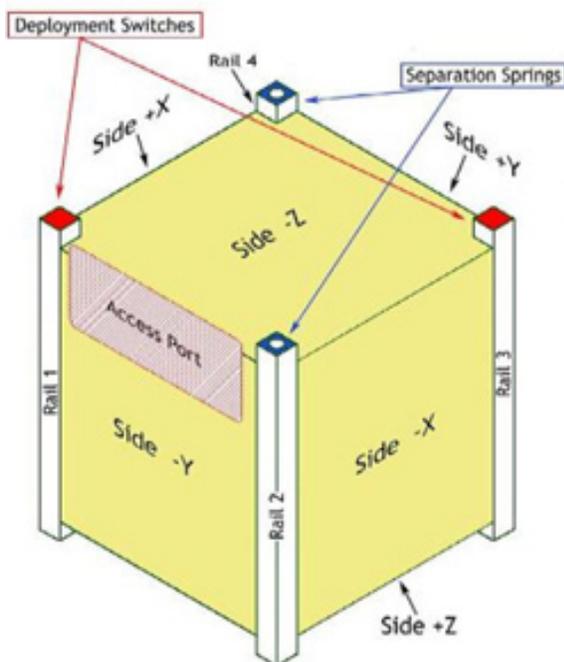
The first decade of the 21<sup>st</sup> century saw the emergence of very small satellites. Without doubt this development has been made by the miniaturization of electronic components that is also seen in, for instance, computers. Accompanying this trend was an evidently reduced cost in the development and construction of satellites that made them attractive to educational institutions as a learning tool.

The California Polytechnic State University (**Cal Poly**), in San Luis Obispo, California, and **Stanford University** took the idea of small satellites for educational purposes one step further by developing the CubeSat concept of small satellites measuring 10 x 10 x 10 cm which, either as a single satellite or as multiple satellites, provided a modern and fun way of teaching science and engineering in a multi-disciplinary environment with the end result being a small orbiting satellite.

To date, 29 CubeSats have been launched, of which 23 were for educational purposes. Another 10 educational CubeSats are scheduled for launch in the foreseeable future, while about 10 are known to be planned. They provide an opportunity to motivate and challenge students' interest in the fields of space, technology and science. In fact, even if an educational satellite does not reach orbit because the launch vehicle failed, the primary objectives as an educational tool, have already been achieved. Getting the satellite in space and getting it to work there, is merely 'the icing on the cake'.

## CubeSat Specifications

Cal Poly and Stanford University have now become the central focus of an international collaboration of more than 40 universities, high schools, and private firms throughout the world.



### Additional Notes:

- No external components other than the rails may touch the inside of the P-POD.
- Must incorporate a Remove Before Flight pin OR launch with batteries fully discharged.
- Components on shaded sides may not extend more than 6.5 mm normal to the surface.
- Rails must be either hard anodized OR made of a material other than aluminum.
- Separation Springs (required) can be found at McMaster Carr (P/N: 84985A76)
- At least one (1) deployment switch must be incorporated on all CubeSats.
- CubeSats cannot weigh more than 1 kg.
- Center of gravity must be less than 2 cm from the geometric center.

**CubeSat basic specifications (Source: Cal Poly)**

FOCUS: CubeSats

Date	Launch veh.	#	Edu	Satellites
30-Jun-2003	Rokot/Briz-KM	5	5	DTUSat, CUTE-1, AAU Cubesat, CANX-1, CubeSat XI
27-Oct-2005	Kosmos 3M	3	3	UWE-1, CubeSat XI-V, Ncube-2
22-Feb-2006	Mu 5	1	1	Cute 1.7
26-Jul-2006	Dnepr (failed)	14	1	Sacred, ION, Rincon-1, ICECube-1, KUTESat, SEEDS, Ncube-1, HAUSAT-1, MEROPE, CalPoly CP-2, AeroCube-1, CalPoly CP-1, Voyager, ICECube-2
16-Dec-2006	Minotaur	1	0	Genesat-1
17-Apr-2007	Dnepr	7	5	PolySat CP-3, Libertad-1, CAPE-1, PolySat CP-4, CSTB-1, AeroCube-2, MAST
28-Apr-2008	PSLV	6	6	AAUSat-2, CanX-2, SEEDS-2, Compass One, Delfi C-3, CUTE-1.7+APD
19-May-2009	Minotaur	4	1	Pharmasat, CalPoly CP-6, HawkSat-1, AeroCube-2
30-Jul-2009	STS	2	2	Bevo-1+AggieSat-2 (failed to separate)

**Table 1 above: Launched CubeSats**

Date	Launch veh.	#	Edu	Satellites
2009	Vega	9	9	SwissCube, XaTcbeo, UNICubeSat, ROBUSTA, ATmoCube, e-sta@r, OUFTI, Goliat, PW-SAT
Oct-2009	Minotaur IV	2	1	O/OREOS, RAX

**Table 2 above : CubeSats Scheduled For Launch**

Cal Poly also provides the basic standards and specifications for CubeSats, prescribing the outer dimensions, recommended materials and restrictions. Cal Poly also acts as a launch coordinator. In addition Cal Poly organizes conferences and workshops.

The satellites can be constructed as single CubeSats, double CubeSat (**10 x 10 x 20 cm**), and triple CubeSat (**10 x 10 x 30 cm**), depending on the payload and mission requirements.

For the deployment of CubeSats, three separate deployment pods have been developed:

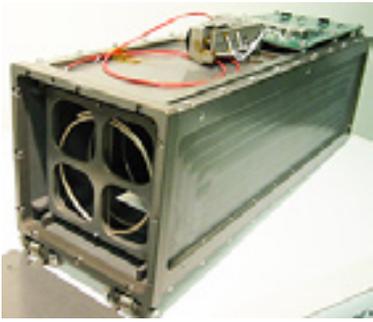
- **P-POD (Poly-Picosatellite Orbital Deployer)**, developed by Stanford University and California Polytechnic Institute. It can hold three single CubeSats stacked on top on each other;
- **T-POD (Tokyo Pico-satellite Orbital Deployer)**, a Japanese deployer that can hold one single CubeSat; and

- **X-POD (eXperimental Push Out Deployer)**, a custom, independent separation system that was designed and built at the University of Toronto's Institute for Aerospace Studies/Space Flight Laboratory for each satellite and may be tailored to satellites of different sizes ranging from a single CubeSat to larger nanosatellites of arbitrary dimensions.

The various PODs are designed to be easily integrated into a launch vehicle and to provide separation between the primary payload(s) of the launch and the CubeSats.

### ***What Does It Cost?***

An obvious consideration for any satellite project is the cost of such a project. In the author's opinion, the financial cost of a University based CubeSat project should be relatively low, as most of it, in particular the infrastructure cost and the labor cost, can be absorbed in the on-going study and research programs undertaken by the University. This should limit the financial outlay during the system development, design and construction phases to the purchase of



**POD-D**  
(Source: Cal Poly)

hardware and specialized services that somehow are not included in the on-going study and research programs.

This leaves the launch cost as the largest single item of expenditure. Currently, most

CubeSats are being launched on decommissioned Russian rockets. Through companies like **Eurokot** and **Kosmotras**, the launch costs are currently about US\$40,000 per single cube. However, the range of launch vehicles that will carry CubeSats is gradually increasing in number and recently it was announced that CubeSats can fly on **Atlas V** launch vehicles. The cost of a single secondary payload on board of an Atlas V has been quoted as \$1 to \$2 million per slot.

*The author, who is a Cost Accountant by profession, proposes to evaluate the cost of a satellite in further detail to a realistic level, using accepted commercial accounting techniques. In doing so, a simplified approach will be taken as the costing is not based on a particular satellite but rather a generic satellite launch.*

Much of the argument revolves around the principles of avoidable and unavoidable cost. *Avoidable cost* is usually defined as the cost that can be avoided if a certain decision is taken or not taken. *Unavoidable cost* is the cost that cannot be avoidable at least for the short term. This means that unavoidable is more or less a fixed cost in the short term which cannot be changed.

To offer an example: a professor at a University is being paid, irrespective of whether a satellite project is undertaken or not. His primary role is to educate. As such, the professor's cost is avoidable for a satellite project and no financial expense should be incurred for the project. Of course, if the professor is engaged only for the satellite project, his cost becomes unavoidable. The same applies for most of the university facilities (buildings, equipment and instruments) which are used in the project — they are there first of all for the purpose of educating. Again, the exception is if equipment etc. is specifically acquired for the satellite project. An identical argument will be made later in this article, for the launch cost.

In addition, there are non-financial costs, such as the cost of the student labor. While they make a significant and essential contribution to the satellite, they are not being paid, so no expense is incurred. This example highlights the difference between 'cost' and 'expenses', with the latter representing an actual cash payment.

### **Project Cost Estimate**

To develop this cost estimating model we adopt, as a base line, a 10 x 10 x 10 cm CubeSat that carries a camera and a transmission system. The satellite mass is limited to 1 kg and it requires some attitude control. The project will pass through various phases each of which should be costed separately.

#### • **Phase I — Project definition and initiation**

This is the phase where the feasibility is studied and a working group is put together. This phase should not incur any financial expenses unless a Workshop is attended. Assuming this is done the cost will involve travel to the workshop and accommodation cost. This is estimated at US\$5,000. Documentation and specifications of CubeSats

that are required in this phase, are freely available from Cal Poly.

• **Phase 2 — Spacecraft construction**

In this phase, equipment will have to be purchased. Remember that cost of labor (students and professor) is avoidable and non existing, as described above. Recently, **ISS** in Delft, The Netherlands, established the one stop, on-line, [CubeSatShop.com](http://CubeSatShop.com) facility that sells off-the-shelf components for CubeSat developers. The components to be purchased include. . .

**Satellite frame:** The ISIS CubeSat structure is developed as a generic satellite structure based upon the CubeSat standard. The design created by ISIS allows for multiple configurations as to give the nanosatellite developers the freedom to develop their satellite with respect to the basic lay-out of their internal configuration — cost: 2,300 euros.

**Attitude control system:** A *Passive Magnetic Attitude Stabilization System* is selected to lock the CubeSat to the Earth Magnetic field like a compass needle — cost: 2,000 euros.

**Camera system:** A *Sanyo VCC-5884E 1/3 in. Color CCD DSP High-Resolution Camera*, 540TVL, 1 Lux Sensitivity, 12VDC/24VAC, Automatic Gain Control (ON/OFF), used for security cameras with a mass of 167 grams and size of 68 x 63 x 52 mm — cost: US\$170.

**Transmission system:** CubeSat UHF downlink, VHF uplink full-duplex transceiver, provides telemetry,

Launch vehicle	LEO kg	Cost \$M	Cost/kg
Pegasus XL	443	13.5	\$30,474
Rokot	1,850	13.5	\$7,297
Start	632	7.5	\$11,867
Taurus	1,380	19	\$13,768
Delta 2	5,144	55	\$10,692
Dnepr	4,400	15	\$3,409
CZ 2E	9,200	50	\$5,435
Soyuz	7,000	37.5	\$5,357
Ariane 5	18,000	165	\$9,167
Proton	19,780	85	\$4,297
STS	28,803	300	\$10,416

**Cost per kg (Futron, 2002)**

telecommand & beacon capability in a single board — Cost: 8,500 euros.

**Antenna system:** The ISIS deployable antenna system contains up to four tape spring antennas of up to 55 cm length, which deploy from the system after orbit insertion — cost: 3,000 euros.

**Solar cells:** The NanoPower P-series power supplies are designed for small, low-cost satellites with power demands from 1-30W — cost: 2,000 euros.

**Miscellaneous minor components**  
Cost: US\$6,270.

This provides an estimated total cost for the construction of the spacecraft of:

$$C_{\text{launch}} = C_{\text{development}} + C_{\text{vehicle}} + C_{\text{flightops}} + C_{\text{recovery}} + C_{\text{refurb}} + C_{\text{insurance}}$$

where

- $C_{\text{launch}}$  \_ Total cost of launch
- $C_{\text{development}}$  \_ Amortization of nonrecurring development cost
- $C_{\text{vehicle}}$  \_ Amortization of vehicle production cost (in the case of a reusable vehicle) or Recurring production cost (in the case of an expendable vehicle)
- $C_{\text{flightops}}$  \_ Total cost of flight operations per flight
- $C_{\text{recovery}}$  \_ Recurring cost of recovery (reusable vehicle only)
- $C_{\text{refurb}}$  \_ Refurbishment cost (reusable vehicle only)
- $C_{\text{insurance}}$  \_ Cost of launch insurance

- Euros  $\{(2,300+2,000+8,500+3,000+2,000) * \text{exchange rate } 1,32\} + (\text{US\$ } 170 + 6,270) = \text{US\$}30,000$  (rounded)

- **Phase 3 — Launch preparation**

In this phase the satellite has to be transported to the launch site and placed in the special CubeSat deployer. The transport of the satellite, along with a team member overseeing installation, is estimated at US\$5,000. Obviously this cost is dependent on the location of the university and the launch facility as well as the degree to which the accompanying team member is prepared to make a vacation of the trip (meaning making some contribution to the travel cost).

A typical 3-Unit **CubeSat Deployer** is available from ISIS CubeSatShop and comes in 1U, 2U, 3U, depending on the number of CubeSats it can contain. The cost of a triple (3U) unit is 25,000 euros.

Assuming this cost is shared with two other CubeSats, this means the cost is 8333 euros per satellite = US\$11,000. The total cost for this phase is therefore estimated to be US\$16,000.

