

Worldwide Satellite Magazine

February 2011

SatMagazine



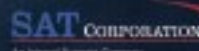
A Ten Year Triumph



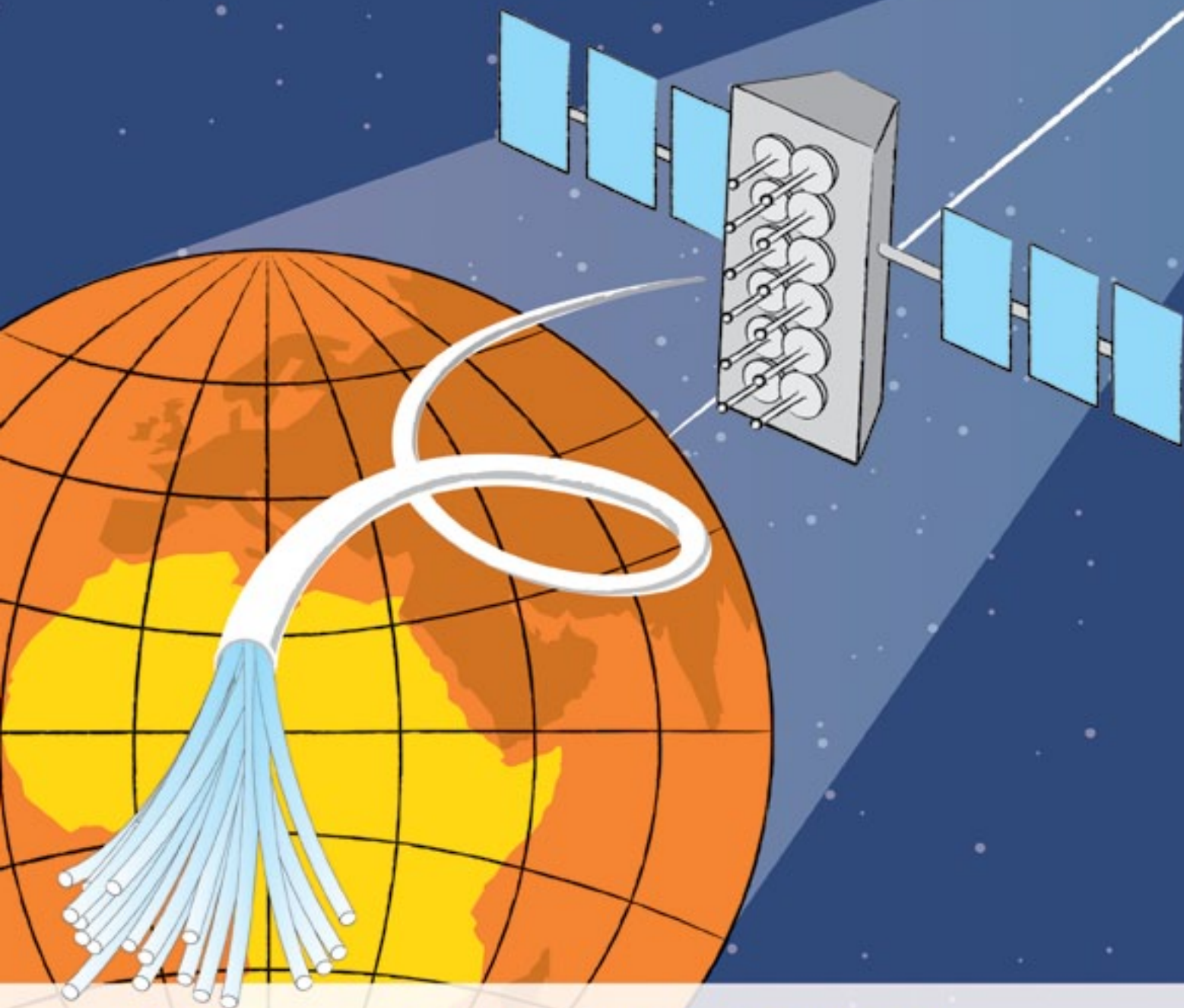
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Vol. 3, No. 12 — February 2011

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Published monthly by
Satnews Publishers
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Sonoma, CA 95476 USA
Phone: (707) 939-9306
Fax: (707) 838-9235
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Ten Years and Counting: EO-1

ATK, an aerospace, defense, and commercial products company, was proud to mark the recent 10 year anniversary of NASA's Earth Observing-1 (EO-1) satellite. The spacecraft, built by ATK for the Goddard Space Flight Center in Greenbelt, Maryland, reached its tenth anniversary in orbit on November 21, 2010. The EO-1 satellite, launched on November 21, 2000, had an initial design and mission life of one year, but has continued successful operations for more than nine years past the initial mission. ATK served as the Prime Contractor, Satellite Mission Integrator and Bus Developer for the EO-1 mission. The Earth Observing One (EO-1) mission developed and validated a number of instrument and spacecraft bus breakthrough technologies designed to enable the development of future Earth imaging observatories.

"ATK-built satellites once again exceeded expectations with an unmatched record of

a significant 10-year milestone for EO-1, ATK has a proven track record of success in small satellite

technology," said *Tom Wilson*, vice president and general manager, **ATK Spacecraft Systems and Services**. "We are proud to mark this historic occasion with our NASA partners and celebrate the fact that EO-1 has far outlived its design life. The successful on-orbit performance of EO-1 can be attributed to ATK's dedicated and talented engineering staff that set us apart in the industry."

Dr. *Stephen Ungar*, former NASA EO-1 mission scientist said, "Although the two major EO-1



Tom Wilson, Vice President and General Manager, ATK Spacecraft Systems & Services

performance and reliability. From the extended mission of TacSat-3 to the new groundbreaking lunar mission for our two THEMIS probes and now

observing instruments, Advanced Land Imager (ALI) and Hyperion imaging spectrometer, have performed flawlessly over the past decade, the

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Ku-Band	Model 110-K					Model 2100-K				
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stunning success of the EO-1 mission is due largely to the unprecedented flexibility and unfaltering operation of the spacecraft bus provided to NASA by ATK. This bus continues to provide an agile and reliable platform for developing and testing new and innovative strategies exploiting the twenty-first century observing instruments and supporting technologies constituting the EO-1 mission.”

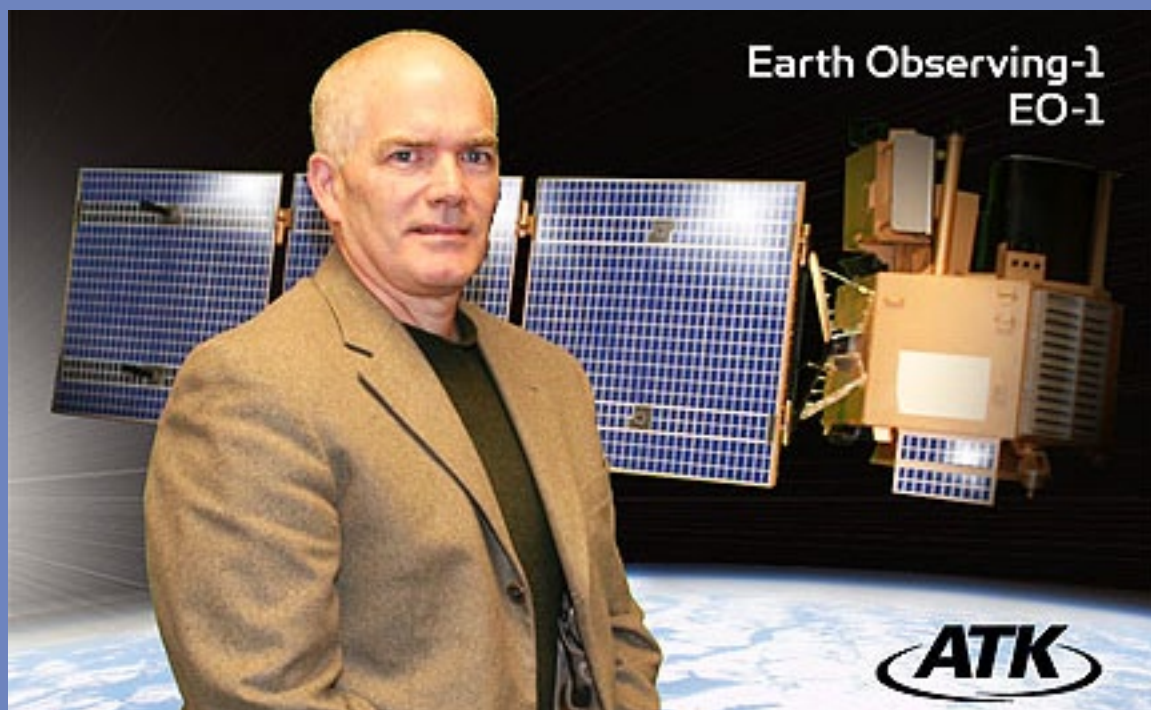
EO-1 has captured more than 100,000 images to date, consisting of equal amounts of multispectral and hyperspectral imagery. EO-1 science data and research has spawned well over 430 related publications and the satellite is currently being used as part of a sensor web that allows autonomous

observing of Earth images. The spacecraft mission has also performed non-traditional Earth observation activities such as the monitoring of brush fires, assessing post hurricane damage and monitoring active volcanic eruptions using both multispectral and hyperspectral imaging.


ATK Program Manager *Mike Cully* directed the mission 10-years ago and, 10-years later reflects on this historic achievement:

“The EO-1 satellite’s outstanding on-orbit performance over the past 10 years represents a major accomplishment for NASA and the Earth Science community. ATK and our team members are proud to be a major contributor to EO-1’s total success. ATK’s ability to manufacture the highest quality spacecraft bus and our leadership in satellite integration and test has been a decisive factor in achieving this milestone. ATK’s dedicated engineers, technicians and staff take pride in knowing that we have significantly contributed to NASA’s mission in furthering societies’ knowledge of planet Earth.”

The 10-year milestone was also marked at a ceremony and symposium at the **Goddard Space Visitor’s Center**, where ATK’s Mike Cully was a featured speaker at the event.



Mike Cully, ATK Program Manager

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EO-1: Ten Years Of Innovation

author: Holli Riebeek, Sigma Space Corporation at NASA Goddard Space Flight Center



A slag mound at Khirbat en-Nahas provides evidence for organized, large-scale copper mining and smelting in the Jordanian desert about 3,000 years ago. The copper slag is piled in black layers under a building some 100 years newer than the heap.

(Photograph ©2008 Thomas Levy, UC San Diego.)

Steep cliffs surround the hot, brown valley that holds Khirbat en-Nahas, one of the largest copper mining and smelting sites of the ancient world.

The desolate valley in Jordan is not the cradle you would expect to nurture a civilization, but archeologists Stephen Savage and Tom Levy think it may be the site of an early organized state.



“Copper mining and smelting is a hallmark of early state-level society in the eastern Mediterranean,” says *Stephen Savage*, a researcher from **Arizona State University**. His team is uncovering evidence for sophisticated economic and political activity in the valley about 3,000 years ago.

Savage has never been to **Khirbat en-Nahas**, but he is revealing things about the site no archeologist has been able to see before. Instead of spending sweltering days in the desert, *Savage* logs in to a website, clicks on a map to select a location, and clicks “*submit*”. With that, he has requested that **NASA’s Earth Observing-1 (EO-1)** satellite point its instruments at his site the next time it flies over.

Dark gray piles of slag define ancient copper mining and smelting sites at Khirbat en-Nahas, in the desert between the Dead Sea and the Gulf of Aqaba. The square feature on the north side of the site is an Iron

Age fortress. (See the lower image on the previous page, which offers a NASA image by Robert Simmon of the site, using Advanced Land Imager data.)

This type of user-driven experience was not part of the initial plans for EO-1, but it is an example of the spirit of exploration and experimentation that has characterized the mission.

Scheduled to fly for a year, designed to last a year and a half, EO-1 celebrated its tenth anniversary on November 21, 2010. During its decade in space, the satellite has accomplished far more than anyone dreamed possible.

“Earth-Observing-1 has had three missions,” says mission manager *Dan Mandl* of NASA’s *Goddard Space Flight Center (GSFC)*. Its original mission was to test new technologies, a mission completed in the first year. Its second mission was to provide images

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EO-1 launch at Vandenberg AFB, photo courtesy of ATK

measurements of forests and crops, coastal waters, and aerosols. Later, an innovative new instrument, the **Hyperion** imaging spectrometer, was added to the mission. Hyperion records more than 200 adjacent wavelengths of light to even better understand the makeup of Earth's surface.

"EO-1 succeeded beyond anyone's expectations," says former project scientist *Steve Ungar* (GSFC). He credits the mission's success to EO-1's "crackerjack team" of engineers and scientists, who were

and data. Its third mission was to test new cost-saving software that operates the satellite semi-autonomously and allows users to target the sensors.

All of the missions come down to one thing: "We're the satellite people can try things on." *Mandl* called EO-1 NASA's on-orbit test bed, and the name certainly rings true.

EO-1 was commissioned as part of NASA's **New Millennium Program**, set up to develop and fly technology that would reduce the risk and cost of future science missions. In short, NASA told its engineers: Find a way to fly faster, better, and less expensively.

"EO-1's primary purpose was to demonstrate that the **Advanced Land Imager** (ALI — see the sidebar for additional information) was a suitable follow-on instrument for Landsat," says *Bryant Cramer*, the program manager at GSFC during EO-1's development and launch.

Like **Landsat-7**, ALI records seven wavelengths of light reflected from Earth's surface. ALI also records an additional two wavelengths to improve

drawn to the mission because they recognized that they could have a stake in the future of satellite technology.

In addition to the two primary sensors, the team proposed 32 new technologies for EO-1, including:

- » *An improved antenna design that enhances the signal to the ground (a phased array antenna)*
- » *A fast data recorder and processor connected by fiber optic cables to improve the speed and capability of onboard computing systems*
- » *"Formation flying" software to keep the satellite exactly one minute behind the Landsat satellite*
- » *A pulsed plasma thruster with a Teflon fuel rod; the team wanted to know if Teflon fuel would maintain the satellite's position without contaminating the science data*
- » *A lightweight, flexible solar panel*
- » *Carbon-coated plates (radiators) to cool the instruments*
- » *The Linear Etalon Imaging Spectrometer Array (LEISA) Atmospheric Corrector (LAC), a hyperspectral instrument designed to improve the way the atmosphere is filtered out of images taken by sensors like Landsat.*

Though each new technology had the potential to advance spacecraft design, they also posed risks. The carbon-carbon radiators used for passive cooling, for example, were much lighter and simpler than traditional cryocoolers. “But when you touched the first carbon plates, your hand would come away black,” recalls *Ungar*. Since this posed a risk to the imagers, the engineers had to come up with a coating to prevent contamination.

Hyperion

“Hyperion is probably the future of remote sensing,” says *Cramer*. *Mandl* added, “Hyperion is a hyperspectral instrument, a change in technology that is like going from black-and-white to color television.”

Other remote sensing instruments — multispectrometers — measure discreet wavelengths of light. It is as if your eyes could only see red and blue light; you could tell much about the world based on how much red and how much blue you saw, but your vision would have gaps in the green tones. A hyperspectral instrument corrects this color blindness by measuring many more wavelengths of light.

The science behind the hyperspectral instrument is spectroscopy, says current EO-1 project scientist, *Elizabeth Middleton* (GSFC). “Spectroscopy is the study of constituents of materials using specific wavelengths,” she notes. “Hyperion measures the chemical constituents of Earth’s surface.”

Chemists have long used spectroscopy to identify

substances because everything reflects electromagnetic energy (including light) at specific wavelengths and in ways that are as unique as a fingerprint. By measuring the energy that comes from a material, scientists can figure out what the material is. Hyperion measures reflected light like many other satellite imagers, but since it is recording more than 200 wavelengths, it can detect the fingerprints of the materials on Earth’s surface.



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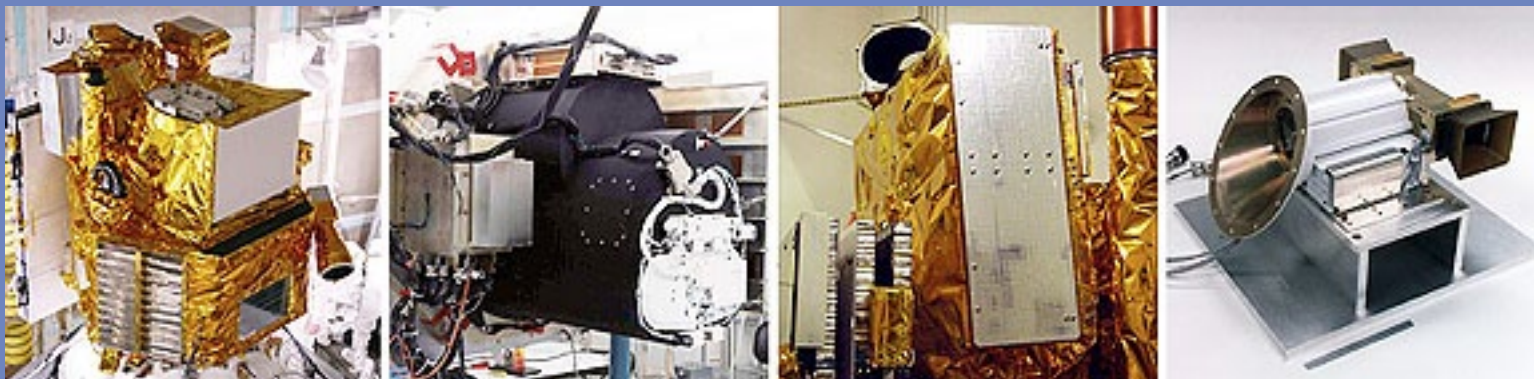
				
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The EO-1 satellite was assembled at NASA Goddard Space Flight Center. From left to right, the photos show the EO-1 satellite, the Advanced Land Imager, Hyperion, and the pulsed plasma thruster. (Photographs courtesy ATK and the NASA EO-1 team.)

Space-based imaging spectroscopy enables a wide range of science, including the search for those ancient copper mines and smelting sites in Jordan.

“I’m looking for the spectrographic signature of copper-bearing minerals,” says **Savage**. He intended to use copper’s unique light signature to find more smelting sites near Khirbat en-Nahas, but as he started to work with Hyperion data, he realized that it could do much more.

“Hyperion has really opened up a whole new avenue of analysis that we hadn’t even explored before,” says Savage. “I can tell you where in the area the ore is coming from; which parts of the site were used for smelting and which were not; and that different parts of the site were drawing ore from different regions.” Such information would be prohibitively expensive to gather in field

research, but Hyperion provides Levy (from the University of California-San Diego) with an affordable map that he can use to better target excavation at likely smelting sites and mines.

Hyperion data have found a wide range of other uses, including tracking the amount of carbon plants take out of the atmosphere everywhere from the Amazon rainforest to the Alaskan tundra. It also has been used to find evidence of microbial life in the Arctic and to monitor volcanic activity.

Perhaps the most important thing Hyperion has done, says Middleton, is teach the community how to work with complex hyperspectral data. Germany will soon launch the next hyperspectral instrument, EnMap, followed by NASA’s HypsIRI satellite, which is still in the planning stage. Both missions build on lessons learned from Hyperion.



Some members of the EO-1 team gathered at NASA Goddard Space Flight Center on November 19, 2010. NASA Photograph by Deborah McCallum.

Advanced Land Imager

The **Advanced Land Imager (ALI)** was built, says *Cramer*, to test new technology and to provide a safe technology shift for future Landsat missions. The Landsat series of satellites has provided a continuous record of changes in Earth's landscape from 1972 to the present. ALI images the Earth at the same level of detail (30 meters per pixel), and it has a more detailed set of sensors that enable crisp, photo-like images.

ALI differs from previous Landsat sensors because of how it takes images. Previous Landsat instruments scanned from side to side, like a whiskbroom. The image is built from horizontal strips of information. ALI, on the other hand, is more like a push broom. It has detectors arranged parallel to one another and facing forward, and they collect information in vertical strips. This arrangement eliminates the need for the sensor optics to move from side to side, and fewer moving parts means less chance of failure, says EO-1 engineer Stuart Frye (GSFC).

A whiskbroom sensor, left, takes images by sweeping horizontally across the landscape as the satellite moves forward. A pushbroom sensor collects data in vertical strips as it moves forward.

After 10 years of operation, ALI has proven that the push-broom technology is stable and reliable enough that the next Landsat satellite, the **Landsat Data Continuity Mission**, uses the same design.