- **Phase 4 — Launch cost**

It has been suggested that the launch vehicle cost is the highest cost of a CubeSat project. As outlined above, commercial prices range from US\$40,000 to US\$2 million. In considering these prices, we should, however, remember that they are;

- **“commercial”, they typically apply to commercial satellites that are placed in orbit to generate a profit to their owners; and**
- **“prices”, which in a commercial environment are only related to the ‘cost’ to the extent that it would be nice to recover all the cost, but with the price ultimately being determined by whatever the customer is prepared to pay.**

In the case of educational (i.e., non-commercial) CubeSats, it will be necessary to investigate launch cost in more detail. To get an idea of how this cost is determined Wertz<sup>7</sup> has proposed the formula located at the bottom of the previous page.

A further idea of the cost per kg to be applied to a launch can be obtained from the table at the top of the previous page:

From the straight ‘proportion by kg basis’ displayed in the above table, launch cost of an educational CubeSat can be reduced further by the application of the concept of avoidability, as outlined above, a concept that is also referred to as marginal costing.

To explain this further the reader must appreciate that there are many components of the launch vehicle cost that are fixed and will have to be paid for by the owner of the primary payload (for instance a communications’ satellite). These costs are not directly related to the mass of the primary satellite and are fixed for the satellite mass +/- a few hundred kg. Other components of the launch vehicle are, however, variable with the mass of the payload.

In marginal costing it is argued that the 1 kg CubeSat should only pay for this additional variable cost that is very specific to the additional 1 kg to be launched by the launch vehicle.

It is suggested that this additional cost is only: *the installation of the launch deployment pod on the framework that supports the principal satellite (or some other part of the launch vehicle); and the additional fuel required to lift the additional 1 kg for the satellite + app. 1 kg to represent the launch pod, i.e., 2 kg additional hardware to be lifted.*

Without much of an idea of the specific trade and expertise that is required to fit the CubeSat + launch pod to the launch vehicle, the author proposes that the cost of this should be for two workers who take about two hours to complete this task. At an hourly rate of US\$100 (a generally accepted tradesman rate), we should be looking at a cost of US\$400 for the installation of the CubeSat + launch pod. To round it off, say US\$500 to be paid by the CubeSat owner.

In absence of detailed information, it is more difficult to determine the cost of the additional fuel, but perhaps US\$100 would be a good ball park figure, making the total estimated cost of placing a CubeSat in orbit a mere US\$600. But let us be generous and estimate this phase at US\$1000.

Of course, the launch vehicle provider plus/or the commercial satellite-to-be-launched owner may decide to ignore this cost in exchange for goodwill.

*Ironically, the above treatment might be less sustainable for launches that have a large number of CubeSats in that the cubesats can no longer be considered as 'marginal'.*

### **Post Launch Operations**

Finally, there is the cost of the operation of the CubeSat once it is launched and is in orbit. Bearing in mind that the prime objective of educational CubeSats is its function as a learning tool, and that such an objective is achieved before the launch takes place, in-orbit operation is a mere bonus. Much like phase I, this final cost should be completely absorbed in the educational program of the university department that built the satellite or, if appropriate, a department that can make use of scientific data.

### **Conclusion**

This, then, brings the total cost of placing an educational CubeSat in orbit at:

$$5,000 + 30,000 + 16,000 + 1,000 = \text{US\$52,000}$$

The author is, however, the first to admit that he has taken many short cuts and assumptions in his development of an estimate for an educational CubeSat. As such, the above estimate should serve only as a demonstration to university professors and students that an educational CubeSat should be within their reach. It should also demonstrate to major launch vehicle operators that they have a choice between either charging a commercial rate for the launch of an educational CubeSat, or providing it for free and invest in the future by stimulating educational institutions.

*As a footnote, Interorbital Systems, a company from California, recently began offering the TubeSat spacebus for just US\$8,000 to anybody who wants to launch a satellite in space. The TubeSat spacebus includes casing, endplates, and mounting hardware, a transceiver, a battery pack, solar cells, a Power Management Control System*

#### **TubeSat Personal Satellite Kit**



*(PMCS), a microcomputer with software, antennas, safety switches and instructions. The total mass of the TubeSat is*

*0.55 kg, leaving 0.2 kg for an experiment. The experiment space has a diameter of 8.56 cm and a length of 5.08 cm. TubeSats are also available as Double TubeSats, Triple TubeSats, or Quadruple TubeSats. The price includes a guaranteed place on one of Interorbital Systems Neptune 30 launch vehicles. It is hoped the first launch will take place in 2010.*

*While this offer is a clear indication that launches can be inexpensive and will attract people that will happily part with US\$8,000 to have a piece of hardware with their name in orbit for as much as three months, this does not seem to be a viable option for educational institutions as the objective of educational CubeSats is the construction of a satellite by students, as a learning tool, and not to fly a small piece of hardware in space.*

### **More Info**

For more details of these satellites, refer to:

**Heyman, J., A Western Australian CubeSat — Floating An Idea, Tiros Space Information News Bulletin Vol. 32 No. 10 (special), 15 July 2007**

For more details regarding these satellites, refer to **Tiros Space Information News Bulletin Vol. 34 No. 10**

CubeSat (<http://CubeSat.atl.calpoly.edu/>)

**England, J., Atlas V — Auxiliary Payload Overview, presentation CubeSat Summer Workshop 2006** ([http://atl.calpoly.edu/~bklofas/SummerWorkshop2006/England-Atlas\\_V.pdf](http://atl.calpoly.edu/~bklofas/SummerWorkshop2006/England-Atlas_V.pdf)).  
<http://cubesat.atl.calpoly.edu/pages/documents.php>  
<http://www.cubesatshop.com>

<sup>7</sup>**Wertz, J.R., Responsible Launch Vehicle Cost Model, Paper No. RS2-2004. Second Responsive Space Conference Los Angeles, CA, April 19–22, 2004**

**Futron, Space Transportation Costs: Trends in Price Per Pound to Orbit 1990-2000, September 6, 2002**

[http://interorbital.com/TubeSat\\_I.htm](http://interorbital.com/TubeSat_I.htm)

## The Benefits Of File-Based Broadcasting

by Kamy Merithew, Vice President, WEGENER

**F**ile-based distribution and broadcasting provides a non-traditional approach to traditional video and audio broadcast applications. The move to an asynchronous transfer of content and playout is a big departure for an industry built around distributing linear programming via satellite. A file-based broadcasting model brings efficient use of bandwidth and streamlined downlink operations, which leads to greater programming flexibility and significant cost savings.

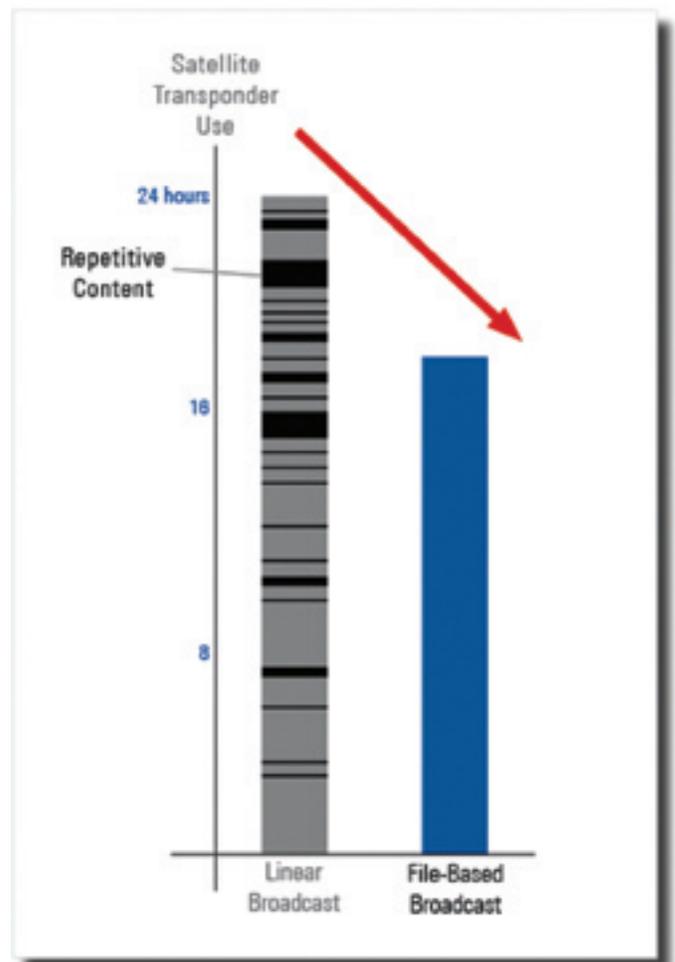
There are many benefits to file-based broadcasting, but adopting this type of business model requires a commitment to a new way of thinking. It's not just about delivery at the network level — file-based broadcasting also affects how content is played at the local level. Program elements are distributed to each location, then played (and replayed) as needed. The file-based design of the model is critical to its success.

One of the most dramatic changes broadcasters will notice immediately with file-based broadcasting is a significant reduction of bandwidth requirements. In a linear-based distribution model, repetitive content means repetitive transmission of that content. Every time a particular movie or program episode is aired or each time a song is played in a programming block, it has to be redistributed.

Consider a television broadcaster that fills a 24-hour daily schedule with repetitive hour or two hour blocks of programming. If those program blocks are simply identical to the original program block or they are scheduled to match different time zones, the network is essentially paying to retransmit multiple hours of content every day. They also miss out on additional regional marketing opportunities.

Another example of wasted bandwidth is a radio network that plays top 40 hits. If the hottest hit of the week is a four-minute song programmed to play every 90 minutes or so, that means the same song is replayed about 16 times a day. That's more than an hour of transmission time each day — and more than seven hours that week — to play the same four-minute song at different times throughout the on-air schedule.

By adopting a file-based broadcasting model, there is no longer a need to redistribute repetitive content. The distribution model builds on satellite network control systems to allow operators to both pre-position repetitive content at each downlink and send commands for playout when



required. To do this, each affiliate is equipped with a device that combines satellite receiver and media server functionality.

The model takes advantage of a network control system's ability to command a group of receivers. Expanding the ability to manipulate an affiliate database to create multiple groups or sub-sets of receivers enables operators to setup the delivery of playlists, regional advertisements or targeted programming to specific receivers. Then, using playlists, operators control what content is played, in what order, and at what time.

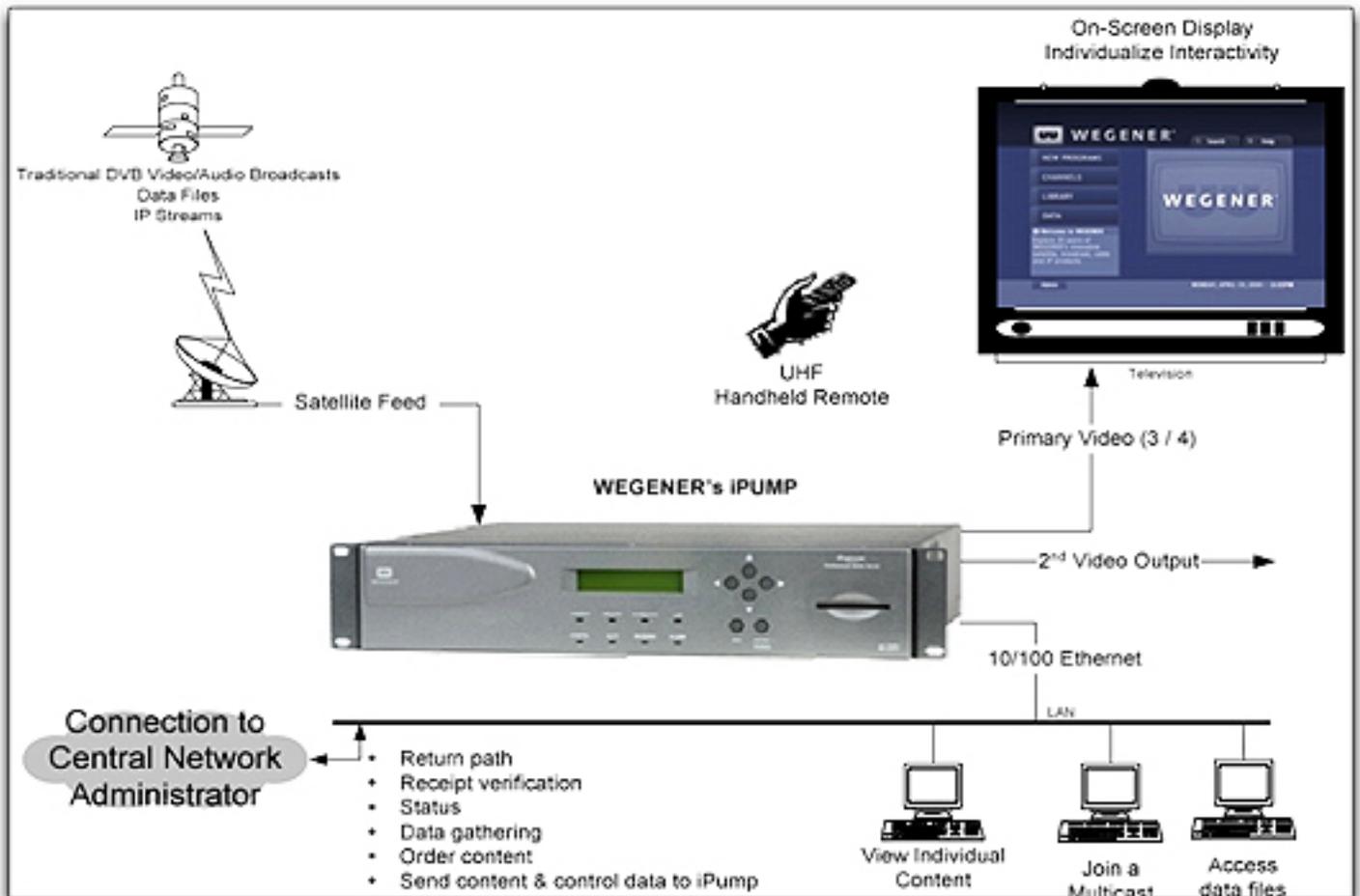
When you consider the amount of content that is repeated on quarterly or annual basis, it's easy to see how quickly a file-based approach can save on transmission costs.