"The Landsat community is treating push-broom sensors like we've been building them for years," says *Cramer*. "That's a tribute to EO-1."

The accumulation of small tweaks has had a large benefit for studying certain types of earthly events. "ALI is very useful in identifying smaller features such as floods and landslides on a local scale," says *Eric Anderson*, a researcher at **Cathalac**, an organization that helps map disasters.

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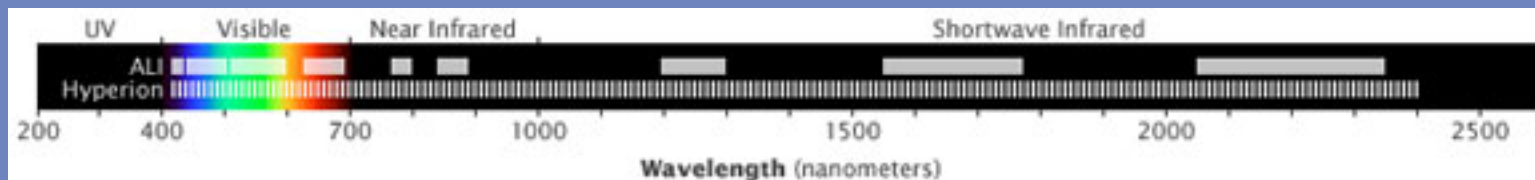
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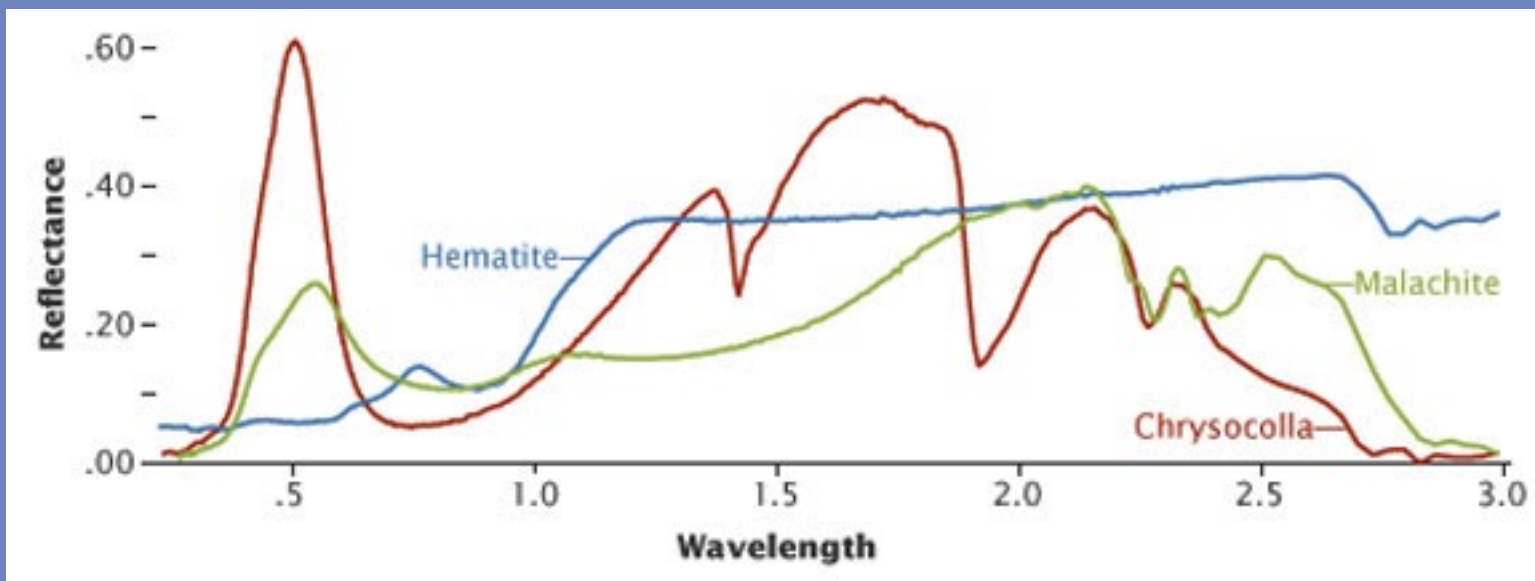
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PRIME TIME



Multispectral sensors such as ALI record discrete wavelengths of light, essentially sampling sections of the electromagnetic spectrum. A hyperspectral instrument like Hyperion records many adjacent wavelengths to image most of the spectrum within a set range. (NASA image by Robert Simmon.)



Just as iron and copper look different in visible light, iron- and copper-rich minerals reflect varying amounts of light in the infrared spectrum. This graph compares the reflectance of hematite (an iron ore) with malachite and chrysocolla (copper-rich minerals) from 200 to 3,000 nanometers. (NASA image by Robert Simmon, using data from the USGS Spectroscopy Lab.)

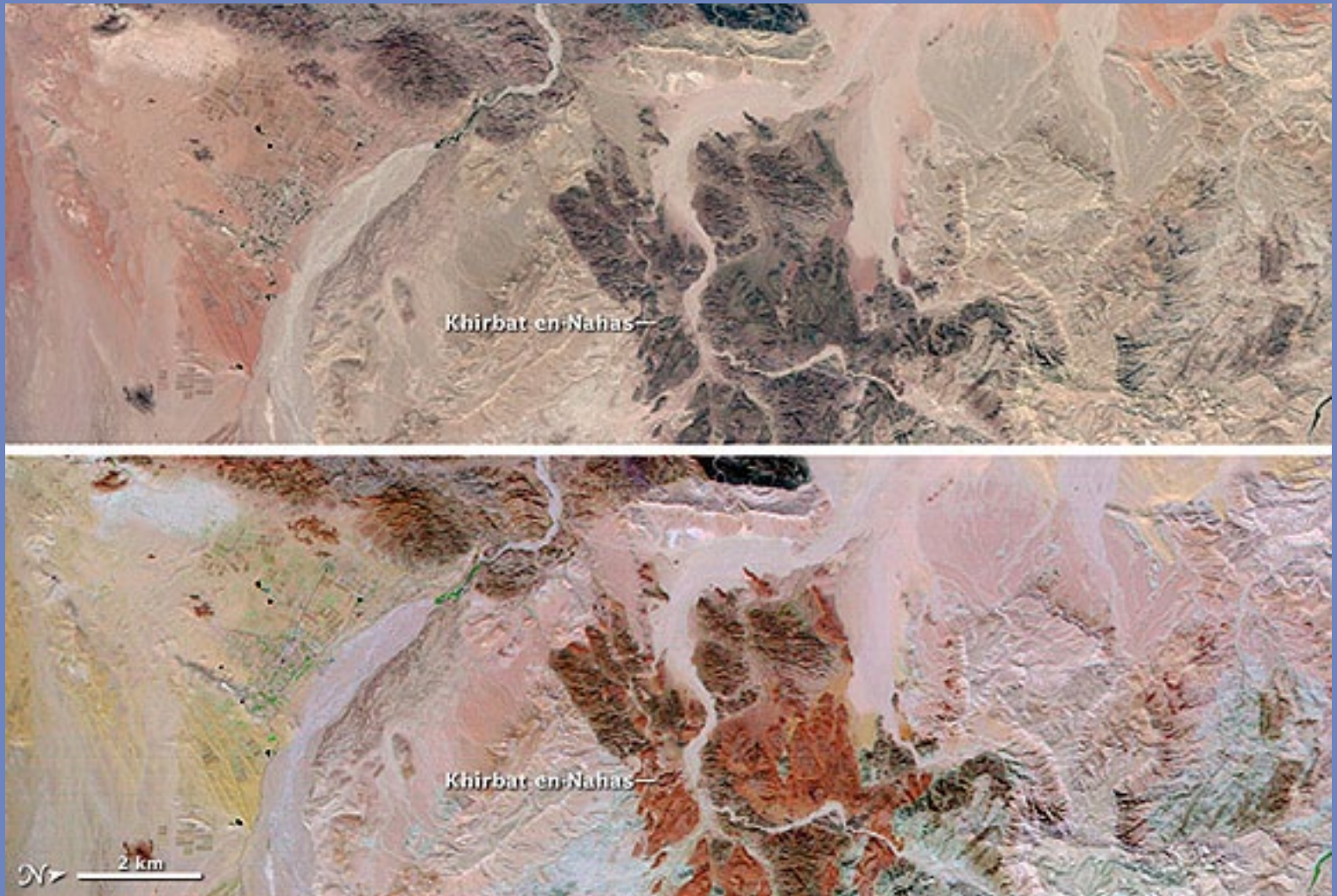
As ALI and Hyperion can be pointed at a particular location on the ground, scientists and disaster relief managers can gather images every two to five days; Landsat is usually limited to once in 16 days because it looks straight down.

NASA's On-orbit Test Bed

As the EO-1 mission has aged, perhaps the most critical innovation has come from the onboard computer. "EO-1 has two separate computer processors with 256 megabytes of extra memory each," says *Mandl*. That may seem paltry compared to a modern desktop computer, but it was enough to reshape a spacecraft's mission. "It meant we had excess capacity to try new things."

The first new software loaded onto EO-1 was the **Autonomous Science Experiment**, an onboard intelligent scheduling tool that allows the satellite to decide for itself which images Hyperion and ALI should take. Before the software, says *Mandl*, it took a flight engineer 67 steps to tell the satellite to acquire an image. "Now we send one command with a goal," says Frye. "If the goal conflicts with another goal, the onboard scheduler decides which to image. Targeting is 100 percent automated."

As the satellite can think for itself, the system can accept a target request as late as five hours before the satellite flies over the target compared to two to three days required for most other sensors. The on-board scheduler prioritizes requests based on what they are for (ranked by theme) and the



The hundreds of bands in hyperspectral imagery enable researchers to differentiate minerals and rocks that appear similar in visible light. Outcrops near Khirbat en-Nahas that are uniformly dark in natural color (top) are variegated in false-color (lower), signifying different rock types. (NASA images by Robert Simmon, using Hyperion data.)

weather. The software uses predictions of cloudiness from the **National Oceanic and Atmospheric Administration**, so if a site is too cloudy, the next least-cloudy target will get priority.

“It’s a customer-driven method of running a mission,” says *Mandl*. Anyone from an archeologist to a disaster response agency can request images. “Flying a mission with a customizable user experience is one of EO-1’s greatest achievements.”


Sometimes the “customers” targeting EO-1 are other satellites. As part of SensorWeb, EO-1 automatically acquires images that are triggered by other satellites.

For example, EO-1 monitors 100 volcanoes. When the **Moderate Resolution Imaging Spectroradiometer (MODIS)** on NASA’s **Terra** or **Aqua** satellites detects a hot spot at any of them, EO-1 automatically acquires an image on its next overpass. Hyperion can then record the temperature and position of lava flows, while ALI tracks ash plumes. If the onboard software detects a hot spot in the Hyperion measurement, the on-board systems automatically re-schedule another acquisition of that target at the next opportunity. The images are distributed to local officials. The **SensorWeb** system is a pathfinder to help build international satellite collaborations, particularly for disaster response.



At ALI's resolution (30 meters per pixel), Paris is pixilated in this image from July 29, 2002. The image becomes sharp and clear when it includes data from ALI's more detailed sensors, the pan band, which see 10 meters per pixel in shades of gray. Image credit: Robert Simmon.

SensorWeb and the scheduling tool have created significant cost savings. "Initially, we were spending about \$7,500 per image to acquire them. Now the cost is less than \$600 a scene," says *Cramer*. "EO-1 is one of the cheapest of NASA's Earth missions," confirms *Middleton*. These cost savings mean that anyone can now target EO-1 and access all data free of charge, making it useful to a growing range of people.

In the end, EO-1's value far outweighs its price tag. "EO-1 has done so many different things, NASA got three or four missions for the price of one," says *Cramer*. "We achieved all of the things that we hoped for and then some." 

Editor's Note

This article courtesy of NASA's Earth Observatory, <http://earthobservatory.nasa.gov>

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- Earth Observing-1 (n.d.) Technology validation. Accessed November 18, 2010.*

For more information regarding EO-1 and its extended mission, head over to

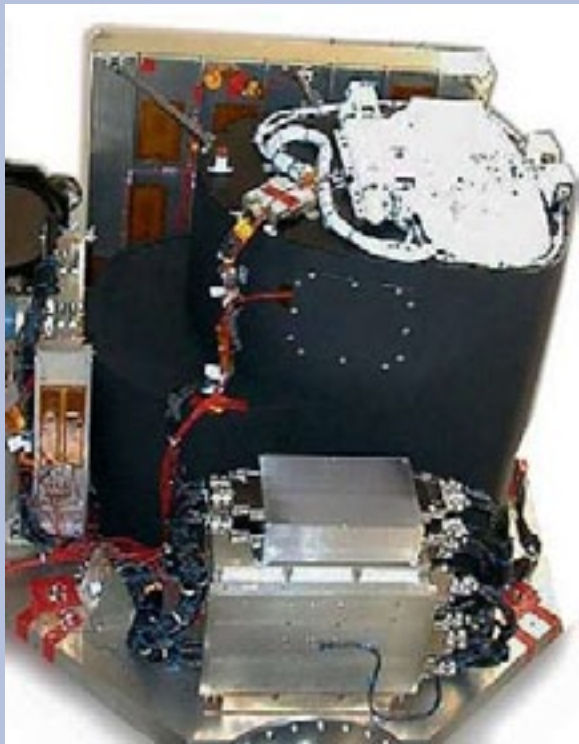
<http://eo1.gsfc.nasa.gov/>

EO-1's Advanced Technologies

The future of Earth science measurements continues to require spacecraft to have ever-greater capabilities packaged in more compact and lower cost spacecraft. To that end, EO-1 tested, for the first time, six new technologies that now enable new or more cost-effective approaches to conducting science missions in the twenty first century.

Advanced Land Image

The Earth Observing-1 (EO-1) Advanced Land Imager (ALI) was the first Earth-Observing instrument to be flown under NASA's New Millennium Program (NMP). The ALI employed novel wide-angle optics and a highly integrated multispectral and panchromatic spectrometer. MIT Lincoln Laboratory developed the ALI with NMP instrument team members: Raytheon/Santa Barbara Remote Sensing (SBRS) for the focal plane system, and Sensor Systems Group, Inc. (SSG) for the optical system.



The focal plane for this instrument is partially populated with four sensor chip assemblies (SCA) and covers 3° by 1.625°. Operating in a pushbroom fashion at an orbit of 705 km, the ALI provides

Landsat type

panchromatic and multispectral bands. These bands have been designed to mimic six Landsat bands with three additional bands covering 0.433-0.453, 0.845-0.890, and 1.20-1.30 μm . The ALI also contains wide-angle optics designed to provide a continuous 15° x 1.625° field of view for a fully populated focal plane with 30-meter resolution for the multispectral pixels and 10 meter resolution for the panchromatic pixels.

“EO-1’s advanced technologies will set the pace for future Earth Science missions in the new millennium.”

X-Band Phased Array Antenna

New generations of Earth science missions will generate terabytes (1,000,000 megabytes) of data on a daily basis which must be returned to Earth. EO-1 demonstrated the X-Band Phased Array Antenna (XPAA) as a low-cost, low-mass, highly reliable means of transmitting hundreds of megabits per second to low-cost ground terminals. The XPAA offered significant benefits over then-current mechanically pointed parabolic (dish) antennas, including the elimination of deployable structures, moving parts, and the torque disturbances that moving antennas impart to the spacecraft.



The XPAA is composed of a flat grid of 64 radiating elements whose transmitted signals are combined spatially to produce the desired antenna directivity. The phases of each of the radiating elements are varied by computer to point the beam in the desired direction. For the EO-1 mission, the radiating elements are combined with low power, high efficiency solid state amplifiers to achieve the required radio frequency power level. The antenna is mounted on the Earth-facing side of the spacecraft to allow communications with ground stations. The antenna's mass is 5.5 kilograms. It has an Effective Isotropic Radiated Power (EIRP) of approximately 160 watts, and transmits data at 105 megabits per second. Boeing Phantom Works, located in Seattle, Washington, developed the antenna for GSFC.

Light Weight Flexible Solar Array

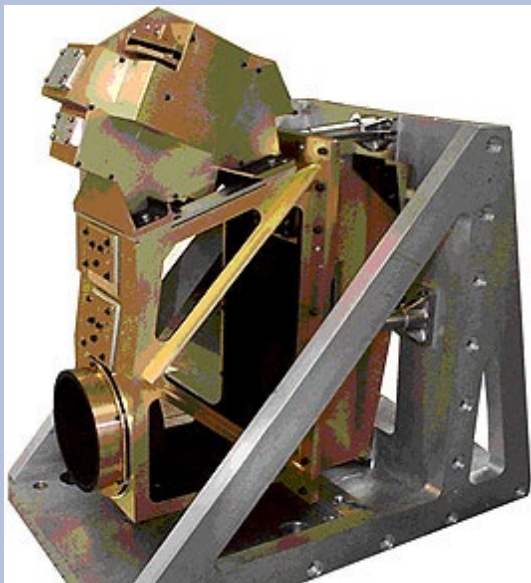
All spacecraft use the sun as a source of electrical power produced by solar arrays. EO-1 featured a new lightweight photovoltaic solar array system called the Light Weight Flexible Solar Array (LFSA). While most photovoltaic cells are made from silicon, selenium, or germanium crystals, the LFSA uses solar cells made of copper indium diselenide (CIS) in a vapor form. Not only is CIS significantly lighter than solar cells designed as crystals, but it can also operate on a flexible, less rigid surface, with significantly higher returns on its electrical output.

EO-1's solar array was built with shape memory alloys instead of typical hinge and deployment systems. Shape memory alloys are novel materials that have the ability to return to a predetermined shape when heated. When the

material is cold, or below its transformation temperature, it has a very low yield strength and can be deformed quite easily into any new shape, which it will retain. However, when the material is heated above its transformation temperature,

it undergoes a change in crystal structure that causes it to return to its original shape. If the shape memory alloy encounters any resistance during this transformation, it can generate extremely large forces. This phenomenon provides a unique mechanism for remote actuation.

The combination of the new solar cell and alloy technologies provides significant improvement in the power-to-weight ratios. Plus, the new alloys fostered a "shockless" solar array deployment, a much safer method than conventional solar array systems that use explosives for deployment. The goal of the LFSA is to achieve greater than 100 Watts/kilogram power efficiency ratios compared to today's solar arrays which provide less than 40 Watts/kilogram.

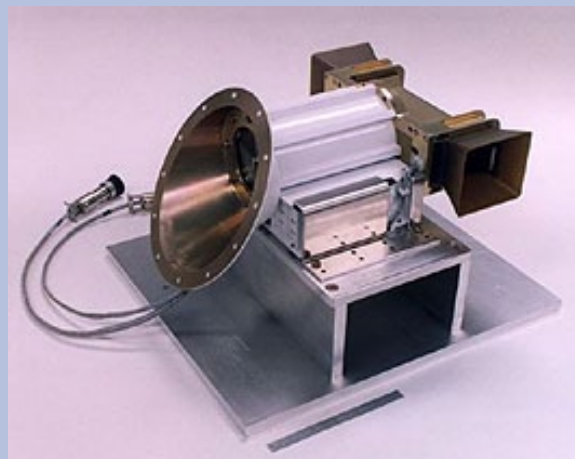


Pulse Plasma Thruster

EO-1 provided the first on-orbit demonstration of a low-mass, low-cost, electromagnetic Pulse Plasma Thruster propulsion unit for precision spacecraft control. The thruster uses solid Teflon propellant and delivers small impulse bits (low thrust per pulse), which are desirable for some precision pointing missions. The thruster consists of a coiled spring to feed the Teflon propellant, an igniter plug to initiate a small trigger discharge, and an energy storage capacitor and electrodes. Plasma is created by the sudden change from a solid to a gas of the Teflon propellant caused by the discharge of the storage capacitor across the electrodes. The plasma is accelerated by an electromagnetic force in the induced magnetic field to generate thrust. By using a high velocity, low-mass propellant such as Teflon, as opposed to a conventional liquid fuel such as hydrazine, there is a higher net propulsion for a given energy input, saving substantial amounts of weight in fuel.

The Pulse Plasma Thruster is used to precisely maneuver the spacecraft and maintain the highly accurate pointing of the instruments.

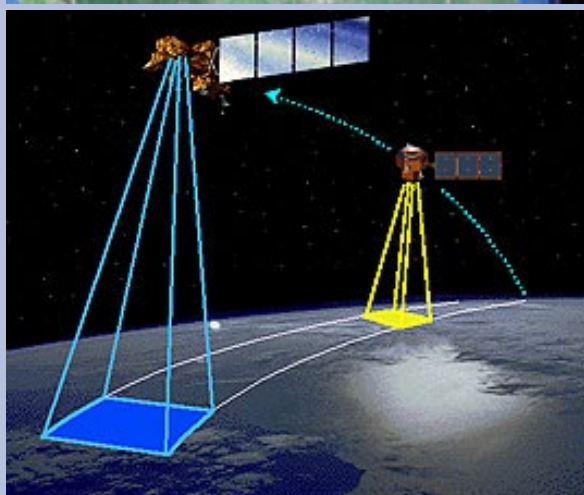
A series of fine pitch maneuvers were conducted with the thruster after the EO-1 mission had completed its primary land scene comparisons with Landsat 7 to demonstrate spacecraft feasibility.



Enhanced Formation Flying

As NASA had planned, and continues to schedule, launches for a substantial number of Earth Observing spacecraft, more efficiency is obtained when operating spacecraft in groups, as opposed to single entities. Enhanced formation flying technology enables a large number of spacecraft to be managed with a minimum of ground support. The result is a group of spacecraft with the ability to detect navigation errors and cooperatively agree on the appropriate maneuver to maintain their desired positions and orientations. Formation flying technology now enables many small, inexpensive

spacecraft to fly in formation and gather concurrent science data in a “virtual platform.” This concept lowers total mission risk, increases science data collection, and adds considerable flexibility to future Earth and space science missions.



EO-1 will fly two minutes behind Landsat-7 along the exact same ground track.

(Image by Chris Meaney, GSFC Studio 13)

Unique features of the EFF technology included an innovative use of fuzzy logic decision making capabilities and natural language to resolve multiple conflicting constraints; a scripting environment to enable algorithm updates without software changes; a flight wrapper that interfaced directly with the command and data handling subsystem for input and output; multiple operating modes that allowed for execution control; generic closed-loop formation flying control algorithms applicable to many missions; and a modular architecture design flexible enough to control the execution of multiple and varying algorithms from several partners (JPL, Phillips Laboratory, SPA, and Microcosm) in addition to NASA's Goddard Space Flight Center.

Carbon-Carbon Radiator

Satellites in orbit around the Earth must dissipate tremendous amounts of heat from absorbed solar radiation and internal heat sources (spacecraft electronics). The primary way to disperse thermal energy is through a series of special aluminum radiator panels attached to the outside of the spacecraft. Researchers would like to enhance the thermal management capability of these panels even further by reducing the costs and weight and possibly extending the operational life of the spacecraft. To accomplish this, EO-1 will carry an experimental radiator panel made of Carbon-Carbon (C-C), a special class composite material made of pure carbon.

C-C has a considerably lower density and higher thermal conductivity than aluminum. Since the trend for satellites is toward smaller



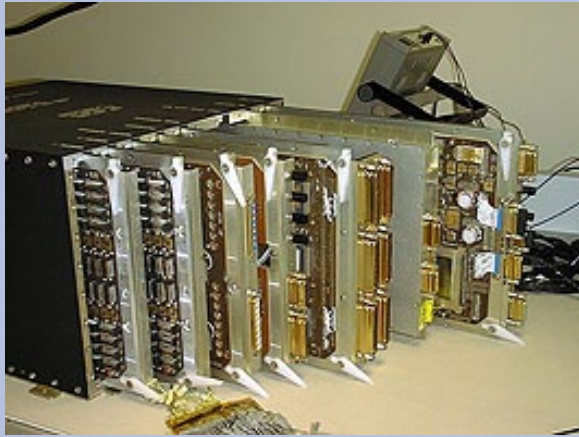
electronics in combination with smaller spacecraft size and weight, C-C offers improved performance for lower volume and mass and will enable more compact packaging of electronic devices because of its ability to effectively dissipate heat from high power density electronics.

Carbon-Carbon uses pure carbon for the fiber and matrix. EO-1 was the first to use this material in a primary structure, where C-C is used as an advanced thermal radiator and a load bearing structure.

Wideband Advanced Recorder Processor

The EO-1 imaging instruments presented a significant challenge to the traditional development of spacecraft. Due to EO-1's high-rate imaging — almost 1 gigabit per second when all three instruments are on — a new compact data-handling system had to be designed.

PRIME TIME



The Wideband Advanced Recorder Processor (WARP) is a solid-state recorder with the capability to record data from all three

instruments simultaneously, and store up to 48 gigabits (2-3 scenes) of data before transmittal to the ground. By using advanced integrated circuit packaging (3D stacked memory devices) and “chip on board” bonding techniques to obtain extremely high density memory storage per board (24 gigabits per memory card), WARP became the highest rate solid state data recorder NASA had flown. It also included a high-performance processor (known as Mongoose 5) that could perform on-orbit data collection, compression, and processing of land image scenes. WARP’s compact design, advanced solid-state memory devices, and packaging techniques enabled EO-1 to collect and downlink all recorded data.

LA-II Thermal Coating

The thermal control coating was referred to as LA-II and is a low absorptance, inorganic, white paint. An absorption coefficient is a measure of the rate of decrease in the intensity of electromagnetic radiation (as light) as it passes through a given substance; the fraction of incident radiant energy absorbed per unit mass or thickness of an absorber;

“absorptance equals 1 minus transmittance. Two flight calorimeters were flown on the Earth Observing-1 (EO-1) spacecraft. They were attached to the EO-1 equipment bay panel, Bay 4 (Carbon-Carbon Radiator panel), as shown in this photo. One calorimeter was coated with the LA-II Paint. The other calorimeter was coated with a known NASA/GSFC Z93P White Paint and used as a baseline for comparison. The data provided from the calorimeters was used to validate the performance of the LA-II paint.



T H E E X T E N D E D M I S S I O N

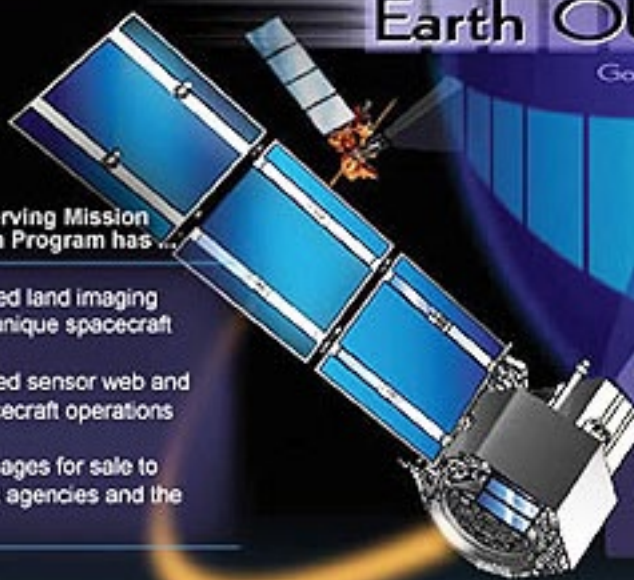
Earth Observing-1

Goddard Space Flight Center

EO-1

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The North American Satellite Market New Methodology Required...

author: Jacobo Gullish, Futron

Unique among satellite capacity markets, North America boasts especially mature video and networking segments, as well as very broad scale and transparent global purchases by the U.S. military. The U.S. and Canada are also satellite innovators, leading the way into new satellite applications best illustrated by the early adoption of direct-to-home (DTH) video business models, and more recently, the successful introduction of satellite radio through Sirius/XM, and direct Internet access (DIA) services such as the WildBlue/ViaSat and Hughes two-way consumer broadband services. Each of these market segments — and others assessed in Futron's 2010 Forecast of Global Satellite Services Demand — have distinctive characteristics, drivers, challenges, and of course, opportunities. Yet with overall annual growth above 3 percent through 2014, and around 2 percent through 2019, North America is likely to remain the world's largest market for satellite services with forecast demand by 2019 for over 2,150 36 MHz transponder equivalent (TPEs), or 120,000 Mbps of satellite capacity.

The Markets For Video

North America's video marketplace provides a global baseline for the role of satellite services in a maturing market where multiple distribution platforms — terrestrial, wireless, and satellite — compete and complement each other in a dynamic setting focused on more immediate access to more content, anywhere. Often referred to as “over-the-top” video, these services respond to individuals, businesses and organizations interested in accessing a wider range of content real-time, from TV episodes and short clips video blogs to full length movies viewed on an increasing range of devices — room-sized HD television set, computers, tablets, and cell phones at home, at work or on the move.

The North American DTH business is part of one of the world's most competitive consumer markets, with players including not only satellite, but also telecom/ fiber and cable companies. The biggest drivers of demand continue to be expansion in high definition (HD), including local channels. In contrast with other segments of the video market (e.g., distribution and contribution), DTH utilization levels have remained high, and in 2009 both **Ciel** and **Telesat** launched fully utilized new satellites, adding 1,000 new channels, dominated by local-into-local HD broadcasts. Looking forward, keep an eye on new competition from so-called “tweener” systems such as Spectrum 5, regulatory issues tied to multi-platform completion across the broader video and content industry, and the evolution of 3D channels.

Outside of the DTH market, the introduction of HD is more tempered, with the number of HD distribution channels jumping from around 30 to just above 150 by the end of the decade, which seems large, but is one tenth the number of DTH HD channels.

Nevertheless, **Futron** expects HD channel growth in this video segment to continue as cable systems demand more content to compete with DTH. C-band is the predominant frequency range for distribution to cable head-ends — and will likely continue into the future.

Looking ahead, the key trends impacting satellite video distribution will be the transition from standard digital to HD, migration of demand to internet video, and movement by cable operators to fiber-optic delivery, starting in the U.S. where **Comcast Media Center**, the operator of the popular *Headend in the Sky* distribution platform, is introducing a fiber-optic delivery method to its cable customers.

The Markets For Networks

Networking services, ranging from corporate VSAT networks to consumer broadband services, further highlight the role of satellites in a mature business environment punctuated by widespread access to fiber networks and growing coverage of high-speed terrestrial wireless such as 4G, Wi-Fi and WiMax systems. North America is also the vanguard for consumer broadband via satellite, as the first region to introduce the service and prove out the business model, and North America currently represents about half of global demand. Despite the availability of multiple terrestrial alternatives in major markets, service has continued to expand in both rural and

ex-urban areas where there are pockets of demand and relatively high incomes to pay for alternative service. With new platforms such as **ViaSat-1** and **Hughes' Jupiter** coming on line in the near term, offering greater capabilities at lower cost, growth is forecast to continue to be strong at around 8 percent per year.

Corporate networks, on the other hand, have experienced softness due to difficult economic conditions reducing deployment of new sites and



Futron 2010 Futron Forecast of Global Satellite Service Demand

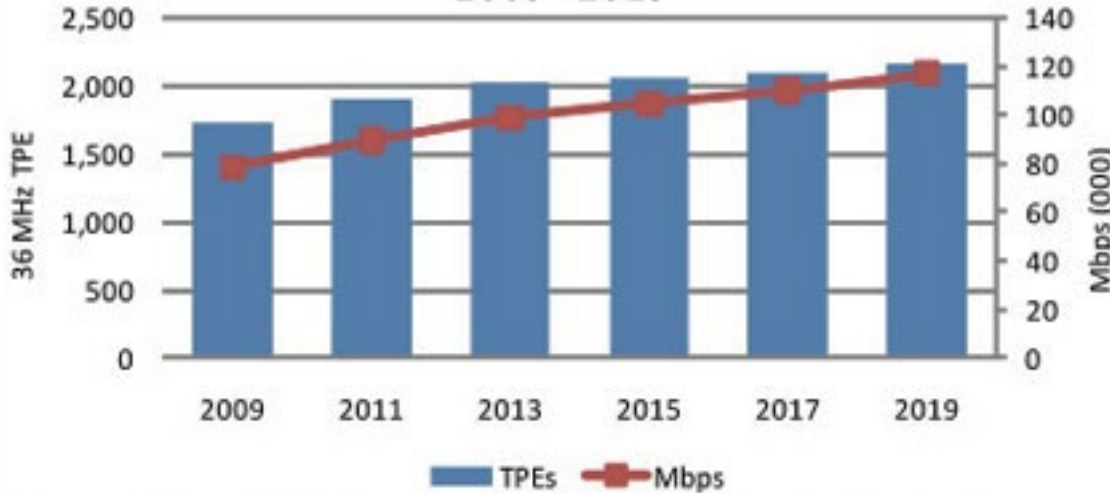
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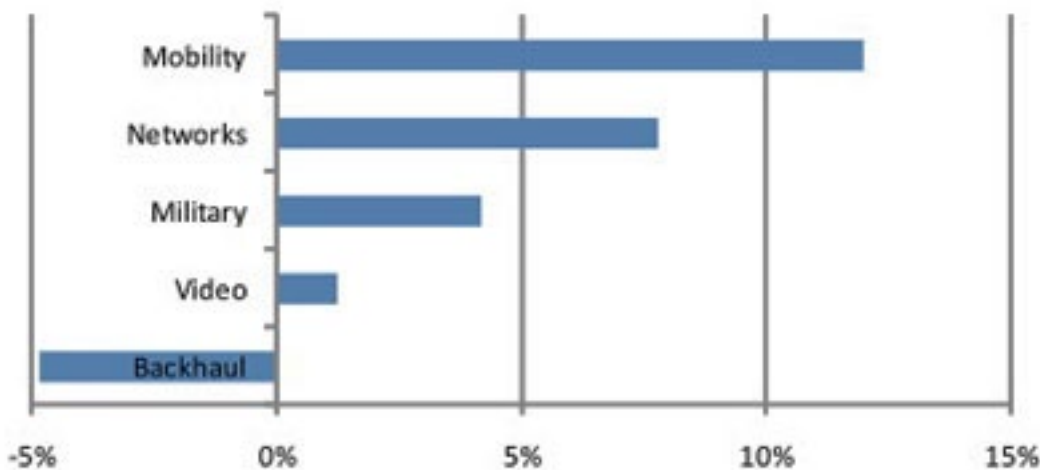
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North American Demand 2009 - 2019



Source: Futron's 2010 Forecast of Global Satellite Services Demand

North American Growth 2009-2014



Source: Futron's 2010 Forecast of Global Satellite Services Demand

The Military Segment

The U.S. military and security agencies dominate global demand for commercial satellite services, although much of their supply requirements do not directly cover the North American geography. Interestingly, Futron's forecast for the military segment is somewhat higher than other estimates based on our belief that demand for classified operations is higher than generally thought; these programs are also a future growth driver.

For North America, military demand includes significant requirements for reach-back downlinks from theaters of conflict, educational programming and broadcast services, naval fleet support, and unmanned systems development, training, and civilian applications such as border security. North American C-band demand is projected to slowly decrease as alternatives become available and

networks. This trend is expected to continue for some time, keeping growth flat in the near term. At the same time, two major segments provide ongoing stability: Continued use of satellite networks for back-up/disaster recovery solutions and demand from government-subsidized broadband initiatives where satellite is likely to play a supporting role. A key opportunity in the longer-term is introducing portability and mobility into these networks, and the evolving role of satellite versus terrestrial wireless (and hybrid) systems.

equipment lifecycles come to an end. However, moves to conduct more in theatre processing of *ISR* data with less reach-back to North America may lessen demand for satellite capacity for these applications.

Efficiency, Creativity, Risk-Taking

Innovation is the key buzzword of the satellite industry today — and North America has long been a major force in driving new satellite applications, business models, and hybrid communications networks. During the recent economic downturn, the North American market highlighted its relative insulation from the broader economic difficulties, in part based on the enabling role and critical nature of many telecommunications services.

Yet, as a market leader, several satellite segments show signs of saturation and maturity. Business and government will adapt to the changes in regulation, competition, and business models, but must stimulate efficiency, creativity, and risk-taking. As the trends in North America suggest, there is a broad global movement towards high power and high throughput capacity, with associated deployment of tailored services for specific applications and customer markets.

The decade ahead is a promising one for the North American communications satellite services market, where mature segments are managed for profit and lower growth, coupled with investment in new applications, services and hybrid services that require new investment, performance measures, and different ways of doing business.



About the author

Mr. Jacob Gullish has more than 15 years of experience in the satellite, communications, media and government sectors in the U.S. as well as Africa, Latin America and South/Southeast Asia. An economist by training, he has participated in a large number of financial transactions, assessments, due diligences, and forecasting and is responsible for management of Futron's forecasting activities. He has conducted strategy development, financial planning and implementation at the senior level and has worked for and with major companies and government clients in some 20+ markets worldwide. Email: jgullish@futron.com.

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The Coming Battle For... The Maritime Market

author: Alan Gottlieb, Managing Director, Gottlieb International Group Inc.

Wielding fixed priced Ku VSAT services, an army of new vendors has been successfully challenging Inmarsat's dominance in the maritime market. Almost overnight, Fleet Broadband's per/byte volume pricing has become less and less attractive as demand for data transmission has soared. Initially, the new fixed priced Ku players were a minor irritation to the communications giant, but now have become a very real threat. In August, Inmarsat finally acknowledged the need for a competitive offering and joined the rush to VSAT with their very own Ka-band VSAT service, Global Xpress.



Introduced with much fanfare and positioned as a revolution in maritime communication, the new service is intended as **Inmarsat's** ultimate defense against Ku VSAT. Armed with 50 Mbps of throughput and a small antenna, Inmarsat is positioning itself to vanquish Ku as the preferred VSAT standard and thereby guarantee its maritime market dominance. Can they succeed?

To determine the results of that all-important question, **Gottlieb International Group** has explored the technical issues associated with the use of Ka-band in maritime environments. While many of the aspects of **Global Xpress** are yet to be revealed, the characteristics of Ka-band are well known and, therefore, offer a basis on which to build a reasonable analysis. We have spoken to several independent experts, and based on their input, have evaluated the new service's potential advantages and disadvantages. The results are surprising.

A Big Plus for Global Xpress

A 60cm antenna offering is definitely an advantage over Ku. While Ku generally requires a minimum of 1 meter in global maritime applications to avoid adjacent satellite interference — except when employed with *Spread Spectrum Technology* — the higher frequency of Ka does allow for use of a small antenna significantly lowering installation costs and speeding installation on large fleet retrofits. However, the advantage does come at a price.

Unlike L-band which uses a very wide beam where pointing is not as critical an issue, Ka uses a very narrow beam. Consequently, the pointing accuracy of the antenna needs to be significantly better — within 0.4 degrees — resulting in the need to engineer a more precise mechanism at significantly higher design and manufacturing costs than the *Fleet Broadband Antennas*. Given this consideration, we expect the end-user cost of the antenna will be much greater than the current \$8,000 to \$14,000 market price for the **FB 500** antenna and would most likely range upward to around \$27,000 to \$30,000.

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Really Faster?

Ka's high frequency does allow greater receive antenna gain than Ku, given the same antenna size. However, with equal Ku and Ka satellite EIRP, this advantage is lost due to a phenomenon known as "path loss." As the high frequency signal radiates from the satellite to the Earth, it experiences a higher spreading loss than a lower frequency Ku signal, which negates the Ka receive antenna gain advantage over Ku. Under rain fade conditions, Ka's atmospheric loss is greater than Ku. Essentially, Ka and Ku satellites with the same transmit power can both be configured to offer 50 Mbps speeds.

What About Rain Fade?

Consequently, with Ka, it may be difficult to avoid downlink link failure in moderate to severe precipitation. The planned 50 Mbps downlink, which would be shared among numerous customers, could severely limit the infrastructure's capability to adjust for rain fade, even with *Adaptive Code Modulation*. Our research indicates that as rain intensity increases, a user's bit rate could decrease rapidly. Due to the additional bits for *Forward Error Correction* at moderate to severe precipitation levels, the downlink could fail or be reduced to an unusable level resulting in the need to deploy the L-band backup.

Furthermore, the rapid drop in bit rate associated with rain could result in suspension of services to all but the most critical applications as bandwidth management software attempts to adjust capacity allocation for loss of resources.

While the intermittent loss of Internet access to crew may seem inconsequential, the loss of video could have severe implications in applications such as telemedicine (remote surgery and diagnostics) and security where continuous video feeds are essential to the health and well being of vessels and crew.

In addition, severe bandwidth fluctuation will likely be detrimental to interactive applications such as access to server-housed databases on shore, remote PC and Bridge Consol Maintenance, video conferencing, and so on. As rain intensity increases and, if and when the downlink fails, vessels would have to rely on **Fleet Broadband**. As L-band is a contended service, in a heavily trafficked area, bandwidth could drop to levels below the minimums required to support even the most essential of services.