Another reduction in bandwidth requirements comes from transmitting some, or all, programming content in non-realtime. Content is now just a data transfer of a file that will be broadcast at a later time. As a result,

it can be distributed at non-peak times or trickle-fed, which can shave off even more transmission costs — an important consideration particularly for video broadcasters, as the demand for bandwidth-hungry high definition content continues to increase.

File-based broadcasting naturally extends from production, where file-based workflows are currently replacing tape-based environments. A central network operator can efficiently move finished media content into the distribution pipe and manage targeted delivery to multiple sites. It opens the door for the use of more custom programming, regional advertising and, in the case of radio, custom radio announcements and station callouts. Combining content collection and playout functionality for all national and localized content into one box at an affiliate site reduces operational complexity and improves production scheduling capabilities at the network level.

Of course, it might not be feasible for an entire network to discard all of its existing hardware at each



**iPump Media Server Interfaces**

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affiliate, backward compatibility is possible to ease the transition. New file-based broadcasting solutions are designed to work with existing local ad servers and to cue local devices. File-based broadcasting also does not mean the end of local or live programming. In fact, it fully supports the blending of live and file-based content at the local level. For example, the new technology can provide automatic time zone shifting — allowing network affiliates to record a live program feed, but automatically play it out at the correct time several hours later.

An additional benefit is the ability to offer new *loss of signal (LOS)* strategies to affiliates. A network can save consumers from experiencing dead air by utilizing the receiver/server's ability to automatically switch to locally stored content during a period a live feed is not available, either due to signal loss or encryption. The network can regularly update this LOS content and associated playlist to keep it timely and, even locally, relevant.

File-based broadcasting can also improve productivity in teleports and digital satellite news gathering (DSNG) applications. For teleports, file-based broadcasting streamlines the process of ingesting and broadcasting client material, plus it increases opportunities to help clients tailor broadcasts to their affiliates. For DSNG, decoder/server units make it easy for affiliates to receive and record live feeds for later use. Plus, feeds can be augmented with pre-packaged media assets filled with related materials (graphics, scripts, web video, archival footage, etc.) from a network to affiliates for local news coverage.

The file-based distribution and broadcast model is a gateway to cost savings at the network and local levels for any video and audio broadcaster. The reduction of bandwidth usage for repetitive material can be significant, while the digital workflow can reduce operational complexity. Meanwhile, the handoff from production becomes more efficient and programming options at the network and affiliate levels more flexible. It is a logical next step for broadcasters managing video or audio, from ingest, through archive, targeted delivery, and playout.

*WEGENER's file-based broadcasting solution builds on a linear satellite network to allow operators to pre-position repetitive content at each downlink and control later playout, while mixing in live broadcasting segments. The solution includes a range of devices that combine satellite receiver with media server functionality called iPump® media servers and the corresponding network control products to manage distribution and digital assets.*

*Each iPump model features an integrated satellite receiver decoder that allows it to record or playout live streams and IP encapsulated files. It can also connect to a local area network for non-realtime file delivery, control and monitoring.*

*The WEGENER video iPump media servers handle MPEG-2 and MPEG-4 video files for commercial broadcasters or private networks, while the WEGENER audio iPump media server is specifically designed to support regionalized affiliate radio broadcasts.*

# LRIT + Ships At Sea

**T**he international shipping community is moving to implement a mandatory program that will enable national authorities to identify and track the location of ships at sea using satellite tracking devices placed on the ships.

The **International Maritime Organization (IMO)** last year adopted regulations requiring all ships subject to the *International Convention for the Safety of Life at Sea (SOLAS)* to be equipped with a satellite **Long-Range Identification and Tracking (LRIT)** device. The LRIT unit will automatically report the ship's identity and position to a database operated by the administration under which the vessel is flagged. This database may be viewed or queried by authorized LRIT data users, such as flag administrations, port authorities and national coast guards, at regular intervals.

The IMO's LRIT requirements apply to the following types of ships engaged on international voyages: passenger ships (including high-speed passenger craft) and cargo ships (including high-speed craft) of 300 gross tonnage and above, and mobile offshore drilling units.

**Iridium Satellite LLC (Iridium)**, with its global satellite coverage over all of the Earth's seaways, low-latency, two-way *short-burst data (SBD)* links and robust network quality, provides an ideal communication medium for LRIT reporting. Importantly, Iridium is the only maritime satellite system that provides coverage over the entire globe, including **IMO Sea Area A4**, comprising those areas not covered by Inmarsat or national coastal systems. This includes Polar Regions above 70 degrees north or south latitude. In other words, ships operating in Sea Area A4 can only meet the carriage requirement with an Iridium LRIT device.



## LRIT Reporting

The shipborne equipment should be set to transmit the ship's LRIT information automatically at six-hour intervals to the LRIT data center identified by the flag administration, unless the LRIT data user (e.g., national maritime surveillance authority) requesting the LRIT information specifies a more frequent transmission interval. When a ship is undergoing repairs in dry-dock or in port, or is laid up for a long period, the flag administration or *Application Service Provider (ASP)* may reduce the frequency of the transmission of LRIT information to one report every 24-hour period, or may temporarily stop the transmission of such information. The performance standard places severe restrictions on the ability of the ship's master to disable or alter the LRIT reporting intervals.

## Ship LRIT Equipment

The IMO performance standards specify that the shipboard equipment must:

- **Be capable of automatically — and without human intervention — transmitting the ship's LRIT information at six-hour intervals to an LRIT data center.**
- **Be capable of being configured remotely to transmit LRIT information at variable intervals.**
- **Be capable of transmitting LRIT information following receipt of polling commands.**
- **Interface directly to the shipborne global navigation satellite system equipment, or have internal positioning capability.**

- Be supplied with energy from the main and emergency source of electrical power.
- Be tested for electromagnetic compatibility per IMO recommendations.
- The following requirements must also be completed for all LRIT devices intended to operate on the Iridium satellite network:
  - » The LRIT device must be tested and certified by Iridium for interoperability via the Iridium satellite network.
  - » It must be type-approved by the ship's flag administration.
  - » It must be tested by an ASP authorized by the ship's flag administration to conduct LRIT conformance testing.

uniform latency, is highly reliable and ensures commercially confidential transmission mechanism for LRIT transmissions. Plus, the service supplies flexible options with its global network of ASPs and Value-Added Manufacturers that offer a range of customizable and cost-effective dedicated Iridium LRIT services. There's unparalleled reach and unrivaled coverage with Iridium's constellation of 66 cross-linked satellites in low-earth orbit — every location on the face of the Earth is covered by one or more satellites. There's full interoperability with all ASPs — an important consideration when ships move from one flag to another.

In recent months, Iridium has signed agreements with four leading ASPs — **Absolute Software**, **Collecte Localisation Satellites (CLS)**, **Fulcrum** and **Kemilinks**. Together, these companies provide LRIT services to the ships flying the flags of the major maritime states. Iridium has also tested and certified LRIT devices from several VAMs to transmit data across the Iridium network. These products include **CLS Thorium**, **EMA BlueTraker®** and **Faria WatchDog®**.

### Iridium Value Proposition

Iridium SBD service offers a unique value proposition for ships to help them comply with the LRIT requirements by providing a dedicated, high-performance terminal and secure communication service that meets or exceeds all IMO communication service provider requirements. The Iridium SBD service offers low

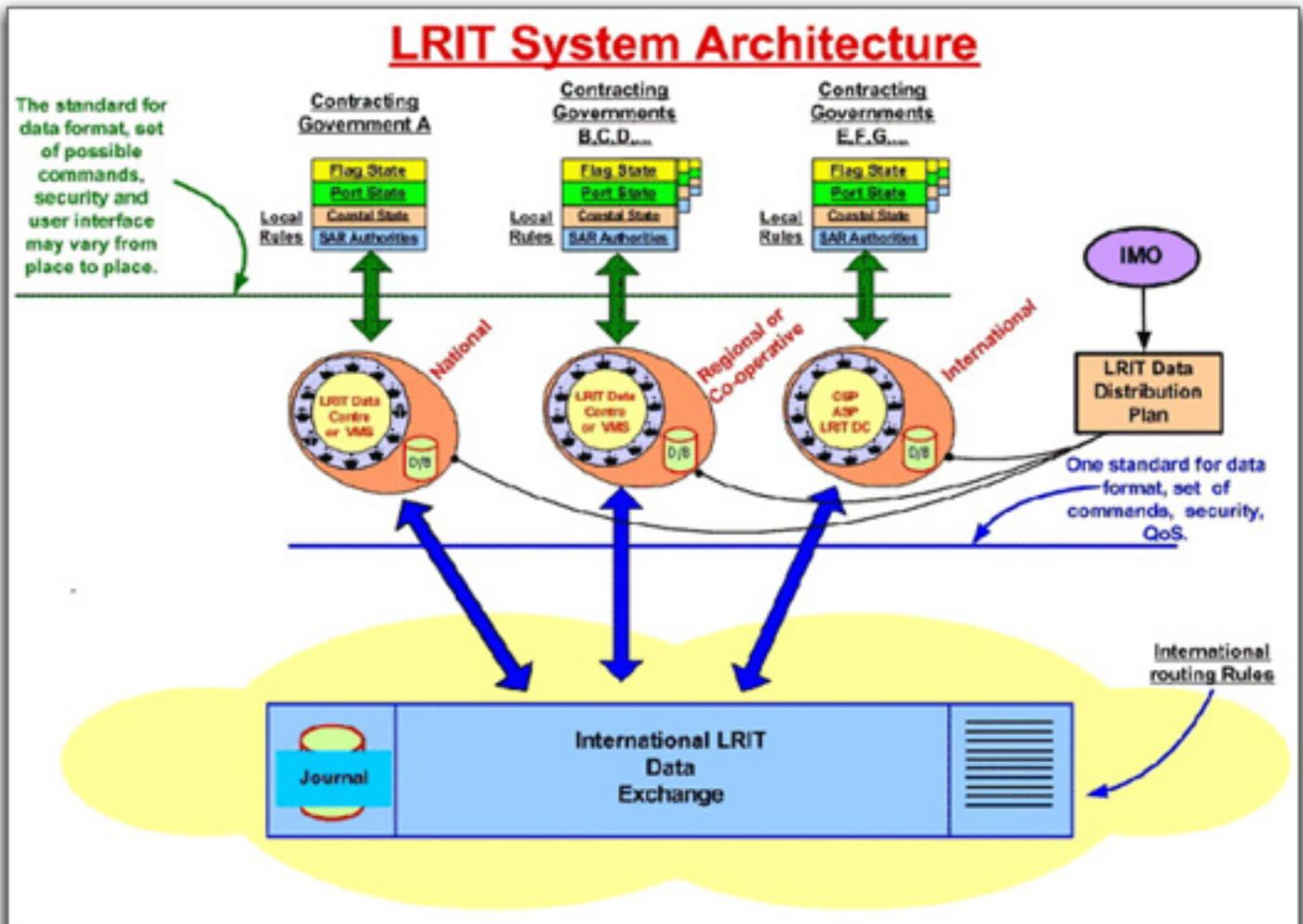


Diagram courtesy of National Maritime Safety Authority (NMSA)

# Executive Spotlight On...

## Dave Bettinger, CTO + Sr. V.P., iDirect

**R**ecently announced by iDirect are two ground-breaking upgrades to its Evolution hardware line and operating software. Dave Bettinger, iDirect's chief technology officer took a few moments to fill in *SatMagazine* on the details of these next-generation enhancements.

Mr. Bettinger joined **iDirect Technologies** as the Director of Hardware Engineering in 1996 and became responsible for all hardware and software development as the Vice President of Engineering in 2002. In his role as Chief Technology Officer, he is responsible for the oversight of all technology decisions within iDirect and serves to drive the strategic direction for product development. In addition to being the lead system architect for iDirect's flagship **NetModem** and **INFINITI** series products, Mr. Bettinger is also active in industry standards organizations and forums and is a member of the *Telecommunications Industry Association, IEEE* and the *IPv6 Forum*.

He currently serves on the Board of Directors for the *Global VSAT Forum* and has been active in the satellite networking industry for more than 15 years. Previous to iDirect, Mr. Bettinger was a senior member of the technical staff at **Hughes Network Systems** in the *Satellite Networks Division*. Mr. Bettinger is a graduate of **Virginia Tech** with a Masters of Science degree in Electrical Engineering.

# Executive Spotlight On...



**iDirect's Evolution X5 Satellite Router**

## **SatMagazine (SM)**

Dave, would you tell us about iDirect's latest hardware and software additions?