While Ku also relies on L-band for backup, the need to go to backup is far less likely — as long as the vessel sails in major shipping lanes — since its lower operating frequency makes it significantly less sensitive to rain fade than Ka.

Is Ka Lower In Cost?

Unlike localized Ka services that cover the U.S., the need to cover vast areas of near empty ocean with cells could result in low utilization rate for the Ka satellite capacity and consequent higher cost per/MHz utilized. This inefficiency combined with the higher cost of Ka satellites vs. Ku satellites results in a service that may actually be higher in cost than a comparative Ku infrastructure, since the much larger Ku beam footprint can service a significantly larger area containing more vessels and thereby achieve greater efficiency.

In addition, Inmarsat's need to operate its L-band network as backup is an added operational cost. While Ku also uses L-band as a backup, the Ku vendor, unlike Inmarsat, bears no network operation cost. Given these factors, and the likely need to provide a back up Ka satellite, it remains to be seen whether the new Global Xpress service will be significantly lower in end user pricing than existing Ku services.

Continuity Of Service

Unlike Ku-band that has multiple providers (for both service and satellite), the Global Xpress service will be highly proprietary. Subscribers will be required to invest in antennas that are only suitable for the Inmarsat service and will, therefore, be totally dependent on their network. Essentially, should one of the Global Xpress satellites fail, there would be no alternative Ka maritime provider. How Inmarsat will deal with this issue is still an open question, but we expect that the only alternative would be to provision the network with a spare satellite thereby assuring continuity of service — an especially important guarantee for the high-end maritime customer.

VPN: A Must For Serious Uses

Large fleet owners in the containership and tanker and drilling contractors and oil industry operating companies typically want to configure their remote operations as nodes on their corporate network. These customers generally deploy critical applications

that need committed bandwidth to assure proper functionality. For example, as security is a major issue, a VPN is a common requirement. Whether the available capacity of Inmarsat's proposed 89 spot beam infrastructure (with each beam shared by multiple vessels) will support the committed bandwidth requirement is an unknown since provisioning this feature would likely require "locking up" capacity in numerous cells thereby limiting overall system capacity.

The Market Reacts

Based on our preliminary survey of Oil and Gas users, we expect the rain fade issue will severely limit acceptance of the Ka service to the Middle East and other rain free areas. As Oil and Gas is an extremely conservative sector, where new technology has a very long acceptance curve, overcoming the perception of Ka's poor performance in high precipitation areas would, in our view, require months of successful trials with industry leading companies, and, even then, widespread acceptance of the service would not be assured.

While acceptance of a Ka-based solution would likely be somewhat better in the maritime sector, we believe that due to the rain fade issue, most adopters would be causal users — essentially vessels wishing to satisfy crew requirements for simple Internet access and VoIP telephony, not "office at sea" users with critical connectivity requirements. In this non-critical segment, we believe Global Xpress should be well received if priced attractively.



This painting depicts the capture of the *Foudroyant 80* in 1758

While penetration of the high-end market will be challenging due to the factors we have enumerated, the introduction of Global Xpress will, in fact, be a huge benefit to this market. Essentially, by providing high capacity to less critical maritime users and military and aviation users, Global Xpress will likely "free up" additional Ku capacity for critical users.

In conclusion, Global Xpress will not likely prove to be the ultimate competitive weapon Inmarsat hopes it to be in its battle with Ku. However, its acceptance in the casual user market, the military for high-resolution video, and use in aviation markets, will likely compensate for the potential lack of penetration in the "mission critical" maritime segment and ultimately result in the deployment of a useful and necessary new service.

[Click here to read Mr. Gottlieb's prior article, *Inmarsat's Ku-Band Challenge @ Sea* \(January 2009 edition\)](#)

About the author

Mr. Gottlieb is Managing Director of Gottlieb International Group Inc. Established in 2001, his firm specializes in the application of VSAT Technology in Maritime and Oil and Gas Markets. Gottlieb International's mission is to provide vendors with the "hands on" information and contacts they need to structure product and service offerings and to assist Maritime VSAT buyers in choosing the appropriate service and vendor. The firm also supports Satellite related Private Equity Merger and Acquisition activities in the Maritime, Oil And Gas and Mobility sectors. Clients have included Iridium, Intelsat, KVH Industries, Globecom Systems, Inmarsat, RigNet, Verestar, Parallel Software, THISS Technologies, (Singapore), Sonic Telecom, and Private Equity Firms Permira Advisors, Apax and Midwood Capital. Mr. Gottlieb's career encompasses an unusual diversity of Market Research, Sales and Technical background in many segments of the wireless industry including VSAT, Cellular and Mobile Commerce. He has served as Vice President of Sales for Audiovox Communications, Director of Sales for Southeast Asia for COMSAT and Aether Systems, and Corporate Market Research Manager for a Division of Baker International (now Baker-Hughes).



Hungry... + Looking For More...

author: Chris Forrester, Editorial Director, RapidTV

UK-based satellite services specialist Arqiva is going through some internal changes, with existing CEO Tom Bennie stepping down once a new CEO has been appointed, and a restructuring of the organisation into three divisions with Nick Thompson looking after Arqiva's broadcast & media division. Thompson is supervising a business that's in robust good shape, helped by its wide portfolio

of revenues and pushed along by the UK's aggressive analogue switch-off of its terrestrial TV system and conversion to digital.

However, **Arqiva** is much more — there's its wireless towers business, its play-out ('media') businesses, and — of key interest to us — its satellite services operation including the UK's largest cluster of uplink dishes — the Company's clients comprise some of the very best blue-chip broadcasters in the business. "Our underlying numbers are extremely solid. We undertook two meaty rounds of financing in 2005 and 2007 in order to acquire National Grid Wireless," says *Thompson*.

"Our investors are themselves well financed, and each — or all — of them could well consider making further investments in us, and our progress. There would probably have to be some equity investments into the business should that [expansion] happen. But Arqiva also continually looks at potential opportunities from its own resources," said *Thompson*. "In other words we are far from closed in our thinking. However, there's a preference, at least in the short term, to focus on organic growth but even this involves some significant capital expenditure."



Thomson explains that the UK's digital switch-over from analogue terrestrial TV transmission was only about 50 percent completed and a significant 'smart metering' trial in the UK will, itself, need financing. Arqiva's 'smart metering' trials are being undertaken with the UK government's *Department Of Energy Change*, and conducted with North American-based **Sensus** (already involved in US/Canadian deployments with its **FlexNet** system to about four million homes).

"We are as well-funded as we need to be, but we are always ready to consider others. We have and are acquiring some unique skill sets and these are reflected in the near-weekly RFPs we receive," adds *Thompson*. "They see what we can offer. The only problem for us is that we are in the middle of a very tough workload and set of deadlines to meet. And half-way through the operation the government decided it needed to take Channels 61 and 62 out of the mix, which meant we had to re-engineer quite a few elements of the network. It means we are busy. And moreover, the schedule itself has a lot of additional work that follows on from switch-off. As to how we can 'export' that skill set I can tell you it is high in our minds. We are actively talking to some very nice potential clients now."

The upside benefit for Arqiva is that while every European nation is committed to its *Absolute Switch-Off (ASO)* date, they are not all happening at the same time, and even the most enthusiastic governments can slip and slide as regards that final TV date, let alone see delays occurring for unexpected Snafus.

"Then there's the radio side of the business. Perhaps the bandwidth implications are not quite so major, but it is a huge headache for some nations," says *Thompson*. "Here in the UK, there have been various dates put forward, some aggressive, some less so. But certainly 2016-2017 is in just about everyone's calendar. Design and clearances are well under way as far as the UK is concerned. I'd love to ring-fence about 15 guys and put a consultancy division under their control and market that, but just at the moment we are looking at individual RFPs and we'll see how they go."

"By and large Europe has not even started to think about radio. Spectrum use is modest, of course, and governments cannot achieve the same benefits from switching off analogue radio, and the costs for broadcasters is significant," says *Thompson*. "In the UK we are sort of half-way there, with DAB, but we know the signals are inadequate. The analogue system is pretty good, and until the automotive manufacturers gets fully behind digital radio I think progress will be slow. For the UK government, and others internationally, where there is a considerable focus on cost-reduction one has to wonder whether an ASO for analogue radio is economically viable."

"The UK leads the way, but if we have not yet figured out the right solutions then the rest of Europe is way behind. The commercial broadcasters have next-to-zero liquidity to pay for this expansion, so it is tough to see how it could be successfully managed. It remains a big challenge. The additional digital radio plans that once existed have all but evaporated. They are all hurting, and we are doing all that we can to make their lives easy. This includes supporting contract extensions to their licences. It isn't a great place to be. I am only five weeks into my new job, and I have spent much of my time talking to the key stakeholders involved in radio, including the regulators, and all of them admit there are considerable challenges."

HDTV

"HDTV is a terrific success for us. We have just conducted a major research study, and looking at all of the channels but in particular some of the smaller broadcasters, and generally asking their intent as far as HD is concerned. We can now see that all of the UK's Tier 1 broadcasters, the major networks, and now on air with HD, at least on satellite and cable. The Tier 2 players are major names, and include the Viacom, Turners, Discovery-type channels and they too are mostly on air with HD for their main brands."

However, *Thompson* stresses that despite more efficient compression, and the availability of DVB-S2 transmissions, the additional costs would be intimidating for some would-be HDTV MPEG4/AVC broadcasters. "Carriage is still a huge element. It is likely to triple uplink costs and this is a big penalty

Arqiva's MUKBH* EBITDA revenues (year to June 30)

2009 — 304 million pounds

2010 — 330 million pounds

*MUKBH is Macquarie UK Broadcast Holdings Ltd., Arqiva's holding company

MUKBN is loss-making, and not surprising given its debt obligations. Borrowings from its investors are significant. For example, the Company is paying 9.75 percent interest on 735 million pounds of debt, and a thumping 18 percent on 518 million pounds of borrowings.

"I see almost all transmissions being in higher definition, therefore. I see a greater demand on overall bandwidth. The general view is that if you look five years out from today there will probably

for some. Besides, if you are screening a recently-made programme, perhaps that was originated in HD, then some of this improved quality will still come to the screen even though transmission is 'only' in standard MPEG2 definition."

The bigger debate is in managing the bandwidth, both on satellite and terrestrial, he says. "Not every channel needs HDTV. However, there's a feeling that, one of these days, BSkyB will switch off its MPEG2 'standard definition' transmissions. I am not sure that I am completely convinced by the concept," he says. "But from a marketing concept, you can see the logic in saying at some point in the future that they'll switch to all-MPEG4 transmissions. They were, after all, quite aggressive in switching from analogue to digital, for example. If Sky goes that route then there will be benefits, even if some broadcasters stick with SD, given that, over time, more and more programming will be captured in HD, and so will look better on screen even if it is an SD transmission."

be fewer channels on air overall, because some of them will find an alternate route to market probably over broadband.

"Consequently, the remaining channels, still measured in the many hundreds, will almost certainly be in higher quality either through HD transmission, or HD origination," said *Thompson*. "We think the net gain should be up, not down. There will certainly be a period of dual-illumination.

"Today it is impossible for broadcasters to transmit on satellite an MPEG4-based service that is NOT high-def because the EPG would not list them. This is not difficult to fix, but it does somewhat depend on Sky. If Sky chooses to go HD-only, then Freesat could become the home for more channels which have no wish to go HD. There might even be confusion in the market as to the options available to smaller broadcasters. But an all-HD platform while pulling many broadcasters up to the HD standard is not going to appeal to everyone."

Arqiva's geographical split (based on revenues of 823 million pounds)

UK — 684 million pounds

Continental Europe — 77.5 million pounds

Rest of World — 61.4 million pounds

Total — 823.3 million pounds

The UK currently has one 3D-TV channel on air, from BSkyB, and *Thompson* is cautiously optimistic about its television prospects, helped by its enthusiasm for 3D-into-cinema, where it has an industry-leading role in the UK. *Thompson* says that 3D has been the catalyst for the

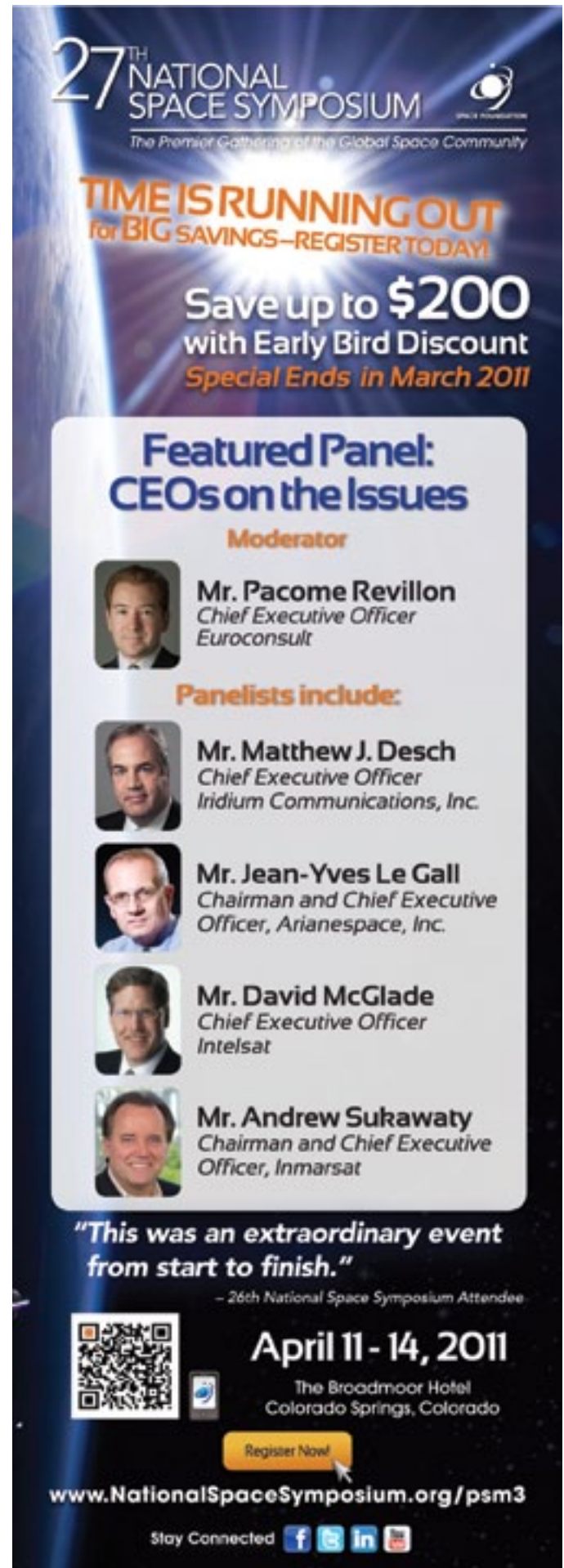
conversion of the UK's cinemas to digital, both in terms of delivery and projection. "I think there will be plenty of interest in sport and movies, but I am not sure that seeing the news in 3D is going to be that compelling!"

Arqiva acquired the Internet television assets formerly known as 'Project Kangaroo' built by Britain's public broadcasters, and is now re-branded as 'SeeSaw'. Arqiva paid about 8 million pounds for the technology. However, Thompson admits that interest is modest, although the prospects for the service remain considerable.

"Not everyone is the BBC, and we see interest coming from those broadcasters, indeed everyone else, looking for a solution to their problems in this area. They are either not in the [broadband] game and need to be in it. But at the same time it costs a fortune, which they don't have. Our perspective is that the SeeSaw model can work with us as a neutral host and have an opportunity. But we need to find a retail partner, a customer-facing partner. Reaching the consumer is more difficult and more expensive. We are not ourselves a broadcaster and we don't own a newspaper group! Calendar year 2011 is key."

2012 is the next quadrennial year, and with the **London Olympic Games** creating more than a casual amount of interest for Arqiva, both in terms of its Outside Broadcast capacity and direct services to the wider world on behalf of the host broadcaster, and also for unilateral links for clients. "Even though many decisions are made well ahead of the event, we find that many broadcasters leave their individual capacity decisions until quite late. We'll be busy enough, but it is just a single spike in the year and the OB facilities are being looked at in some detail but when we get to the 12-month mark there will be the normal rush for facilities. Whatever we have available. I guarantee will be sold."

Thompson says Arqiva has spent the past few years looking at Asia and China, in particular, partly to support existing clients. But also to seek out new contracts. He admits that they had hoped to acquire a local presence in the region. That has not happened.




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Macquarie, building up its transmission assets...

Funds under the management of Australian investment bank Macquarie, in addition to its stake in Arqiva, is also expanding its broadcasting and transmission investments. In mid-December 2010, Macquarie spent 574 million euros to purchase Ceske Radiokomunikace, the Czech Republic's main TV and radio transmission service provider.

On December 5th, Macquarie participated in the acquisition of international facilities house Ascent Media.

As regards to the Czech purchase, Macquarie has bought 100 percent of Ceske Radiokomunikace from Falcon Group, itself controlling or managing funds on behalf of Mid Europa Partners. Radiokomunikace serves 99 percent of the Czech TV and radio broadcasting market and provides corporate and wholesale services to nearly 500 business customers.

agendas. We are on the tender lists, but pricing is key and yet we have to maintain a responsible margin. There are still savings to be made here, especially as a result of the assorted mergers and acquisitions we have gone through. Focus on cost, as always, and trying to ensure that we don't lose business that we want."

2

"We are still looking. We will find a way of having a presence in Asia either by way of ownership or a partnership locally. The Arqiva brand needs to be in the region. The Americas is still important to us, and again we have looked closely at certain businesses but either the price expectation on behalf of the seller has been too rich or for other reasons we have failed to make an agreement. But it is still a high target for us. The New Year will see a renewed focus from us, once the changes here settle down."

Thompson also said they are seeking a larger role in satellite communications for governmental clients. They already have considerable expertise in secured communications, and are looking to build on those skills.

As to Arqiva's other objectives and challenges ahead Mr. Thompson admitted that business in the UK had gone through a tough period. "People have tightened their belts and value for money is higher than ever on our client's

About the author

Chris Forrester is a well-known broadcasting journalist and industry consultant. He reports on all aspects of broadcasting with special emphasis on content, the business of television and emerging applications. He founded *Rapid TV News* and has edited *Interspace* and its successor *Inside Satellite TV* since 1996. He also files for *Advanced-Television.com*.



Arqiva's ownership...

The business is owned by a consortium of eight shareholders including Canada Pension Fund Investment Board (48 percent), Macquarie European Infrastructure Fund (21 percent), other Macquarie funds (13 percent) and minorities.

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Spotlighting National Space Symposium

One of the most venerated organizations that supports our various industries and market segments is the Space Foundation, an international, nonprofit organization and the foremost advocate for all sectors of the space industry, from civil and commercial to national security. Founded in 1983 and based in Colorado Springs, Colorado, the Space Foundation is a leader in space awareness activities, major industry events, including the National Space Symposium, space-related educational enterprises, and space-related research. The Space Foundation has an office in Washington, D.C., and field representatives in Cape Canaveral, Florida, as well as and Houston, Texas.



Speaking of the **National Space Symposium**, the 27th gathering occurs from **April 11th through the 14th** in beautiful Colorado Springs, Colorado. The inaugural event occurred in 1984 at **The Broadmoor Hotel**, which has continued to host the National Space Symposium each year. The hotel has grown, in part, to accommodate the event.

Original event attendees numbered barely 250 space enthusiasts, while expected participants at the 27th National Space Symposium will surpass 8,000. The Symposium has become widely known as the premier U.S. space policy and program forum and the “must attend” opportunity for information and interaction on all sectors of space.

What drives NSS as a premiere event is the caliber of its participants, the extraordinary venue, and the structure of the agenda that creates the perfect environment for making contacts and getting business done. The number one reason attendees continue to return to NSS is the opportunity to network, meet with customers, and to make things happen — all in one place at one time.

Since the early years, the Symposium’s target audience has consistently represented all sectors of the space community: civil, commercial and national security. Military space commands, NASA, NOAA, NRO, NGA and other national security organizations have always been well represented at the Symposium. The event continues to evolve, incorporating in more recent years imaging and Earth observation services representatives, launch providers, satellite manufacturers and operators, space policy experts, space entrepreneurship,

finance, congressional and administration officials and staff. Additionally, the New Generation Space Leaders program is expected to increase substantially in the coming years.

The National Space Symposium engaged in an important new dynamic in the late 1980s when it opened its doors to students and their teachers from across the nation. Education has been an increasingly important element of the event ever since, and the educational outreach increases every year.