### **Dave Bettinger**

iDirect has expanded its **Evolution DVB-S2/ACM** product line with the high-performance **Evolution X5 Satellite Router** and two new line cards, coupled with an upgrade to iDirect's operating software, **iDX 2.0**. For service providers, the suite of new features delivers greater hardware processing power to boost network capacity and performance, a breakthrough in inbound bandwidth efficiency and expanded network design flexibility to differentiate service offerings and increase end-user satisfaction.

### **SM**

Can you explain the 'Power of 2' theme that surrounded this new product launch?

### **Dave Bettinger**

The 'Power of 2' represents the performance and efficiency gains that iDirect has packed into this release.

With iDX 2.0, our customers gain the ability to support dual operating modes on the same hub, along with all hardware. This enables the complete integration of *Evolution* and *iNFINITI* products as well as iDirect's enhanced feature set into one platform.

iDX 2.0 also integrates two of iDirect's advanced networking technologies: *Group Quality of Service (QoS)* and *Adaptive Coding and Modulation (ACM)*. By coupling these technologies, service providers can design and enforce "fair service" pricing models and create associated service level offerings at differentiated price points. They also have the ability to improve customer satisfaction in geographies commonly affected by adverse weather conditions.

Customers will also benefit from *2D 16-State*, another built-in feature of iDX 2.0. *2D 16-State* is the most powerful inbound coding option available today, providing a 10 to 20 percent increase in inbound IP throughput without sacrificing link performance.

### **SM**

How does the new Evolution X5 router improve upon current product standards?

The graphic features the iDirect logo at the top left. Below it is a large blue number '2' with 'iDX 2.0' written underneath. To the right of the '2' is a dark blue box with the text 'Operating Software'. Below this box are three horizontal bars: a blue bar for 'Hub Series', a green bar for 'Satellite Router Series', and an orange bar for 'iVantage™'. At the bottom is a large blue arrow pointing downwards with the text 'Endless IP Applications'. To the right of the '2' is a dark blue header for 'Operating Software'. Below this header is a text block: 'iDX 2.0 delivers new gains in bandwidth efficiency and service flexibility – from the most powerful inbound coding technology on the market to new options that guarantee data performance in adverse weather conditions.' Below the text is a link: 'Click on a feature to learn more.' To the right of the text are two small icons: the top one is a graph labeled '2D 16-State Inbound Coding' and the bottom one is a network diagram labeled 'GQoS/ACM'.

# Executive Spotlight On...

## **Dave Bettinger**

The X5 is an extremely flexible and powerful dual-mode remote that supports high-speed, high-efficiency IP broadband connectivity. Operating at twice the processing power of iDirect's Evolution X3 router, the X5 enables service providers to support higher data rates and greater traffic volumes to meet increased customer demand across a wide range of growing vertical markets.

The Evolution X5 can operate in DVB-S2 or iNFINITI mode, making it very versatile in its deployment. The hardware supports various software enabled options such as AES encryption and spread spectrum. Unlike the X3, *Global NMS* and *Automatic Beam Switching* are standard on the X5, allowing seamless roaming as it passes through several iNFINITI or DVB-S2 networks around the world.

## **SM**

Are these new features targeted towards any specific iDirect customers?



**Dave Bettinger**



2.0, service providers in verticals such as cellular backhaul, maritime, international defense, and high-end enterprises including banking and financial institutions can benefit from a newly enhanced product line.

## **Dave Bettinger**

iDX 2.0, when used with any of the Evolution products, will be geared towards commercial and government iDirect customers that want to either use DVB-S2 now or have plans to use it in the future.

When combining the X5 launch with the advanced features in iDX

## **An Intelligent Platform?**

***The benefits of true enterprise connectivity touch nearly every facet of the enterprise, providing greater efficiencies, lower operating costs and increased productivity. Whether it's enabling faster, more secure financial transactions, assuring business continuity through network failures, or keeping a mobile, disperse workforce trained, IP connectivity drives business success.***

### **Solution Overview**

***iDirect technology is trusted to support critical IP applications across the enterprise, providing the essential integration across terrestrial and satellite networks and platforms.***

***Whether it's VoIP, VPN, streaming media, Internet access or data backup, iDirect's advanced technology is an essential part of global enterprise networks everywhere, enabling workers from headquarters to the most remote offices to better connect and collaborate, and share information.***

***The iDirect Intelligent Platform™ is an easily deployable, efficient, fully encrypted solution that supports all the voice, data and video communications requirements with high network availability. It can be seamlessly integrated into terrestrial infrastructures. iDirect's unique IP-based approach to shared bandwidth significantly reduces satellite capacity by dynamically allocating bandwidth between enterprise locations based on a bandwidth pool, providing a more efficient and cost-effective option. Award winning Group QoS allows for intelligent and extremely efficient bandwidth sharing and priority management while mapping to terrestrial CIRs and established SLA guarantees. iDirect networks allow service providers to establish real private networks with unmatched reliability and security, easily controllable from iDirect's powerful network management software iVantage®.***

***With extremely efficient bandwidth technologies such as iDirect's DVB-S2/ACM implementation and large scalability of its hubs, networks can easily be scaled from just a few sites to several thousand sites.***

# The Power + The People

by Carri Karuhn

**A**pril 1, 1960 — a Thor rocket engine developed by what is now **Pratt & Whitney Rocketdyne** powered the first successful spacecraft into orbit to take pictures of Earth's clouds. Images from the **Television Infra-red Observation Satellite (TIROS-I)** which were dark and grainy, but they proved — for the first time — a satellite could be used to survey global weather conditions from space. Pratt & Whitney Rocketdyne went on to boost increasingly sophisticated weather satellites over the years that produced clear, crisp images in startling detail. Most recently, the company's **RS-68** engine helped launch the latest **Geostationary Operational Environmental Satellite**, designated **GOES-O**, enabling scientists to monitor weather that leads to tornadoes, flash floods and hurricanes.

Over the history of U.S. satellites, Pratt & Whitney Rocketdyne has provided the dependable thrust to place them into orbit. The **RS-68** is one of the newest advances in large engine propulsion that makes it possible to place some of the heaviest satellites into space. However, such wouldn't be possible without the talented people who actually design, develop and test the launch engine.

“An early warning system is absolutely critical when dealing with unpredictable weather that can impact so many people,” said *Craig Stoker*, RS-68 program manager, Pratt & Whitney Rocketdyne. “It's a great feeling knowing we're involved with such an effort.”

The RS-68 is unique because it is the world's largest hydrogen-fueled engine, generating 17 million horsepower — the equivalent of 11 Hoover Dams. Standing 17 feet tall with an eight-foot diameter, the RS-68 consumes a ton of fuel per second, with a thrust of 656,500 pounds.

The RS-68 has boosted satellites that assist the military in intelligence applications and monitor the environment for elements such as deforestation in the Amazon basin or the effect of climate change on glaciers in the Arctic. The **Delta IV** also launches satellites that supply communications, global positioning, and navigational systems to help even the most wayward motorists find their way.

The RS-68 has proven so successful that, in 2006, NASA announced six of the engines would be used on **Ares V**, the large cargo launch vehicle scheduled to deliver hardware to the moon. The **United Launch Alliance (ULA)** also recently commissioned a modified RS-68, known as **RS-68A**, to power heavier payloads than currently possible with its predecessor.

“The RS-68 engine’s reliability is the key to powering the Delta IV first-stage booster that has deployed a variety of spacecraft into orbit including weather satellites,” said *Jerry Jamison*, ULA vice president, Launch Operations. “The RS-68 powered two

separate Delta IV medium vehicles that launched NASA and National Oceanic & Atmospheric Administration’s GOES-N and GOES-P satellites that will improve weather forecasting for decades to come. Pratt & Whitney Rocketdyne’s RS-68 engines have served as the crucial first step in powering 11 successful Delta IV missions, including three Delta IV Heavy missions, since 2002.”

Pratt & Whitney Rocketdyne engineer *Kurt Coffman* became fascinated with space exploration as a child growing up in California’s San Fernando Valley, where rocket engines were built and tested — including the massive **F-1** engine, which lifted **Apollo 11** on its maiden voyage to the moon 40 years ago. As a boy, he remembers ice skating at a local shopping mall and seeing a real F-1 engine on display across the street at Pratt & Whitney Rocketdyne’s headquarters in Canoga Park. He wondered what people did at the building, and what that engine was. Then Apollo 11 landed on the moon and he learned Pratt & Whitney Rocketdyne manufactured the engines that helped make that mission possible.



**Saturn V + It's F-1 engine boosts Apollo 11 into space**

"I was proud and fascinated to know this was all happening down the road in my hometown," he said. *Coffman* went on to get a mechanical engineering degree from **Cal State Northridge**, just seven miles from the Canoga Park building. He landed a job at Pratt & Whitney Rocketdyne, where he worked hands-on with technicians putting all the parts together on the RS-68.

To help accommodate the new engine for its first hot fire test, *Coffman* helped configure the test stands, first at **Edwards Air Force Base Research Laboratory** in California, and later, **Stennis**

**Space Center** in Mississippi. But the real thrill comes when he experiences launches in person.

"Watching as the very first Delta IV lifted gloriously toward the heavens was one of the highlights of my life," said *Coffman*, who now leads the Pratt & Whitney Rocketdyne team that monitors data and engine health systems prior to flight to make sure the rockets are ready for lift-off. "It was very emotional and spectacular, shaking Cape Canaveral Air Force Base with all its power. It's very rewarding to know we help put satellites into orbit so they can do their important jobs."

*Nacer Thomas*, a senior engineer working in the systems analysis group for the RS-68, was fascinated with exploration while growing up in Haiti. He would often be found drawing rocket boosters in his school notebooks while sitting in class. *Thomas* remembers being glued to the TV, overcome with sadness when Space Shuttle *Challenger* broke apart, killing all seven of its crew members and stunning the world.

*Thomas* immigrated to the United States, earning a mechanical engineering degree from **Purdue University**. Pratt & Whitney

Rocketdyne hired him as an entry-level engineer on the **X-33**, the prototype for a reusable launch vehicle for NASA. *Thomas* later transferred to the RS-68 program, where he evaluates the rocket's engine performance to ensure it satisfies the customer's performance requirements. This requires constant review of the data to ensure the engine's components are performing perfectly.

To this day, *Thomas* is overwhelmed when he sees the smoke and fire that signals a successful engine test at Stennis Space Center. "It's always a special feeling to see and feel the RS-68 engine roar into action," said *Thomas*. "That experience never gets old. Every time is as exciting as the first."

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*Jeffery Hagel*, a mechanical staff engineer who has worked at Pratt & Whitney Rocketdyne for 27 years, still remembers standing at the test stand's perimeter fence during his first experience at a hot-fire test.

"The immensity of this rocket's engine becomes immediately obvious when it lights off," said *Hagel*. "The sound is an ear-piercing roar with intense flames that give way to white cracking clouds of steam."

A retired Pratt & Whitney Rocketdyne employee who was working as a professor in mechanical engineering at the **University of Oklahoma** inspired *Tammi Covarrubias* to join the company. Pratt & Whitney Rocketdyne hired her directly from college, and she currently works as a systems' hardware engineer on the RS-68. Her responsibilities include ensuring the engine hardware is acceptable for flight and resolving concerns that could arise during engine assembly to lift-off.

"It is sometimes easy to get caught up in the smaller picture and be too focused on some small piece of hardware that you are responsible for, forgetting that we as a team are responsible for so much more," said *Covarrubias*. "The engines we work on supply the power that gets satellites where they need to be. From weather satellites to national defense satellites, we can and do make a difference."

All of the engine parts are delivered to Stennis Space Center, where Pratt & Whitney Rocketdyne has set up shop to assemble the RS-68s and conduct test firings. After the engines pass all of their tests, they are installed on the Delta IV rockets in preparation for final countdown.

"I have had the pleasure of being at events and speeches where the Air Force has described the benefits of our work, recognizing that the satellites we help put into space save lives and provide data to preclude another 9-11," said *Stoker*. "When you watch a weather report that provides early warning to help people avoid another Katrina-type disaster, you realize Pratt & Whitney Rocketdyne makes that warning and information possible by launching many of the satellites that provide the weather data we take for granted. We are incredibly proud to be a part of such important missions."