The Symposium has also been the stage from which many notable space leaders have addressed the world. Prominent speakers have included the vice president; cabinet officials such as the secretaries of commerce, transportation and defense; secretaries of the Air Force; directors of the National Reconnaissance Office; commanders of United States Strategic Command, United States Northern Command and Air Force Space Command; NASA administrators; leading members of Congress; and senior industry executives as well as a host of state officials, astronauts, private space travelers, futurists, media personalities and leading educators.

In example, Gen. *James Cartwright*, **USMC**, the vice chairman of the *Joint Chiefs of Staff* and the nation's second-highest-ranking military officer, will be a featured speaker. He is the eighth vice chairman of the Joint Chiefs of Staff, which is comprised of leaders from all branches of the U.S. armed forces and advises the civilian government on military matters.

He chairs the *Joint Requirements Oversight Council*, co-chairs the *Defense Acquisition Board*, and serves as a member of the *National Security Council Deputies Committee*, the *Nuclear Weapons Council* and the *Missile Defense Executive Board*.

Exhibit Center



He also co-chairs the *Deputies Advisory Working Group*, which provides advice to the deputy secretary of defense on resourcing and other high-level departmental business issues.

Cartwright was commissioned a second lieutenant in the Marine Corps in 1971. He completed *Naval Flight Officer* training in 1973 and graduated from Naval Aviator training in 1977. He has had operational assignments as an non-flight officer in the F-4, and as a pilot in the F-4, OA-4 and F/A-18. He is also a distinguished graduate of the Air Command and Staff College at Maxwell AFB, earned a Master of Arts degree in national security and strategic studies from the **Naval War College**, Newport, R. I., and completed a fellowship with **Massachusetts Institute of Technology**.

The Symposium is also known for its expansive exhibit center, which has grown from just one building and a few companies in its first years; to include an expanded temporary structure, in addition to the main building, from 1999-2006; and then today to two permanent buildings plus the lower level of **Broadmoor Hall**. This year's exhibit center is nearly six times larger than it was in 1984 and filled with more than 150 companies and organizations representing the best of the space industry.

Top 5 Reasons to Attend the National Space Symposium

Networking

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Influential Participants

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Powerful Agenda

Learn about critical industry issues and developments from focused panels and featured speeches.

Forward-Thinking Activities

See the latest in space technology in the Boeing Exhibit Center, learn about the emerging cyber space domain at the Cyber 1.1 event, and, for young space professionals, participate in the greatly expanded New Generation Space Leaders program.

Global Perspectives

Learn from and build relationships with representatives from the ever-growing global space community.

For a complete list of the outstanding speakers at this year's NSS, [access this direct link](#).

A special benefit to attending NSS happens to be the location — **The Broadmoor Hotel**, a magnificent hotel that is the longest-running, consecutive winner of the *AAA Five-Diamond* and the *Mobil Travel Guide Five-Star Awards* — which also happened to celebrate its 90th anniversary in 2008.

The pet-friendly resort is located under the shadow of Cheyenne Mountain and offers an award-winning spa, fitness center, two swimming pools, three outdoor hot tubs, one lap pool; 54 holes of championship golf, six tennis courts; children's programs; 24-hour room service, and 25 specialty retail shops. Many of The Broadmoor's 593 guest rooms and 107 luxury suites offer breathtaking mountain views and balconies. It's no surprise rooms at The Broadmoor sell out more than a year in advance for the National

A future-oriented agenda, lively and productive networking discussions, global representation and an expansive exhibit center showcasing the latest in space technology — these components create one of the National Space Symposium's greatest strengths: an exhilarating, dynamic, and forward-thinking environment. Come and see for yourself why NSS is a "must attend" event, after all, it's where your customers will be — don't miss this opportunity to learn and connect!

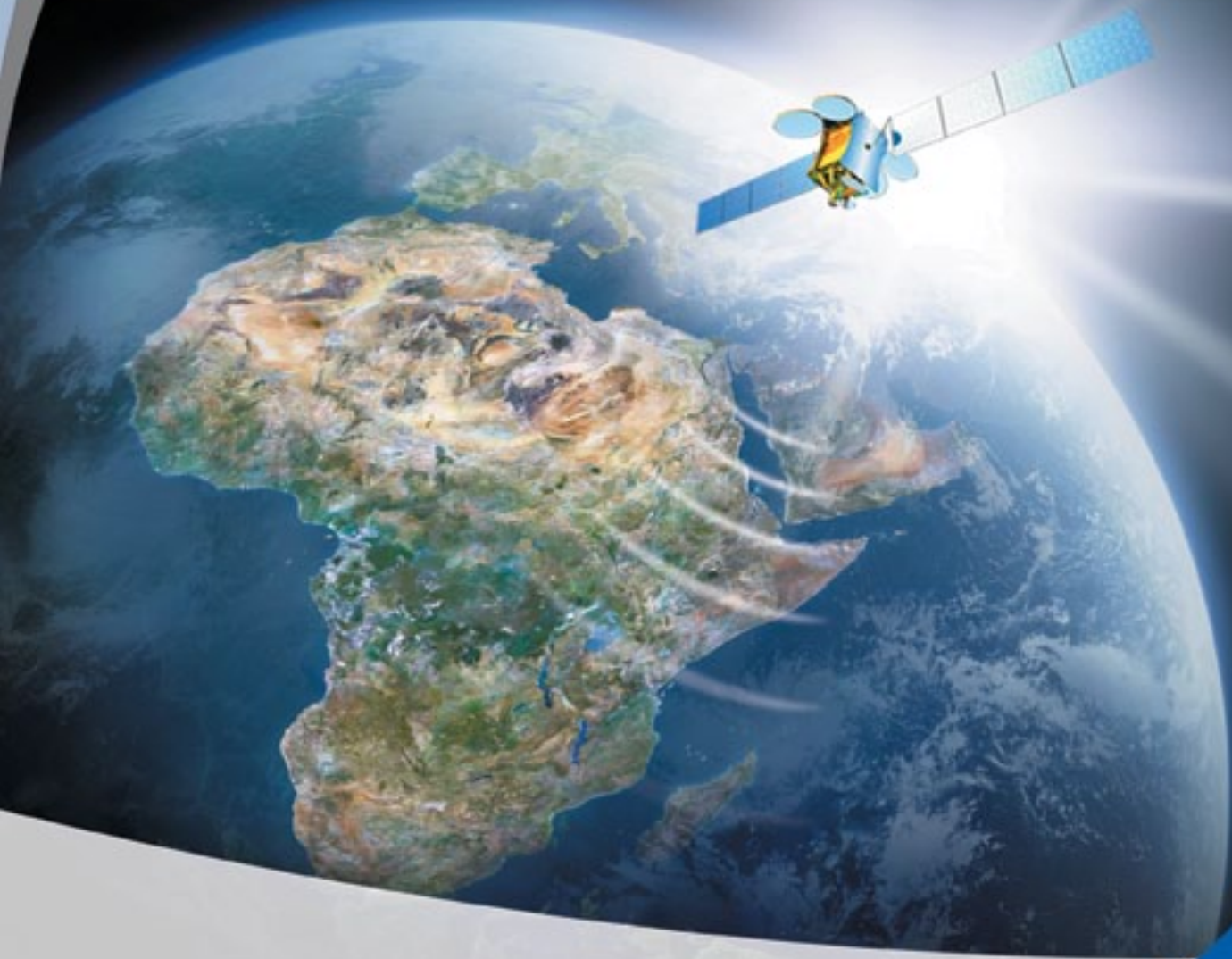
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Going For The Gold...

author: Martin Coleman, Director, Colem, and Chairman, Video Committee, SUIRG

Having discussed Carrier ID, the way forward and the future thinking on interference, in the last of this series of articles, Martin Coleman presents the industry with a challenge! With the 2012 Olympics drawing closer, which is an enormous undertaking in our world of broadcast, surely that should be our target for the roll-out of Video Carrier ID and other global initiatives? How do we make that happen?

Why 2012?

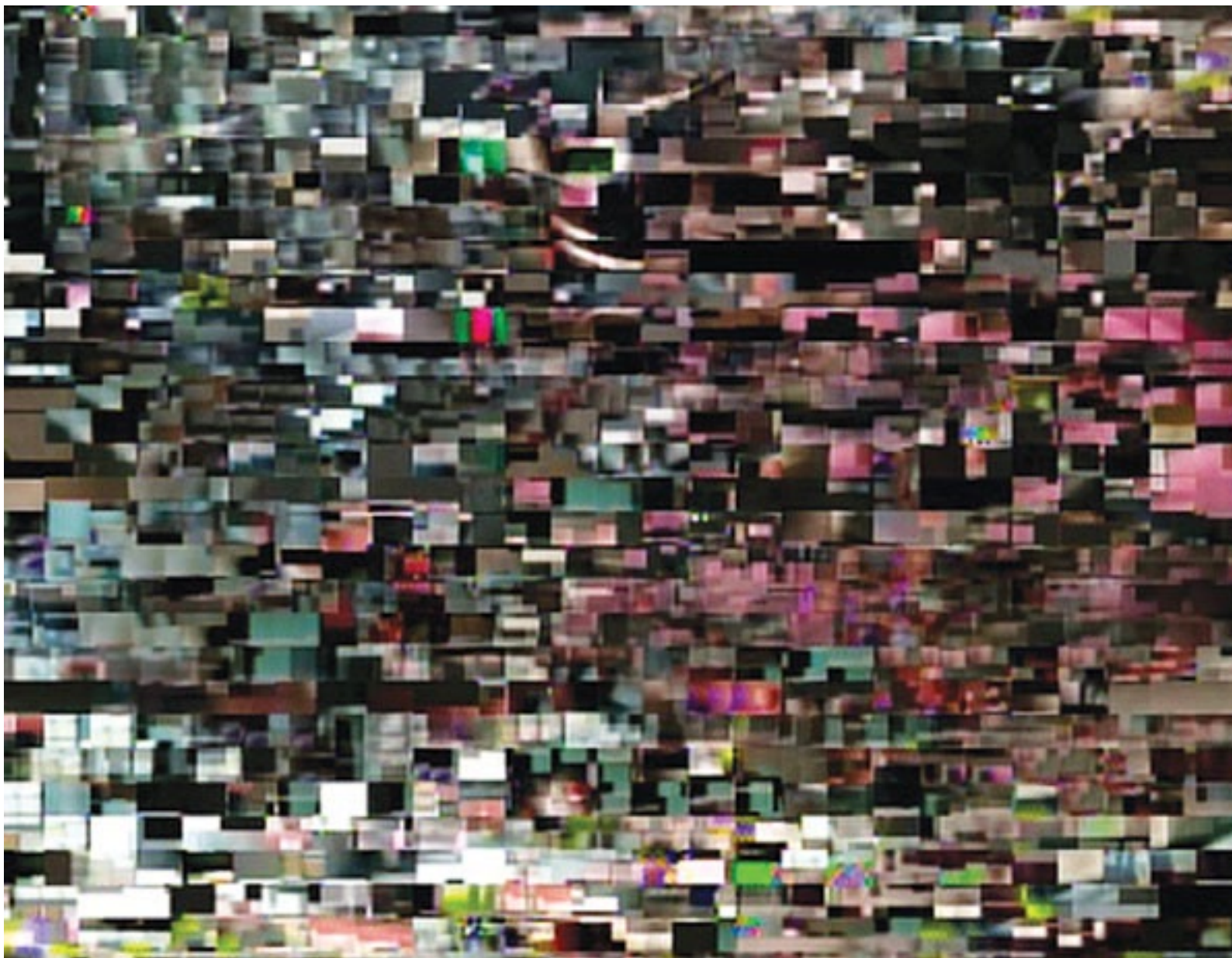
As we are all aware, getting any initiative in place is no quick job. Taking **Video Carrier ID**, I would ideally love to say by the close of 2011. However, knowing where we are today, that would clearly not be realistic. It is also better to have a realistic challenge that has global focus to make ID truly global for all transmissions from that point.

I truly believe that 2012 is achievable, and with the Olympics that year, it is the ideal milestone to target. Of course, such a large sporting event means a whole lot of additional satellite activity, with



broadcasters from across the world descending on London to acquire feeds and uplink them via satellite to their home countries. With so much activity, the risk of interference increases, and so, too, does the need to take measures to reduce it.

With that in mind, I would think that most broadcasters would be more than happy to get the Video ID initiatives in place in time for the Olympics, and with their support, and that of the equipment manufacturers and other satellite operators, I truly believe we can achieve that goal.



As we know from recent transmission events during the World Cup, imagine the annoyance of TV viewers across the world switching on their sets to watch their athletes in action, then, at the crucial moment, they lose their connection due to satellite interference. We have to try and avoid such interference happening again. Naturally, we are always at risk of those determined to deliberately undermine transmissions at such events, usually for political ends only, a trend not easily averted.

What's Next?

If we agree the Olympic event is our goal, the next crucial question is — how do we make that happen?

My aim during 2011 is to strengthen working relations between the *Video Carrier ID group* (and, indeed, the rest of **SUIRG**) and both **GVF** and the **WBU-ISOG**. GVF is leading a number of initiatives in the training and type approval areas and WBU-ISOG has the 'ear' of the global world of broadcasters.

As always, I see that by sensible and considered debate, our industry can be educated on the reasons behind the initiatives and their implementation. This is how we get those broadcasters involved with the Olympics to ensure Video Carrier ID becomes the norm throughout that event. SUIRG, being a specialist group, can easily support these larger, more influential groups in the global task of combating interference. By joining forces, we will be able to make that difference happen sooner.

As a dedicated group, we have been working hard at bringing existing bodies, suppliers, and broadcasters alike, on board. As I mentioned in my previous articles, we have experienced a certain amount of success with this, but we are not quite there yet. In particular, broadcasters are still lagging behind in understanding what we are trying to achieve. However, the last few months have seen steady progress in changing attitudes and getting those companies geared up for a big push on Video Carrier ID.

Measuring Success

As with any initiative involving many different players, getting together on a regular basis is important in order to track success and make plans for the next stages. At the same time, it is important to carefully plan this to coincide with events those companies are already attending to keep costs to a minimum and to ensure the whole process is as efficient as possible.

One such gathering was the recent *WBU-ISOG Conference* at the **ASBU** headquarters in Tunis. Here the *WBU-ISOG Rogue Carrier Working group* was resurrected and a nominated member from each of the world's broadcasting groups will be working with GVF and SUIRG to initially start the push of Video Carrier ID, followed by all types of transmission over the years to come.

The intention is to run this as a project and manage accordingly. The initial plan includes private meetings with SUIRG directors and broadcasters

in early January in Atlanta, followed by our **CabSat** and the Washington D.C. satellite show sessions currently being organized to engage the Americas and Middle East users and satellite operators. The recently convened GVF meeting on satellite Earth station quality assurance and Earth station type approvals being hosted by **Eutelsat** in late February will now be included within the plan. These events will be followed by others at **Broadcast Asia** and **IBC** later in the year.

Crossing The Finish Line

I believe the 2012 Olympics is an achievable goal that's set within a practical timeframe for getting all broadcasters, encoder manufacturers, and satellite operators are on board with Video Carrier ID. Not only is it achievable, but for the broadcast world it is an essential start to achieving the wider aim of ID on all transmissions. We should switch into top gear and get everyone doing their part to make this happen — now. The hope is that a working group of members in 2011 will engage and formulate such future thinking, as such is imperative for success.

As we continue to deliver the basics, we also continue to grow our products and technology and, for once, share that information with the industry. By enticing people to discuss and share their information and ideas, this is the only way to make a significant impact on solving the interference challenges — once and for all.

About the author

Martin Coleman is the Director of Colem



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Executive Spotlight

Brent Bruun

Vice President, Sales & Business Development, KVH

Mr. Bruun joined KVH in 2008 as the Vice President for Sales and Business Development. His focus was on the planned global expansion of KVH's mini-VSAT Broadband satellite communications service. Prior to joining KVH, Mr. Bruun served as Senior Vice President of Strategic Initiatives for SES AMERICOM, where he concentrated on global mobile broadband opportunities with particular emphasis on the maritime and aeronautical markets. He holds a bachelor's degree in accounting from Alfred University and is a Certified Public Accountant (CPA). His considerable experience in the maritime satellite communications industry also qualifies him as an expert on the evolution, importance, and current condition of the industry as a whole.



Yachts at anchor in Malorca — KVH's TracVision satellite TV systems are quite evident.



SatMagazine (SM)

Brent, what brought you to KVH, and what are your current responsibilities?

Brent Bruun

The path I followed that ultimately led to KVH is unique. I started my career at KPMG in Stamford, Connecticut. While at KPMG, I fulfilled the necessary requirements (including passing an extremely brutal three-day exam) to become a CPA. After seven years at KPMG, I left the firm and went to work for one of their clients, GE Capital. At GE Capital, I was a Senior Analyst in the Financial, Planning and Analysis (FP&A) department. I spent several years at GE Capital before transferring to one of its businesses, GE Americom in Princeton, New Jersey, assuming leadership responsibilities for Americom's FP&A department.

I was actively engaged in the deal structuring process for GE Americom, including the business' sale to SES. After SES acquired Americom, it was a natural progression for me to move into a business development role and assume the title of Senior Vice President of Business Development for SES Americom. I was introduced to mobile broadband connectivity, supported by ViaSat technologies, for the first time during this experience.

My early experience in the mobility arena included a revenue share arrangement with Arinc's SKYLink business unit, which offered broadband connectivity to general aviation aircraft. The SKYLink service offering is based on ViaSat's ArcLight® platform, the same platform that is used for KVH's mini-VSAT Broadband (SM) network.

Subsequent to the SKYLink deal, I led SES Americom's ConnexionByBoeing (CbB) transaction. The CbB service offering was also based on ViaSat technology. The Boeing Company

funded a significant portion of the AMC-23 spacecraft, which is positioned over the Pacific Ocean at 172 degrees East. Although the CbB business didn't survive, the Boeing Company was instrumental in getting Ku-band capacity in place over the Pacific and Atlantic Oceans. This capacity is a cornerstone for KVH's mobile broadband service.

My interactions with SKYLink and CbB personnel left me with two lasting convictions. First, that there was a future in FSS satellite-based mobile broadband service offerings, and second, that ViaSat's



Commercial shipping companies like Vadero use KVH's TracPhone V7 and mini-VSAT Broadband service to support business operations and crew morale.

Executive Spotlight

technology was (and is) the best alternative due to their unique spread spectrum waveform.

While still at SES, I was actively engaged in an alignment involving SES bandwidth and KVH's mini-VSAT Broadband service offering, which is based on ViaSat's ArcLight technology. While providing account management services on behalf of SES for the mini-VSAT Broadband initiative, I was afforded the opportunity to better familiarize myself with KVH. KVH is an incredible company.

Martin Kits van Heyningen (KVH's co-founder and CEO) literally started the company in his basement. KVH has always paid incredible attention to delivering quality products, which helped make me a true believer in KVH's mobile broadband service offering. The mini-VSAT Broadband initiative combined with KVH's suite of quality product offerings and entrepreneurial spirit are the key factors that make

KVH a wonderful place to work.

In 2008, when I was offered the opportunity to join KVH and help guide the mobile broadband portion of the business, I was excited to accept.

Overseeing

the global commercialization of the network is still one of my biggest responsibilities and one I continue to be passionate about. I also oversee our entire satellite product sales team, so I manage aspects of all of our TracPhone® and TracVision® products and how they are marketed and sold.



KVH's TracPhone V7 is a compact, affordable satellite communications system that works with KVH's own mini-VSAT Broadband service.

SM

KVH has several diverse product lines that are of interest to audiences in multiple markets and regions. Can you give us an overview of how KVH fits all these pieces together?

Brent Bruun

KVH is a leading provider of in-motion satellite TV and communication systems around the world. We've designed, manufactured, and sold more than 150,000 mobile satellite antennas for applications on vessels, vehicles, and aircraft, and we also manufacture guidance and stabilization solutions for military and commercial applications. That's a lot — especially as we handle our own engineering, manufacturing, marketing, etc. Everyone who works on KVH products works for KVH, so everyone has experience with all the markets we serve. I think that makes it a little easier to manage the multiple brands and product lines. We are headquartered in Middletown, Rhode Island, and we also have facilities in Illinois, Denmark, Norway, and Singapore. As the business grows globally, we may open additional international offices. KVH is very visible in the marine market, both with leisure and commercial mariners.

SM

Can you give us an overview of the company's approach to this valuable market?

Brent Bruun

Sure. KVH started off making compasses for sailboats, which we still manufacture and sell. From there, the business grew into TV receive-only (TVRO) products like our TracVision series of satellite TV antennas and then two-way satellite communications solutions, including Inmarsat airtime and compatible TracPhone antennas as well as the TracPhone V7, which was specifically designed for use on the mini-VSAT Broadband network.

Recently, both our satellite TV and satellite communications technology have grown. With TV, we developed the TracVision HD7, which solves the issue that mobile users faced when DIRECTV® began moving high-definition programming to Ka-band satellites. We feel our TriAD™ technology is the best solution available to meet that challenge, because it tracks up to three Ka- and Ku-band satellites simultaneously, allowing boaters to have

a user-friendly DIRECTV HD solution in a single, compact dome.

Of course, our biggest development has been, and continues to be, the mini-VSAT Broadband network and the TracPhone V7. We have deployed a dual purpose network for maritime and aeronautical broadband connectivity with our partner, ViaSat. KVH focuses specifically on the maritime industry while ViaSat's concentration is dedicated to the aeronautical industry. The deployment of the mini-VSAT Broadband network has transitioned KVH from solely manufacturing hardware to taking a more holistic approach, offering a turnkey solution that includes hardware, airtime service, network management, and a variety of value-added services. We expect this to be a major growth area for many years to come.

In late 2010, we made a move that will bring a great deal of flexibility and functionality to mini-VSAT Broadband subscribers. KVH acquired Virtek Communication AS (now KVH Norway), who developed the CommBox™ ship/shore network manager. We're very excited about this technology — it increases network capacity through data compression and transmission optimization, it enables remote PC management, includes integrated e-mail, web compression, firewalls, and security, and also provides least-cost routing and bandwidth management for multiple communication services. We're thrilled to complete the integration and demonstrate to the commercial maritime industry in particular how to make their satellite communications solutions work harder for them.

SM

Clearly, the mini-VSAT Broadband network and the TracPhone V7 are a major focus for KVH and for you personally. What makes this solution the best?

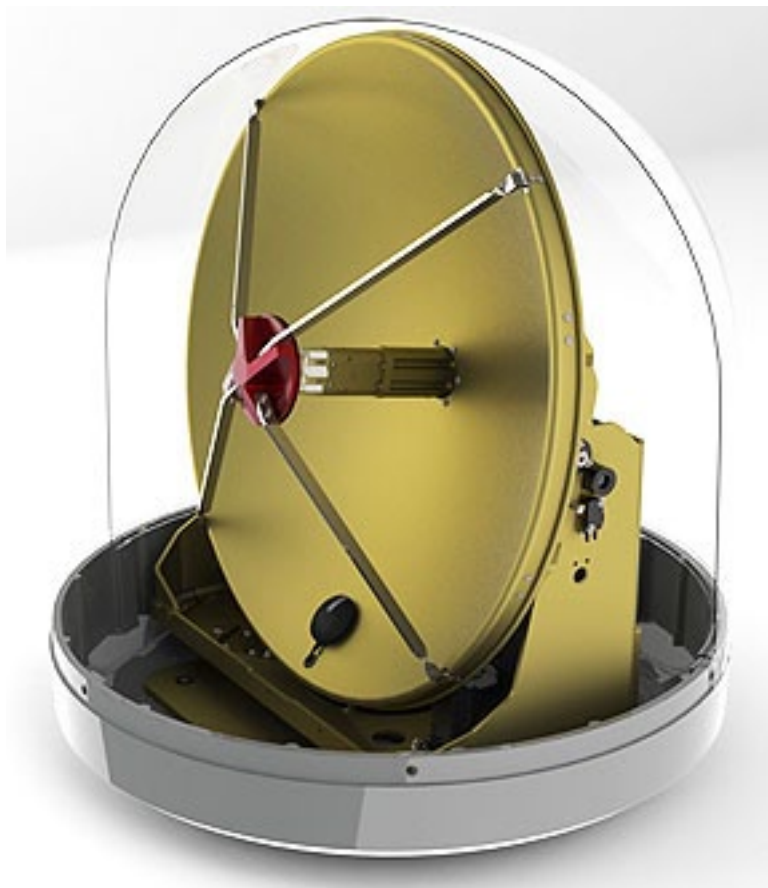
Brent Bruun

Our customers love that they can get everything in one place when they purchase our TracPhone V7 — in addition to getting KVH-designed and manufactured hardware, they activate their mini-VSAT Broadband airtime through KVH, and our sales and technical support teams are the only people they need to call for service. This, combined

with the fact that the network is based on ViaSat's ArcLight platform (which in my opinion is the optimal mobility platform), provides our customers with superior service.

Competitive services combine hardware components from a couple of companies with service from another, which often means mariners get bounced from one place to another when they need service. We've eliminated that problem. Boaters also like having compact hardware that doesn't require a crane and a whole team to install — we have customers who operate commercial fleets and have just a few crew members install the antenna themselves in less than a day.

The mini-VSAT Broadband network grew from a regional to a global solution covering most of the world's major shipping routes in just three short years. Our network operations team is doing a great job at monitoring the network and identifying elements we can improve, which allows us to keep the mini-VSAT Broadband service fast, reliable, and affordable.



KVH TracVision HD7 cross section

Executive Spotlight

These are all important reasons why customers like the U.S. Coast Guard are choosing mini-VSAT Broadband and why it has become the fastest growing maritime VSAT solution.

Best of all, the mini-VSAT Broadband network is poised to support many value-added services that will help mariners (particularly commercial operators) leverage the system and service as a business tool. Our crew calling option allows vessel managers to customize their crew communications programs, and makes administration of the program nearly effortless. We also offer a picocell solution that enables convenient cell phone access at sea, for crew, passengers, and even contractors who are onboard. In 2011, we will begin supporting Internet café functionality, which we expect to be popular both for crew use aboard commercial vessels and for passengers on charters and ferries.

SM

The global economic downturn has obviously had an impact on the maritime community. How is KVH dealing with this challenge?

Brent Bruun

Our diversity is a huge factor in how we are facing the economic challenges. We made a long-term commitment to key strategic initiatives in both the satellite communications and fiber optic gyro markets. Fortunately, these markets began to accelerate and make significant contributions to our revenues just as our traditional marine and land mobile markets started to feel the pinch. We also recently won a \$42 million contract to sell TracPhone V7 systems and the mini-VSAT Broadband service to the U.S. Coast Guard. This is a huge boost for our military and commercial maritime markets, both financially and in terms of visibility.

Another sustaining factor is that KVH manufactures reliable, high-quality products — period. Our dealers and our customers know that and rely on it, which gives us tremendous staying power. That's why the National

Marine Electronics Association (NMEA) has named our TracVision systems the best marine entertainment products for 13 consecutive years, and also named the TracPhone V7 the best marine communications product in 2010. Many of the same qualities that make us a leader in the markets we serve also help us to successfully navigate economic ups and downs.

SM

What new developments can we expect from KVH in 2011?

Brent Bruun

We have great plans for the mini-VSAT Broadband network this year. Some very exciting hardware enhancements will be introduced during the first half of the year, which will make mini-VSAT Broadband available to an even bigger audience of mariners around the world. We also plan to continue to implement our global commercialization strategy, making the mini-VSAT Broadband service even more valuable to our customers with several enhancements, some which are new and some of which are already underway.

We announced the GlobalCare premium support program in 2010, and we'll continue building out the infrastructure for that program to provide the best possible service to our customers at sea and around the world. To support that infrastructure, we're training more qualified dealers and technicians in ports around the globe via a convenient, interactive online training program that will go live early in 2011. As the network and our customer base grow, we will expand our technical support team as well.

Overall, KVH's fully integrated solutions, proven quality and reliability, and outstanding service are helping us succeed in our mission to provide the best communication and entertainment solutions to people who are on the move around the world.



For more information on KVH Industries and its products, [access this direct link](#).

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Director General
Nigeria
Broadcasting
Commission



Amadou Vamoulke
Director General
Cameroon Radio
Television,
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John Ugbe
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Teamwork Enables Brazilian Voting

author: Catherine Melquist, Vizada

It takes a strong message, one that resonates deeply and broadly with the electorate, to motivate the masses to vote a candidate into office. While politicians and their advisors were fine tuning their messages in the months and weeks leading up to the historic Brazilian presidential elections of 2010, an equally dedicated and talented team of telecommunications experts and technicians from today's leading satellite communications companies were fine tuning and testing the reliability and strength of the nationwide network that would support the surge of citizens casting their vote for the first woman president.



The highly coordinated and collaborative, behind-the-scenes effort of **Vizada**, **Inmarsat** and **Arycom** was vital in ensuring the successful conclusion of the elections on October 31, 2010. These three companies formed an unprecedented partnership during the months leading up to the elections.

Their assignment was to provide seamless, secure and reliable network services throughout the country during both election periods. The three separate global organizations created a cross-functional team of more than 35 professionals — network engineers, product managers, customer care representatives and commercial staff — to effectively address transmission, support, security and reliability needs for this critical application.

Coordinating simultaneous activations and registrations of Inmarsat BGAN terminals as well as data transmissions during specific voting periods were the team's biggest challenges — and their biggest achievements.

Brazil's three time zones had to be covered by the satellite solution and each time zone had a different requirement as to when the voting period must close. The total number of BGAN terminals was more than 1,400. During the peak voting period across all three regions, more than half of these sites required activation and near real-time transmission of results. Even at this peak activity, with more than 700 simultaneous transmissions taking place, the network delay was minimal. Furthermore, the remote voting sites concluded their data transmissions in less than a minute. The election results were processed and concluded in record time, only one hour and four minutes after the polls closed.

To achieve these results, it was critical that activations, registrations and data transmissions did not degrade the average network delay. To support simultaneous activity during peak hours, Inmarsat optimized the network capacity, allocating more resources to manage it. Under most circumstances, each regional beam

handles a volume of BGAN terminal activations based on the probability of simultaneous activations per region. In this case, that number was multiplied to avoid any risk of delayed registrations. It was vital that network operators saw no network congestion. With this network optimization strategy in place, the operator's experience was virtually the same as if he or she were activating just one BGAN per beam.

While the team had confidence in their strategy, it required testing, traffic analysis and training before it could be implemented effectively. In advance of the voting period, the team executed several pre-test procedures over the network with the customer's participation. They activated and registered a large number of BGAN terminals — nearly 700 — simulating the conditions projected for Election Day. These BGANs were all operating simultaneously, just as they would be during the election.

Additionally, network simulation covered each of the 15 Brazilian states participating in the election. During the testing period, the team was able to refine operational procedures, verify the accuracy of the APN (Vizada), make sure they were using the correct IP addressing scheme, and optimize satellite pointing, or line of sight. With these in-depth simulations and comprehensive training during the testing period, Inmarsat, Vizada and Arycom greatly reduced the possibility of human error on Election Day and improved the overall security of the operation.



Ensuring integrity of the network transmissions was also a critically important security measure. Vizada's network engineers located in the United States and France implemented a dedicated **Terralink Interconnect** solution that relied on a site-to-site IP security VPN tunnel from Vizada's New York City PoP to the Brazilian TSE election HQ data facility. **Vizada Engineering** support helped to design the technical solution for the IP network using private addressing and preventing public Internet access.

Through these collaborative efforts during the elections, Inmarsat, Vizada and Arycom made terminal activation, registration and data transmission as easy, secure and fast as possible. The team created a network to successfully handle nearly 15,000 voice and data calls in a roughly 24-hour period during both rounds of the election. The name of the new president was officially confirmed an hour after voting concluded — a new record.

Short of a natural disaster, there may not be a more important use for satellite communications than creating a network that helps ensure that everyone — including people from remote regions of the world — are able to participate in the democratic process and elect new leadership for their countries. In the end, it was both a powerful message and a robust network of satellite technology that led to the election of the country's first woman president.

About the author

Catherine Melquist has served as the head of marketing for the Americas division of Vizada since 2007. She's responsible for developing and driving Vizada Americas marketing strategy, aligning corporate vision and goals with commercial initiatives and building brand equity with through channel outreach programs and new product roll outs. Before joining Vizada, Catherine held strategic marketing director positions with positions at Telenor Satellite Services, Lockheed Martin Global Telecommunications and COMSAT Corporation. She holds an MBA from The American University and a B.A. in Political Science from the University of California at Santa Barbara.



The All-Star Team

- ◇ *Each of these professionals, along with their company's technical and commercial teams, worked on site in Belo Horizonte, Brazil for the entire month of October. Because of their collaborative efforts, the satellite network and related applications supporting the voting process for Brazilian Election were implemented flawlessly.*
- ◇ *Fabio Alencar, head of Latin American sales for Vizada, served as project manager. He was responsible for interacting with team members at Inmarsat, Arycom and Vizada to ensure coordination of testing and to detect network performance issues in advance of and during Election Days.*
- ◇ *Lee Marston, Solution Manager at Inmarsat, also acted as a project manager. His responsibilities included coordinating activities and communications among personnel at Inmarsat. His role was integral in understanding the complete network design and the satellite network operation.*
- ◇ *Tord Wester, a system engineer expert at Arycom and lead engineer for the project, worked with Vizada and Inmarsat to debug every network problem in advance of the Election Days. He was also responsible for successfully implementing the configurations, like the VPN, and providing on-the-ground training to most of the engineering support in the field, during the testing period and Election Day.*
- ◇ *Also contributing were the Technical and Commercial Teams of Inmarsat, Vizada and Arycom with locations spanning the U.S., U.K., France and Brazil.*

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Eyes In The Sky Remote Sensing To Protect Rights

As high-resolution satellite imagery from civilian sources becomes cheaper and more accessible, human rights activists and environmental organisations are increasingly using it to uncover and investigate instances of abuse around the globe. Olivia Edward of Geographical magazine reports...



The village of Angabo, Darfur, Sudan, on 21 June 2006. Angabo is one of a cluster of villages that was reportedly burned following the Darfur Peace Agreement in May 2006. This first attack was followed up six months later on 11 November 2006 by a larger attack that resulted in the burning of villages and an unspecified number of casualties. Two days later, the Janjaweed and Sudanese troops reportedly burned the village's water centre and killed eight civilians. A comparison between this image and another taken on 15 February 2007 as part of Amnesty International's Eyes on Darfur project revealed that more than 550 structures within the village had been completely burned, mostly in close proximity to the village centre

In May 2009, as the Sri Lankan army closed in on a rebel Tamil group in the country's northeast, reports began to come in of a 'bloodbath', with more than 10,000 civilians killed. A UN spokesman accused the government of being responsible, but with outsiders banned from entering the area, it seemed unlikely that it would ever be held accountable.

However, 'someone' had been 'watching': a US-owned satellite. When geospatial experts at the American Association for the Advancement of Science (**AAAS**) were asked by **Amnesty International** and **Human Rights Watch** to analyze images of a civilian safety zone, the truth began to be revealed.

The refuge area was located on a sandy spit, and as the analysts began comparing images taken a few days before the clash with those taken afterwards, they not only saw destroyed buildings and freshly dug graves, they also noted a series of craters dotted across the sand. "They were shell holes," says **Susan**

Wolfenbarger, a geographer who has recently taken over as head of the AAAS's *Geospatial Technologies and Human Rights Project*. This meant that someone had been firing into the civilian safety zone. But who?

Apportioning blame in such situations is understandably difficult, but in this case, the shells had fallen into soft sand, producing tell-tale 'ejector' patterns. A closer inspection of this spewed-out sand indicated the direction from which the shells had been fired. And when those trajectories were traced back, they led directly to areas where the Sri Lankan government forces were thought to have been present.

It wasn't the whole story — eyewitness and UN reports suggested that civilians were coming under fire from both government and rebel forces — but it provided a rare glimpse of what was really going on in an area from which journalists and researchers were banned.



A village near Ishma, Darfur, Sudan, on Christmas Day 2004 (*left*) and 10 February 2007 (*right*). The village was one of several that were attacked along the main road going northeast out of Nyala as the Sudanese government attempted to cut off the rebels' supply routes. Comparison of these two images shows that it had been completely destroyed in the attack

Dark Corners

With more and more satellites in the sky, and the price of high-resolution satellite images dropping, remotely gathered imagery is increasingly being used by the UN and NGOs to investigate allegations of human rights and environmental abuse. “It’s like a light shining into the dark corners of the world,” says **Mark Brender**, chief executive of the **GeoEye Foundation**, which provides free imagery to NGOs from satellites that belong to **GeoEye**, a commercial organization that sells satellite and aerial imagery to everyone from governments to **Google**.

The commercial availability of high-resolution satellite imagery is a relatively recent phenomenon, only really taking off since the turn of the millennium, but it has already facilitated the investigation of a range of events and issues, including the destruction of homes in Sudan and Zimbabwe, and the environmental effects of the notorious Rio Tinto gold and copper mine in Papua.

“Gathering information in these places is often incredibly dangerous,” says Dr. **Chris Lavers**, a remote-imaging expert based at the **University of Plymouth** who has been helping organizations such as Amnesty and tribal-rights **NGO Survival**. “Journalists have been killed trying to approach the Rio Tinto mine, and aid workers can be targeted as they fly into remote areas in Sudan. Satellite imagery means that we can find out what’s happening in these areas without risking people’s lives.”

But analyzing remote satellite imagery isn’t like looking through a series of CCTV tapes. There’s still a lot of detective work involved, explains US geographer **Lars Bromley** of UN unit **UNOSAT**, who was brought in by the UN to strengthen its human rights monitoring work through the use of remotely gathered data.

It makes the world a safer place... Satellite imagery acts as a visual truth serum and forces people to react

“A lot of people think that there’s a satellite above their head every moment of the day, and that it’s simply a matter of calling in these images to find out

what’s going on, but there are only about five or six satellites that we can use for this sort of work and they only cover a very finite area of the Earth every day,”

Satellite imagery means that we can find out what’s happening in these areas without risking people’s lives

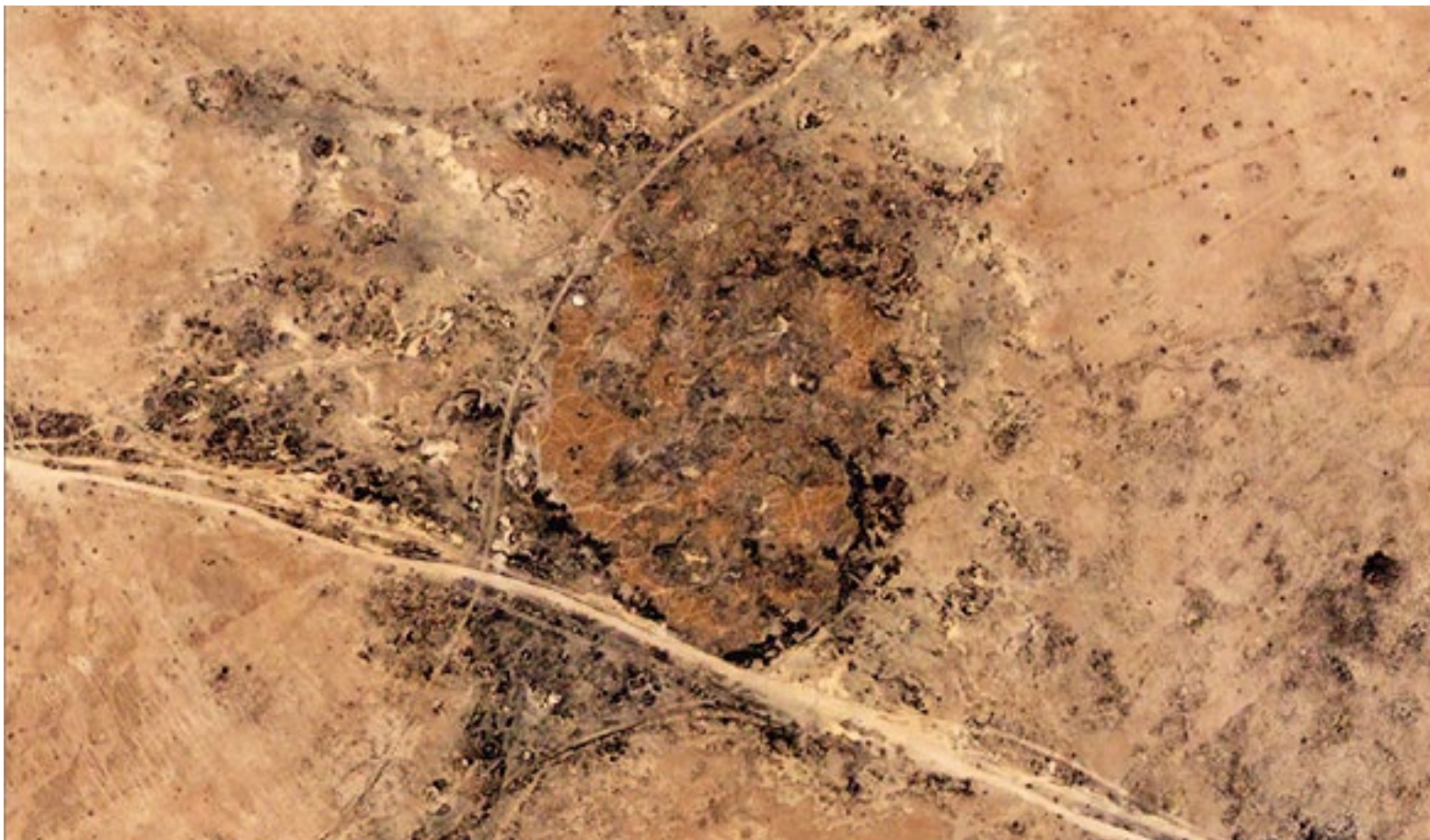
he says. “The resulting satellite images are really only a snapshot, taken in a picosecond [one trillionth of a second], so you don’t get ‘smoking guns’, such as a burning Sudanese village surrounded by a group of militants in government jeeps.”