## Protecting Endangered Whales New Apps In SCADA/M2M Emerging Markets Area

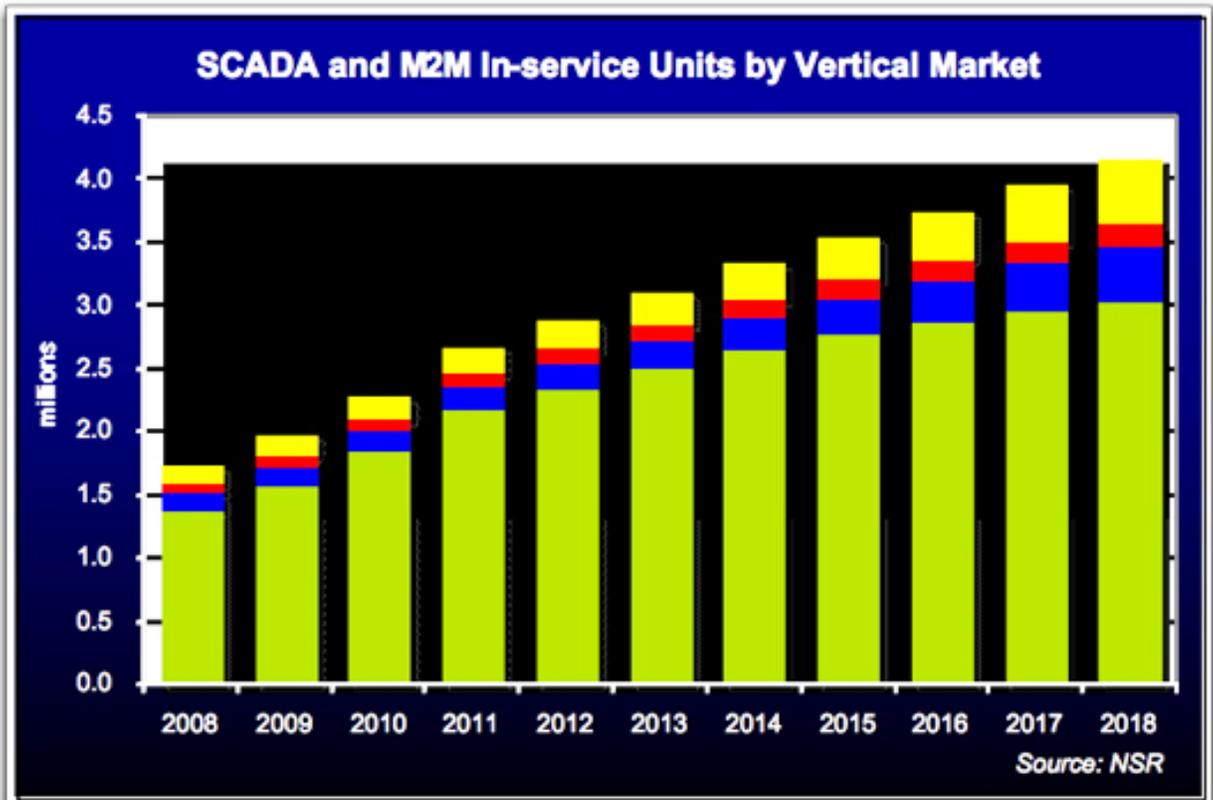
**E**ndangered whales are being protected from their biggest threat with the help of Inmarsat safety services. After almost being wiped out by whaling before its ban in 1935, North Atlantic right whales are facing extinction through collisions with commercial ships and entanglement in fishing gear. With only 350 to 400 right whales remaining, the International Union for Conservation of Nature (IUCN) lists them as one of the most endangered whale species.

### Novel Idea

To address the problem, a mandatory ship reporting system (**MSR**) developed by the **U.S. Coast Guard** and **National Oceanic and Atmospheric Administration (NOAA)** is helping vessels steer clear of the whales in the busy shipping lanes that cross their habitats. MSR provides ships with the most up-to-date sightings from NOAA so they can watch out for, and make way for, the whales, which reach 18 meters (59 feet) in length. The sightings are received via **Inmarsat C** or as standard Internet-based emails.

The idea is so simple, which makes it so brilliant. When a vessel reports its entry into one of two reporting areas, off the Massachusetts coast, or the right whales' calving waters off Georgia and Florida, the MSR system provides the vessel with a whale location report and precautionary advice on how to avoid collisions. An interface with the U.S. Coast Guard's vessel management data provides ship routing information, determines system compliance and identifies possible violators. To date, MSR has received and processed more than 2,000 ship report records.

The application is not limited to protecting whales by monitoring ships and their routes. The application can be extended by tracking the whales themselves via satellite monitors and can, likewise, be applied to other endangered species. Whether the animals are marine-based, land-based, or take to the skies, animal tracking technologies via satellite can serve many purposes.



Migration patterns, temperature readings and other measurements can be taken to serve scientific and conservation goals.

### ***Inter-agency Cooperation***

This example set by Inmarsat's solution and application reveals that two agencies, U.S. Coast Guard and NOAA, are working closely together to address the problem. The example above is in a way "easy," as the whales have a habitat that these agencies can track within their territorial waters.

However, the overarching policy of protecting endangered marine species becomes bureaucratically problematic if the animals are migratory, or their patterns and habits cover large ocean regions that may be under the jurisdiction of several countries. Moreover, the effect of climate change and other environmental impacts may lead to a change in the habits of species, forcing them to leave or find other habitats — such necessitates coordination of policy with other countries.

Protection of whales and other marine species is one application and requirement that will likely involve more agencies within and outside the United States as marine life travels and migrates to different regions of the globe. Protecting certain species in one ocean area is useless if the same migratory species is not protected in other ocean regions.

Territorial jurisdiction will dictate the role other agencies around the globe will have to play in the future. The global agenda is still not quite global as fishing practices, Law of the Sea issues and other maritime policy differences exist among nations. However, the net effect actually has the potential to increase the need for satellite communications, whether the agenda shifts to truly global proportions or remains dominated by a handful of nations.

In the first scenario, a truly global agenda obviously drives SATCOM procurement as the maritime authorities and scientific agencies of many nations cooperate and track ships in the path of migratory species, such as whales.

In the second scenario, a conservation agenda dominated only by a handful of nations that are suspicious of countries that do not adhere to international treaties will lead those treaty nations to increase their reach in order to protect these animals outside their territorial borders. They accomplish this by enabling organizations that do have that international reach, such as the United Nations and other international agencies.

### ***Bottom Line***

- ***The role and advantage of satellite technology is easy to see in the example of protecting whales. Only satellite technology can support this specific application due to coverage issues.***
- ***As the global agenda in saving endangered species progresses, tracking migratory patterns and the effects climate change has on animals that may be threatened over the long term becomes more serious. Satellite technology will become even more important as an important part of the solution for addressing these issues.***
- ***The market forecasts provided by NSR on the "Emerging Market" front can easily double over the course of the forecast period. The market dynamics really depend on the seriousness and policy initiatives forwarded by governments on conservation, protection, climate change and environmental impact.***

# Enlightenments: Events

**T**here are any number of exhibition trade shows in a year for our industry. Most are certainly worthwhile to attend, if for nothing more than catching up with our peers and to see what's flying, SATCOM-wise. Then there are the **MUST ATTEND** shows — CCW's SATCON is in this category. Being situated in the financial hub of our nation, and having been an exemplary trade show for several years, this event is actually three shows in one. One pass to SATCON allows you to also experience HD World and the IP Media Expo. What a bargain!

This **SATCON** premier conference and exhibition for satellite communications and content delivery assists attendees in developing their crucial strategies to manage communications infrastructure, including video, data, voice and Internet, using hybrid networks including satellite, fiber, mobile and wireless. With economies of scale and expenditures currently on everyone's minds, this show offers such a broad range of information — the expense involved is justified in a results-driven ROI.

This conference features more than 50 end-user speakers who discuss real-world issues and solutions for a variety of markets including:

- **Media & Entertainment, Broadcast & Cable**
- **Military, Defense and Homeland Security**
- **Federal, State and Local Government**
- **Telcos & ISPs**
- **Utilities**
- **Education & Training**
- **Emergency Response, Relief and Non-Governmental Agencies**
- **Retail & Hospitality**
- **Financial, Banking & Insurance**
- **Energy, Oil & Gas**
- **Healthcare & Pharmaceuticals**
- **Maritime & Shipping**
- **Transportation & Fleet Management**
- **Government Contractors**
- **Service Providers, Integrators and Resellers**

SATCON is a perfect mix of buying power, timing, and ease of access. In today's economy, you must go to the market to acquire new business. SATCON is in the heart of your market, with many buyers a short cab or car ride, train, or shuttle flight away. Plus, the early 4th quarter time frame is ideal to meet with technology and business executives to discuss your current projects.

For information on exhibits, sponsorships, advertising and sponsored speaking opportunities please contact David Reynolds, Sales Director at **203.371.6322 ext. 205** or email [dreynolds@jdevents.com](mailto:dreynolds@jdevents.com).



## Satellite Broadband In Europe + North Africa

by Maxime Baudry

**A**fter mild success in the early 2000s, new opportunities have opened up over the past two years in two-way satellite access, particularly in North America, Asia, as well as in Europe.

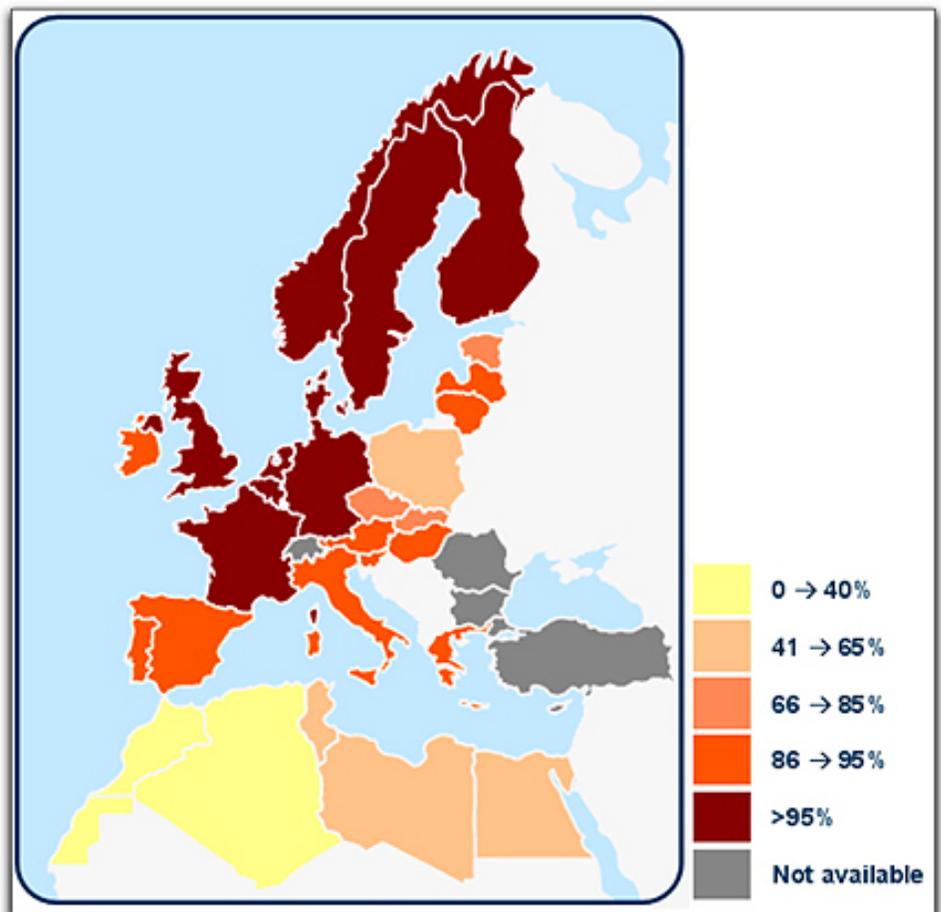
In addition to the substantial decrease in the price of satellite terminals, the introduction of Ka-band frequencies, thanks to spectrum reuse, has been largely responsible for the revival. In addition to available capacity, the central issue for satellite operators when implementing this frequency band is the lower cost of employing it: overall, the current price per Mb for the Ka-band is four to 10 times less than for the Ku-band. This means consumer prices are substantially lower than they were five years ago, spurring faster take-up by users in the zones targeted by the technology.

Encouraged by the advancements being made, several European satellite operators have recently launched, or are about to launch, satellite services in the Ka-band. However, given the competition from wireline and wireless terrestrial technologies, what is the actual market outlook for satellite technology? What positioning strategies will be most suited for a satellite operator, taking account of the particular features of the broadband market, in the various targeted geographical zones?

### **DSL Network Coverage + Bitrates**

It appears that broadband coverage by terrestrial networks (DSL and cable) is still limited in rural areas. The level of a country's terrestrial broadband coverage, a chief indicator of the competitive environment, has a relevant impact on market opportunities for satellite Internet access solution.

Western Europe is well covered, with rates that often well exceed 95 percent of the population being covered. Eastern Europe



**Figure 1: Total DSL network coverage in 2008 (% of population)**

Source: iDATE

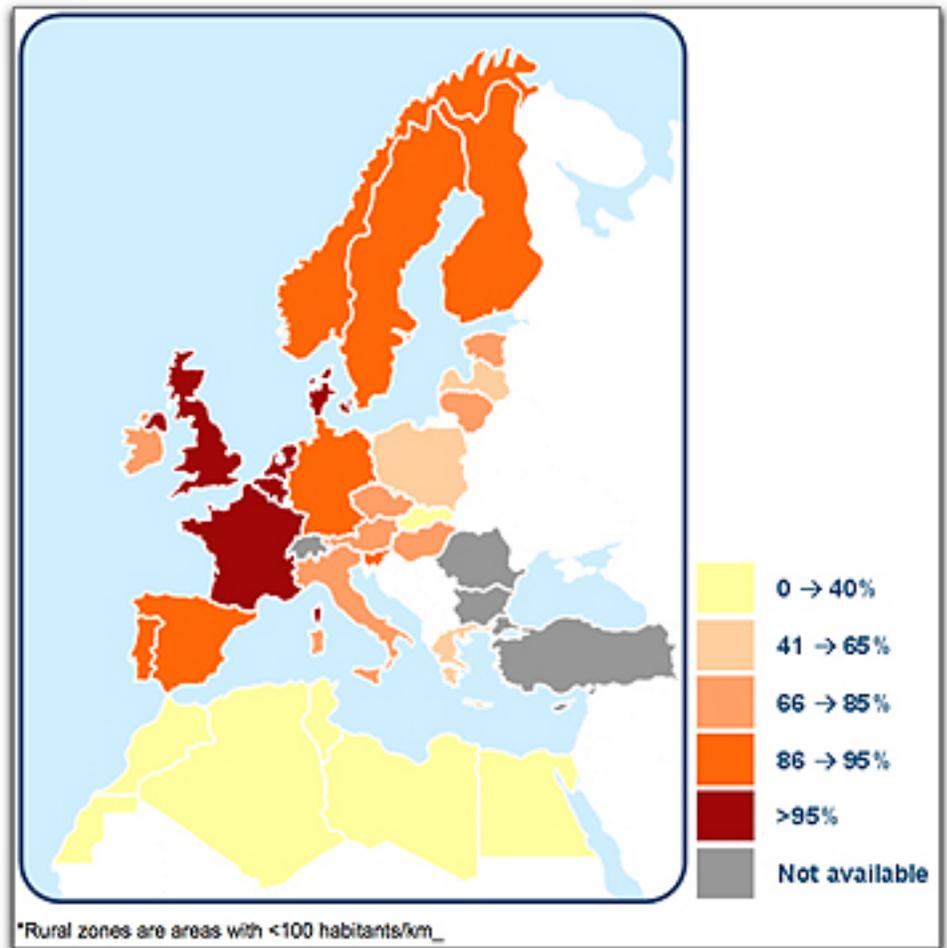
still lags behind Western Europe, although this region is catching up — its largest markets, such as the Czech Republic (85 percent) and Poland (64 percent) continue to report coverage rates that are well below those found in Western Europe.