And there are plenty of other challenges involved in the process. “The first thing we have to do when we’re asked to investigate an event that has occurred in a particular place is to find out where that place is,” says **Wolfenbarger**. “And that’s not always as easy as it sounds.”

Recently, when the AAAS team, at the time led by **Bromley**, was asked to look at a problem in Myanmar, they had to resort to using old Russian topographic maps because the military regime had changed all of the country’s place names. “It has become a lot easier now thanks to Google Earth, which includes some really remote places but, in the past, sometimes we’ve had to say, ‘Sorry, we can’t investigate such and such a place because we can’t find its coordinates,’” says **Wolfenbarger**.

Once a place has been located, analysts usually hope to acquire a set of before and after images that they can compare for evidence of wrongdoing. Ideally, these images will be held in the archives of satellite-imaging companies, but the imagery will only be available if someone else has already commissioned it, so the less attention a conflict has received, the less likely it is that images of it will exist.

If there are no archive shots, new images can be commissioned for around one sixth of the price of an archive image. “They cost around US\$2,000 each,” says **Wolfenbarger**. “And then when you get them back, there’s always the worry that the one village you want to look at will have a cloud over it.”



If the skies above their chosen area are clear, analysts can begin comparing the before and after shots to see how an event has transpired. In Zimbabwe in May 2005, president *Robert Mugabe's* government began a campaign called *Operation Restore Order* or *Drive Out Trash*, in which the homes of about 700,000 people were demolished. Images taken after some of the 10,000-plus residents of Porta Farm were driven from their homes clearly showed the result. "You can see the square black holes on the map," says *Lavers*. "They are buildings whose roofs have been removed, probably through the use of fire."

Although the information gathered often needs to be 'ground-truthed' — combined with eyewitness reports — the resulting evidence is still strong. "We're a scientific organization, so we just produce our analysis then hand it over to advocacy organizations to use for their causes," says *Wolfenbarger*. "But it adds a lot of legitimacy to their reports, and our imagery is currently being used in three cases before the international courts."

Even the lower-resolution imagery found on sites such as **Google Earth** can have a powerful effect. "An image is very persuasive and easy to understand," says Dr. *Jo Woodman*, a researcher at **Survival** who worked on the campaign against the construction of Vedanta's aluminum mine on a mountain in the Niyamgiri Hills in eastern India that's sacred to the Dongria Kondh. The company claimed that it had taken Dongria leaders to the nearby Panchpatmali mine and that they were "amazed to see the positive impact of bauxite mining."

"It was ridiculous," says *Woodman*. "But we were able to show shareholders satellite images of the destruction caused by the existing mine and say, 'How likely do you think it is that the Dongria Kondh said that this was something they wanted on their mountain, too?' It helped people realize that what we're talking about is real. And by helping to persuade high-profile shareholders such as the Church of England to sell their shares, I think it definitely helped raise the profile of the case and save the mountain."

Information Voids

Today, there are few corners of the globe that are beyond the reach of the satellite's eye. "It makes the world a safer place," says **Brender**. "Satellite imagery acts as a visual truth serum and forces people to react."

However, *Bromley* adds a note of caution, pointing out that although there are no longer any 'information voids' around the globe that can be used as 'a hiding place for repressive governments', in order to make the world a better place, that information still has to be acted upon, or it will simply be "highlighting the impunity with which they can act."



Members of India's Dongria Kondh tribe protest against a mine planned by Vedanta. Satellite images of another Vedanta mine helped to turn shareholders against the plan



Editor's Note

This article is courtesy of **Geographical** magazine and was originally published at <http://www.geographical.co.uk> in January of 2011.

Smoke Alarm

In an ideal world, satellite imagery could prevent human rights or environmental abuses from even occurring by sounding an alarm if anything untoward was spotted taking place. There's no all-seeing eye, as yet, but Brazil does already use a satellite-image linked program to warn Amazon land managers if unexpected deforestation is occurring in certain areas. Lars Bromley, a geographer and geospatial information expert based at the UN, is working on a computer program that will detect conflict by using satellite data of fire occurrence.

While he was carrying out his graduate research, Bromley discovered that on-the-ground fire levels in Darfur increased dramatically during the worst periods of violence to civilians, and were far higher than that which would usually be occurring at that time of year due to farming. He realized that the presence of fire was a clear indicator of homes and land being maliciously burned, and he was proved right when the UN later spotted the same pattern during conflict in Nairobi and Georgia.

"The presence of fire doesn't always correlate with levels of civil strife," says Bromley, "but in my experience, if you're seeing a lot of fire, then the fighting is very likely to be having a heavy impact on civilians."

He's now attempting to create a model that will automatically notify the UN of fire-accompanied conflict events. "It's a fantastic mathematical and technological challenge," says Bromley, but he acknowledges the need to be pragmatic. "Can I build a million-dollar system to detect conflict on the ground automatically? Yes, I probably can. But would it be wiser and more cost-effective to simply pay attention to what local people are saying in these areas? Yes, it probably is. And if it's more cost-effective to verify local reports of conflict using satellite imagery then we'll do that, and worry less about space-based conflict-detection systems."

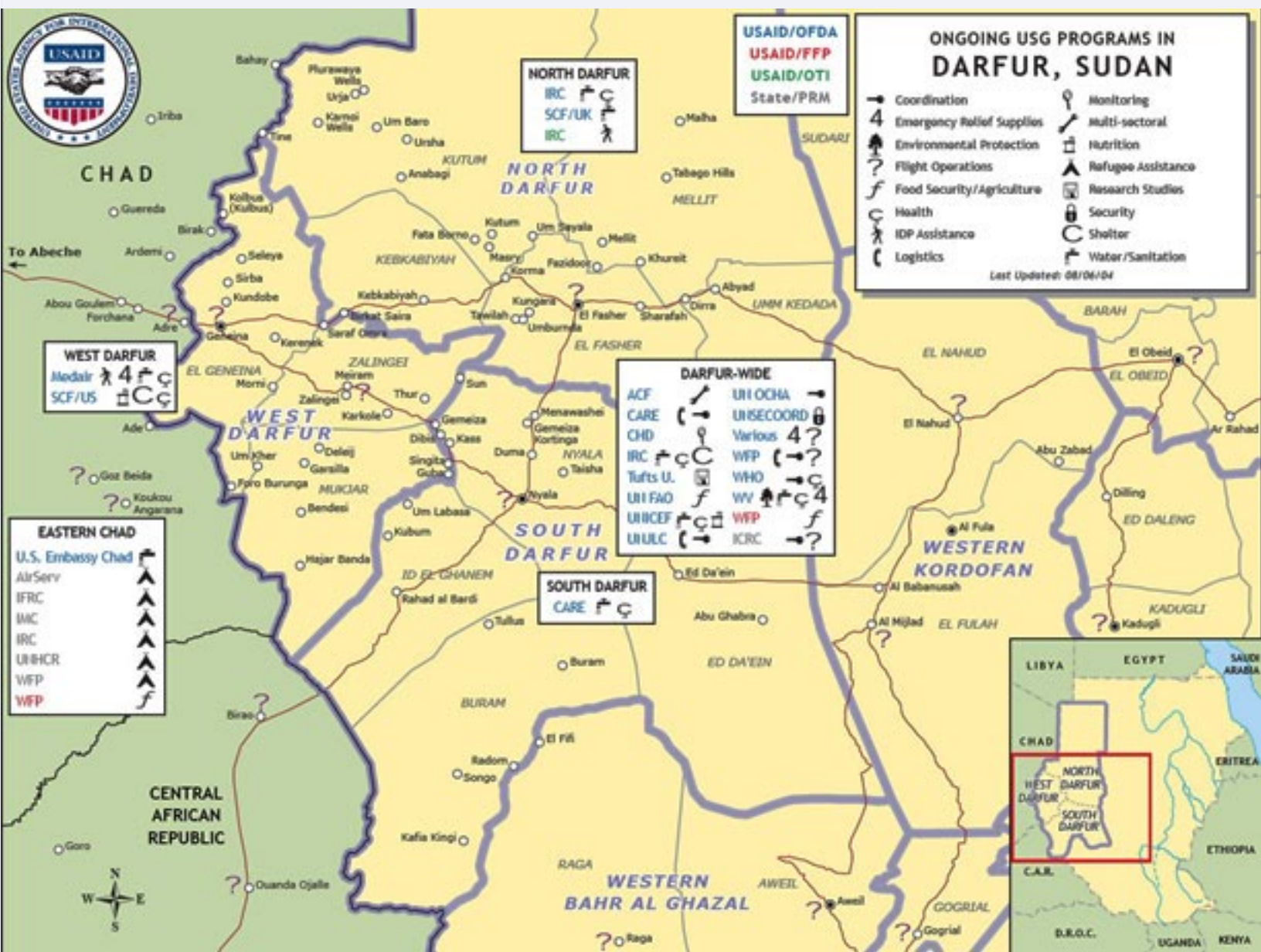
Clearing The Air

Astrophysicist *Chris Bishop*, who works at the **University of Plymouth** with Dr. *Chris Lavers*, usually spends his time looking at star births in images produced by a state-of-the-art telescope based in Hawaii, but the techniques he uses to compare images of stellar newborns can also be applied to satellite imagery of the Earth. "In order to work out whether anything has changed between before and after satellite images, you need to subtract one image from the other," says *Bishop*. "If nothing has changed, the resulting image will be completely blank, but if something has changed, it should immediately be revealed."

It sounds simple, but the problem with looking at both stars and the Earth from a long way

away is that the Earth's atmosphere often gets in the way. Between the time of the first image being taken and the second image being taken, the conditions in the atmosphere often change, making it a lot more difficult to compare the images," says *Bishop*. "The astronomy community uses an experimental program called **ISIS** to balance out the blurring caused by the atmosphere so that two images can be compared," he continues. "It had never been used in a non-astronomical context before, but Chris and I are now using it to compare satellite images of the Earth."

"It makes a real difference — the image resolution is improved by about 10 to 15 percent. You can spot something such as a damaged hut in Sudan that might previously have been invisible."



A Case In Point

DeformationComms

Located in an unassuming office park in Boulder, Colorado, UNAVCO is a non-profit, membership-governed consortium sponsored by the National Science Foundation (NSF) and National Aeronautics and Space Administration (NASA), and supports a myriad of science communities — including those who focus on the deformation of ice, imaging the structure of the atmosphere, and the Earth's response to ground water, sea level, and other aspects of the hydrosphere. UNAVCO also provides science support through a combination of community coordination, field engineering, technology innovation, and instrument testing.





One **UNAVCO** project, **Plate Boundary Observatory**, provides unprecedented imaging of the Earth's plate boundary deformation. In addition to the UNAVCO facility in Boulder, Plate Boundary Observatory maintains regional offices in San Clemente, California and Anchorage, Alaska and has deployed hundreds of global positioning systems (GPS) and seismic monitoring stations in the western U.S. to collect seismic data.

To transfer and archive these large amounts of data from remote stations, Plate Boundary Observatory relies on the **HughesNet**® satellite broadband service. Unlike terrestrial solutions, HughesNet does not rely on cable or phone wires, so it's available to consumers, businesses, and research organizations anywhere in the continental U.S., regardless of how remote the location — which allows the Plate Boundary Observatory team to transfer data back to UNAVCO quickly, easily, and securely.

Rough Terrain For Data Collection

In the early 1980s, soon after the first experimental GPS satellite was launched, UNAVCO was created to solve the challenge of applying GPS to geosciences for measurement and imaging purposes. UNAVCO, in turn, formed Plate Boundary Observatory in the late 1980s using GPS to study the three-dimensional

strain field resulting from deformation across the active boundary zone between the Pacific and North American plates. It now comprises arrays of GPS receivers and Strainmeters that are positioned across the western U.S. and used to measure underground strain over time periods ranging from 15 seconds to decades and longer.

Originally, Plate Boundary Observatory engineers were required to haul the GPS equipment out to a research site, survey and gather data manually, transport the data back to UNAVCO, and repeat everything the following year to measure movement over time.

"As GPS costs declined over the next few years, it became more economical for us to install the equipment permanently," said *Warren Gallaher*, Senior Network Engineer. "We also were able to get dial-up connectivity at a few of the less remote sites that helped with communication and data transfer."

The Move For Satellite Broadband

With such spotty connectivity, however, dial-up didn't prove to be a permanent solution for data transmission. "We really needed a stable, reliable service that could help us archive everything we collected," said *Gallaher*.

A Case In Point

After researching options for high-speed connectivity and trying out a very expensive satellite solution from a Canadian service provider, *Gallaher* and the Plate Boundary Observatory team signed up for **HughesNet** satellite broadband in 2002.

“We spend a lot of time at research stations like our location in Yellowstone where satellite connectivity is really our only option for communicating and archiving data at UNAVCO,” said *Gallaher*. “The Hughes satellite modem and small antenna are just perfect for what we need.” *Gallaher* also likes the stability of their HughesNet service.

With remote locations across California, Oregon, and Washington, along with five in Yellowstone, reliability and ease of use are extremely important for the Plate Boundary Observatory team of engineers.

“Our job is to get new, important data back to geologists at our member organizations and universities. They aren’t very interested in how the equipment works or how we transfer it, they just want the data,” said *Gallaher*. “For the sake of our program, it’s crucial that we are able to do that without any headaches and HughesNet allows us to — it truly satisfies a niche that we couldn’t find with other providers.”

Broadbandquake

Today, Plate Boundary Observatory has installed more than 1,000 GPS stations and about 80 strain seismic stations, all of which can get online and transmit data back to Boulder. The data collected is also freely available online as soon as it can be downloaded and moved to the archives. UNAVCO is also using HughesNet to support and maintain reference stations for **NASA’s Jet Propulsion Laboratory** in California and is considering deploying it for a different project in Africa.

“Similar organizations and small businesses with various locations should realize that HughesNet, above all else, is a stable, easy-to-maintain solution,” said *Gallaher*. “We’re committed to cutting-edge geodynamics research and HughesNet allows us to bring back important data really easily.”

HughesNet offers a full suite of services designed to help organizations such as UNAVCO and Plate Boundary Observatory adapt to their environment. Download speeds range from 1 Mbps up to 5 Mbps — additionally, the seven HughesNet Business Internet plans also can be customized to include private networks and backup solutions.

About UNAVCO

The UNAVCO Facility in Boulder, Colorado, is the primary operational activity of UNAVCO, Inc. and exists to support university and other research investigators in their use of Global Positioning System (GPS) technology for Earth sciences research. The Facility performs this task by providing state-of-the-art GPS equipment and field engineering support for projects, installing, operating and maintaining continuous GPS networks globally, undertaking new technology development and evaluation of commercially available products for research applications, and by archiving GPS data and data products for future applications. The Facility is funded under multi-year grants from the National Science Foundation (NSF) and National Aeronautics and Space Administration (NASA).



The Mt. Lewis site, which is part of the organization's BARGEN network.

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Executive Spotlight

James Kramer, Sr. V.P. + G.M. Civil & Commercial Group, Integral Systems

James B. Kramer joined Integral Systems in 1999. He is the Senior Vice President and General Manager of the Civil & Commercial Group at Integral Systems. In this role, he is responsible for the Civil Programs Division, the Commercial Programs Division, and two wholly owned subsidiaries located in Toulouse, France and Newcastle Upon Tyne, United Kingdom. Before assuming his current role, Mr. Kramer served in a variety of positions for the company including: Senior Vice President and General Manager of the Commercial Group, Vice President of the Commercial Programs Division, Director of Commercial Command and Control Systems, and Program Manager for the company's efforts on the Intelsat and New Skies satellite programs. Prior to joining ISI, he worked for Orbital Sciences Corporation as a Mission Operations Lead, and for Orion Satellite Corporation (later part of Loral Space & Communications), where he held various positions in the satellite engineering and operations department. Mr. Kramer is a member of American Institute of Aeronautics and Astronautics and active in the Satellite Industry Association and the Aerospace Industries Association. He holds a Bachelor of Science degree in Aerospace Engineering from the University of Virginia.



SatMagazine (SM)

Mr. Kramer, thanks for joining us in this issue. Can you tell us about your background and your current position with Integral Systems?

James Kramer

After graduating from the University of Virginia with an Aerospace Engineering degree, I was fortunate enough to get a job with a small startup satellite operator called Orion Satellite Corporation, which was later acquired by Loral Space and Communications.

At Orion, I was part of small engineering team that provided me with the opportunity to be involved in all aspects of satellite engineering and operations. The team included some very experienced members who instilled in me the importance of building solutions from the best possible technology with consideration for life cycle cost. We learned, sometimes the hard way, that there is always a cheaper way to do something, but in the long run that solution might not be the most cost-effective one for that particular situation.

As the company grew, the team had a hand in shaping the ground system and the satellite operations concept, which is a pretty unique opportunity for a young engineer. I still take great pleasure working with startup companies during the initial stages of their ground system design and implementation. Understanding their unique needs and delivering the solution that meets those needs in a cost-effective manner and can scale with their growth is the definition of a successful deployment in my mind.

Currently, I am the head of the Civil & Commercial Group at Integral Systems. "We provide commercial product-based ground system solutions and services to the commercial industry, the civil government sector in the US and worldwide and international military.

"Our group delivers full turnkey ground systems, from the antenna/RF system to the control system software in the satellite or network operations center. It is rare to find a ground system supplier who can provide end-to-end solutions using internal, commercial-based products and services that are the best available on the market. Our more than 20 years experience focusing on ground system solutions is a clear differentiator for us."

SM

What are your thoughts regarding the North American satellite market? What do you see as some of the pressing issues as we move further into 2011?



Executive Spotlight

James Kramer

The North American satellite market continues to thrive as bandwidth demand for fixed satellite services, direct broadcast services and mobile satellite services continues to grow. As I'm sure your readers are well aware, there is certainly no shortage of new satellites being deployed to serve the North America region. However, due to industry consolidation, we have seen a reduction in the number of commercial companies in North America that are physically operating these satellites.

Five years ago, there were seven or eight commercial companies in North America that operated geosynchronous satellites, currently there are only four or five. This has generally been a positive, as it has driven some efficiencies into the industry. However, for satellite companies who wish to outsource their satellite operations, it has somewhat reduced their options. As a result, the satellite control system becomes a significant selection criterion for these companies as they evaluate the available providers.

procurement plans also may play into the decision. A system with proven experience on many different bus types from different satellite manufacturers is definitely a plus. Integral Systems' **EPOCH Integrated Product Suite (IPS)** operates on all commercially available satellite bus types and is used to operate more third party satellites than any other system in the world. In fact, about 50 percent of the commercial geosynchronous satellites owned by one company but operated by another company are operated on an EPOCH IPS-based system.

Essentially, we have leveled the playing field for the satellite owners looking to outsource their operations when it comes to the satellite control system. All but one of the North American satellite operators use the EPOCH IPS for their third-party satellite operations, and because the EPOCH IPS is a proven, scalable and cost-effective solution, the other operator could easily offer an EPOCH IPS solution should the satellite owner desire.

SM

What is Integral Systems doing for its customers to meet the challenge you just discussed?

James Kramer

An important consideration for satellite owners when deciding what satellite control system is best for their fleet is the operational heritage of system. Whether or not a satellite owner actually operates their own satellite or not, the health and safety of their fleet is paramount to their business. Therefore, the satellite owner must find a system with a proven track record for safely operating the same satellite bus type as their satellite.