Meanwhile, North Africa is characterised by a dire lack of fixed infrastructure. In 2008, only Egypt, Tunisia, and Libya were reporting coverage for more than half the population, while Morocco, at 16 percent, is the country with the lowest wireline network coverage. (See Figure 1 on the previous page.)

Urban and suburban coverage rates in Western Europe are naturally very high, and in many cases, close to 100 percent. A migration to ultra-fast broadband (VDSL, FTTx) is underway in these zones, thanks to existing or scheduled rollout plans. In France, for instance, several FTTx deployment projects are underway in the country's largest cities, operated by both the incumbent carrier, **France Telecom**, and by alternative telcos such as **Free** and **SFR/Neuf Cegetel**.

Eastern Europe has been gradually making up for lost time over the past few years but, without exception, a rate of 95 percent coverage in urban zones is not expected to be achieved until 2010 at the earliest. As to North Africa, coverage is meagre in the major cities where coverage can vary considerably from one neighborhood to the next.

Analyzing the rate of coverage of the rural population is central to establishing whether a market is a potential target for satellite access, as these are the areas where satellites can best compete with terrestrial technologies, thanks primarily to the broad coverage provided by orbits 36,000 km above the Earth.



**Figure 2: DSL coverage of rural areas in 2008 (% of population)**

**Source: iDATE**

A detailed study of coverage rates reveals massive disparities between zones and even between countries in the same zone. In 2008, the rate of coverage of the rural population in several countries in Western Europe was below 85 percent, with cases in point that include very populated countries such as Austria, Ireland and Greece. The rural population in central and Eastern Europe was even less well served by wireline networks, with the average rate of coverage nearing 65 percent. And, lastly, the rural populations of North Africa are not covered by broadband networks at all and, as it stands, there are few government initiatives aimed at changing the situation which is therefore likely to continue as is for some time to come. (See Figure 2 above.)

Concerning access speeds, residential DSL services differ considerably, depending on the user location

(urban/suburban or rural zone). On the whole, most have access to a very high-speed service (more than 2 Mbps), which made real strides between 2005 and 2008, as shown in the chart below. It is likely that the speeds offered to subscribers will increase in the coming years, as telcos roll out FTTx technologies.

(See Figure 3 below.)

The bitrates delivered over cable are also very high, generally more than 1 Mbps, and there is little difference between the service provided to urban/suburban users and those located in rural areas.

As with DSL, it is likely consumers will be offered faster services as cablecos upgrade their infrastructure to be able to compete with the speeds offered by ADSL2, VDSL and FTTx technologies.

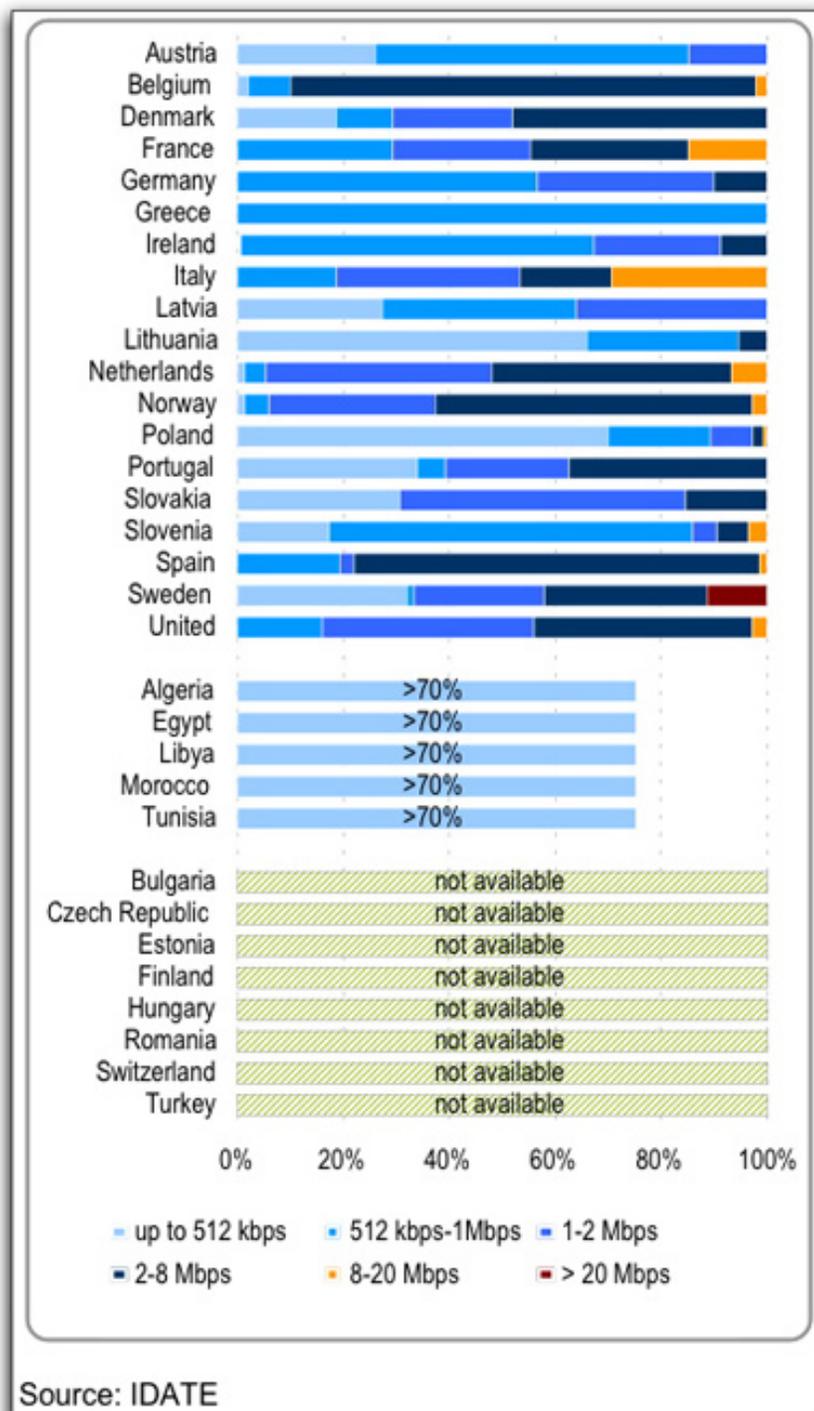
However, iDATE notes that in several cases, subscribers can actually have a subscription to a high speed broadband package but in reality have speeds of only 512 Kbps, depending on their locations from the DSLAM.

iDATE estimates that in 2008 there were more than 30 million households in Europe and North Africa that still did not have access to broadband, compared to 37 million in 2007 — a high percentage of them residing in North Africa where landline infrastructure is still extremely limited.

### Satellite, WiMAX, 3G... Who's Going To Win?

Covering broadband dead zones requires sizeable investments that telcos have no obligation, and perhaps no economic reason, to make. In many cases, providing these areas with coverage requires government intervention, starting with the involvement of local authorities.

The choice of a satellite or a wireless solution is often the result of a compromise between technical efficiency and cost-effectiveness, but also depends on a political desire that favors one solution over another. In mid-2008, Ireland issued a call for candidates as part of its "*National Broadband Scheme*" aimed at covering households that were not eligible for DSL. After several months of deliberation, it was ultimately a 3G-based solution proposed by mobile operator **3 Ireland** that was selected. **BT Ireland** had proposed an



**Figure 3: End-user DSL bitrates in Europe and North Africa in 2008**

offer based on WiMAX, which it ultimately withdrew, considering it too costly to deploy when compared to the spectrum licences awarded by the Irish regulator. It appears, however, that 3 Ireland is having some economical issues with 3G in rural areas... and is actively looking at satellite technology.

In France, national regulator **Arcep** is also pushing for a WiMAX-based solution, but is by no means hostile to a satellite solution. However, it has recently indicated that the WiMAX technology experienced great delays in terms of deployment, and similar cases are found with several other European countries. The regulator has admitted that satellite does have the advantage of being immediately available, but also points out a number of weaknesses, including the inability to serve all ineligible households, the caps on traffic that are often imposed, and the price of the CPE which, even though it has dropped substantially over the past few years, still remains high.

3G, meanwhile, is not considered as a serious alternative in the short term, notably because the technology does not cover dead zones and that its terms of use, especially its price and traffic caps, are still a major obstacle.

Despite its minor weaknesses, satellite currently remains the best and most cost-effective technology to cover white zones. With the coming launch of highly capable satellites such as **Ka-Sat (Eutelsat)** and **Hylas-1 (Avanti)**, iDATE expects a strong boost to satellite subscriber bases over the coming years.

*About the author*

*Maxime Baudry joined iDATE as a senior consultant in April of 2006. His main area of endeavor is monitoring the satellite industry, the telecommunications services market, and operator strategies. Before coming to iDATE, Maxime worked two years for a strategy consulting firm that specialized in the space industry, where his work focused primarily on analysis of satellite telecommunications for space agencies and the sector's equipment providers.*



## Five New Stars In The Sky — RapidEye

**T**oday, the use of GIS technology is of growing importance for governmental and private economy bodies. A GIS is the main tool for collecting, managing, manipulating and visualizing data, referenced to a certain place on Earth. Already now most of monitoring and decision making processes are not feasible without modern GIS technologies.

However, the power of GIS technologies is limited by the unavailability of geo-data. While in larger scale applications for local governments or for limited areas land survey techniques are preferable, for larger areas (smaller scales), regions or even countries, remote sensing technologies are most appropriate.

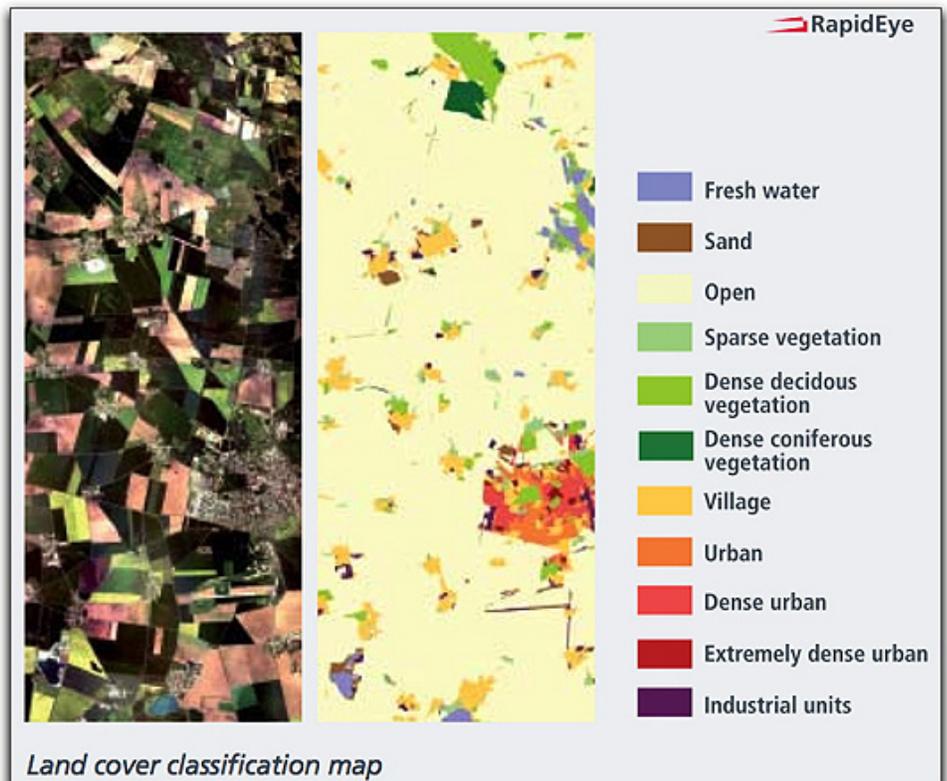
**RapidEye AG**, Germany, launched its own satellite system August 29th, 2008. The RapidEye satellite constellation is the first, and currently the only, operational system that is able to repeatedly image larger areas in short intervals up to 24 hours. With its capability to produce orthorectified imagery with 5m resolution in 5 spectral bands (including a red-edge band), it is an ideal data source for monitoring tasks in the fields of environment, agriculture, and forestry.

The advantage provided by RapidEye is data availability and quality. The Company provides a wide spectrum of services for clients in our core markets: *Agriculture, Forestry, Energy and Infrastructure, Spatial Solutions, Emergency Analysis* and *Environment*. A few solutions will be presented in detail: crop typing, field boundary extraction, crop condition assessment, forest monitoring, and change detection for infrastructure and environmental purposes.

### Bring On EO

The development of Earth observation (EO) satellites allowed for high and very high spatial resolutions. Currently, systems with 0.6m resolution are available and others with as much as 0.4m resolutions are being manufactured. The use of satellite remote sensing applications in a number of application areas is still somewhat limited, especially in cases where information is needed at

a predefined moment in time, where imagery is needed with a high repetition rate, or where image availability *must* be guaranteed. High repetition rates, for instance, are necessary for multi-temporal investigations, based on plant growth models, in agriculture and forestry, for monitoring applications, for ecological tasks,

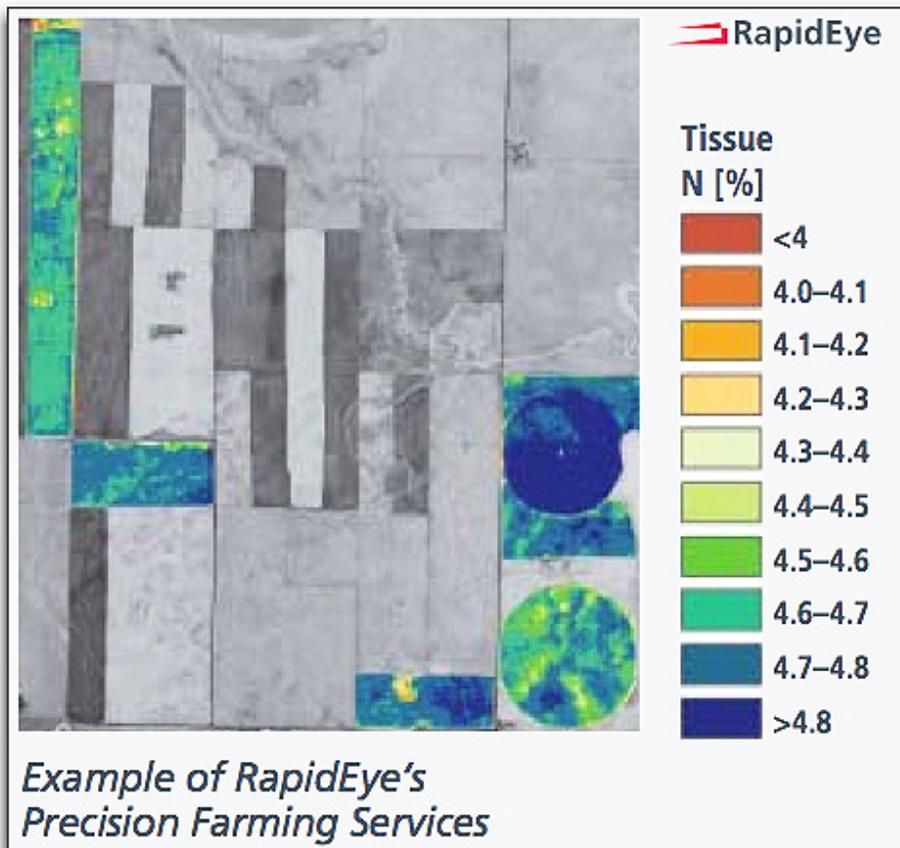


as well as for land cover classifications. As the image availability for optical systems is highly dependent on a lack of cloud coverage, only a high repetition rate can increase the probability of image acquisition. The temporal aspect of data acquisition, and therefore the probability of image availability in a given time frame, has an increasing impact on the acceptance and usage of remote sensing technologies.

### **The RapidEye System + Approach**

Based on the limitations discussed above, the concept for the RapidEye satellite system was developed as a solution. The core capability of the system had to be a high temporal resolution in combination with high spatial resolution and large, daily area coverage. The relationship between ground resolution and area coverage was optimized to 6.5m ground sampling distance, resampled to 5m pixel size, and a 77 km swath width for the sensor. With a system comprised of five satellites in a nearly polar orbit, any point on the Earth's surface can be accessed every 24 hours. Each satellite performs 15 orbits per day, and the whole system can cover as much as 4 million square kilometers per day (within the mentioned specifications). Each of the satellites is equipped with a multispectral imager, designed as pushbroom-scanner with 5 CCD lines, one for each spectral channel. The integrated image memory is capable of storing

an overall length of 1,500 km of image stripes in 5 spectral bands. During image sessions, the camera can be switched on and off to spread the image capacity over the entire orbit. Further, every satellite is equipped with a tilting system — this enables RapidEye to point the satellite to an area located to the left or to the right from the nadir-looking footprint. Large continuous areas, such as the sample of Eastern Europe, can be fully covered in a few days.



25 km with 5m pixel size, ready to be loaded into any GIS. Optional atmospheric correction can also be applied. The tile size is an internal storing solution. Customers can order data for individual areas of interest and will be charged for the ordered area only.

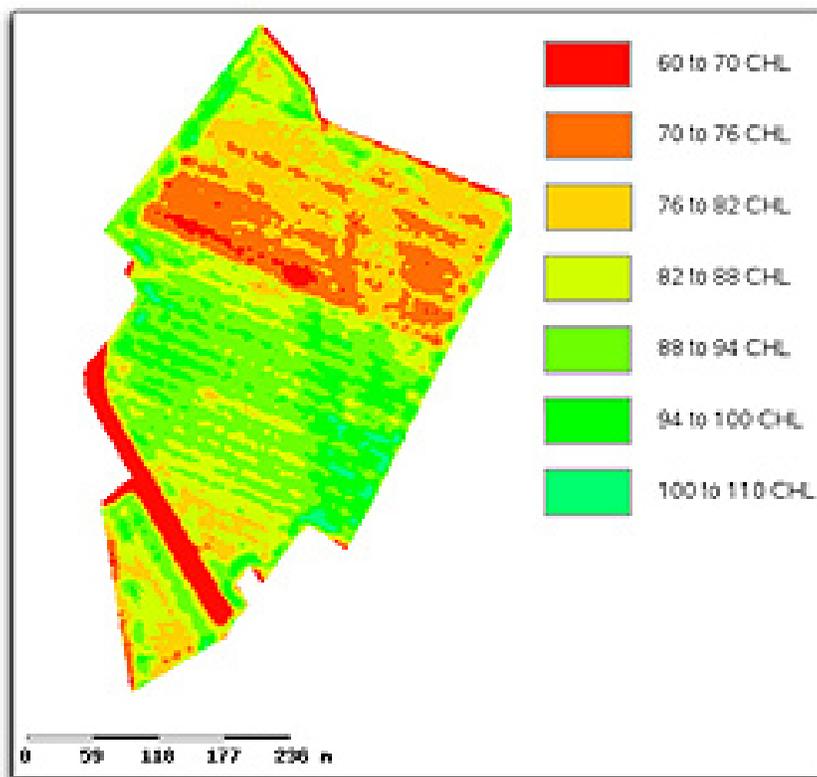
RapidEye also provides a wide spectrum of value added products and services to its customers, each service being an individual solution for that customer.

**For Agriculture...**

The RapidEye system was designed to meet agricultural demands, especially the need for up-to-date information for precision farming technologies. RapidEye imagery with its high spatial, temporal and spectral resolutions is an excellent data source for this group. Thematic information still must be extracted

In addition, the RapidEye satellites contain a sophisticated infrastructure for order handling, satellite control, data downloading and image processing, all located in the company headquarters in Brandenburg, Germany. A customer request, entered by electronic order system into, or by an operator, will be sent to the satellites via S-band connection to the satellites twice a day. During each session, the imaging program for the next seven days is uploaded into the satellites' memory. This ensures image acquisition even in the event a satellite cannot be contacted for some time. Together with the area to be imaged and other special options, an up-to-date cloud forecast is factored into the acquisition planning.

After successful image acquisition, the data is downloaded to Svalbard, Norway, and subsequently transferred by land-line to the Brandenburg headquarter. Here, the data is subjected to the standard processing of as many as three levels. The highest is level 3, an orthorectified image tile of 25 x



**RapidEye chlorophyll map of a wheat field in northern France from mid May 2009**

from the data and can be prepared for immediate use in agriculture GIS.

An initial product is crop area detection. With the help of multi-temporal land cover classification approaches RapidEye specialists can detect and map arable land, distinguish between crop types, and determine field boundaries. This provides the base information for an agriculture GIS setup. Currently, the Company develops a web-based GIS — this enables customers to visualize, edit, and store field data for further thematic investigations.

In addition, RapidEye is currently defining and operationalizing detection methods for further crop types, applicable for certain environmental conditions.

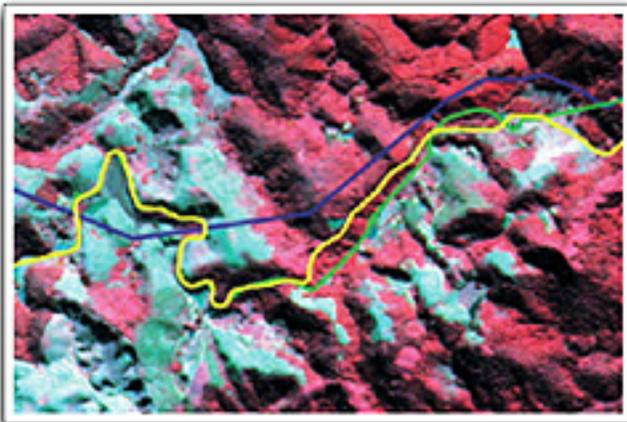
The RapidEye system with its red-edge spectral band is especially sensitive to chlorophyll in plant tissue, which is an important indicator for plant vitality. A repeated visit of plant chlorophyll content allows for the monitoring of the nitrogen nutrition status of plants.

RapidEye specialists use vegetation indices for the derivation of growth curves, which can be used to distinguish crop types and to assess crop condition and growth stages. Once the “normal” growing behavior of a certain crop type is known, repeated data acquisition enables the specialist to assess the plants’ status in comparison to what is standard for this particular area. Farmers

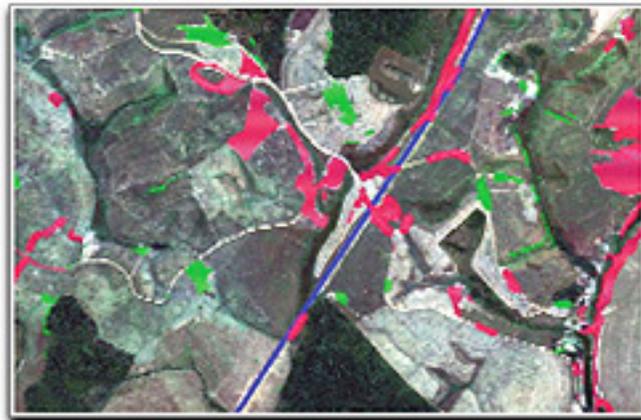
receive helpful information in order to apply the right measures for optimal growing.

In this context, RapidEye can provide customers with ground cover maps. Such maps reveal what percentage of the ground is covered with green vegetation in various parts of a field. Areas with a lower percentage of ground cover may need special treatment, such as fertilizer application, irrigation measures, and pesticide application.

Ground cover maps offer an overview about plant status, but do not indicate reasons for either poor or good plant



**This image is a result of a project that RapidEye performed for a South American mapping company. The blue line is the original road. The green line represents the corrected road by RapidEye, and the yellow line is the true road.**



**Pipeline Monitoring: The image illustrates changes along a pipeline (blue line). Critical changes like vegetation encroachment or construction activities are visualized in red, all other changes are shown in green.**

growth. The chlorophyll content highly correlates with the nitrogen content of the plant, which can be observed with the help of the red-edge band of RapidEye imagery. If the detectable relative content can be scaled by means of ground-based nitrogen measurements, an absolute value can be calculated, visualized as map layer, and later used for precision fertilizer application. The knowledge of plant status at different moments in the growing cycle and their comparison to standard values gives an indication about expected yields.

Of course, the results in the earlier stages of a growing season are less reliable than those acquired a few weeks prior to harvest. The accuracy of yield estimations further depends on the knowledge of other factors, such as meteorologic conditions, solar radiation, and so on. The RapidEye spatial resolution allows such investigations at field level. With the help of field size values, determined during creation of agriculture base information collection, real yield estimation values can be calculated.

An accurate estimation of yield will help to plan harvest, warehouse and food processors' logistics as well as predicting the food supply and/or overhead, that's ready to export. In greater scale, this is an indicator for food prices in the world market.

### **For Forestry...**

Forestry is the another huge vegetation class. Frequent image acquisition for monitoring purposes doesn't actually make a great deal of sense for forests because of their low growing activity. Nevertheless, customers ask us for annual status images of their forests. Such imagery is needed, especially if damage appears, such as after a storm event. The content of an image, acquired after such an occurrence, will be compared to the previous status image to determine the area affected and wood volume loss.

For boreal forests, RapidEye can determine the stem volume of coniferous trees with 70 to 80 percent accuracy. This technology is of interest for damage assessments and for plantation evaluation, wood supply management for paper mills and so on.



Insect infestations detection is another area of focus imagery that is of great value, as it gives an indication of trees' vitality. Infestation centers, distribution directions, and speed, can be assessed. This is valuable information for responsible and cost effective pesticide application.