Future satellite

EPOCH Client™

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SM

What are some other needs that you see in the market looking forward and how will Integral Systems respond to address these needs.

James Kramer

Over the past few years we have seen a growing demand for more extensive Quality of Service (QoS) monitoring in order to meet the more stringent Service level Agreement (SLA) performance criteria being levied by the US Government on commercial Satellite Communications (SATCOM). Likewise, with this increased emphasis on QoS at the Radio Frequency (RF) link level there has been a natural desire to also curb the ever increasing threat of RF interference within both the government and commercial service sectors.

As a company that prides itself on listening to our customers, Integral Systems stood up a services organization to provide SATCOM NetOps subscription-based services. **Integral Systems Service Solutions (IS3)** makes use of a company-

owned and operated global infrastructure of signal monitoring sensors and RF **interference Detection and Geolocation (iDetGeo)** systems, delivering these valuable capabilities to customers via an annual subscription services model.

The backbone of IS3 services are Integral Systems' industry-leading **Monics®** interference monitoring and detection solutions, **satID®** geolocation system and **COMPASS Network Management System (NMS)**. The dedicated network is run from our 24x7 NOC in Colorado Springs, Colorado. Not only have we seen extensive interest from the primes who provide bandwidth to the Government, but also from many commercial operators and resellers who find our service more cost effective than owning and operating their own capabilities. This is yet one more example of how Integral Systems capitalizes on its commercial products and system engineering heritage to deliver solutions and services that matter to both the commercial and government market segments.

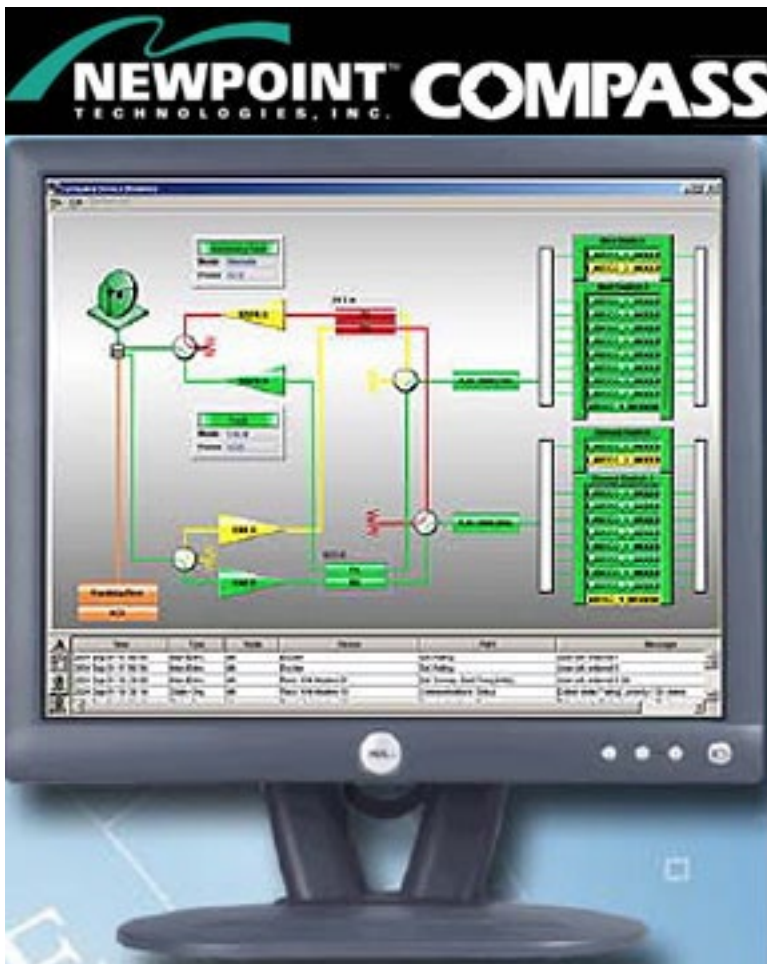
SM

Integral Systems' commercial-based EPOCH Integrated Product Suite (IPS) Command and Control solution has been a standard in the industry for the past two decades. What are you doing to ensure that customers continue to see the value from EPOCH and can we expect to see any innovative updates in the near future?

James Kramer

Well, I'm not sure if we can say that our industry has adopted a standard command and control system, but EPOCH IPS is certainly the most widely used, commercially available command and control system and we very proud of that we've been able to help so many customers around the world.

With our large customer base, comes a responsibility to continually enhance and improve our products based on the needs of our customers – something we take very seriously at Integral Systems. We recognize how quickly technology moves with respect to computing hardware and software, so we move products to the latest hardware platforms and operating systems in a timely manner, while still supporting older versions for a reasonable period of time.



Executive Spotlight

We continually add capabilities to our products that allow our customers to drive efficiencies into their operations. Many of the ideas for product enhancements come directly from our customers. When our teams return from onsite activities at our customer's facilities, they invariably bring back valuable suggestions from our customers on how we might improve our products. We have numerous staff with real-time operations experience that are able to work with our developers to turn these suggestions into value-added product features. These new features become part of EPOCH IPS and are available free of charge to all customers that participate in our software support program.

Traditional software maintenance programs typically only cover bug fixes, and as a result many customers choose not to participate in such programs. Because our software support program includes new features and enhancements in addition to bug-fixes, it is extremely popular, evidenced by the fact that nearly 100 percent of customers participate in it.

In addition to the general product maintenance and enhanced capabilities, we also add completely new products to EPOCH IPS when needs arise. For example, the industry has been demanding a platform-independent user interface that operates in an enterprise architecture. We have answered the call by introducing our Webic web-based user interface. Webic is able to collect data from any subsystem within the entire ground system and can also include third party web-based data where available.

SM

Tell us a little more about your new Webic product, which sounds like a most interesting addition to EPOCH IPS.

James Kramer

Webic, is an integrated platform for situational awareness and control of SATCOM performance systems. Designed to be simple to deploy, use and manage, Webic provides real-time data from Integral Systems' best of breed solutions, third-party products and web-based external sources. Using a standards-based browser, users are able to access information from any **Windows, Linux, or Mac** computer, as well as mobile devices such as the *iPad* or *Droid*. In addition, changes can be made directly to the system in real-time through Webic.

From a technology perspective, Webic supports multi-source display to provide updated information to a number of different users. New data sources can be easily added to the interface by accessing a data source registry. Webic is enterprise ready and integrates with most middleware solutions, including **NASA's GMSEC** bus. In addition to data source extensions, new visualization objects which provide additional graphical or special purpose rendering can be added to Webic. User interface extensions can be created and tailored to a specific data source.



As I'm sure *SatMagazine* readers can imagine, having instant access to critical, real-time data that matters most to the user from one source, and being able to dynamically make changes on the fly is incredibly powerful.

SM

James, you head up the Civil and Commercial group for Integral Systems. You have talked a lot about the solutions you bring to the commercial markets, but can you share a little bit about what Integral Systems has been doing in the Civil government arena to help your customers increase efficiencies, cut costs and better manage their satellite ground systems?

James Kramer

US Civil Government agencies are facing tighter budgets and are looking for innovative ways to accomplish their missions within these budget constraints. Agencies are looking for cost-effective ways to extend the life of existing systems rather than replace them. Integral Systems brings an unparalleled knowledge of many of these legacy systems, particularly at **NOAA**.

We have nearly completed a relocation of the *Fairbanks Satellite Operations Facility* to NOAA's new, modernized facility, without disrupting operations and we are in the process of providing a technology refresh of the NOAA polar ground system hardware and software, which will allow the several critical polar-orbiting weather satellite missions to continue into the next decade. Our solutions and expertise, based on our commercial products and practices, are equally

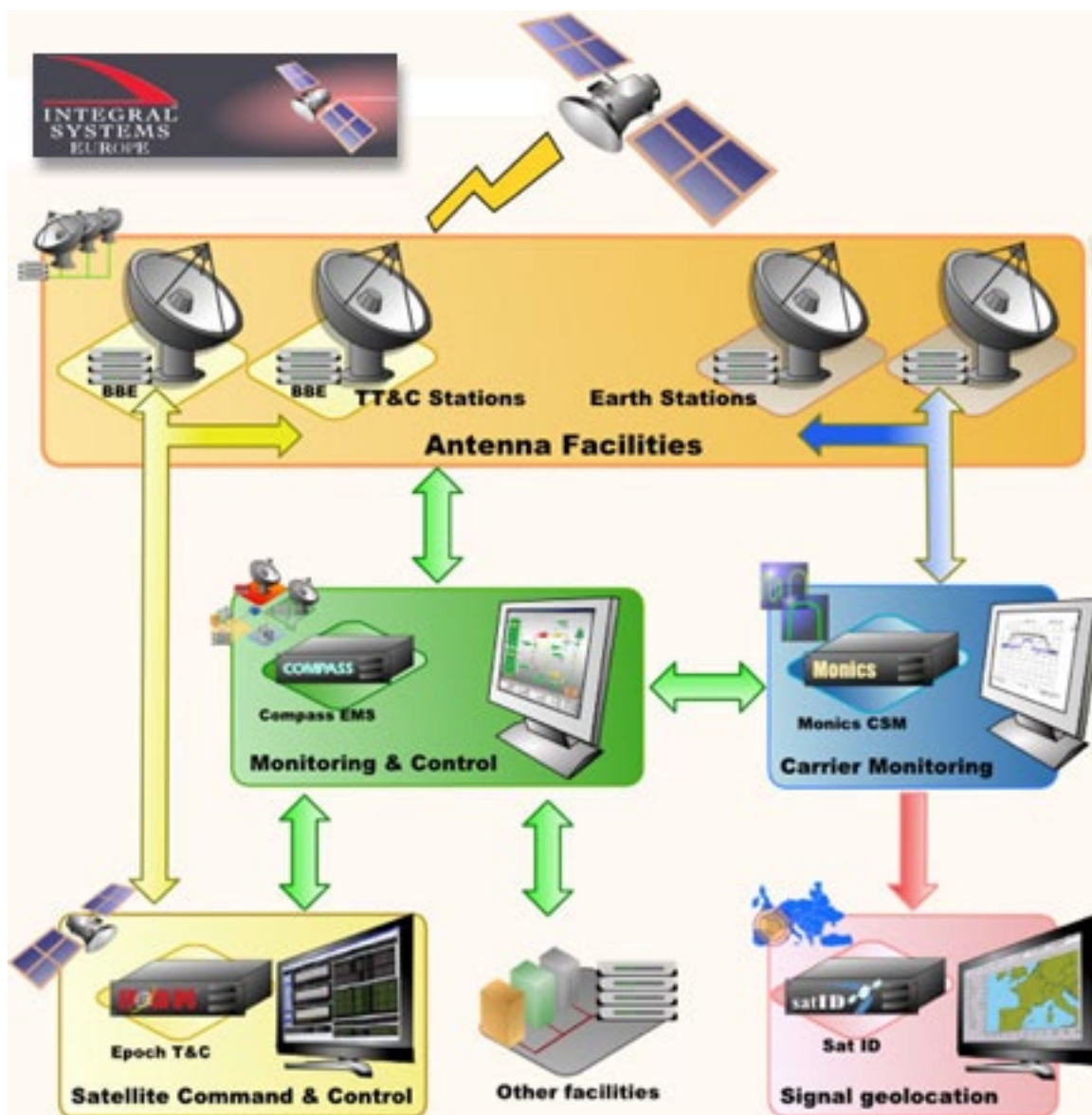
attractive to other US Civil agencies, and we continue to bring our capabilities to bear for USGS, NASA and the FAA.

SM

You mentioned Integral Systems Europe earlier so clearly your Group has moved beyond a U.S. focus and into global segments? How does one get a "foot into the door" in such arenas to counter another nation's homegrown solutions, if such are present?

James Kramer

We have been a global company for many years. In fact, we are the dominant supplier of satellite command and control systems in Asia. **Integral Systems Europe (ISE)** just celebrated its 10-year anniversary. ISE provides commercial-based products



and solutions to customers in the Europe, Middle East and Africa (EMEA) region but also to many other international locales.

With ISE, we have effectively grown our European presence in the commercial market. In addition, we also wanted to ease our ability to provide solutions to European government space programs, and the work we have done for **EUMETSAT**, **CNES** and **NATO** are good examples of this. These are all positive indicators that our global focus is on target, and we expect to continue to bring our capabilities to bear to other international commercial and government organizations throughout the world.

An important factor when doing international business is local content. All countries, including the US, inherently promote protectionism to a certain extent, but using local partners and teammates, is an effective way to ensure local work share while bringing best-of-breed capabilities to that country.

As a US company, we adhere to all US export compliance regulations. This can be onerous at times, particularly when the international customer establishes technology transfer initiatives as part of the program requirements. At Integral Systems, our experienced project personnel and export compliance experts work together to ensure minimal impact to our international customers and programs.

At the end of day, the real key to success in any market is establishing long-term trusting relationships and delivering on commitments. Most of our international customers have relied on us for many years and we take pride in being considered a long-term partner rather than just a vendor. Not only do we have a significant international customer base, but we have high volume of repeat business from these customers, which speaks to the fact that we continue to provide best-value solutions that meet their needs.

SM

Because of the community's late-to-the-game and sudden realization and emphasis on STEM training for our youngsters, what do you see as crucial needs for today's students to develop them into our future SATCOM leaders?

James Kramer

The critical need is to get today's students excited about space and the SATCOM industry. Integral Systems is committed to helping through our support of programs like the *CanSat Competition* (www.cansatcompetition.com) where more than 20 university teams build, test, launch, and operate can-sized satellites. While it's setup to be a fun, educational activity, the competition is structured to be as similar to a real-world satellite program as possible



with full slate of industry-standard reviews, such as PDR, CDR and pre- and post-flight reviews.

We are also active with the **AIAA** educational activities, including STEM, through involvement with the *AIAA Space Operations and Support Technical Committee (SOSTC) Education Subcommittee*. A career in the space and SATCOM industry is exciting and incredibly rewarding, especially as the country and the world increasingly relies on space for global communications. Integral Systems will continue to do its part to foster enthusiasm in STEM programs, and we look forward to working with our partners in the industry on this critical initiative.



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Connections: The Middle East Changing Regional Demands

author: Paul Simms

Vast stretches of the Middle East satellite market are in transition and expansion modes. Economies and governments are maturing and delivering new services to their people. U.S. troop withdrawals in Iraq have also altered connectivity demands.



"The flexibility of our satellite fleet has enabled a quick migration from imported IP-based connectivity via Asia or Europe to the deployment of VSAT networks delivering a wealth of communications capabilities within the region," explained *Hussein Oteifa*, Senior Regional Director in the Middle East for **SES**.

"As the demand has shifted, we've been able to reconfigure our spacecraft and unify our resources to meet the changing needs of our customers and the marketplace," noted *Oteifa*. "Whether it's extending the reach of fiber and mobile phone services into remote places or enabling the rapid establishment of reliable data networks virtually anywhere in the region, the Middle East is increasingly counting on SES."

"SES WORLD SKIES and SES ASTRA have pooled their resources to better serve the Middle East and Africa with advanced satellites and experienced people under the SES banner," explained *Deepak Mathur*, Vice President of South Asia and Middle East Sales for SES. "Our One SES approach provides a single point of contact for our customers doing business across the region where both SES WORLD SKIES and SES ASTRA are enabling exciting applications," he added.

"In a time of market and economic weariness, SES provides strength and stability," explained *Oteifa*. "We are far more than simply a bandwidth provider. SES is here for the long haul with the satellites, technologies and peerless expertise to help our customers grow and succeed."

The Capacity To Connect

Huge demand for satellite bandwidth is on the horizon in the Middle East. Innovators in Saudi Arabia, Egypt, Kuwait, Lebanon, Libya, Afghanistan and the United Arab Emirates, to name just a few, are using SES capacity over GSM backhaul and VSAT networks to both augment and create growth opportunities.

Telecom operators are developing regional and nationwide banking, education and emergency communications networks over VSAT. The systems will enable financial institutions, for example, with everything from email and Internet access to ATM transactions.

"Leading providers, such as Lunasat, Saudi Telecom and others across the region, are reaping the benefits of VSAT networks: it's quick to implement, secure and extremely reliable," *Oteifa* noted. "As a result, satellite is being strongly embraced in a wide range of industries in the Middle East, including oil and gas, financials, maritime, even education," he added.

Saudi Arabia is linking more than one-thousand schools to the Internet over SES satellites. The sultanate of Oman also has plans to connect students at more than 500 schools using satellite-delivered broadband. "The educational benefits are limitless and we're extremely proud to be playing such a vital role in putting a world of educational information at the fingertips of tens-of-thousands of children," said *Oteifa*. "This is absolutely an area where satellite will truly shine in the Middle East."

Mobile phone operators are keenly focused on expanding their use of satellite-delivered GSM backhaul, as big city telecom markets approach the saturation point. "There's very strong demand among a lot of regional telecom players who are leveraging satellite's reach to extend their service areas and subscriber base into the rural areas of the Middle East and Africa," explained *Mathur*.



SES-4 West Hemi Beam w/ EIRP

“SES offers a very advanced world-class global backbone infrastructure,” said Engineer *Saad Demyati*, VP of **Saudi Telecom’s Wholesale Business Unit**. “Saudi Telecom being the leading provider of telecommunication services in the Middle East values its important relationship with SES. Such a relationship permits Saudi Telecom to further extend and diversify its network reach, thereby enabling it to offer high-quality and reliable innovative telecom services to its customers within the Kingdom of Saudi Arabia as well as in the Middle East.”

SES has an ambitious satellite fleet investment strategy aimed at ensuring enough capacity to meet the burgeoning regional demand. **SES WORLD SKIES’ NSS-5, NSS-6, NSS-7, NSS-10** and **NSS-12** satellites, along with **SES ASTRA’s ASTRA-3B** spacecraft, currently serve the Middle East. Four additional satellites will be launched in the next two years to bolster the bandwidth necessary to enable the connectivity evolution in Africa, India and the Middle East. **SES-4** and **SES-5** are both scheduled to initiate service this year, while **ASTRA 2F** and **ASTRA 2E** are expected to launch in 2012 and 2013 respectively.

SES is also a major financial backer of **O3b Networks**, a next generation satellite operator building an innovative fiber-speed Medium Earth Orbit satellite constellation. The network will combine the ubiquitous reach of satellite with the speed of fiber to deliver satellite Internet and mobile backhaul services to emerging markets such as the Middle East and Africa.

The Expertise To Deliver

Capacity alone isn’t enough — not for a region tapping the full range and potential of satellite technologies and solutions. Service providers, operators and government agencies across the Middle East rely on SES and its broad offering of training and educational programs aimed at maximizing successful deployments and minimizing interference.

“The more our customers know about satellite, the more successful they’ve become at driving business and connectivity improvements across the region,” *Oteifa* said. “Expertise runs deep in our team, which is fully capable of arming our customers with everything

from the basic to advanced satellite knowledge they need to launch, secure and manage their networks,” he added.

Satellite interference is a major concern in countries such as Saudi Arabia, where the SES team is making significant progress battling the issue with educational efforts that have drawn praise industry-wide. “Even our competitors have taken note of our ability to reduce outages and their impact on satellite-delivered services in the Middle East and Africa,” explained *Oteifa*, citing piracy as another key problem facing the region. “SES has invested heavily in technologies and platforms that enable us to deliver secure video, voice and data regionally and globally,” *Oteifa* noted.

Poised For Regional Growth

The demand for flexible and reliable connectivity across the Middle East, Africa and beyond is driving the delivery of new and mission-critical applications. Like multinational corporations and early technology adopters, governments are latching onto an entrepreneurial spirit, thanks to satellite. For example, Kuwait plans to link all of its embassies worldwide over a satellite-delivered VSAT network. The UN is set to tap VSATs to deliver connectivity to conflict areas in Palestine, Israel, Afghanistan and Darfur, among other places.

“We have consistently anticipated the needs of our customers by immersing ourselves in their operations,” said *Oteifa*. “SES has worked side-by-side with our clients in every phase of development and deployment — from engineering design and technology training to the reliable delivery of solutions tailored to meet their business demands and challenges,” he added.

“We rely on SES satellites and people with the know how to help us deliver everything from IP trunking and backhaul services throughout Lebanon, Iraq, Afghanistan, Iran, Jordan and Saudi Arabia,” explained Peter Samaha, Vice President of Marketing and Business Development for Lunasat, a leading provider in the Middle East and Africa. “In a market that has our teams scrambling to meet evolving demands, SES is a great source of stability and flexibility that keeps us ahead of the curve.”

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