### **For Monitoring + Change Detection Services...**

Another strength of the RapidEye system is the frequent image availability, which makes the data very suitable for monitoring applications. With the help of repeated status images over a specified time period, changes between the different image dates can be detected. This helps identify trends, describes ongoing processes, and is the base for mathematical modeling with the goal of predicting future status of this process.

Changes result from different causes. If changes are related to spatial movements, the objects of interest need to be identified with high confidence in the data. The difference of coordinates describes the dynamics of location changes within a certain time period.

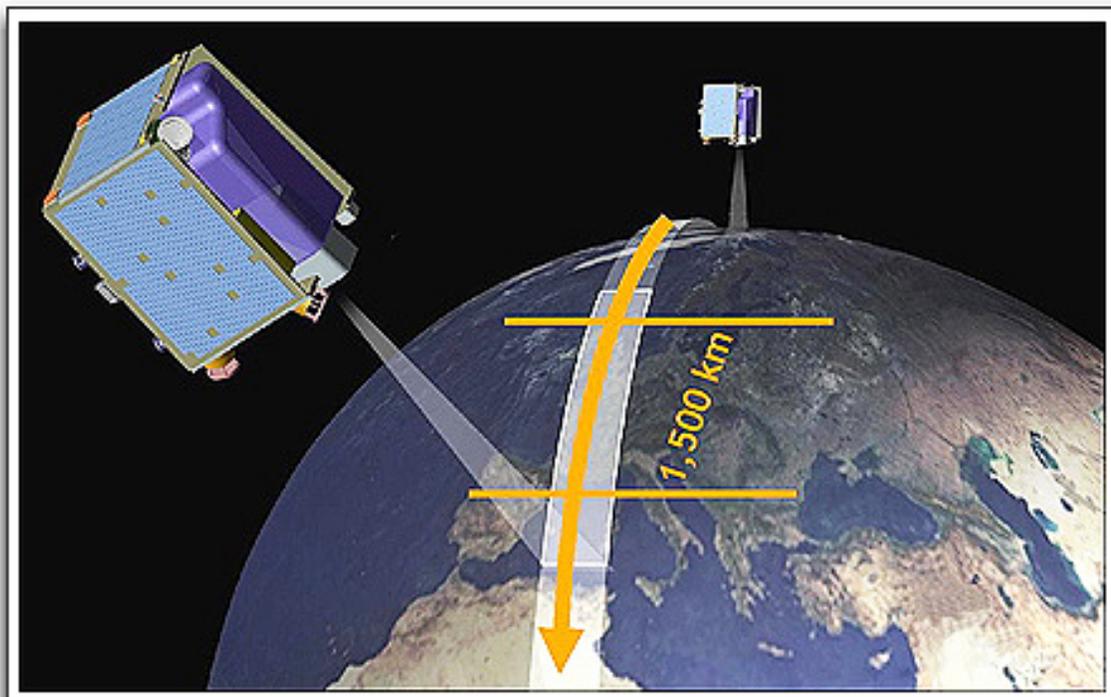
Changes in objects' features, expressed in different spectral values, require a normalization of auxiliary conditions. Only in this case, the relevant changes can be detected. Due to the inhomogeneity of objects, a

prior classification and masking will be necessary. This step results in change detection for whole classes of image content.

Appearing or disappearing objects can be detected, as well. This requires an initial detection of objects. Then, a comparison between identified objects can be completed. As a result, positive changes, or the appearance of new objects, and negative changes, and disappearing objects can be visualized at a map layer.

The RapidEye images' pixel size allows detection of changes in objects greater 20x20m, or of linear objects wider than 10m. Infrastructural changes are often smaller. RapidEye imagery can be helpful in detecting areas of change, even if such is not possible to visualize exactly what has changed. This can be further investigated by ground teams, or with the help of other information sources.

Requests for environmental monitoring can also be fulfilled by RapidEye satellites. The vegetation cover is a good indicator of environmental impact. A regular image of an area of interest serves as a reference. Whenever a new image is acquired, changes to the last image can be detected. Areas of noticeable change point to abnormal impact to growing conditions. A highly productive vegetation area in the vicinity of a water pipeline in the desert indicates leakage.



A decreasing vitality of arable crops indicates plant stress, possibly caused by low soil moisture level. This is a first indicator for identifying progressive desertification activity. Abrupt changes, especially with sharp borders, speaks to accidental changes, such as land slides.



## Constellation Competence

The RapidEye satellite constellation is a long awaited system and is now able to reliably provide up-to-date imagery in 5 spectral bands with 5m image resolution for a wide range of customers. The constellation overcomes the hinderance of using satellite imagery for frequent Earth observation — the uncertain image availability. Cloud cover remains an obstacle, but the system can attempt to acquire the requested imagery at frequent intervals. Simultaneously, large areas can be imaged.

The information content, represented by 5 spectral bands, each with 12 bit radiometric resolution, is tremendous. With its high standard processing level Rapid Eye imagery is a preferable data source to be used in GIS, especially for agriculture, forestry, environmental and monitoring applications, as well as for topographic mapping and other spatial applications.

## About RapidEye AG

RapidEye is an ISO-certified geospatial information provider focused on integrating customized and industry specific solutions into the workflow of global customers in agriculture, forestry, energy, infrastructure, government, security and emergencies.

RapidEye experts and the satellite system — a constellation of five satellites capable of downloading more than 4 million km<sup>2</sup> of high resolution, multi-spectral imagery per day, and a ground segment for processing and archiving data — this allows for cost-effective and highly customized services. The combination of large area coverage, high spatial resolution, and the possibility of daily revisits to an area, all provide for superior management information solutions.

Currently, more than 90 experts from 20+ countries are employed by RapidEye, with plans to grow the team to 140 during 2009. RapidEye benefits from a public-private partnership with the Space Agency of the German Aerospace Center (DLR), which is supported by the Federal Ministry of Economics and Technology. RapidEye is also cofinanced by the European Regional Development Fund (ERDF).

RapidEye regularly monitors large areas of the Earth, while also being able to react quickly to the special coverage requests of its customers. The RapidEye satellite constellation can observe a particular area every day, if necessary. The Company delivers timely information regarding any specified area, and also assists in critical planning and decision making for your organization.

For more information on ERDF please contact...

[efreinfo@mw.brandenburg.de](mailto:efreinfo@mw.brandenburg.de)

# Executive Spotlight On...

## Markus Schäfer, Managing Director, atrexx

**E**stablished in 2002, the **atrexx Trading Platform** is a satellite marketplace designed to bring buyers and sellers of satellite related resources and services together. The Platform offers free registration to buyers and sellers. Once registered, they are able to post their request, or their available services, onto the platform. All postings are publicly accessible worldwide, to everyone with access to the Internet.

**atrexx** professionals handle all trades. Posters to the Platform, whether they are making requests or offers, remain anonymous. This enables an efficient and fair transaction. On registering, the subscriber may choose to be alerted about new postings to the Platform by e-mail on a daily or weekly basis. The Platform operates within an established framework that ensures good practice.

Conventional procurement methods can often result in an inefficient and lengthy process. The atrexx Trading Platform eliminates the problems associated with traditional procurement and offers a high-quality service for both buyers and sellers. The company is now aiming to elevate the profile of this unique resource and to develop it further so that more can benefit from its offerings. We talked with Markus Schäfer to find out how the platform originated and how he sees the future of the operation.



### SatMagazine (SM)

Markus, how was the 'need' for the atrexx platform identified and how long was it in development?

### Markus Schäfer

The idea for the Trading Platform came about in the fall of 2001 and began as a consulting project. At the time, there were other similar platforms in existence. However, we felt we could offer more to customers due to our extensive experience in the satellite and the online industries. We decided to use our expertise to help bring together those who had unused resources available who could then offer such to those who needed such equipment and services. By placing this facility online, it immediately reached an international audience.

The platform is unique in that the online facility enables buyers and sellers to reach potential customers all over the world with the click of a mouse. This can result in new and long-term relationships between players in the industry that may not have even been aware of one another before. This platform was made available. Additionally, the services offers access to unadvertised capacity.

We developed the platform over a period of six months. atrexx went live in February 2002 and was an instant success. An interesting point is that the majority of the other trading platforms were closing down or becoming dormant during the months and years after we initially started our service. This was largely due to the deflation of the dot com bubble.

atrexx was actually a latecomer to this particular market. By 2006, when we re-modeled our website, there were practically none of our competitors remaining in the business. Today, atrexx is the worldwide market leader. As far as we know, there is no other Trading Platform similar to ours and we are quite proud of this fact.

### SM

Did atrexx carry out Beta-testing before launching the Trading Platform?



# Executive Spotlight On...

## **Markus Schäfer**

atrexx had to be extremely cautious in the development of the Platform. We carried out extensive beta testing in-house to ensure we had developed a system that was correct for the market.

The Platform is easy to use, yet sophisticated, and has a self-provisioning system where the subscriber places postings, edits and updates them, and eventually deletes them. The system guarantees all postings are current: If the poster does not update or confirm a posting after 30 days, that posting is erased — after two reminders sent via email to the poster. atrexx does not update the online facility — the Platform takes care of itself. People who post on the website can do so without any assistance.

**SM**

*What are the main advantages of using the marketplace for the buyer and seller?*

## **Markus Schäfer**

There are many advantages for the buyer and the seller. First, the seller benefits by making a sale on capacity that would have otherwise not been used. Instead of allowing the capacity to lay “idle,” they can make a profit and also encourage new business.

Then, atrexx professionals become the mediators when a buyer shows interest in a certain posting. This is an efficient and cost-effective way for the supplier to do business. This is all made possible at nominal cost to the seller. Sellers put themselves at no risk in using atrexx’ services and gain access to a vast audience in

# Executive Spotlight On...

posting their available services to the Platform.

From the buyer's point of view, the atrexx platform provides them with a broad selection of suppliers and allows them to find the best deal possible and to realize considerable savings. This is a single point of contact that enables them to access a large part of the telecom and broadcast marketplace.

Possibly the most attractive benefit to the buyer is that the service is absolutely free of charge to them. Once they have identified a post that is attractive, atrexx takes over. We open the bidding process with the supplier on the buyer's behalf, pre-negotiating the contract terms, and acting within a well-defined framework. All parties know exactly where they stand.

## **SM**

*What role does atrexx play within the Platform itself?*

### **Markus Schäfer**

atrexx acts as a mediator in the buying/selling process.

atrexx has extensive experience within the satellite market and knows it very well. When an atrexx professional is engaged in the negotiating process between buyer and seller, both parties know that they have a highly qualified and experienced mediator working for them — the mediator wants to ensure both receive the best deal available.

This means that the atrexx Trading Platform is not simply an online service — it is a reliable and fair service that operates within strict guidelines.

## **SM**

*How is atrexx using Twitter to engage new users with the platform? Do you envisage using any more social networking sites in the future?*

### **Markus Schäfer**

I recognized that social networking is actually becoming an integral part of marketing strategies for all sorts of companies and has really taken off over



# Executive Spotlight On...

the past year. I also recognize it is a powerful tool, so I decided to take the step of establishing the atrexx Trading Platform on *Twitter* — the results have been encouraging. We have built up quite a following!

We regularly post the leads from the trading platform onto Twitter. It provides us with a novel way of spreading the word about the platform and also to keep our followers informed of atrexx news. Twitter has increased awareness of the Trading Platform and has presented us with another way of reaching the market. It is still in the early days for atrexx and Twitter, but we look forward to seeing how it develops. We may explore the use of additional social networking sites in the future.

## **SM**

*How does atrexx envisage the platform's future Platform development?*

## **Markus Schäfer**

It is very important to us that atrexx is viewed by users of the Trading Platform as a trustworthy and reliable partner infused with integrity. We want buyers and sellers to know that using our Platform means they can be absolutely sure of an excellent service.

In the future, we want to offer value-added services on legal, financial, and technical level in order for users to turn to us for advice on the services they may require, or for help with other satellite-related business. For selected offerings, atrexx will purchase the resources and resell them as part of our portfolio of products and services. In this case, atrexx will be the contract partner for both the seller and the buyer — a highly trustworthy partner. atrexx has access to a wide portfolio of satellite resources and we will be offering our expertise to those who use the Trading Platform to help receive the most assistance out of the service.

This is an extremely interesting market. We want to promote atrexx as a strong partner for buyers and

sellers. I must reiterate that atrexx offers much more than being just an online platform. We are absolutely committed to offering a service of the highest quality and will endeavor to continue to develop and evolve this offering.

## **SM**

*atrexx offers a number of telecommunications and broadcast services. Perhaps you could tell us about a few of them?*

## **Markus Schäfer**

I do think it is very important to emphasize the fact that atrexx is about more than the online trading platform. We have become a one-stop-shop and a key solutions provider for the telecommunications and broadcast industries, with a strong focus on satellite communications. Offerings include Internet and IP via Satellite, Mobile Satellite Services, Voice Communication, Corporate Networks, Wireless Access and Radio and TV via Satellite. We supply sophisticated hardware for VSAT and broadcast services including VSAT antennas, electronic sets, satellite modems, transmitters, cable sets and VoIP gateways and routers.

Once engaged in a project, we provide a dedicated, complete, end-to-end solution and support our customers at all stages from the design of a network to implementation and ongoing support. atrexx is currently working in over 35 countries with a focus on the Middle East, African, European, Asian, and Latin American regions. We work with several hundred customers that include commercial and industrial enterprises and governmental institutions and military bodies.

